



*education sciences*

# Online and Distance Learning during Lockdown Times COVID-19 Stories (Volume 1)

---

Edited by

Palitha Edirisingha

Printed Edition of the Special Issue Published in *Education Sciences*

# **Online and Distance Learning during Lockdown Times: COVID-19 Stories**



# Online and Distance Learning during Lockdown Times: COVID-19 Stories

## Volume 1: K-12 Education

Editor

**Palitha Edirisingha**

MDPI • Basel • Beijing • Wuhan • Barcelona • Belgrade • Manchester • Tokyo • Cluj • Tianjin





*Editor*

Palitha Edirisingha  
University of Leicester  
UK

*Editorial Office*

MDPI  
St. Alban-Anlage 66  
4052 Basel, Switzerland

This is a reprint of articles from the Special Issue published online in the open access journal *Education Sciences* (ISSN 2227-7102) (available at: [https://www.mdpi.com/journal/education/special\\_issues/learning\\_education](https://www.mdpi.com/journal/education/special_issues/learning_education)). It includes papers covering K-12 educational sector representing international experience of teaching and learning from the start of the first episode of lockdown due to the Covid-19 pandemic.

For citation purposes, cite each article independently as indicated on the article page online and as indicated below:

LastName, A.A.; LastName, B.B.; LastName, C.C. Article Title. *Journal Name* **Year**, *Volume Number*, Page Range.

**Volume 1**

ISBN 978-3-0365-5247-7 (Hbk)

ISBN 978-3-0365-5248-4 (PDF)

**Volume 1-2**

ISBN 978-3-0365-5245-3 (Hbk)

ISBN 978-3-0365-5246-0 (PDF)

© 2022 by the authors. Articles in this book are Open Access and distributed under the Creative Commons Attribution (CC BY) license, which allows users to download, copy and build upon published articles, as long as the author and publisher are properly credited, which ensures maximum dissemination and a wider impact of our publications.

The book as a whole is distributed by MDPI under the terms and conditions of the Creative Commons license CC BY-NC-ND.

# Contents

<b>About the Editor</b> . . . . .	vii
<b>Preface to “Online and Distance Learning during Lockdown Times: COVID-19 Stories”</b> . . . .	ix
<b>Ute Kaden</b>	
COVID-19 School Closure-Related Changes to the Professional Life of a K–12 Teacher Reprinted from: <i>Educ. Sci.</i> <b>2020</b> , <i>10</i> , 165, doi:10.3390/educsci10060165 . . . . .	1
<b>Rachel K. Schuck and Rachel Lambert</b>	
“Am I Doing Enough?” Special Educators’ Experiences with Emergency Remote Teaching in Spring 2020 Reprinted from: <i>Educ. Sci.</i> <b>2020</b> , <i>10</i> , 320, doi:10.3390/educsci10110320 . . . . .	15
<b>Francesco Vincenzo Ferraro, Ferdinando Ivano Ambra, Luigi Aruta and Maria Luisa Iavarone</b>	
Distance Learning in the COVID-19 Era: Perceptions in Southern Italy Reprinted from: <i>Educ. Sci.</i> <b>2020</b> , <i>10</i> , 355, doi:10.3390/educsci10120355 . . . . .	31
<b>James Russo, Janette Bobis, Ann Downton, Sharyn Livy and Peter Sullivan</b>	
Primary Teacher Attitudes towards Productive Struggle in Mathematics in Remote Learning versus Classroom-Based Settings Reprinted from: <i>Educ. Sci.</i> <b>2021</b> , <i>11</i> , 35, doi:10.3390/educsci11020035 . . . . .	41
<b>Liina Lepp, Triinu Aaviku, Äli Leijen, Margus Pedaste and Katrin Saks</b>	
Teaching during COVID-19: The Decisions Made in Teaching Reprinted from: <i>Educ. Sci.</i> <b>2021</b> , <i>11</i> , 47, doi:10.3390/educsci11020047 . . . . .	55
<b>Frances K. Harper, Joshua M. Rosenberg, Sara Comperry, Kay Howell and Sierra Womble</b>	
#Mathathome during the COVID-19 Pandemic: Exploring and Reimagining Resources and Social Supports for Parents Reprinted from: <i>Educ. Sci.</i> <b>2021</b> , <i>11</i> , 60, doi:10.3390/educsci11020060 . . . . .	77
<b>Petra Poláková and Blanka Klímová</b>	
The Perception of Slovak Students on Distance Online Learning in the Time of Coronavirus—A Preliminary Study Reprinted from: <i>Educ. Sci.</i> <b>2021</b> , <i>11</i> , 81, doi:10.3390/educsci11020081 . . . . .	101
<b>Iman Oraif and Tariq Elyas</b>	
The Impact of COVID-19 on Learning: Investigating EFL Learners’ Engagement in Online Courses in Saudi Arabia Reprinted from: <i>Educ. Sci.</i> <b>2021</b> , <i>11</i> , 99, doi:10.3390/educsci11030099 . . . . .	109
<b>Piret Luik and Marina Lepp</b>	
Local and External Stakeholders Affecting Educational Change during the Coronavirus Pandemic: A Study of Facebook Messages in Estonia Reprinted from: <i>Educ. Sci.</i> <b>2021</b> , <i>11</i> , 113, doi:10.3390/educsci11030113 . . . . .	129
<b>Puspa Khanal, Fabio Bento and Marco Tagliabue</b>	
A Scoping Review of Organizational Responses to the COVID-19 Pandemic in Schools: A ComplexSystems Perspective Reprinted from: <i>Educ. Sci.</i> <b>2021</b> , <i>11</i> , 115, doi:10.3390/educsci11030115 . . . . .	143

<b>Jonathan Brown, Carrie McLennan, Daniela Mercieca, Duncan P. Mercieca, Derek P. Robertson and Eddie Valentine</b>	
Technology as Thirdspace: Teachers in Scottish Schools Engaging with and Being Challenged by Digital Technology in First COVID-19 Lockdown	
Reprinted from: <i>Educ. Sci.</i> <b>2021</b> , <i>11</i> , 136, doi:10.3390/educsci11030136 . . . . .	<b>165</b>
<b>Dirk Lauret and Durdane Bayram-Jacobs</b>	
COVID-19 Lockdown Education: The Importance of Structure in a Suddenly Changed Learning Environment	
Reprinted from: <i>Educ. Sci.</i> <b>2021</b> , <i>11</i> , 221, doi:10.3390/educsci11050221 . . . . .	<b>181</b>
<b>Liina Adov and Mario Mäeots</b>	
What Can We Learn about Science Teachers' Technology Use during the COVID-19 Pandemic?	
Reprinted from: <i>Educ. Sci.</i> <b>2021</b> , <i>11</i> , 255, doi:10.3390/educsci11060255 . . . . .	<b>203</b>
<b>Luísa Mota Ribeiro, Rosário Serrão Cunha, Maria Conceição Andrade e Silva, Marisa Carvalho and Maria Luísa Vital</b>	
Parental Involvement during Pandemic Times: Challenges and Opportunities	
Reprinted from: <i>Educ. Sci.</i> <b>2021</b> , <i>11</i> , 302, doi:10.3390/educsci11060302 . . . . .	<b>223</b>

# About the Editor

## **Palitha Edirisingha**

Palitha Edirisingha is an Associate Professor of Education at the School of Education, University of Leicester, UK. He is a Senior Fellow of the Higher Education Academy.

Palitha's research, teaching and PhD supervision interests are on digital technologies and their application to teaching and learning in international contexts. He also carries out research concerning international education in distance learning contexts. He leads three distance learning programmes at the University of Leicester: International PGCE, MA International Education, and Post-Graduate Certificate in Learning Technologies.

He has published on topics related to podcasting, mobile learning, virtual worlds, digital literacy, and open and distance education in developing countries. He conducts learning technology workshops for academic staff and has been involved in developing Open Educational Resources (OERs) for the University of Leicester OER repository.

Palitha is also an editorial board member of the Journal "Interactive Learning Environments", "Trends in Higher Education", and "Journal of Studies and Research on Technological Education". He is a topic board member of the journal "Education Sciences".



## Preface to “Online and Distance Learning during Lockdown Times: COVID-19 Stories”

It would be an understatement to say that the COVID-19 pandemic turned our lives upside down. Some refer to it as a once-in-a-century pandemic (comparing it with the 1918 influenza pandemic). The world began to take notice of the severity of the COVID-19 from about early March 2020 when The World Health Organisation declared that COVID-19 had become a pandemic. To control the spread of the disease, governments introduced severe measures restricting movement, closing buildings and preventing access to public spaces. Physical building in schools, colleges, and universities were closed allowing only for, in some contexts, limited access to children with special education needs and those whose parents were key workers. Teachers and school leaders had several days, if not hours, to prepare to move their teaching online.

These unprecedented events provided a useful context for researchers and practitioners to examine how teachers, students and parents responded to a world-wide public health emergency and overcame barriers to education. The Special Issue published in the journal *Education Sciences* under the title “Online and Distance Learning during Lockdown Times: COVID-19 Stories” brought together empirical evidence from a diverse range of countries across the world on the use of online, remote, and blended teaching and learning methods in all levels of educational contexts during these unprecedented times.

The present volume is a collection of papers from the Special Issue covering **K-12 educational contexts** representing the international experience of teaching and learning from the start of the first wave of lockdown. Our authors explored both the positive and negative experiences and consequences of remote teaching and learning methods for teachers, educational leaders, parents, and students. These paper also offer an insight into how policymakers and teachers developed innovative ways to help children continue to engage in their learning during the pandemic.

The first paper in this volume is by Ute Kaden whose descriptive explanatory single case study explores how school closures changed the life and work of a teacher in rural Alaska in the USA. This paper may be considered as one of the first studies on remote teaching because of school closures in early 2020. Based on the empirical evidence gathered using qualitative methods, Kaden reports on the impact of remote teaching on the teacher’s workload and its potential for amplifying inequality and socio-economic divisions in society. She offers several recommendations for both practitioners and policy makers.

Rachel K. Schuck and Rachel Lambert’s paper on teachers working with students with special education needs is particularly interesting given the multiple challenges of teaching and learning under lockdown conditions. They report the experience of two elementary special education teachers’ transition to emergency remote teaching. With interview data gathered from a school with a largely Hispanic/Latin American student population, the study reveals the inequality in resources among students and challenges of meeting students’ special education needs at home.

Next, Francesco Vincenzo Ferraro and colleagues report on the experience of students’ remote online learning experience during the first wave of the pandemic. Based on survey research carried out in secondary schools in Naples, Italy, their study is particularly interesting given the fact that about 20% of these students did not have access to digital devices essential for remote learning. They revealed the levels of anxiety and stress the students felt during the unfamiliar forms of the learning period.

Issues that primary students face in learning mathematics at a distance is the focus of the paper

by James Russo and colleagues. Based on data collected using a mixed methods approach from 82 early years maths teachers in Australia, the authors report these issues from the perspective of teachers. They identified a range of challenges that students faced in engaging in productive struggles when learning maths remotely. Their research provides an insight into the conditions that promote students' learning of maths which is challenging to achieve in remote learning contexts.

Liina Lepp and colleagues' paper draws our attention to the tensions between factors influencing pedagogical decisions by teachers and how they are reflected in the teaching/delivery of online classes. Based on semi-structured interviews carried out with primary schools in Estonia, the authors identified a range of factors contributing to teachers' pedagogical decisions including the availability of and their familiarity with digital tools. Maintaining student interactions, motivation and own workload were some of the key factors that guided decisions in remote teaching during the pandemic.

The paper by Frances K Harper and colleagues focuses on parental involvement in teaching Mathematics at primary level during lockdown conditions. Based on secondary data from Twitter and responses to a survey from parents primarily in North America, New Zealand, and Australia, their paper offers an insight into an innovative approach to collecting and analyzing data appropriate for lockdown conditions. The authors provide insight into the resourcefulness of parents when helping their children's learning remotely. Implications for the maths education community are also provided.

The paper by Petra Poláková and Blanka Klímová reports the results of their research project investigating challenges associated with online teaching and learning from the perspective of students in the Czech Republic. Using a questionnaire as a data collection tool, they investigated secondary level tourism and gastronomy students' readiness for online learning. Their findings offer implications for future developments of education to integrate distance learning methods in predominantly face to face teaching contexts.

Iman Oraif and Tariq Elyas's paper investigates students' engagement in online learning in the Kingdom of Saudi Arabia. Their context was learning English as a foreign Language in secondary level schools in KSA. Based on data gathered from questionnaires from a sample of 379 all-female student sample, the authors report the students' engagement from a number of motivational perspectives. Their recommendations are useful for the future integration of online methods for teaching and learning in schools.

Research reported in the next paper used messages in Facebook as data to gain insight into the multiple set of activities that a range of stakeholders in education engaged in during the pandemic to ensure education continued in their communities. Based on data from Estonia, the findings of Piret Luik and Marina Lepp provide insight into the roles, experiences and views of different stakeholders during the unprecedented situations that schools and communities found themselves in almost overnight.

Puspa Khanal and colleagues' contribution from Norway is based on a scoping review of the literature on how schools adapted to remote teaching. They looked at the organisational level issues in this adaptation process during one of the most challenging times in our living memory. Their paper offers an insight into how teachers explored strategies that allowed them to continue with teaching with minimum disruption to students' learning. The authors raise several questions about the continuation of some of the good practices beyond the pandemic. The paper offers a methodology for carrying out scoping reviews that other researchers might find useful as well.

In the next paper, Jonathan Brown and colleagues report their study carried out during the first lockdown in Scotland from March–June 2020. Using the concept of the Thirdspace and based on interviews with primary school teachers and head teachers, the authors explored how lockdown

and digital technologies facilitated a Thirdspace for the continuation of education during the first lockdown. Their paper encourages us to think about how technologies could be used to extend the functions of schools.

The study of Dirk Lauret and Durdane Bayram-Jacobs explores the impact of online teaching and learning in secondary schools in the Netherlands. Based on data collected from interviews with teacher and students, and questionnaire data from students, their paper highlights both positive and negative aspects of online learning. They also report the supportive role of the school management in helping teachers and students navigate challenges in remote learning.

Liina Adov and Mario Mäeots's contribution to this volume is based on their research on teachers' experience of using digital technologies for remote teaching in Estonia. Having conducted an interview-based study with science teachers, the authors identified different levels of willingness to use technology and explored the way teachers changed their technology practices during their online teaching, as well as the variety of technologies that they experimented with and used. Their paper also identifies barriers to using technology and implications for future uses of digital technologies in classrooms.

The final paper in this volume by Luísa Mota Ribeiro and colleagues offers an insight into teaching during the pandemic from the perspective of parents who had to take on responsibilities for their children's learning during school closures since early 2020. Involving a large set of online questionnaire data from 21,333 parents in Portugal whose children were attending primary and secondary schools, the chapter offers insight into how the parents supported their children in different ways during home schooling. The authors also found variations in roles performed by parents according to the gender of children, type of schools and curriculum.

The authors who contributed to the Special Issue reflected on how educational institutions might need to rethink their teaching and learning provision as we learn to live with health and other emergencies, such as COVID-19. The knowledge that we can gain from exploring the developments of teaching and learning approaches in many countries and educational contexts in response to the pandemic would be useful for all stakeholders in education to reconsider the future of education and meet the challenges in the months and possibly years to come.

**Palitha Edirisingha**  
*Editor*





Article

# COVID-19 School Closure-Related Changes to the Professional Life of a K–12 Teacher

Ute Kaden

School of Education, University of Alaska Fairbanks, Fairbanks, AK 99775, USA; ukaden@alaska.edu

Received: 31 May 2020; Accepted: 18 June 2020; Published: 19 June 2020

**Abstract:** The COVID-19 pandemic forced K–12 school closures in spring 2020 to protect the well-being of society. The unplanned and unprecedented disruption to education changed the work of many teachers suddenly, and in many aspects. This case study examines the COVID-19 school closure-related changes to the professional life of a secondary school teacher in rural Alaska (United States), who had to teach his students online. A descriptive and explanatory single case study methodology was used to describe subsequent impacts on instructional practices and workload. Qualitative and quantitative data sources include participant observations, semi-structured interviews, artifacts (e.g., lesson plans, schedules, online time), and open-ended conversations. The results of this study demonstrate an increase and change in workload for the teacher and that online education can support learning for many students but needs to be carefully designed and individualized to not deepen inequality and social divides. The forced move to online learning may have been the catalyst to create a new, more effective hybrid model of educating students in the future. Not one single model for online learning will provide equitable educational opportunities for all and virtual learning cannot be seen as a cheap fix for the ongoing financial crisis in funding education.

**Keywords:** teaching profession; COVID-19 school closure; online learning; K–12 education; public education; distance education; rural education; educational technology

---

## 1. Introduction

The COVID-19 pandemic forced widespread K–12 school closures in the spring of 2020 to protect the well-being of society. K–12 (kindergarten to 12th grade) school districts in the United States reacted to the pandemic in various ways based on location, infrastructure, financial resources, socioeconomics, and community needs [1,2]. This unplanned and unprecedented disruption to society and education changed the work of many teachers suddenly, and in many aspects [3,4]. School buildings were closed, and schooling migrated to an online environment. This paradigm shift caused ripple effects and public education may have changed in ways that are yet to be determined [5]. Teachers needed to find ways to connect to students and transition to unfamiliar modes of teaching fast. Whether we call it distance, online, or virtual learning, teachers were challenged to provide meaningful educational experiences to all of their students [6,7]. Those types of learning and instruction are not new, but they were new to many teachers and the roles of the teacher changed during the crisis. Confined to working from home, with existing lesson plans no longer adequate, challenged to quickly learn new technologies and removed from students themselves, many teachers experienced the single most traumatic and transformative event of the modern era [8]. K–12 students had to develop new learning skills and often struggled at home with social isolation and loneliness [1]. School principals and district leadership moved to online meetings and had to find ways to connect students to the internet, provide computers, and expand foodservice [3]. The effectiveness of school closures on virus transmission is not well established, however, school closures for a long period of time may have detrimental social and health consequences for children living in poverty and are likely to exacerbate existing inequalities [5,9].

Public health officials have urged that social distancing, spotty access to health care, and the economics of part-time employment add to a pandemic inequality. The closures are also likely to widen the learning gap between children from lower-income and higher-income families [2]. Children from low-income households often live in conditions that make homeschooling difficult. Siblings who have to learn together from home and parents who work and may not be able to supervise learning add to the difficulties. In the USA, an estimated 5% of students in public schools do not live in a stable residence. In New York City, where a large proportion of COVID-19 cases in the USA have been observed, one in ten students were homeless or experienced severe housing instability during the previous school year [9]. Two of the biggest hurdles to moving America's schools online have been an inadequate number of digital devices for students, and millions of families' lack of high-speed internet at home. Children from lower-income households are struggling to complete online homework because of their housing and unstable family situations [2]. The unexpected COVID-19-related interruptions to K–12 education created a need to research and document the major shifts in teaching practices and teachers' responsibilities [10]. Some of those new approaches to education may influence the education policy of the future. Caring for educators is an important part of the recovery and a sustainable education model of the future. Research shows that successful student learning outcomes begin with caring about teachers, prioritizing their mental health, nurturing their combined self-confidence, and understanding their workload [8].

This study examines the COVID-19 school closure-related changes to the professional life of one public K–12 schoolteacher and the substantive impacts on planning, teaching, and workload.

The results of the study may support educational stakeholders in developing transformed instructional models and encourage teachers to learn new educational practices for the future.

### *1.1. Context*

This single case study took place in a rural Alaska school district during the COVID-19 closure of the physical school buildings and the transition to online teaching. The participant of this study is a secondary teacher with the pseudonym name "Mr. Carl" who is employed by this rural school district. Consistent with national trends, rural Alaska schools are serving high rates of minority students, special needs students, and students experiencing higher than average rates of poverty and lower than average rates of academic achievement [11–13]. Mr. Carl's rural school district is located in the interior of Alaska and on the road system. To avoid hours of long, dangerous, and sometimes impossible wilderness travel and providing a community center for the people, very small schools still exist in rural areas [13]. The school district, where the teacher is employed, has about 240 students enrolled in three K–12 brick and mortar schools, one larger school (180 students), and two smaller schools. The school district provides stable and supportive leadership. Mr. Carl's small rural school has 32 students enrolled in grade levels kindergarten to grade twelve (K–12) and employs four fulltime teachers. The fulltime teachers are supported by three teacher aides and several itinerant district educators delivering special content areas, such as music, counseling, or acting as the school nurse. Itinerant teachers travel to different district schools during the week to provide services to all students of the small schools, which are unable to have specialized staff. Mathematics and English Languages Arts proficiency rates at Mr. Carl's school are below 40% of the national average. About 23% of the students at Mr. Carl's school are special needs students and more than 60% of students qualify for other special services, such as Title One. Those numbers point to the socioeconomic inequalities in rural areas [11,13]. The rural community is accessible by road and dirt roads, but major services such as hospitals or shopping are at least 100 miles away. Students of the school are (73%) Caucasian White, while the largest minority are Alaska Native groups with 18% and 4% Asian (US Census, 2015). On average, 5% of students are homeless and 8% of students are transient.

## 1.2. Research Questions

The purpose of this study was to describe and explain the experiences of a secondary teacher switching to online instruction during the COVID-19 crisis. Thus, the following research questions were addressed:

1. How did the teacher experience the implementation of the COVID-19 “emergency” online instructional model?
2. What changes in workload did the teacher report to provide equitable instruction to his students?
3. What elements of online delivery were identified as successful or challenging by the teacher?
4. How did the teacher perceive the student experience?

Throughout this paper “online instruction” is recognized in the context of the pandemic (e.g., emergency online teaching), which involved the switch to online delivery of curriculum that would otherwise be delivered face-to-face in a physical classroom.

## 2. Materials and Methods

### 2.1. Design

This descriptive and explanatory [14–16] single case study focuses on the changes to the instructional practices and everyday professional life of a rural K–12 teacher who had to teach his students online during the COVID-19 spring semester. Although a single case study has limitations, the strength of this methodology was that it allowed for the exploration of the teacher’s voice in-depth, using varied methods of data collection [17]. Multiple approaches to triangulating data across stages increased the validity and trustworthiness of the case study results [18,19]. Data sources included direct and participant observations (e.g., workspace, online teaching activity, student interactions), semi-structured weekly interviews, open-ended conversations (e.g., perceptions of student learning, changes in teacher identity, time commitment, overall well-being), and artifacts (e.g., schedules, lesson plans, ZOOM recordings).

The researcher had in-depth knowledge of the teacher’s workload before the shift to online education and maintained a critical lens during the research process to identify and document the impact of school closure and the move to online education as seen by the participant teacher.

### 2.2. Participant

The participant is a secondary teacher with the pseudonym name Mr. Carl. He has worked during the study in a small rural community school in central Alaska. After approval by the Institutional Review Board and the employing school district, Mr. Carl agreed to participate. He was purposely chosen as a participant based on his long work-experience at the rural school, his community connection to families, and effective teaching practices. He had taken online classes himself during his master’s degree and had some distance delivery experience as a teacher for his school district before the study. Mr. Carl is middle-aged, has a valid teacher certificate for mathematics/sciences, and has more than 20 years of teaching experience. He has been teaching at his current school for 12 years and taught at public schools in the United States and abroad. He holds master’s degrees in educational leadership and curriculum and instruction and has completed many subsequent teacher professional development sessions focusing on bilingual-bicultural education in Alaska, technology integration into the curriculum, Advanced Placement (AP) College Board workshops, place-relevant educational strategies, and others. He was the lead teacher at his school during the study. His workload is very typical for a teacher in a small rural K–12 school in Alaska. He teaches mathematics and science secondary grade levels, and also all other subjects and grade levels as needed. He was the basketball, volleyball, and track and field coach, supported many other extracurricular events at his school and school district, helped with school maintenance, and cultivated school and community connections. He is known for supporting all students and valuing effective student–teacher relationships as the

key to success. As a result of his long residency at the school, he had detailed knowledge about his students, the school district, and the rural community where the school is located.

### *2.3. Data Collection*

Multiple sources of rich, descriptive data regarding the teacher's experiences, perspectives of the school closure, and the switch to online instruction were collected over three months from the initial school closure in March of 2020 to the end of the school year in May of 2020. Weekly semi-structured reflective interviews (eight total), daily conversations, and ten observations of online instructional meetings with students were conducted and recorded using the web-based video conferencing tool ZOOM. Interviews and conversations focused on the overall participant perception of the implementation of an online home learning model, planning, delivery and assessment of online instruction, time commitments, workload, and the development of new teaching skills.

The semi-structured interview questions included open-ended and closed questions about how teaching instruction changed, how student learning was perceived, what challenges were encountered, how the transition to online education was handled, and what relationships supported the well-being of teachers and students [19]. Questions also focused specifically on the role of the school district leadership, technology support, the role of student-teacher relationships during online learning, the role of parents, and the future of schooling. Questions for the daily conversations were: (a) What was working well this week? (b) How much time did you spend on planning and feedback, staff meetings, parent meetings, technology, and ZOOM student instruction? (c) What did you learn? (d) How did you engage and assess your students? (e) How did you perceive student participation and engagement?

Open-ended questions were crafted with a focus on content, clarity, and sequencing [17]. Conversations focused on subject-specific instructional goals, individual student performance, student well-being, interaction with colleagues, technology needs, personal professional skill development, facilitation, the role of families, and evaluation of online instruction. The categories, themes, and connections formed a storyline that allowed the description, explanation, and summary of phenomena emerging from the data [20]. Care was taken to not use technical terms familiar to educational technology experts but unfamiliar to a teacher new to online education. Archival data sources, such as lesson plans, weekly and daily schedules, and field notes, were sorted to support data collection and check for validity.

### *2.4. Analysis*

Data were analyzed using a qualitative general inductive approach [17,20]. Recorded interviews were transcribed verbatim. Transcripts, observation notes, and documents were uploaded into a MAXQDA database to facilitate organization and analysis [20]. The initial analysis started with coding prompted by the research question and literature. As the study unfolded, additional themes emerged and were included in the coding process. Examples of these codes include "Time", under which child codes were created, such as "Planning", "Feedback", "Staff meetings", "ZOOM-Student Instructional Meetings", "Technology", "Support", and "Student Assessment". The second round of coding proceeded to identify themes specifically related to the new online schooling concept, categories were refined, and new categories were added to describe task frequencies. MAXQDA software helped to locate words and phrases relating to specific categories using archival data including lesson plans, meeting notes, and student products as a way to check the reliability and that nothing was missed [20]. Frequency tables were used to identify connections and the importance of themes. The process helped to locate similarities of thought and reflections over time. For reporting, codes were combined into the following categories to focus on answering the research questions: (a) ZOOM instruction, (b) workload, (c) planning instruction and feedback to students, (d) perceived student experience, (e) implementation and challenges, and (d) unexpected factors. The recursive cycle of code, explore, relate, and study supported a chain of evidence that revealed meaning in the data and increased the reliability and

credibility of the results. Validity in qualitative research requires that the findings represent the participants' data [20]. During the data analysis processes and reporting, the participant was involved (member-checking) and read the transcripts to ensure the accuracy of the intended responses.

### **3. Results**

The following sections report on data from interviews, observations, archived data (e.g., lesson plans, schedules, ZOOM recordings), and personal conversations with Mr. Carl, describing how he experienced the transition to the COVID-19 "emergency" online instructional model, the period of implementation of online teaching, and changes to his workload.

#### *3.1. Teacher Experiencing the Implementation of Online Education after COVID-19 School Closure*

The first phase of implementation of the emergency online model started in March of 2020, lasted one week, and included providing teachers and students with the technology to participate in distance education and developing the master schedules for teachers and students. Mr. Carl reported that the leadership of the school district worked with all staff members and the local school board transparently to transition to online learning. This collaboration was seen as very important by Mr. Carl for setting processes in place for open communication during the crisis.

Mr. Carl on the transition to online learning:

I started actively listening to the COVID-19 pandemic unfolding in March. Things moved very fast and the unthinkable happened. My school district had to close schools and the move to online education started right after spring break, in the middle of March 2020. The school district suspended classes for the first week after spring break for the K–12 students. This time was needed by the district leadership to develop student and teacher schedules for the new remote learning model, which we sometimes called "emergency online teaching model." We as teachers used the time to prepare materials needed for online instruction and at-home learning for our students. I drove around the community many times to deliver paper packets with learning materials, books, computers, and Wi-Fi hotspots for students who did not have the internet at home. Our district was a One-to-One district before the pandemic, which means that every student and teacher had a computer or tablet available for learning. This previous experience took the anxiety out a bit and helped tremendously with the switch to online learning. It was a very unreal situation.

Mr. Carl's statement confirmed that many rural students and teachers did not have reliable internet connections at home and the costs for even spotty internet were extremely high [21]. As a result, school administrators reached out to the families and supplied students and teachers in need with internet hotspots and other technology necessary for online learning and teaching. Besides, internet providers offered temporary discounts and more bandwidth in the areas they covered. Mr. Carl explained during the interviews that the school district had invested in computer technology and teacher training before the crisis and had a working technology support infrastructure available for students and teachers. This previous experience with educational technology and the overall effective and collaborative administrative leadership were both critically important factors during the transition to online education. After many meetings and discussions, at the end of the first week of school closure, teachers and students had received their schedules, materials, and technology for online learning. Families were informed that education was going to be remote from now on.

#### *3.2. Mr. Carl's Workload*

Mr. Carl's teaching schedule is reflective of the workload of a teacher in a small rural K–12 school environment. Teachers are required to teach multiple grade levels in one class and a variety of different subject areas [13,22–24]. His teaching assignments included multilevel-multisubject Mathematics, British Literature, Earth Science, Alaska History, Art, and Cooking, as shown in Table 1. His classes

were relatively small and included multiple grade levels, and in Mathematics, multiple subject areas. Not all of his students were engaged in online learning. Three high school students could not be reached despite many phone calls and e-mails. Mr. Carl explained that he had homeless students in his high school classes and transient students who could not be located. The middle school class participated 100% in the elective Cooking.

**Table 1.** Mr. Carl's teaching assignments and students served.

Subject	Grades	Students (N)	Students Engaged (N)
Mathematics (Algebra 1, Geometry, Algebra 2, Trigonometry, Consumer Math)	9–12	8	5
British Literature	9–12	8	5
Earth Science	9–12	6	4
Alaska History	8–12	6	3
Art	8–12	6	5
Middle School Cooking	6–8	8	8

Note: This lists the teaching assignments during spring 2020.

Mr. Carl explained that the online schedule was significantly different from the regular schedule, as shown in Table 2. Class meeting times for core subject areas were reduced to one 2-hour ZOOM meeting per week, and elective classes were shortened to 1 hour per week compared to daily face-to-face meetings at school. This new schedule shortened the instructional time significantly. Mr. Carl described that the impact on instruction was mostly felt in mathematics due to the different subjects that had to be taught to different students during the short two-hour ZOOM meeting time, once a week. Teacher professional development was held on Fridays, and each day of the week included an hour of technical support. Mr. Carl could call-in or e-mail questions to the technical support staff about integrating the tablet into ZOOM meetings, working with different computer screens, and other issues. He felt that the tech support was needed, very helpful, and effective [22]. The schedule included also one-to-one support for students. This was very helpful in his multisubject mathematics class and for the special education students who needed extra support.

Mr. Carl:

My workload was above average especially at the beginning of the switch to online teaching. I had to prepare myself a workplace at home, where I could teach ZOOM meetings and plan with relatively few interruptions. It turned out that a second larger computer screen was helpful, an external microphone supported sound quality better, and a comfortable office chair improved overall well-being. In the first two weeks, my stress level was the highest. I had to find new ways to engage and assess students. More time was spent on preparing assignments digitally and organizing digital documents. The textbooks, I was using, were not available as e-books, and all kinds of other tech issues and challenges developed. Student engagement in learning needed constant daily contacts (e.g., phone calls) outside the ZOOM meetings.

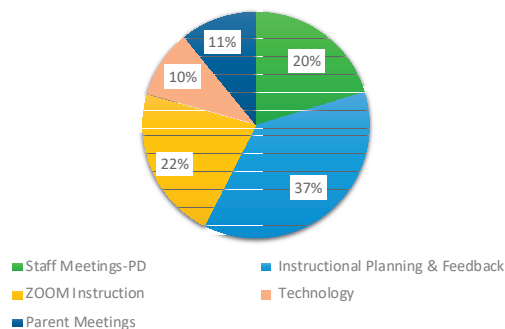
Mr. Carl's workload distribution, as shown in Figure 1, and weekly hour allocations by categories, as shown in Figure 2, during the 9-week online learning implementation were calculated based on ZOOM meeting records, the official schedule, and his daily activity log. Only the main categories of his workload were included. His actual time spent on schoolwork was higher. More than half of his time (59%) was spent on instructing students in real-time on ZOOM, planning for instruction, and giving feedback. Surprising was the relatively small amount of time spent on technology learning (10%). This can be attributed to the One-to-One technology district concept, which had provided teachers with previous technology experience and computer training. Parent meetings accounted for 11% of his time and staff meetings and professional development (PD) for 20%.

**Table 2.** Mr. Carl’s ZOOM class meeting schedule March 30 to May 15.

Time	Monday	Tuesday	Wednesday	Thursday	Friday
8:00–9:00 a.m.	Tech Support	Tech Support	Tech Training	Tech Support	Tech Support
9:00–9:30 a.m.				Staff check-in	Instructional Leadership Meeting (bi-weekly 10:00–12:00)
11:00–1:00 a.m.	Math *	Brit Lit	Independent Studies	Earth Science	
2:00–3:00 p.m.	Art	One-on-One student support	Alaska History	One-on-One student support	Professional Development
3:00–4:00 p.m.	Cooking (Middle school)				
4:00–5:00 p.m.			Curriculum Committee (monthly)		
7:00				School Board Meeting (monthly)	

\* Algebra 1, Geometry, Algebra 2, Trigonometry, Consumer Math.

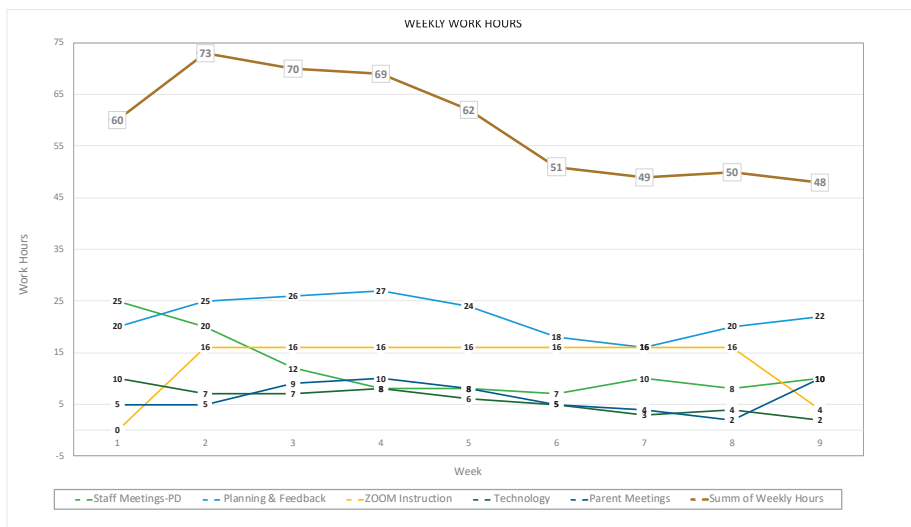
**Teacher Workload Time Distribution**



**Figure 1.** Overall time distribution during the 9-week online learning period.

Mr. Carl’s time allocation and workload changed during the 9 weeks, as shown in Figure 2. Planning and feedback time remained high and ZOOM time for student instructional meetings followed a relatively constant schedule. Mr. Carl noted that establishing routines and fast feedback for his students was key during the transition to online learning. Staff meetings included teacher collaborative meetings and PD. This time commitment decreased until it stabilized in week four. The weekly overall workhours spiked in week two and stayed high for the next two weeks, as shown in Figure 2. Mr. Carl explained that he spent more hours on planning and feedback during the first weeks, and with routine settling in, his days became more balanced. He described his overall workload during the online teaching period as above average compared to his regular workload [8,25].





**Figure 2.** Weekly workhour allocations. Note. Not all teacher activities are reported. The actual workload was higher.

### 3.3. Online Delivery, Success, Challenges, and Student Experiences

The following sections summarize Mr. Carl’s answers to interview questions\* addressing the challenges and successes of online learning, student experience, engagement, and equitable learning.

\* The interview responses are corrected for grammar and checked by Mr. Carl for accuracy.  
*Interview question: Describe teaching online and what was most challenging?*

**Mr. Carl:** I greatly underestimated the complexity of successful online teaching, the amount of content I could teach, and how to engage students. Not being able to look over my kids’ shoulders and having equipment set up to do science laboratory work was hard for me. Teaching Earth Science without hands-on activities is just challenging and no fun. Explaining mathematics concepts online is another challenge. I used an additional tablet to support writing formulas and math problems by hand and to share it in real-time with my students in ZOOM meetings. The cooking class turned out to be good for family engagements. Access to buying ingredients in a store was difficult in our rural location, but kids used what was available at home with great creativity, even cooking on a wood stove was for some the only option.

*Interview question: In your opinion, what is your students’ perception of online learning?*

**Mr. Carl:** Students who like to share, being involved in group work, and taking on social activities would like to return to school. Socially reserved students enjoyed working at home but missed the hands-on activities as well. Students are taking ownership a bit more because they’re no longer under the bell schedule of the school day. Most students want to come back to school as soon as possible. I think they found a new appreciation for their school and teachers.

*Interview question: What are the strategies you have used to reach and engage all your students?*

**Mr. Carl:** Daily communication was key. I called home if a student was not in class and encouraged to join. Breakout rooms and group assignments, partner work, and sharing some

personal stories about coping with the situation helped engagement. I tailored assignments for learning toward personal interests, hobbies, and skills and we shared (about everything) in ZOOM meetings. Reflective learning and assignments that were tailored to students' interests and offered choices helped with engagement. Posting pictures of their work or creating short videos worked well. Instant and motivating feedback helped to keep students on track. Being able to use breakout rooms for individual instructions especially during mathematics together with screen share were essential features of ZOOM. I asked students to submit reflection videos or send photos of handwritten work to assess learning. Students often used their phones to take pictures of their work. Screenshots also worked well.

*Interview question: How prepared did you feel for online teaching at the beginning of the COVID-19 school closure?*

**Mr. Carl:** I felt moderately prepared. I took online delivered classes during studying for my masters. This experience was very helpful. Our school district was already a One-to-One district, which means all students and teachers have their computers or tablets.

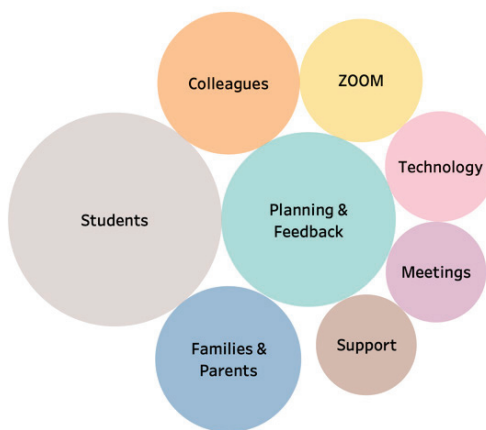
*Interview question: What support was most helpful?*

**Mr. Carl:** Conversation, dialogue, and networking with my teaching colleagues have helped me to navigate challenges in learning how to teach online. Professional development time in breakout rooms with colleagues helped a lot to feel not so lonely and gave me the support that was needed. It was great to have a daily technology support time from 8 a.m. to 9 a.m. scheduled for tackling tech problems and sharing best practices with apps, computer use, and communication. The administration worked hard to support us with information regarding teaching, procedures, and available support. I can say my school district leadership team supported me well and that was important for dealing with the crisis.

*Interview question: What are your perceptions about student engagement and assessing learning during the COVID-19 school closure?*

**Mr. Carl:** Checking on my students' well-being and asking them about their day was crucial for me. Nurturing good student–teacher relationships is critical. Some of my students had to provide childcare for younger siblings and help with their schooling. Family support was not equal. Living off the grid and depending on a generator for electricity caused issues for recharging the computers. Selecting tools such as Flipgrid or Kahoot worked well for me to engage students and assess learning. As a teacher, I provided written feedback through *Google Classroom* and short sound recordings for oral feedback. During synchronous ZOOM sessions, I put students in breakout rooms for personal instructional support with a teacher assistant and also for assessing learning. Personal conversations with my students remained the most powerful and meaningful way to check for understanding. Assignments were interest-driven and utilized the home environment. I used a short survey at the end of the school year to reflect on overall student engagement and learning and to inform myself what I could do better.

The keywords used most frequently, as shown in Figure 3, by Mr. Carl during those interviews and conversations to describe his COVID-19 transition to online learning show that students and instruction-related activities were central to his thinking and work.



Key Words. Size shows sum of Frequency. The marks are labeled by Key Words.

**Figure 3.** Frequency of keywords from interviews and personal conversations.

In distance learning environments there is a risk of being further isolated, but some students seemed to be thriving in the new circumstances [2]. Mr. Carl speculated his kids were doing well because “they enjoy the freedom to work at their own pace and decide how they want their day to look.” Socialization at school can be distracting or intimidating to some. Pressures to look good or fit in socially at school or bullying are well-known distractors. The online environment may allow for voices to be heard without the added social anxiety [5,26,27]. Some social situations and the inflexible bell schedule simply do not work well for all. Mr. Carl’s experiences emphasize that in an era of social distancing, humanizing digital instruction is more important than ever. Using online class time to connect with students and creating a safe environment is one of the most important functions of schooling.

#### 4. Discussion

Mr. Carl experienced an above average workload especially during the first three weeks of the implementation of the COVID-19 “emergency” online learning model. He had underestimated the complexity of successful online teaching, the time needed for preparation, the amount of content he could teach, and how difficult it was to engage students and assess learning. He centered his worktime around reaching all students, checking on their well-being, and planning for individualized instruction. Effective and collaborative school district leadership was important during this transition time [22,28]. Not being able to have all students participate in online classes due to social and home environmental issues was difficult to accept for Mr. Carl. Overall, caring about his students’ well-being and humanizing digital learning while teaching remotely was more important than learning new content [2]. Equity was at the center of his remote learning plans, with increased guidance needed for special education populations [4]. Despite many forms of outreach by e-mail or phone, three of his transient students could not be reached. Although remote learning has brought many challenges, some of his students seem to be thriving in the new learning setting. Observations of his online lessons showed that his diversified and individualized assessments using video reporting, digital storytelling, or science explorations in the back yard engaged students and that they had fun. Checking for understanding and providing timely and meaningful feedback was essential. Giving students the freedom to select place-relevant science activities based on their interests and grading in different ways, was much more successful than trying to recreate school [2,7]. Meaningful learning experiences that connect to students’ home lives, family, and their identities gave his students agency to pursue what was relevant to them. Freed from the constraints of standards-based learning and the bell schedule,

there was more time to focus on connected learning, hobbies, and interest-driven projects, which was appreciated by Mr. Carl and his students. Mr. Carl will use some of this newfound freedom in his future teaching. Yet, he and his students missed the hands-on science teaching, which requires special instrumentation only available in a laboratory setting. Online learning has limitations [27]. Most of his students missed social interactions, peers, and their school [29]. What was learned by students during this emergency-driven move to online education was less than in the face-to-face classroom. Mr. Carl expressed that current concerns about students who may fall behind as a result of the COVID-19 school closure seem to be valid, but a bit exaggerated. He believes that some of his secondary students might finish the quarantine period having developed valuable new life skills, gained personally relevant knowledge, and take better charge of their own learning. Mr. Carl stated during the conversations that blended learning should be part of future schooling and will give especially older students more flexibility in education, better access to a wide range of content, and pursuing their interests. Supportive school leadership, technology help, meaningful PD, and scheduled collaboration with his colleagues were essential for Mr. Carl's own well-being and professional development as an online teacher during the COVID-19 crisis [30]. Mr. Carl and his colleagues ended the school year with a drive-by visit to see most of their students followed by a drive-by graduation. Seven cars painted in school colors and driven by the teachers of a small rural Alaskan school drove the unpaved roads to greet their "kids", the parents, the families, and the community. There was a collective relief that the school year was over and a new appreciation for educational opportunities.

## **5. Conclusions and Recommendations**

The massive COVID-19 online learning experiment brings new insights and cautionary tales about what works in education. The crisis emphasized the critical importance of schools for the economy of a country. Digital access and connectivity remain a pervasive equity issue, especially in rural areas [24,31]. The COVID-19 homebound orders have also magnified existing socioeconomic problems and the critical social role schools play in today's society [32]. Seeing online education as a cheap alternative and quick fix to equity in access to education will not work. Replicating the engagement and discourse from an in-person classroom should not be the goal of online education. The forced move to online education offered also new possibilities. During COVID-19, school schedules have suddenly become more fluid, allowing students more choice over when and how they do their schoolwork. Students are getting a taste of more independence and take on new responsibilities for their own learning. Assessment can suddenly take on many individualized forms using technology to showcase the learning and skills of students and large-scale standardized testing may become obsolete. Not one single model for online learning will provide equitable educational opportunities for all and virtual learning will not be a cheap fix for the ongoing financial crisis in the US education system. Online delivery can reduce the time and costs for travel, increase opportunities to access and collaborate with expert professionals in a global range, provide students with the flexibility to access courses at their convenience, and allow adjustments to subjects and content [27]. During the COVID-19 school closures, it was important to place issues of equity at the center of remote learning plans, with increased guidance for special populations. However, not all students could be reached during the crisis to participate in online education despite many efforts. Those missing students were among the most vulnerable and included transient students, homeless students, students with disabilities, and students living in poverty.

The future of education will include discussing equity issues and testing new ideas and models about the length of school days and the school year, flexible scheduling, the costs of the needed technology infrastructure, what can and what should not be taught in online environments, and what new pedagogy skills teachers may need. In many teacher-education programs, "online" learning is referenced loosely to require teacher educators only to use multimedia tools and digital resources in their teaching. New teachers must be prepared in their teacher education programs to serve the rapidly growing number of online students and have the pedagogy skills for the blended learning models of

the future. In summary, a strong system of public schools with flexible delivery models and scheduling must be an essential component of the US and global economy. This pandemic has utterly disrupted the education system. The severity of the COVID-19 crisis is a wakeup call to strengthen public education including public school financing. The sudden move to online learning may be the catalyst to create a new, more effective method of educating our students. A big question remains—what will be the future of public education after this large-scale experiment with online education from home? The final statement comes from Mr. Carl: “I hope all people involved in education including students, parents, teachers, educational leaders, and policymakers rethink the importance of a *good education* and how we can prepare ourselves to face the global challenges of the future.”

#### Future Research

Distinctive impacts of online education on elementary students and older students need to be studied in depth. Conditions and support systems for equitable learning outcomes for students with disabilities, and transient and homeless students must be explored to generate new guidance for supporting a variety of vulnerable populations. Teachers and educational stakeholders have to be actively involved in future research designs and discussions.

**Funding:** This research received no external funding.

**Acknowledgments:** The author likes to thank “Carl” for sharing his experiences as a teacher during the COVID-19 crisis for this research.

**Conflicts of Interest:** The author declares no conflict of interest.

#### References

1. Brooks, S.K.; Webster, R.K.; Smith, L.E.; Woodland, L.; Wessely, S.; Greenberg, N.; Rubin, G.J. The psychological impact of quarantine and how to reduce it: Rapid review of the evidence. *Lancet* **2020**, *395*, 912–920. [CrossRef]
2. Reich, J.; Buttner, C.J.; Fang, A.; Hillaire, G.; Hirsch, K.; Larke, L.R.; Slama, R. Remote learning guidance from state education agencies during the covid-19 pandemic: A first look. *EdArXiv* **2020**. [CrossRef]
3. Fagell, P.L. Career Confidential: Teacher wonders how to help students during coronavirus shutdown. *Phi Delta Kappan* **2020**, *101*, 67–68. [CrossRef]
4. Laster Pirtle, W.N. Racial Capitalism: A Fundamental Cause of Novel Coronavirus (COVID-19) Pandemic Inequities in the United States. *Health Educ. Behav.* **2020**. [CrossRef] [PubMed]
5. Van Lancker, W.; Parolin, Z. COVID-19, school closures, and child poverty: A social crisis in the making. *Lancet Public Health* **2020**, *5*, e243–e244. [CrossRef]
6. De Witt, P. 6 Reasons Students aren’t Showing Up for Virtual Learning. Available online: [http://blogs.edweek.org/edweek/finding\\_common\\_ground/2020/04/6\\_reasons\\_students\\_arent\\_showing\\_up\\_for\\_virtual\\_learning.html?intc=main-mpsmvs](http://blogs.edweek.org/edweek/finding_common_ground/2020/04/6_reasons_students_arent_showing_up_for_virtual_learning.html?intc=main-mpsmvs) (accessed on 12 May 2020).
7. Merrill, S. Teaching through a Pandemic: A Mindset for This Moment. Available online: <https://www.edutopia.org/article/teaching-through-pandemic-mindset-moment> (accessed on 21 May 2020).
8. Baired, K. Caring for Educators is the First Step in Serving Students. Available online: <https://thejournal.com/articles/2020/05/19/caring-for-educators-is-the-first-step-in-serving-students.aspx> (accessed on 26 May 2020).
9. Cohen, J.; Kupferschmidt, K. Countries test tactics in ‘war’ against COVID-19. *Science (New York N.Y.)* **2020**, *367*, 1287–1288. [CrossRef] [PubMed]
10. Yang, X. Teachers’ Perceptions of Large-Scale Online Teaching as an Epidemic Prevention and Control Strategy in China. *ECNU Rev. Educ.* **2020**. [CrossRef]
11. Anthony-Stevens, V.; Langford, S. What Do You Need a Course Like That for? Conceptualizing Diverse Ruralities in Rural Teacher Education. *J. Teach. Educ.* **2020**, *71*, 332–344. [CrossRef]
12. Barley, Z.A.; Wegner, S. An examination of the provision of supplemental educational services in nine rural schools. *J. Res. Rural Educ.* **2010**, *25*, 1.
13. Kaden, U.; Patterson, P.P.; Healy, J.; Adams, B. Stemming the revolving door: Teacher retention and attrition in arctic Alaska schools. *Glob. Educ. Rev.* **2016**, *3*, 129–147.
14. Stake, R.E. *Multiple Case Study Analysis*; Guilford: New York, NY, USA, 2006.

15. Baxter, P.; Jack, S. Qualitative case study methodology: Study design and implementation for novice researchers. *Qual. Rep.* **2008**, *13*, 544–559.
16. Yin, R.K. *Case Study Research: Design and Methods*; Sage: Los Angeles, CA, USA, 2014.
17. Miles, M.B.; Huberman, A.M.; Saldana, J. *Qualitative Data Analysis: A Methods Sourcebook*; Sage: Thousand Oaks, CA, USA, 2014.
18. Merriam, S.B.; Tisdell, E.J. Designing your study and selecting a sample. In *Qualitative Research: A Guide to Design and Implementation*; Jossey-Bass: San Francisco, CA, USA, 2016; pp. 73–104.
19. Harrison, H.; Birks, M.; Franklin, R.; Mills, J. Case study research: Foundations and methodological orientations. In *Forum Qualitative Sozialforschung/Forum: Qualitative Social Research*; 2017; p. 18. Available online: <http://www.qualitative-research.net/index.php/fqs/article/view/2655> (accessed on 30 May 2020).
20. Creswell, J.W. *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*, 4th ed.; Sage: Thousand Oaks, CA, USA, 2014.
21. Herold, B. The Disparities in Remote Learning under Coronavirus. Available online: <https://www.edweek.org/ew/articles/2020/04/10/the-disparities-in-remote-learning-under-coronavirus.html> (accessed on 22 May 2020).
22. Borup, J.; Stimson, R.J. Responsibilities of Online Teachers and On-Site Facilitators in Online High School Courses. *Am. J. Distance Educ.* **2019**, *33*, 29–45. [CrossRef]
23. Biddle, C.; Azano, A.P. Constructing and Reconstructing the “Rural School Problem”: A Century of Rural Education Research. *Rev. Res. Educ.* **2016**, *40*, 298–325. [CrossRef]
24. Azano, A.P.; Stewart, T.T. Exploring place and practicing justice: Preparing preservice teachers for success in rural schools. *J. Res. Rural Educ.* **2015**, *30*, 1–12.
25. Azano, A.P.; Stewart, T.T. Confronting challenges at the intersection of rurality, place, and teacher preparation: Improving efforts in teacher education to staff rural schools with qualified teachers. *Glob. Educ. Rev.* **2016**, *3*, 108–128.
26. Starr, J.P. On Leadership: Responding to COVID-19: Short- and long-term challenges. *Phi Delta Kappan* **2020**, *101*, 60–61. [CrossRef]
27. Cook, K.C.; Grant-Davis, K. *Online Education: Global Questions, Local Answers*; Routledge: New York, NY, USA, 2020.
28. Viner, R.M.; Russell, S.J.; Croker, H.; Packer, J.; Ward, J.; Stansfield, C.; Booy, R. School closure and management practices during coronavirus outbreaks including COVID-19: A rapid systematic review. *Lancet Child Adolesc. Health* **2020**, *4*, 397–404. [CrossRef]
29. Wang, G.; Zhang, Y.; Zhao, J.; Zhang, J.; Jiang, F. Mitigate the effects of home confinement on children during the COVID-19 outbreak. *Lancet* **2020**, *395*, 945–947. [CrossRef]
30. McKenzie, K.; Christman, D.; Hernandez, F.; Fierro, E.; Capper, C.; Dantley, M.; Scheurich, J.J. From the field: A proposal for educating leaders for social justice. *Educ. Adm. Q.* **2008**, *44*, 111–138. [CrossRef]
31. McLaren, P. *Life in Schools: An Introduction to Critical Pedagogy in the Foundations of Education*, 4th ed.; Allyn & Bacon: Albany, NY, USA, 2003.
32. May, S.; Sleeter, C.E. *Critical Multiculturalism: Theory and Praxis*; Routledge: New York, NY, USA, 2010.



© 2020 by the author. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).



Article

# “Am I Doing Enough?” Special Educators’ Experiences with Emergency Remote Teaching in Spring 2020

Rachel K. Schuck \* and Rachel Lambert

Gevirtz Graduate School of Education, University of California, Santa Barbara, CA 93106, USA;  
rlambert@ucsb.edu

\* Correspondence: rkschuck@ucsb.edu

Received: 17 September 2020; Accepted: 2 November 2020; Published: 5 November 2020

**Abstract:** While the COVID-19 pandemic radically changed all aspects of everyone’s life, the closure of schools was one of the most impactful, significantly altering daily life for school personnel, students, and families. The shift to Emergency Remote Teaching (ERT) presented particular challenges to special educators of students with significant support needs who often benefit from strong interpersonal connections, modeling, and the use of physical manipulatives. This paper details the experiences of two elementary special education teachers as they navigated the transition to ERT. The teachers reported three distinct stages of ERT: making contact, establishing routines, and transitioning to academics. They also discussed the challenges they faced during this period, such as the inequity in resources amongst their students, needing to rely on at-home support in order to meaningfully teach students, and changes in what it meant to be a teacher while having to teach online. While clearly not in favor of online learning, the teachers do present glimmers of hope, for example, with regards to increased communication between teachers and parents. The challenges and strategies used to overcome these challenges will be of use to educators in the coming months, with implications for distance learning in this population.

**Keywords:** emergency remote teaching; COVID-19; special education; teachers; elementary school

---

## 1. Introduction

In the spring of 2020, schools across the world shut down in response to the COVID-19 pandemic, leaving over 90% of children in the world without in-person schooling [1]. Schools and districts had to immediately adapt to a host of new concerns including ensuring the physical health and safety of students (for example, by providing food for those who had relied on school lunches), providing technology to families at home, and implementing quality educational techniques from a distance. This Emergency Remote Teaching (ERT) [2] exacerbated concerns of educational equity, as students with fewer resources were less likely to have access to the technology needed to meaningfully engage in distance learning [3]. ERT also presented a heightened challenge for special education teachers, particularly those who teach students with significant support needs [4]. Given the issues of equity in ERT and the challenges inherent in online special education, it is crucial to learn more about the experiences of special educators during spring 2020 and understand how they dealt with ERT. We are particularly focused in this paper on the experiences of teachers whose students have significant support needs, and we are conscious of equity concerns for this group of learners.

### 1.1. Special Education and Distance Learning

While distance learning during COVID-19 presented challenges for special education teachers, online special education is not completely unheard of. Some research has focused on practical tips for teachers who are teaching online [5–8], while other studies have focused on how to organize an



online classroom (for example, Vasquez and Straub's [9] review of K-12 special education distance learning found that five out of six of the studies reviewed utilized only asynchronous sessions, while Sorenson [10] found that one-on-one online sessions were the most common instructional type in elementary school compared to higher grades).

Several studies have highlighted areas of potential benefits with regards to distance learning for students with disabilities. For example, having open access to course materials can facilitate repetition of material, such as watching a demonstration video multiple times [11]. For example, two studies found that university students who either were autistic or who scored high on an assessment of autism were more likely to prefer review of videos and blogs as opposed to interacting with peers and instructors than students who had fewer autistic tendencies [12,13]. In another study of adult students with learning disabilities, participants reported appreciating the flexibility and self-management in their online classroom and also reported not having to worry about social stressors around feeling "inferior" to other students [14]. A potential benefit with regards to distance learning in younger grades is that parents may have the opportunity to be more involved in their child's learning [10].

However, it is important to note that the majority of studies on K-12 special education distance learning were conducted with families who chose to enroll their child in distance learning. Therefore, the ERT of the COVID-19 pandemic is not synonymous with online/distance learning in general (see Hodges et al. [2] for a discussion of the differences at the university level). Given that online learning requires intrinsic motivation to stay engaged, parents may need to be involved at all times [15], especially if their child struggles with executive functioning and self-management [11]. This time commitment may be too much for some parents, even in times of societal normalcy [16,17]. The unexpectedness of the move to mandatory distance learning was thus a major transition for all stakeholders (e.g. teachers, students, and parents), presenting challenges above and beyond those normally inherent in distance learning.

It is also important to note that a large portion of research on special education distance learning appears to have been done with students with less significant support needs [18]. For example, in Vasquez and Straub's [9] review of online K-12 special education, none of the six empirical studies identified were conducted in self-contained classrooms (instead, they were in mainstream and resources classrooms, as well as an after school program). Much research on online learning for individuals with disabilities also seems to be focused on postsecondary learners (e.g. a recent review of K-12 online special education indicated that they had to exclude many articles focused on adult participants [19]). Research has also highlighted that even state special education directors have doubts regarding the ability of Individualized Education Program (IEP) teams to adequately ensure a free and appropriate education in the least restrictive environment for students with disabilities who are receiving schooling online [20].

### *1.2. Students with Disabilities and the Current Crisis*

Little research has been done with regards to the ERT brought upon by the COVID-19 pandemic, as the crisis began only months ago and is still ongoing. Several articles describe the loss of in-person schooling for students, particularly with regards to their mental health [21–23]. Lee [23] notes that this disruption can be particularly devastating to students with disabilities such as autism, who thrive on routine and regular schedules. Additionally, the lack of built-in social opportunities that come along with school can be detrimental to autistic students' social development [22]. A significant number of students with disabilities also have co-occurring mental health issues; for example, students with autism have much higher rates of anxiety than their general population counterparts [24]. Increased isolation and lack of mental health services may lead to exacerbation of mental health issues during this time [23]. A survey of UK parents of students with disabilities documented an increase in worry, anxiety, and isolation for these families [25]. Many parents reported that the changes they experienced when schools closed had a negative effect on their own mental health as well as that of their children. The authors sum up the situations for families,

Staying at home, and in most cases not attending school, creates a uniquely stressful situation for children with [disabilities] and their families. Carefully developed routines have been disrupted; support networks have disintegrated; and parents have been asked to do a job that trained teachers find challenging, without any training.

(para. 4 [25])

The same project also surveyed families about what kind of support they desired during COVID-19 [26]; families reported wanting (1) specialized professional advice on how to meet academic and mental health needs, (2) materials for home learning, and (3) provision of opportunities to “see familiar faces.” Similarly, parents in the United States report wanting recommendations for dealing with challenging behavioral issues and increasing motivation for school while at home [27]. Though some scholars have put forth suggestions and strategies for parents [28], many parents may feel that they have to balance too many competing responsibilities [29] to implement such strategies effectively.

ERT not only transformed students’ and parents’ lives, but teachers’ as well. In an interview study of twenty-four general education teachers in the U.K., teachers discussed feelings of uncertainty and anxiety about their student’s safety and access to resources, as well as concerns about grading [30]. As we prepared this manuscript, we found only one study that analyzed the perspective of special education teachers during COVID-19 ERT, and none were set in the US. Iivari et al. [31] documented the experiences of special education teachers in India and a widening digital divide based not only on disability but also on the socioeconomic class of students. While increasing student engagement was challenging, the teachers did note that some parents and students did do well during the lockdown, provided they could implement and follow a routine. Access to technology is also a major factor in ERT, affecting both families and teachers [32].

### *1.3. Current Study*

Given the novelty of the situation into which special educators were thrust, and the likelihood that teachers will be faced with the prospect of teaching online in the near future, it is crucial to understand more about their experiences. Therefore, the current study was an exploratory, qualitative study aimed at learning more about what it was like to teach during spring 2020’s ERT through qualitative analysis of the experiences of two special education teachers. More specifically, we aimed to answer the following research questions:

1. How did Emergency Remote Teaching evolve over the course of the spring 2020 semester?
2. What problems emerged for teachers of young students with disabilities?
3. How, and to what extent, were those problems handled?

## **2. Methods**

### *2.1. Participants*

Three elementary teachers participated in this study, though this paper focuses only on two of them. Data from the third teacher was focused on a different student population (analysis of this teachers’ experiences can be found elsewhere) [33]. The two teachers whose data is presented herein, Belen and Rose (pseudonyms, both female), worked at the same school in the same district in a large, urban city in the Western US. Their school had a predominantly (over 90%) Hispanic/Latinx student body, with over approximately 70% of students socioeconomically disadvantaged, 18% English language learners, and 15% students with disabilities. Belen and Rose both taught self-contained special education classes for students with disabilities with significant support needs. Rose taught grades 1–2; Belen taught grades 3–5. The most common disabilities in Rose’s class were autism, intellectual disability, and speech-language impairment, while those in Belen’s class all met criteria for autism. Both teachers had nine students, mostly boys. Both have Educational Specialist (Moderate/Severe) credentials.

Belen had been teaching for five years (though she worked for 15 years prior as a paraprofessional); Rose had been teaching for six. Belen and Rose have both been teaching at the same school for the duration of their teaching careers.

Prior to participating in the current investigation, Belen and Rose had participated in a research project regarding mathematics teaching with students with disabilities with the second author and were both active participants in ongoing professional development on Cognitively Guided Instruction (CGI) [34]. Both were named by district personnel as exceptional special education teachers.

## *2.2. Interview Procedure & Analysis*

Because we were seeking insight into a novel phenomenon, we designed exploratory interviews, as we could not know what exactly to ask about in advance [35]. Due to the challenging nature of facilitating exploratory interviews, the second author conducted the interviews, given her prior experience interviewing teachers [36,37] and her decade of experience teaching students with disabilities. The interviews with Belen and Rose were conducted in April 2020, approximately three weeks after school buildings closed. Belen's interview lasted approximately 35 min, while Rose's was 20 min. While a semi-structured interview protocol that was based on the second author's expertise as well as a literature review of extant research on online learning for students with disabilities was prepared to guide the interview's major themes, the interviews were exploratory and took an informal conversational tone [38], with initial questions asking generally how teachers were doing (e.g., "How's it going?"). Other questions on the protocol included: What concerns do you have at the moment? What supports do you feel you need? On-the-spot follow-up questions were used to explore emergent issues in the teacher's practice during ERT.

In order to recognize patterns within our data, we utilized a thematic analysis, using an inductive approach [39]. We took an inductive approach due to the novel nature of our topic and research questions. Though we had reviewed the literature on online special education prior to analysis, it did not provide us with enough of a theoretical orientation to code deductively. Analysis began with both authors open coding and then focused coding the interviews [40]. Open coding refers to themes and ideas that a coder thinks of during a first pass through an interview transcript. Focused coding occurs after the initial codes are reviewed and summarized, such that coding at this stage applies the same coding scheme to all data. Both authors separately identified themes across participants; codes were then compared amongst the two authors and discrepancies resolved. We then created a memo (Interview 1 Themes Memo) that summarized the themes of the first set of interviews.

Our second interview was a focus group, again exploratory in design as the teachers were still in the process of adapting to novel conditions. This uncertainty necessitates exploratory methods with a skilled interviewer [35]. We began again with open-ended prompts (e.g., "How is it going?" and "What's changed?") to elicit any shifts since the first interview. We then asked questions based on the themes identified in Interview 1 Themes Memo. Again, because of the emergent nature of the phenomenon under investigation, we were intentionally exploratory in our questioning to allow for unanticipated responses. For example, when a teacher brought up the way parents think about their children who are in special education, the interviewer encouraged more discussion on that topic by asking, "What are you seeing about how these parents think about their kids and their learning?" Themes from the individual interviews, such as the early theme of parent over-involvement, were presented to the participants as a member check.

Following the focus group, the first and second author coded all focus group data using the existing themes from the individual interviews. Open coding was used to look for new themes within the focus group data. All data were then reviewed again using focused coding with all codes from both the interviews and the focus group. Data were sorted into categories for further analysis, determining if the category described all data within it [41] When the first draft of the findings was complete, the draft was sent to the teachers again for feedback as a second member check. We used member

checks in this research because the topic is emergent, and we wanted to ensure we were accurately capturing their perspective. This also serves as a form of respondent validation [42].

### **3. Findings**

This section reports first on the different stages of teaching through which the teachers navigated. Second, we explore the challenges the teachers faced in terms of connecting with families and introducing effective teaching practices.

#### *3.1. Stages of Emergency Remote Teaching during Spring 2020*

Belen and Rose described three main stages of teaching during this spring's ERT. The first was making initial contact with families and setting up the technology. Academics were not the focus during the first stage. The second phase entailed establishing routines within students' homes and a focus on socio-emotional well-being. The third phase consisted of the teachers beginning to include more academics. Though Belen and Rose both progressed through stage two before stage three, there was considerable overlap between those two stages as the teachers saw both socio-emotional and academic goals as paramount to their teaching.

##### **3.1.1. Stage One: Making Contact**

For the first one to two weeks after school abruptly closed, teachers were focused mostly on making contact with students and their families. Efforts in these first weeks focused on ensuring all families felt supported and had access to the technology necessary to engage in online distance learning. As Belen described,

It was more trying to meet with them or talk to them, to how can I come and support you? What is going on? So it was a check in all last week. This week, it was again now doing even manual phone calls to every family to get this same kind of idea of where they're at.

Rose similarly said, "The first week, it was kind of me talking to the parents mostly. Okay, trying to get the parents connected. I was able to send home like a couple resources for online learning."

Belen and Rose's school was able to allocate an iPad to each student, which were available via pick-up during this period. However, teachers had trouble reaching some families, and not all picked up the devices immediately. Belen had trouble getting in touch with one parent and hoped that he would be able to pick up the iPad: "So I was able to talk finally with one parent who I couldn't get a hold of. And finally, he called . . . hopefully [he'll be] able to come and pick up an iPad from school . . . And I shared with him, I think the most important piece is for your son to see me and to see his peers." Rose reported that by week three, she had been in touch with all families and "no one's like a ghost" anymore.

While the district was initially busy ensuring all students had access to the technology and food, during this time, Belen and Rose felt that they had little idea what they should focus on academically, how they might provide services, and, legally, how IEP services would work. They began wondering about what their goals would be during ERT and what equitable solutions they could implement. However, at this stage, parents were primarily concerned with their children's emotional states and subsequent behaviors. The teachers described upset parents with children whose routines were upended. Belen described "that it's changed the routine on the students. So when [parents] try to get them to do work at home, it's a big, big behavior outbursts, like, we never do work at home." With this in mind, both teachers realized the need for routine and structure at home in order to effectively teach their students.

##### **3.1.2. Stage Two: Establishing Routines**

Stage two began about two weeks after the closing of physical schools as teachers began to provide additional services for students. By this point, focus was shifted away from the paper packets

sent home at the beginning of the school closure, and the teachers both began to rely on the school's Digital Learning System (DLS) for communication and academics. Now that the majority of families were connected, this stage focused on creating new routines at home in order to support learning, as well as the teachers developing their own routines on how to provide instruction to students. Though there was initial resistance from some students on schooling from home, Belen described needing to establish a "new normal . . . then I can start introducing the things that we were actually doing in class, like, okay, now you guys are going to go and do a counting collection, because they're so familiar with those things." Rose mentioned a similar sentiment, saying, "It's hard for me just to be, like, come on, we're going to do math now, right?... Like, they need to know there's a beginning and end."

Both teachers emphasized wanting to make families feel comfortable during this unprecedented time. Both began holding individual and group meetings via Zoom. At the beginning, Belen said, "Right now I just want the parents to feel comfortable. And I said the standard is I just want the students to be able to see their peers. So I'm not putting any expectations as far as this is work time, yet." Similarly, Rose also put parents' stress at the forefront of her teaching, ensuring that parents and students were at least able to access the online content before working on more academic skills: "So just slow, like not trying to overwhelm parents and kind of doing, like, one week at a time, like, hey, our goal this week is for you to access this resource. Please try it at home, please let me know if you're not able to do it so I can help you troubleshoot."

As time went on, both teachers saw more students and families attend the Zoom meetings. These meetings became more structured and consisted of games, stories, and check-ins using the format of Morning Meetings [43]. Belen described,

Today was the first time I kind of attempted to create a routine through this format and do part of my Morning Meeting, which is just, today, all I did was take attendance and choose the greeter of the day. So, from the four kids that were there, I asked one to say good morning to all of them. So that was the greeter. And they had to wait for the other person to respond and say, 'Good morning.' When I took attendance, I did like I do in class, and the expectation is they have to raise their hand and say, 'I'm here.'

Setting up this kind of routine was crucial to the success of Belen's students, with one parent telling her, "this four days a week, thirty minutes is the closest to school that my son gets. So yes, I want the four days because that sets us up for the rest of our day." Rose also highly valued the social aspect of synchronous learning, saying, "Like, even if they can't do the more interactive stuff or do responses or upload their own work, like, at least I can see them and they can see each other."

### 3.1.3. Stage Three: Transitioning to Academics

The transition from setting routines to engaging students in academics was not a smooth one. Belen discussed feeling a tension between her high academic expectations that she normally set for her students and the reality of her families' drastically shifted lifestyles. She described her "crude reality" as she realized she would not be able to do everything she wanted via distance learning:

Let me start doing what we do in class, right? Let's get them involved in, let's do the counting collections. Let's do routines in this [digital] platform, but then my crude reality, and that was a shocker for me, [is] trying to do the 15 min with the students and the behaviors, running around, jumping up and down or having a lot of stim behaviors and just getting them to focus or to sit . . . Okay, I might be asking too much for my kiddos right now. This is not their new norm. And here I am, like here, I'm ready to teach, guys. And they're like, no, you're, you can't come into my house and have me work now. . . . So that's my, that was my reality. So it's, like, okay, I need to tone it down.

While this initial attempt at incorporating academics was unsuccessful, by the time of the focus group, roughly 6 weeks after the beginning of ERT, Belen was meeting her students on Zoom four days a

week for 30 min at a time. Part of her meetings were devoted to work designed to emulate the classroom “centers” for English language, art, math, and other subjects. She was also meeting parents one-on-one if they desired additional support, particularly in the area of managing challenging behaviors. By this point, Rose was also meeting families individually for behavioral support consultations and was also holding daily “morning meetings” via Zoom. Whereas the meetings were first focused on social activities (e.g., stories, songs), they were gradually shifted to a more academic curriculum, while still preserving the social emotional goals of a Morning Meeting. In addition to the synchronous Zoom meetings, both teachers also uploaded activities to the DLS for families to access and implement at home. The curriculum for both teachers included reading stories, phonics exercises, writing activities, and counting collections. Belen described her plan for introducing counting collections at home: “Yes, I think that would be a fun, first real math activity. Have something, something that you already have at home, prepare it ahead of time for them. Like that’s gonna be your homework, and then record it and then we just get together and we share.” Rose began using the Zoom annotation feature to engage her students in her meetings by having them indicate choices on the screen.

Though Belen and Rose attempted to incorporate more academics into their teaching, both struggled with juggling between socio-emotional and academic goals throughout the entire ERT period. When faced with this challenge, Rose also felt the need to shift perspectives in terms of what was expected for each student based on feasibility:

What can I do so that I can provide something to those students that’s, like... they don’t need to, like, create a response? They don’t need to really do anything, but just be there. Like, just being there is enough or just watching it is enough.

This echoes a quote from Belen in the previous section, in which she tells a parent that the most important thing is for his son to simply see his teacher and peers. Both Belen and Rose were constantly balancing the socio-emotional needs of their students and their families with the desire to push them academically.

### *3.2. Major Challenges with Emergency Remote Teaching*

When trying to work with families to establish new routines, maintain academic skills previously learned, and teach new material, the teachers described multiple hurdles. These challenges were interleaved throughout all of the aforementioned stages, from initially making contact to setting up new routines to including more rigorous academics. The main challenges that emerged from the teachers’ interviews were (1) inequity inherent in ERT; (2) providing adequate support to families under duress; and (3) changes in the teaching experience.

#### *3.2.1. Inequity of Support and Resources at Home*

The inequity of resources and access to technology was a common topic amongst the teachers. There was wide variation in the amount of support students were given at home. Some students consistently had an adult working alongside them all day (5/9 of Belen’s students; 3/9 of Rose’s), whereas other students did not receive any one-on-one school assistance at all (2/9 students for both teachers). The remaining students sometimes had adult support, but not consistently. Rose described some of the various situations her students faced, saying:

And not to be, like, not to penalize anyone, because, like I said, it’s not equitable. And I have students at home that, their parents aren’t home, like, they’re essential workers, grandmas, they’re watching four little kids, one with, you know, severe autism and, like,... how can I expect her to be the teacher, right?

This clearly created inequities for the teachers’ students with the most significant support needs, who needed assistance getting out a device, turning on the necessary online programs, and engaging

meaningfully with Zoom or the DLS (only one of the 18 total students was able to engage without adult support). Many caregivers were still working at this time, either from home or outside the home as essential workers. Food insecurity and other economic realities were stark. Rose specifically highlighted the fact that distribution of resources is not equitable at home as it is at school:

And also, like, I'm always thinking about equity, right, like right now it's so glaring the kids that have the resources and have parents who can spend time with them to learn at home, and the kids that don't have that ... the justice angle of this, like, we all need to keep in the back of our heads, like, and kind of the, I guess, the attitude right now is, like, yeah, we get that it's not, it's not equitable. It's not going to be equitable. But we, just, we're going to teach the kids that are showing up.

Later on, during the focus group, she elaborated, discussing how learning from home can present issues for disenfranchised students by forcing them to be responsible for things outside of their control.

Belen gave examples of such inequity by discussing the difficulties some parents had logging on to the online portals and even getting access to the internet. She described one mom who, "At first ... didn't have internet, then she couldn't, didn't, have a device. Finally, we got her a device. Now she has internet, she didn't have a phone number, she didn't have an email. I have to still help her to get all those things in place. And, and, but I haven't been able to see the student on Zoom." She also described another family whose problems were not solved by simply having access to her child's school-issued tablet:

[She said] 'Oh, that is a very nice thing you guys are doing, but right now' she says, 'We both got laid off,' like, her husband and her, 'from this coronavirus, so' and she says they owe money to Comcast, so they can't even jump into the free WiFi because she feels like they already have a tab with them. So they couldn't get the free, the free internet during this time. And she doesn't have a device either. And on their phone, I believe they don't have data either. So it's not, like, I can join her on Zooms through her phone. They only have call. And that's, yeah. There's a lot of challenges just to, to get everybody on the same page.

### 3.2.2. Reliance on At-Home Support

One of the major changes that occurred with ERT was that these special education teachers now had to rely on support from parents or other caregivers to facilitate education. The students in their classrooms had significant support needs, and in most cases required support from an adult or older child to engage in educational activities. This theme is composed of three subthemes: learning at school versus home; parents as educational partners; and teaching students with limited adult support.

*Learning at School versus Home.* Distance learning created an opportunity for the teachers to see their students in a new light: their home environment. By witnessing students working at home, interacting with family members, the teachers realized that not all of the work they had been doing in the classroom was being translated to the home. Rose described a student who, at school, "gets along well, he communicates well, he knows, he knows what to do. He's, he's doing it. ... I see that same student at home now and I was like, wow, ... [he] is not plugged into his world in a way that he seems like when he's at school." This may be related to the fact that parents and teachers have different roles in children's lives, as well as different expectations. According to Rose:

I think just generally, at home, the expectation is different for a lot of my students. Not all but many. Like, I just sent home worksheets. And [a parent said], 'I didn't think he could do it, I wasn't gonna give it to him, but he knows exactly what to do.' And I'm like, 'Yeah, like, he understands that skill.'

Whereas Rose brought up issues of engagement and independence, Belen saw her students exhibit an increase in challenging behaviors due to the disruption in their routines: "The behaviors again



that we're seeing is that their routine has been broken and the, whether it's aggression, just a high level of non-compliance and throwing tantrums at home because they don't want to do the work." Rose acknowledged that some of her students' parents struggled with getting their child to sit down to do school work.

These issues regarding expectations (both academic or behavioral) were not as salient in Belen's and Rose's in-person classrooms, likely due to the fact that expectations had been set from the beginning of the school year, and the teachers were able to apply strategies to address problems that arose. It was therefore important for the teachers to realize that buy-in from parents, at least those who were able to be regularly involved in the ERT, was crucial in order to reach their students.

*Parents as Educational Partners.* Both Belen and Rose acknowledged that parents are usually not trained in behavioral and learning strategies in the same way that classroom teachers and paraprofessionals are. To address this, Belen decided to offer one-on-one Zoom sessions with parents in order to give suggestions and feedback tailored to each individual student, similar to the training she would do with a paraprofessional:

So I told one dad, even if we were to have one-on-one Zoom meetings, where I can sit with both of you and your wife, and whatever things that are happening at home, that you're struggling to figure out how to manage; we can troubleshoot.

She saw this as an opportunity to bridge gaps between classroom and home:

This is, like, the time for me and the parents to really be on the same page and teach them. When we're in the classroom, I never really get those opportunities for them to come; let's practice this, let's do it together.

Not all efforts to include parents in teaching went smoothly, however, especially with regards to parental implementation of more complex teaching strategies, such as the constructivist mathematics taught by these teachers. According to the teachers, teaching mathematics means developing a carefully trained eye for noticing the mathematics in what students do and building on what students understand. Rose discussed how she sent home videos of students doing math in her class, but felt it would be difficult for parents to understand why, for example, she might allow a student to make a mistake and let them try to correct it themselves. Both Belen and Rose discussed the difficulties of trying to convey their approach to mathematics to their students' parents, and the issues inherent with assuming that parents can take on the role of being their child's teacher. This crisis represented a shift in roles for the teachers. Not only were they now expected to provide instruction online, they were also trying to design professional development for parents in a much more involved way than ever before.

*Teaching Students with Limited Adult Support.* While the teachers did their best to involve parents in the educational process, as mentioned earlier, there was wide variation in the amount of support students were given at home. Not all students had an adult working alongside them all day. In Belen's class, two out of her nine students were unable to access the DLS without constant parent support and prompting. Rose describes how she made videos for the students with significant support needs who did not have sufficient support: "And just trying to think of what can I put out for them so that if they don't have the supervision to interact, and they don't have the skills they need to interact on their own, they can just watch." Rose also said, "... I want to make sure that we're putting content out that the kids that aren't able to show up can have, can just watch, like, they know their teacher is there." This was emotionally troubling for Rose, as she tried to provide for students who needed, but were not being given, one-on-one adult support.

### 3.2.3. Changes in the Teaching Experience

Beyond the challenge of trying to teach parents how to implement educational strategies and/or having to worry about reaching students who had limited adult support, Belen and Rose also faced additional changes in how their teaching looked during ERT. The subtheme of changes in the teaching



experience had three subthemes: teaching through a screen; accountability, grading, and attendance; and shifting work conditions.

*Teaching through a Screen.* During ERT, digital interfaces mediated all interactions between students and teachers. While technology allowed interaction, it took away relational aspects of teaching and learning that were upsetting to the teachers. Rose spoke of the screen as a massive barrier to communication and pedagogy. She noted that, for her young students, teaching relies on modeling and encouraging joint attention. Without the ability to use manipulatives, model what to do, and direct her students' attention with her eyes and body, Rose saw her students struggle, even with activities she knew they had mastered. For example, with regards to 10 frames, she said, "Like, he can do that. But when it turns into a screen, match the 10 frame in the number, like, that becomes harder for him to demonstrate, like, he knows that skill." Something fundamental was missing when she was not sitting next to the students, working with them.

Furthermore, it is not only interaction with teachers that shapes learning, but with peers as well. Belen and Rose were both very concerned with students coming to the synchronous Zoom meetings so they could see their peers. Belen described seeing each other via Zoom as "reassuring"—"a sense of, yeah, it's like, okay, everything's gonna be okay. And even if our students are non-verbal, like I noticed was with my student today that came in, once he started seeing us and seeing more, he, you can see his demeanor and him sitting." She said of the same student, "It's like he, he saw his friends. And when I had one of the friends talk to each one of them . . . you can see that light up like, 'Oh, there. Oh, I'm seeing you.' So it's also, I think, a sense of comfort and joy to see each other."

*Accountability, Grading, and Attendance.* The teachers described a tension around accountability that they found difficulty to manage. They knew that students needed accountability and feedback but were unsure of how to go about providing it. According to Rose, the lack of accountability and feedback made students who were doing work feel like "they're just shooting the work off into the ether." She also acknowledged that "for a lot of parents, um, it might be nice just to be like, 'Hey, do this small thing and then we're gonna come back and talk about it.' So it's not just like, it feels like we're doing it for a reason." Yet to hold students and parents accountable for schoolwork when their home situations were out of their control felt inequitable as well, with Belen saying, "Well, how do we grade our students? Because it almost seems like we are grading the parents."

This issue also presented itself even during synchronous Zoom sessions, with Rose explaining:

But that's what I am kind of nervous about, even in a small group with one other kid, like, 'Oh, hey, buddy, it looks like you didn't do any work this week.' Like, like, how do I navigate that? Like, how do I offer feedback and, you know, revisit work that they've done, but also not make anyone feel bad for not doing the work because that's not where I want to go either.

*Shifting Work Conditions.* Both teachers brought up the fact that they felt personal changes in their jobs as teachers as a result of the pandemic and resultant ERT. Given everyone's heightened stress, the increased focus on socio-emotional support, and uncertainty regarding academic progress, Belen wondered, "Am I doing enough? Is there something I should be doing, something I could be doing better? It just feels like we have to do it all."

Belen and Rose both commented on the number of virtual meetings they were expected to attend each day, on top of their teaching responsibilities. While Belen saw the potential benefit of these meetings, she also felt that it was a sense of anxiety driving her to attend them, worried that she might miss out on important information:

It almost feels like it's almost a panic mode for us as well, almost like when you go and overstock and start buying everything, that's how it feels with this. It's like, I need to go to everything and get all the info.

For Rose, not only were the meetings inconvenient, but they were a poor replacement for the face-to-face contact she loved engaging in with her students:

And it's been really tough for me. It's like all the favorite parts of my job, I don't really get to do anymore. Like being with the kids and, like, I don't know, just being in my classroom and, like, being around that energy has just been, like, stripped away. And I feel like I'm left with a lot of the parts I don't love, like, all the meetings and all, like, the long term planning and just, like, the little tediousness of making stuff for them to do is what I feel like I'm doing right now. So it's, it's been an adjustment for me, personally.

Similar to how the teachers focused on making families comfortable, Belen made sure to note the importance of self-care, saying, "We need to give ourselves that time also to, to process, because it seems like now we're connected all day on these devices."

#### **4. Discussion**

The abrupt shift from in-person learning to ERT in spring 2020 was deeply unsettling for the special education teachers in this study. Not only did it present major challenges in promoting their students' academic achievement, it also led to an increase in familial socio-emotional stress. Throughout the three stages of ERT, both Belen and Rose did what they could to address their two competing goals: supporting students and families socio-emotionally and furthering academic achievement. This tension was compounded by the issue of inequity of resources.

As the teachers reflected, we found that they were able to identify how critical person-to-person learning was, now that they had lost it. They reflected on how important it was to be near a student who was close to giving up, how important holding manipulatives in your hand was to children's learning. In the focus group, Belen noted that they were just starting to get into a groove with ERT. Rose responded with passion—"But I don't want to get into this groove." She noted the pervasive equity problems with distance learning, particularly for her students with significant disabilities, and also noted her concern that, because distance learning was cheaper, any success they had might be used to replace in-person teaching. She noted, "The goal should be to get back in the classroom and get back to, like, small group, in-person, face to face learning, and, like, that classroom culture."

The teachers echoed previous researchers' assertions that online learning can be quite demanding for parents of children with significant support needs [16,17], particularly during a time of widespread stress. While it is clear that these teachers do not believe it reasonable to expect parents to act as teachers, it is encouraging that both teachers used this time to work one-on-one with parents, sharing strategies with them that they might not have had time for otherwise (which is in line with Sorensen's [10] claim that parents whose children engage in online learning might have enhanced knowledge of their child's educational plan).

##### *4.1. Implications for Stakeholders*

Our findings present multiple practical implications for teachers and school administrators. First and foremost, though, we offer these stories to honor the incredibly hard work of teachers in the spring of 2020 and to offer solidarity and inspiration to others planning online learning as the COVID-19 pandemic continues. We believe it is important to acknowledge teachers' work during this time when many of them may be feeling lonely and disconnected from their work [30], a sentiment echoed by our participants. It is important that special education teachers are exposed to stories of others going through the same process.

Belen and Rose's stories also hold implications for administrators planning the continuation of online and/or hybrid learning. Clearly, access to technology is a huge issue with which to contend, making it difficult for teachers, especially those with students who need intensive supports from parents, to deliver high quality instruction and maintain supervision of IEP goal progress. This, of course, can have legal ramifications, adding additional uncertainty and stress for teachers. Administrators may also want to be cognizant of what kind (and amount) of professional development is provided to teachers. While training in supporting students who develop trauma as a result of the pandemic [44]

will likely alleviate some stressors, it is also important to note that the teachers in the current study felt overwhelmed by the number of resources and trainings provided. We recommend targeted professional development for the specific needs of educators teaching students with significant support needs.

Another important take-away from our findings is the importance of parent-teacher collaboration and communication. While this is always an important aspect of teachers' work [45,46], the COVID-19 pandemic has highlighted just how crucial those relationships are. While recruiting parental engagement is helpful to general education teachers as well [47], as special educators, Belen and Rose felt the need to educate parents to implement educational techniques and strategies, all the while recognizing that parent and teacher expectations are not always aligned. Though they had varying levels of success in this endeavor, it highlights the importance of teachers and parents being on the same page. For teachers continuing to teach online during the pandemic, it may be helpful to try to implement a system similar to the *Partners in School* intervention that was developed pre-COVID to improve the coordinated use of evidence-based practices at school and at home [48]. This might include explicitly discussing the students' strengths, challenges, and preferences at the beginning of any instructional period; identifying one or two specific goals to work on; and highlighting evidence-based practices that can be used to address such goals, including any instructional accommodations that might be necessary. Though the daily note between home and school used in the *Partners in School* program may not always be feasible, keeping lines of communication open is key in order to monitor not only student but also parent progress. Though teachers are likely trying to implement many of these things already, having a clear, executable plan ahead of time is likely to alleviate some of the uncertainty and stress felt by parents and students.

#### 4.2. Limitations and Future Research

Though our study is one of the first to highlight the experiences and perspectives of special educators during the COVID-19 pandemic, there are several limitations to highlight. First, this paper presents a case study of only two teachers. We cannot therefore assume our findings are generalizable to other educators (though they are in line with other emergent literature on education during COVID-19 [30,47]). This is especially true given the fact that Belen and Rose are both experienced educators who were identified as skilled teachers within their district. Other teachers may face entirely different challenges. More research must therefore be conducted with a larger and more diverse group of special education teachers. For example, it may be useful to compare rural versus urban, elementary versus high school, and senior versus novice teachers' experiences with ERT. However, it is important to note that the students served by these teachers (i.e. minorities with low average socioeconomic status) are usually underrepresented in this field [49,50].

Another limitation of the current study was that we did not use previously validated interview instruments and instead conducted exploratory, semi-structured interviews. While this type of interview guide was necessary under the emergent conditions of COVID in order to gather data on individual's experiences and perspectives [38], it may be useful for future studies to use validated measures in order to increase consistency amongst participants, especially if a larger study is conducted. This will also allow for results to be compared to pre-COVID-19 studies that used the same instrument. Findings can also be strengthened via data triangulation [51], for instance, by interviewing parents or reviewing student work produced during ERT.

Finally, while we were specifically focused on understanding teachers' perspectives as events surrounding school closures unfolded, it is also necessary to now have teachers reflect on these events retroactively and understand how they will use their experiences with ERT in future teaching. Similarly, because we were probing for an overview of Belen and Rose's experiences, we were not able to explore any particular theme in detail. Researchers must therefore do a more in-depth investigation of the specific themes discussed in this paper. For example, what were the experiences of other special education teachers in terms of having parents implement educational strategies? How did changes in

parent-teacher communication and expectations affect parent-teacher relationships? And what does this mean for teachers moving forward?

## 5. Conclusions

Like these teachers, we agree that online, distance learning for students with significant support needs is not equitable, especially when it is hoisted upon families and teachers against their will. However, given the ongoing global pandemic, teachers and families must continue to adjust to these changes. We hope special educators and the families they work with can take some amount of solace from knowing that they are not alone in this struggle. Tweaks to the provision of online special education will be needed on a consistent basis, particularly in the areas of access to technology and provision of academic and socio-emotional supports for both teachers and families. At the end of the day, the findings from this preliminary case study speak to the importance of strong parent-teacher ties and will hopefully encourage more research in this area.

**Author Contributions:** Conceptualization, R.L.; methodology, R.L.; validation, R.L., R.K.S.; formal analysis, R.K.S., R.L.; investigation, R.L., R.K.S.; resources, R.L.; data curation, R.L., R.K.S.; writing—original draft preparation, R.K.S., R.L.; writing—review and editing, R.K.S., R.L.; supervision, R.L.; project administration, R.L. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. UNESCO. COVID-19 Impact on Education. Available online: <https://en.unesco.org/covid19/educationresponse> (accessed on 11 September 2020).
2. Hodges, C.; Moore, S.; Lockee, B.; Trust, T.; Bond, A. The Difference Between Emergency Remote Teaching and Online Learning. *Educ. Rev.* **2020**, *27*, 12.
3. Masonbrink, A.R.; Hurley, E. Advocating for Children During the COVID-19 School Closures. *Pediatrics* **2020**, *146*. [[CrossRef](#)] [[PubMed](#)]
4. Stenhoff, D.M.; Pennington, R.C.; Tapp, M.C. Distance Education Support for Students with Autism Spectrum Disorder and Complex Needs During COVID-19 and School Closures. *Rural Spec. Educ. Q.* **2020**. Available online: <https://journals.sagepub.com/doi/epub/10.1177/8756870520959658> (accessed on 30 October 2020).
5. Burgstahler, S. Inclusive Online Science Education: What Teachers Need to Know. In *Towards Inclusion of All Learners through Science Teacher Education*; Koomen, M., Kahn, S., Atchison, C.L., Eds.; Brill Sense: Leiden, The Netherlands, 2018; pp. 115–123.
6. Coy, K. Universal Design for Learning and Digital Environments: The Education Superpower. *J. Incl. Pract. Furth. High. Educ.* **2018**, *10*, 119–134.
7. Dietrich, K.; Wanat, E. Online Learning: Meeting the Needs of the Diverse Learner. In Proceedings of the Minnesota Summit on Learning & Technology, Minneapolis, MN, USA, 1 August 2018.
8. Straub, C.; Vasquez, E. Effects of Synchronous Online Writing Instruction for Students with Learning Disabilities. *J. Spec. Educ. Technol.* **2015**, *30*, 213–222. [[CrossRef](#)]
9. Vasquez, E.; Straub, C. Online Instruction for K-12 Special Education: A Review of the Empirical Literature. *J. Spec. Educ. Technol.* **2012**, *27*, 31–40. [[CrossRef](#)]
10. Sorensen, T. Special Education in Idaho Virtual Schools: An Analysis of the Efficacy of Service Delivery. Ph.D. Thesis, Northwest Nazarene University, Nampa, ID, USA, 2019.
11. Serianni, B.A.; Coy, K. Doing the Math: Supporting Students with Disabilities in Online Courses. *Teach. Except. Child.* **2014**, *46*, 102–109. [[CrossRef](#)]
12. Nieminen, J.H.; Valtti Pesonen, H. Taking Universal Design Back to Its Roots: Perspectives on Accessibility and Identity in Undergraduate Mathematics. *Educ. Sci.* **2020**, *10*, 12. [[CrossRef](#)]
13. Satterfield, D.; Kelle, S. Ethical Issues in Online Education. In *Advances in The Human Side of Service Engineering, Proceedings of the AHFE 2016 International Conference on the Human Side of Service Engineering, Orlando, FL, USA, 27–31 July 2016*; Ahram, T.Z., Karwowski, W., Eds.; Springer International Publishing: Berlin, Germany, 2017; pp. 257–266. [[CrossRef](#)]

14. Murders, M. A Phenomenological Study of the Online Education Experiences of College Students with Learning Disabilities. Ph.D. Thesis, University of Arkansas, Fayetteville, AR, USA, 2017.
15. Greer, D.; Rowland, A.L.; Smith, S.J. Critical Considerations for Teaching Students with Disabilities in Online Environments. *Teach. Except. Child.* **2014**, *46*, 79–91. [CrossRef]
16. Rice, M.; Ortiz, K.; Curry, T.; Petropoulos, R. A Case Study of a Foster Parent Working to Support a Child with Multiple Disabilities in a Full-Time Virtual School. *J. Online Learn. Res.* **2019**, *5*, 145–168.
17. Smith, S.J.; Burdette, P.J.; Cheatham, G.A.; Harvey, S.P. Parental Role and Support for Online Learning of Students with Disabilities: A Paradigm Shift. *J. Spec. Educ. Leadersh.* **2016**, *29*, 101–112.
18. Tomaino, M.A.E.; Greenberg, A.L.; Kagawa, S.; Doering, S.A.; Miguel, E.S. An Assessment of the Feasibility and Effectiveness of Distance Learning for Students with Severe Developmental Disabilities and High Behavioral Needs. **2020**. preprint. Available online: <https://europepmc.org/article/ppr/ppr197396> (accessed on 3 November 2020). [CrossRef]
19. Rice, M.F.; Dykman, B. The Emerging Research Base on Online Learning and Students with Disabilities. In *Handbook of Research on K-12 Online and Blended Learning*, 2nd ed.; Kennedy, K., Ferdig, R.E., Eds.; ETC Press: Pittsburgh, PA, USA, 2018; pp. 189–206.
20. Greer, D.; Harvey, D.; Burdette, P.; Basham, J. FAPE and LRE in Online Learning: Special Education Directors' Perspectives. *J. Am. Acad. Spec. Educ. Prof.* **2015**, *Spring-Summer*, 53–71.
21. Duan, L.; Shao, X.; Wang, Y.; Huang, Y.; Miao, J.; Yang, X.; Zhu, G. An Investigation of Mental Health Status of Children and Adolescents in China during the Outbreak of COVID-19. *J. Affect. Disord.* **2020**, *275*, 112–118. [CrossRef] [PubMed]
22. Patel, K. Mental Health Implications of COVID-19 on Children with Disabilities. *Asian J. Psychiatry* **2020**, *54*, 102273. [CrossRef]
23. Lee, J. Mental Health Effects of School Closures during COVID-19. *Lancet Child Adolesc. Health* **2020**, *4*, 421. [CrossRef]
24. van Steensel, F.J.A.; Bögels, S.M.; Perrin, S. Anxiety Disorders in Children and Adolescents with Autistic Spectrum Disorders: A Meta-Analysis. *Clin. Child Fam. Psychol. Rev.* **2011**, *14*, 302–317. [CrossRef] [PubMed]
25. Asbury, K.; Fox, L.; Deniz, E.; Code, A.; Toseeb, U. Brief Report: How Is COVID-19 Affecting the Mental Health of Children with Special Educational Needs and Disabilities and Their Families? *J. Autism Dev. Disord.* **2020**. [CrossRef]
26. Toseeb, U.; Asbury, K.; Code, A.; Fox, L.; Deniz, E. Supporting Families with Children with Special Educational Needs and Disabilities During COVID-19. **2020**. preprint. Available online: <https://psyarxiv.com/tm69k/> (accessed on 3 November 2020). [CrossRef]
27. Frederick, J.K.; Raabe, G.R.; Rogers, V.R.; Pizzica, J. Advocacy, Collaboration, and Intervention: A Model of Distance Special Education Support Services Amid COVID-19. *Behav. Anal. Pract.* **2020**. Available online: <https://link.springer.com/article/10.1007/s40617-020-00476-1#citeas> (accessed on 3 November 2020). [CrossRef] [PubMed]
28. Narzisi, A. Handle the Autism Spectrum Condition during Coronavirus (COVID-19) Stay at Home Period: Ten Tips for Helping Parents and Caregivers of Young Children. *Brain Sci.* **2020**, *10*, 207. [CrossRef]
29. Garbe, A.; Ogurlu, U.; Logan, N.; Cook, P. Parents' Experiences with Remote Education during COVID-19 School Closures. *Am. J. Qual. Res.* **2020**, *4*, 45–65. [CrossRef]
30. Kim, L.E.; Asbury, K. 'Like a Rug Had Been Pulled from under You': The Impact of COVID-19 on Teachers in England during the First Six Weeks of the UK Lockdown. *Br. J. Educ. Psychol.* **2020**. Available online: <https://bpspsychub.onlinelibrary.wiley.com/doi/epdf/10.1111/bjep.12381> (accessed on 30 October 2020).
31. Iivari, N.; Sharma, S.; Ventä-Olkkonen, L. Digital Transformation of Everyday Life—How COVID-19 Pandemic Transformed the Basic Education of the Young Generation and Why Information Management Research Should Care? *Int. J. Inf. Manag.* **2020**, *55*, 1–6. [CrossRef]
32. Samaila, D.; Ayanjoke, K.M.; Mailafia, I.A.; Joshua, C.E. Impact of Covid-19 Pandemic on People with Disabilities and Its Implications on Special Education Practice in Nigeria. *Int. J. Innov. Sci. Res. Technol.* **2020**, *5*, 6.
33. Lambert, R.; Schuck, R.K. "The Wall Now Between Us": Teaching Math to Students with Disabilities During the COVID Spring of 2020. Under Review. Available online: <https://osf.io/xe6b2/> (accessed on 30 October 2020).

34. Carpenter, T.P.; Fennema, E.; Franke, M.L.; Levi, L.; Empson, S.B. *Cognitively Guided Instruction: A Research-Based Teacher Professional Development Program for Elementary School Mathematics*. Research Report; National Center for Improving Student Learning and Achievement in Mathematics and Science: Madison, WI, USA, 2000.
35. Merriam, S.B.; Tisdell, E.J. *Qualitative Research: A Guide to Design and Implementation*, 4th ed.; John Wiley & Sons: San Francisco, CA, USA, 2015.
36. Lambert, R. 'When I Am Being Rushed It Slows down My Brain': Constructing Self-Understandings as a Mathematics Learner. *Int. J. Incl. Ed.* **2017**, *21*, 521–531. [[CrossRef](#)]
37. Lambert, R. Constructing and Resisting Disability in Mathematics Classrooms: A Case Study Exploring the Impact of Different Pedagogies. *Educ. Stud. Math.* **2015**, *89*, 1–18. [[CrossRef](#)]
38. Patton, M.Q. *Qualitative Research and Evaluation Methods*, 3rd ed.; Sage Publications: Thousand Oaks, CA, USA, 2002.
39. Braun, V.; Clarke, V. Using Thematic Analysis in Psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [[CrossRef](#)]
40. Bogdan, R.; Biklan, S.K. *Qualitative Research for Education*, 3rd ed.; Allyn & Bacon: Boston, MA, USA, 1997.
41. Marshall, C.; Rossman, G.B. *Designing Qualitative Research*, 6th ed.; Sage Publications: Thousand Oaks, CA, USA, 2015.
42. Maxwell, J.A. *Qualitative Research Design: An Interactive Approach*, 3rd ed.; Sage Publications: Thousand Oaks, CA, USA, 2013.
43. Kriete, R.; Davis, C. *The Morning Meeting Book*, 3rd ed.; Center for Responsive Schools, Inc.: Turner Falls, MA, USA, 2014.
44. Tremmel, P.; Myers, R.; Brunow, D.A.; Hott, B.L. Educating Students with Disabilities During the COVID-19 Pandemic: Lessons Learned from Commerce Independent School District. *Rural Spec. Educ. Q.* **2020**. Available online: <https://journals.sagepub.com/doi/epub/10.1177/8756870520958114> (accessed on 30 October 2020).
45. LaBarbera, R. A Comparison of Teacher and Caregiver Perspectives of Collaboration in the Education of Students with Autism Spectrum Disorders. *Teach. Educ. Q.* **2017**, *44*, 35–56.
46. Staples, K.E.; Diliberto, J.A. Guidelines for Successful Parent Involvement: Working with Parents of Students with Disabilities. *Teach. Except. Child.* **2010**, *42*, 58–63. [[CrossRef](#)]
47. Kim, L.; Leary, R.; Asbury, D.K. 'We Need Clear Directions, If We're Going to Move Forward. It's as Simple as That': Teachers' Narratives during Partial School Reopenings in the COVID-19 Pandemic. **2020**. preprint. Available online: <https://psyarxiv.com/m8scj/> (accessed on 3 November 2020).
48. Azad, G.F.; Williams, B.J.; Minton, K.E.; Sheridan, S.M.; Mandell, D.S. Partners in School: An Example of Care Coordination to Ensure Consistency of Evidence-Based Practices Across Home and School for Youth with Autism Spectrum Disorder (ASD). In *Interprofessional Care Coordination for Pediatric Autism Spectrum Disorder: Translating Research into Practice*; McClain, M.B., Shahidullah, J.D., Mezher, K.R., Eds.; Springer Nature: Cham, Switzerland, 2020; pp. 153–167. [[CrossRef](#)]
49. Pierce, N.P.; O'Reilly, M.F.; Sorrells, A.M.; Fragale, C.L.; White, P.J.; Aguilar, J.M.; Cole, H.A. Ethnicity Reporting Practices for Empirical Research in Three Autism-Related Journals. *J. Autism Dev. Disord.* **2014**, *44*, 1507–1519. [[CrossRef](#)]
50. West, E.A.; Travers, J.C.; Kemper, T.D.; Liberty, L.M.; Cote, D.L.; McCollow, M.M.; Stansberry Brusnahan, L.L. Racial and Ethnic Diversity of Participants in Research Supporting Evidence-Based Practices for Learners with Autism Spectrum Disorder. *J. Spec. Educ.* **2016**, *50*, 151–163. [[CrossRef](#)]
51. Brantlinger, E.; Jimenez, R.; Klingner, J.; Pugach, M.; Richardson, V. Qualitative Studies in Special Education. *Except. Child.* **2005**, *71*, 195–207. [[CrossRef](#)]

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



© 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).





Article

# Distance Learning in the COVID-19 Era: Perceptions in Southern Italy

Francesco Vincenzo Ferraro <sup>1,\*</sup>, Ferdinando Ivano Ambra <sup>2</sup>, Luigi Aruta <sup>2</sup> and Maria Luisa Iavarone <sup>2</sup>

<sup>1</sup> Department of Health and Social Science, Bournemouth University, Bournemouth BH125BB, UK

<sup>2</sup> Dipartimento di Scienze Motorie e del Benessere, Università degli studi di Napoli Parthenope, 80133 Naples, Italy; ivano.ambra@uniparthenope.it (F.I.A.); lu.aruta@gmail.com (L.A.); marialuisa.iavarone@uniparthenope.it (M.L.I.)

\* Correspondence: fferraro@bournemouth.ac.uk

Received: 11 November 2020; Accepted: 25 November 2020; Published: 27 November 2020

**Abstract:** The first case of pneumonia was reported on 8 December 2019 and identified on 7 January 2020 as COVID-19. On 9 March 2020, to stop the spread of COVID-19 cases, the Italian government declared a health emergency, forcing all citizens to go into lockdown. Suddenly, schools were constrained to using distance learning strategies with little or limited experience on the topic. Particularly, in the southern regions of Italy, approximately 20% of the students did not have access to any devices and were excluded from learning, producing a direct risk of increased adolescent delinquency. This research team intended to report the results of an observational study that focused on the perceptions of distance learning in adolescents from secondary school in Naples (Italy) between April and May 2020. The questionnaire comprised 11 questions focused on the perceptions of distance learning in comparison to live classrooms, relationships with peers and teachers, and levels of anxiety. The study is amongst the first to report the effect of the pandemic from a student-centred perspective and hopes to produce information to develop future research on asynchronous learning.

**Keywords:** pedagogy; sport science; transdisciplinary; childhood learning; technologies; relationship; civil education approach; distance learning; COVID-19; education

## 1. Introduction

The first case of pneumonia was reported on 8 December 2019 and identified on 7 January 2020 as COVID-19 [1]. In less than two months, COVID-19 has reached almost every corner of the world, becoming the most reported and known pandemic in history [2]. The effects upon the economy [3], health system [4], and life in general [5] are known and documented. However, our interest was to investigate the perceptions of the pandemic restrictions from the perspective of adolescents, particularly in relation to distance learning. Distance learning is a mode of teaching and learning that was already available before the pandemic. Generally, learning can be synchronous, involving students learning together in a live environment (e.g., classrooms), which allows greater engagement and a higher sense of community. On the contrary, asynchronous learning allows students to learn on their own using email or online platforms [6]. On this matter, many theories have been reported investigating the most effective ways to create online learning platforms [7]. However, all such theories seem to conclude that the students involved in asynchronous courses need to be extremely self-motivated to learn and need to have a high level of self-discipline to complete courses [8]. To help draw new methods of interaction with students, a recent article in *Nature* described helpful tips about the transition from synchronous to asynchronous learning in the COVID-19 era, underscoring the importance of adopting a student-centred approach [9,10].



On 9 March 2020, to stop the spread of COVID-19 cases, the Italian government declared a health emergency, forcing all citizens to go into lockdown [11]. Following this, schools were constrained to using distance learning strategies, with little or limited experience on the topic [12]. The whole situation produced a significant negative impact on students, with an increase in the number of cases of mental distress [13], with spikes in depression, anxiety, and stress cases [14,15]. The Italian National Institute of Statistics (ISTAT; [www.istat.it](http://www.istat.it)) reported that 45% of youths (between 6 to 17 years old) had difficulties coping with distance learning due to a lack of devices (such as a computer or smartphone) in their houses. This particularly affected the southern regions of Italy, where 20% of students did not have access to any devices and were excluded from learning, producing a direct risk of an increase in adolescent delinquency [16]. We previously demonstrated that the usage of technologies plays a crucial role in educational development in childhood [16–20]. In particular, our most recent publication using the S.M.A.R.T. questionnaire [21] showed that female adolescents have a more conscious use of technology compared to their male peers [22]. Our observational study showed that females use technology to a lesser extent and have a higher self-awareness of the information that can be transferred over social media [22]. We considered this to be related to the potential influence of parental control [23] over the female population. As summarised in a recent meta-analysis, gender-differentiated parental control in child behaviour is driven by gendered stereotypes [24], which might explain why the female group resulted in more awareness of technology usage than the male group. These aspects are extremely significant considering the direct effects of technology on adolescents' behaviours [25] and how abusive use of digital devices can have an effect on learning capacity [26] and social skills in youths [27–30].

With the recent lockdown in Italy, students were forced to adopt novel distance learning strategies via digital communication software (such as CISCO, Zoom, Skype, and Microsoft TEAMS) [31]. During this period of time, the transdisciplinary research team from the University of Naples Parthenope and Bournemouth University, under the supervision of Prof. Iavarone, developed a questionnaire concerning the perceptions of distance learning among young students (13–19 years old). The questionnaire was developed to report students' perceptions of the use of distance learning compared to standard (in class) lessons. The full questionnaire has already been published [32] and preliminary data have been discussed [33]. This research team intended to report the full pooled data collected over the lockdown period in Italy, as this information can be beneficial for future research and discussion regarding learning strategies to adopt in a period of crisis, such as the one we are currently living. Based on our previous findings with the S.M.A.R.T. questionnaire [22], we hypothesised that usage of technology in distance learning by females would show a higher level of adaptability and would benefit mostly from novel digital pedagogic tools. The overall aim was also to report the analysis of the full set of data collected over the lockdown period in Italy as this information can be beneficial for future research and discussion regarding learning strategies to adopt in period of crisis, such as the one we are currently living.

## **2. Materials and Methods**

### *2.1. General Design*

This observational study was created to report the perceptions of distance learning in adolescents from secondary schools in Naples (Italy) during the recent lockdown. The questionnaire comprised 11 questions on the perceptions and usage of distance learning. The questionnaire has been fully published already in [32] and the preliminary data have been presented [33].

### *2.2. Participant Characteristics*

A group of 83 adolescents (descriptive data: 64 females (F), 19 males (M); age  $16.3 \pm 2.7$  years) completed the online questionnaire between April and May 2020. To include a broad sample of adolescents, non-specific inclusion/exclusion criteria were selected. Due to the lockdown restrictions,

the questionnaire was delivered on an online platform ([www.surveymonkey.com](http://www.surveymonkey.com)) [34] via email and social media (i.e., Twitter, Facebook, and WhatsApp). Data were anonymised and collected according to the guidelines of the 1975 Declaration of Helsinki, revised in 2013.

### 2.3. Data Analysis

The aim of this manuscript was to report the full pooled data analysis collected over the lockdown period in Italy, as this information can be beneficial for future research and discussion regarding learning strategies to adopt in a period of crisis, such as the one we are currently living. Based on our previous findings from the S.M.A.R.T. questionnaire [22], we hypothesised that during distance learning, females would show a higher level of adaptability and would benefit mostly from the novel digital pedagogic tools. Hence, a quantitative approach was used, and the data were grouped by gender, and the descriptive analysis reported the characteristics of our cohort. The Shapiro–Wilk Test was used to address normality, and since the data were not normally distributed, to test the effects of gender in the participants' responses, a Mann–Whitney *U* test was used. The threshold for statistical significance was determined a priori as  $p \leq 0.05$ . Data are reported as mean and standard deviation. The analysis was completed with IBM SPSS 26 software.

### 3. Results

A total of 83 students ( $16.3 \pm 2.7$  years old) completed the questionnaire (19 M and 64 F). No significant differences in gender (M vs. F;  $p > 0.05$ ) were reported in the answers. To describe the characteristics of the students during the lockdown, we asked the students to complete questions in relation to the software that was used, the location where they followed classes, if they were multitasking (i.e., using other devices while following the lessons such as surfing on social media), and the amount of hours they were actually in virtual classes. The descriptive data are reported in Table 1.

**Table 1.** Descriptive characteristics of the 83 students ( $16.3 \pm 2.7$  years old) undergoing distance learning during the 2020 lockdown in southern Italy.

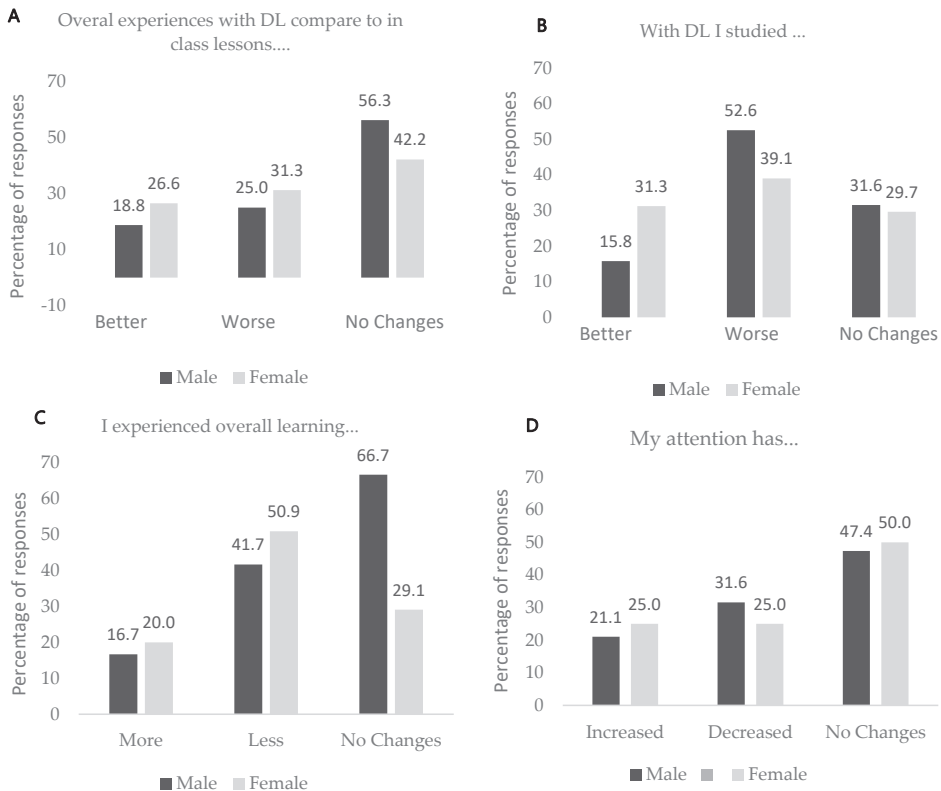
Software	Percentage
Google	26.5%
Zoom	25.3%
Other	20.5%
Skype	19.3%
Microsoft Teams	6.0%
CISCO	2.4%
Location	Percentage
Own room	68.7%
Different room	30.1%
Device	Percentage
Computer	43.4%
Smartphone/tablet	56.5%
Multitasking	Percentage
Yes	95.2%
No	4.8%

The students also reported that they had followed between 1 and 11 lesson per week for 1–8 h per day. The percentages reported in Table 2.

**Table 2.** Descriptive characteristic of number of classes and hour of lessons followed by the students expressed in percentage.

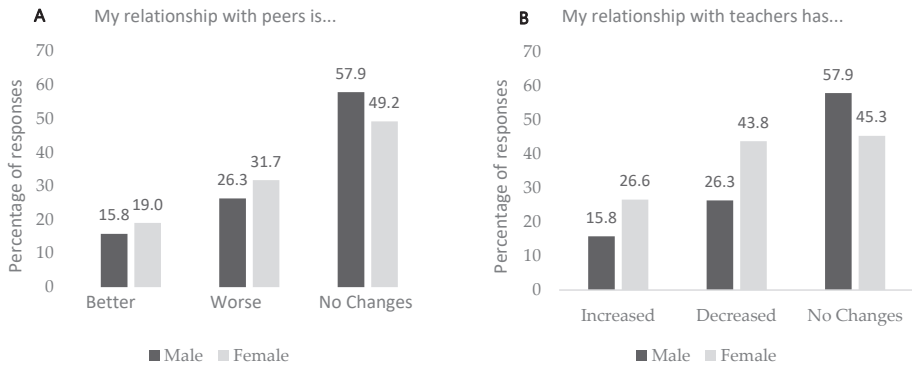
Classes (n)	Percentage	Hours of Lessons (h)	Percentage
1	1.2	1	3.6
2	0.0	2	10.8
3	0.0	3	42.2
4	7.2	4	34.9
5	14.5	5	20.5
6	20.5	6	1.2
7	24.1	7	0.0
8	24.1	8	2.4
9	8.4		
10	1.2		
11	7.2		

The data on the perceptions of distance learning between males and females are reported in Figure 1.



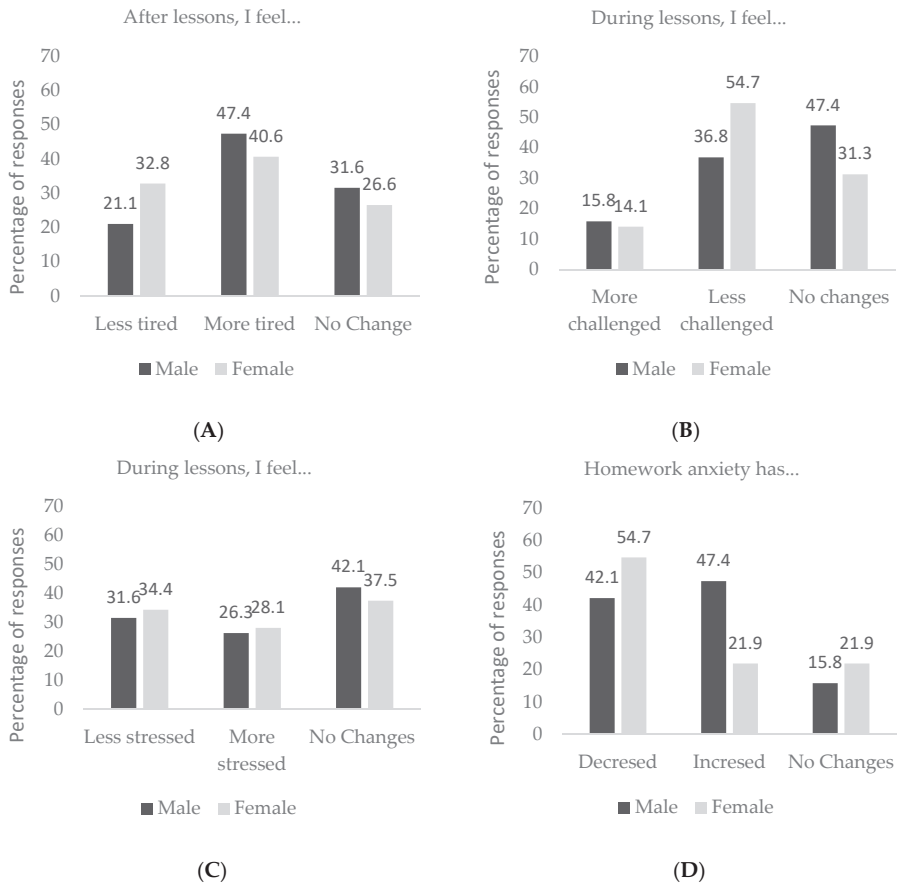
**Figure 1.** Perceptions of distance learning in males and females based on: (A) Overall experience of distance learning compared to standard classrooms; (B) study perceptions during distance learning; (C) overall learning experience; (D) level of attention.

The data on the relationships with peers during distance learning between males and females are reported in Figure 2.



**Figure 2.** Effect of distance learning on relationships with peers (A) and teachers (B) between males and females.

The levels of anxiety and stress perceived are reported in Figure 3.



**Figure 3.** Perceptions of anxiety and mental stress between males and females after lessons (A), during lessons (B,C), and during homework (D).

#### 4. Discussion

This observational study was carried out to report and explore the perceptions of distance learning in adolescents from secondary schools in Naples (Italy) during the recent lockdown. The questionnaire comprised 11 questions on the perceptions and usage of distance learning. It has already been fully published [32] and preliminary data have been presented [33]. The research team delivered the questionnaire between April and May 2020, with the lockdown restrictions starting in March. The overall questionnaire explored three main areas of pedagogic interest: (i) The perceptions of distance learning, (ii) the relationships with peers and teachers, and (iii) the levels of stress and anxiety. Our cohort of 83 students showed no differences between gender, which shows common perceptions along males and females. These data could have been predicted based on previous findings [22]. However, we anticipated that the female group might have had a higher level of parental control regarding the usage of technologies, as demonstrated in previous studies [23,35,36]. Thus, it seems that when it comes to distance learning, the effect of parental control is no longer applicable and males and females perceived the experience similarly. Further studies should produce a questionnaire tailored to adults and tutors in order to report the effects of stereotypes and parental control and the limitations on the use of technologies that different groups (social, gender, and cultural groups) might experience.

Relationship with peers and teachers showed a tendency to be perceived as identical to what it was before the lockdown (i.e., in class sessions). These results show two important aspects of distance learning. First, the new generation of *digital natives*, defined as hyper-cognitive generation [37], is able to interact with peers via social media platforms (e.g., TikTok, Facebook, Twitter, and Snapchat) in more efficient ways than previous generations [38,39]. Social media relationships have changed the way adolescents interact. Previous research, before the lockdown, documented that there is an increase of social media interactions with peers in contrast with a less in-person interaction [40]. However, even if social media platforms might produce benefits in relation to adolescents' loneliness [41], there are many other aspects, such as body perceptions and sexualised behaviours, that require further investigation and monitoring by adults and tutors [42]. The second important aspect to consider concerns the relationships with teachers. As described in other research, the new generation has replaced "communication" with "interaction" [43], forcing teachers to create classroom setups that incorporate new technologies into their classrooms [44]. These aspects are extremely interesting when we look at the results on multitasking. In our cohort, 95.2% of the students admitted having used other devices and surfing the web while they were following distance learning classes. Further research should now investigate the effect of multitasking on learning in the younger generation. In line with recent pedagogic exploration that introduced the concept of multiplexing rather than multitasking, it is possible to develop conditions that make written interaction through social media beneficial to education [45].

Levels of anxiety and stress were also included in our questionnaire. Our data showed a tendency toward diminishing anxiety levels in relation to homework. Anxiety is a major concern when it comes to education, affecting learning and teaching outcomes [46]. Previous research has shown that student anxiety decreases during active-learning activities and when multiple ways of learning opportunities are provided [47]. The situation of lockdown experienced between March and May 2020 might therefore have favoured a more student-centred approach [48] in contrast to a teacher-centred approach [49,50]. As anticipated in the introduction, to cope with distance learning difficulties, teachers need to increase their interaction with students that promote the transition from synchronous to asynchronous learning, helping students to increase collaboration (even if virtually) and critical thinking. Indeed, as reported by the structural equation modelling in Kember's study (2008), the teaching environment should favour teacher–student and student–student relationships to increase intellectual aspects (e.g., critical and creative thinking), as well as collaboration (e.g., communication and interpersonal skills) [51].

These preliminary results need to be considered also in parallel with recent findings from the Italian Educational Research Society (SIRD) who recently conducted an investigation into the experience of

Italian teachers during the COVID-19 pandemic. In particular, the SIRD reported information on the organisational strategies and teaching methods adopted during the lockdown [52].

## 5. Conclusions and Limitations

In conclusion our research produced the following take-home points. First, there were no gender differences in the perceptions of distance learning, indicating a transversal effect of asynchronous teaching upon our cohort. Secondly, the importance of student–student and student–peer relationships. Regardless of the distance created by asynchronous learning, the students did not perceive a decrease in their relationships with peers or with teachers. This indicates an incredible resilience and ability to deal with technology never seen before in previous generations. Third is the level of anxiety, as it seems that asynchronous learning might be beneficial in decreasing the level of anxiety in some students, particularly in relation to homework.

The COVID-19 pandemic is still present in our lives, where schools continue to be closed every time a student tests positive for COVID-19. Thus, there are further aspects that need to be evaluated; further analysis should investigate in more detail the parental control regarding the use of technology, especially to anticipate and predict information concerning stereotyped parental control (e.g., gender, social, and cultural differences). Additionally, we recommend a broad analysis concerning relationships with peers using social media to define what can be defined as a healthy social media relationship and what is not. There are many types of interactions that take place via novel *apps* (e.g., Facebook and TikTok) that especially need additional monitoring to prevent phenomena such as unhealthy body perceptions and sexualised behaviours.

Further research should also report details about anxiety levels during asynchronous teaching and how to increase the quality of students' experiences during a dramatic situation such as the recent lockdown. We also reported the vast use of multiplexing. Research is necessary to investigate the effect of multiplexing in the younger generation and how this phenomenon can be integrated as a pedagogic tool. In conclusion, we aimed to report the perceptions of distance learning during the Italian lockdown in a cohort of young students. We focused on three main aspects: Learning, relationships, and anxiety. Distance learning has many downsides, one of which is the lack of live participation, which is an important aspect of *social pedagogy* [16–18,20], particularly in relation to the evident lack of inclusive activities (such as sport practices). As suggested [53], it is now important to help adolescents that are going through these difficult times. We can do this by being responsive adults [16], setting an example for the younger generations, that for the first time have to deal with self-managing their learning experiences, which require both distance and live assistance.

There are several limitations to our analysis. First is the lack of a hypothesis to drive a strong statistical analysis. The lack of a hypothesis was due to lack of information concerning the current DL in the southern regions of Italy and the perceptions and coping strategies that students have developed regarding DL. Another limitation is the lack of detail in relation to teachers' strategies in southern Italy. As anticipated, a very recent report was completed by SIRD that describes information about the organisational strategies and teaching methods adopted during the lockdown [52]. We recommend combining these findings with student perceptions in order to produce a parallel pool of data on lockdown DL strategies.

**Author Contributions:** Conceptualization, F.V.F. and F.I.A.; methodology, F.V.F. and F.I.A.; validation, F.V.F., F.I.A. and M.L.L.; formal analysis, F.V.F.; investigation, F.I.A. and L.A.; resources, F.V.F.; data curation, F.V.F.; writing—original draft preparation, F.V.F.; writing—review and editing, M.L.L., F.I.A. and L.A.; visualization, F.V.F.; supervision, M.L.L.; project administration, F.I.A. and L.A.; funding acquisition, F.V.F., F.I.A. and M.L.L. All authors have read and agreed to the published version of the manuscript

**Funding:** This research received no external funding.

**Acknowledgments:** The authors would like to thank all of the participants who took their time to take part in this research.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. Wu, Z.; McGoogan, J.M. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: Summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. *JAMA* **2020**, *323*, 1239–1242. [CrossRef] [PubMed]
2. Velavan, T.P.; Meyer, C.G. The COVID-19 epidemic. *Trop. Med. Int. Health* **2020**, *25*, 278. [CrossRef] [PubMed]
3. Baldwin, R.; Weder di Mauro, B. *Economics in the Time of COVID-19*; CEPR Press: London, UK, 2020.
4. Armocida, B.; Formenti, B.; Ussai, S.; Palestra, F.; Missoni, E. The Italian health system and the COVID-19 challenge. *Lancet Public Health* **2020**, *5*, e253. [CrossRef]
5. Pfefferbaum, B.; North, C.S. Mental health and the Covid-19 pandemic. *N. Engl. J. Med.* **2020**, *383*, 510–512. [CrossRef]
6. Chen, E.; Kaczmarek, K.; Ohyama, H. Student perceptions of distance learning strategies during COVID-19. *J. Dent. Edu.* **2020**, *1–2*. [CrossRef]
7. Cook, D.A.; Dupras, D.M. A practical guide to developing effective web-based learning. *J. Gen. Intern. Med.* **2004**, *19*, 698–707. [CrossRef]
8. Clark, J.T. Distance Education. In *Clinical Engineering Handbook*; Elsevier: Amsterdam, The Netherlands, 2020; pp. 410–415.
9. Gibbs, G. Teaching Students to Learn: A Student-Centered Approach. Available online: [https://www.scirp.org/\(S\(i43dyn45teexjx455qlt3d2q\)\)/reference/ReferencesPapers.aspx?ReferenceID=478920](https://www.scirp.org/(S(i43dyn45teexjx455qlt3d2q))/reference/ReferencesPapers.aspx?ReferenceID=478920) (accessed on 27 November 2020).
10. Zibers, B.; Estes, J.S. Creating a Virtual Reality Lab: Using a Student-Centered Approach. In *Current and Prospective Applications of Virtual Reality in Higher Education*; IGI Global: Pennsylvania, PA, USA, 2020; pp. 145–169.
11. Rossi, R.; Succi, V.; Talevi, D.; Mensi, S.; Niuolu, C.; Pacitti, F.; Di Marco, A.; Rossi, A.; Siracusano, A.; Di Lorenzo, G. COVID-19 pandemic and lockdown measures impact on mental health among the general population in Italy. *Front. Psychiatry* **2020**, *11*, 790. [CrossRef]
12. Pellegrini, M.; Maltinti, C. ‘School Never Stops’: Measures and Experience in Italian Schools during the COVID-19 Lockdown. *Best Evid. Chin. Educ.* **2020**, *5*, 649–663. [CrossRef]
13. Pisano, L.; Galimi, D.; Cerniglia, L. A Qualitative Report on Exploratory Data on the Possible Emotional/Behavioral Correlates of Covid-19 Lockdown in 4–10 Years Children in Italy. Available online: <https://psyarxiv.com/stwbn/> (accessed on 27 November 2020).
14. Lakhan, R.; Agrawal, A.; Sharma, M. Prevalence of Depression, Anxiety, and Stress during COVID-19 Pandemic. *J. Neurosci. Rural Pract.* **2020**, *11*, 519. [CrossRef]
15. Sher, L. The impact of the COVID-19 pandemic on suicide rates. *QJM Int. J. Med.* **2020**, *113*, 707–712. [CrossRef]
16. Iavarone, M.L.; Trocchia, N. *Il Coraggio Delle Cicatrici: Storia Di Mio Figlio Arturo E Della Nostra Lotta*; Utet: Milan, Italy, 2020.
17. Iavarone, M.L.; Iavarone, T. *Pedagogia del Benessere. Per Una Professionalità Educativa in Ambito Psico-Socio-Sanitario*. 2004. Available online: <https://sites.google.com/site/quitchiwcapitor3/9788846457677-71nestfrunGEhau50> (accessed on 27 November 2020).
18. Iavarone, M.L. *Alta Formazione Per Lo Sviluppo Educativo Locale*. 2009. Available online: <https://www.amazon.com/Alta-formazione-sviluppo-educativo-locale-ebook/dp/B007QQHS1A> (accessed on 27 November 2020).
19. Pierluigi, M.; Maria, L.I.; Luigina, M.; Teresa, G.; Maria, G.R.; Roberto, F.; Milena, S.; Lucia, C.C.; Loiodice, L.; Massimiliano, F. Landscape education as Italian contribution to the implementation of the Agenda 2030. *Pedagogia OGGI* **2018**, *1*, 259–276. Available online: <https://fair.unifg.it/handle/11369/370309?mode=full.699#.X8CWS-cRU2w> (accessed on 27 November 2020).
20. Iavarone, M.L. Curare i margini. Riprendersi il senso dell’educazione per prevenire il rischio. *Annali Online Della Didattica Della Formazione Docente* **2019**, *11*, 1–5.
21. Ambra, F.I.; Ferraro, F.V.; Ferra, V.; Basile, S.; Girardi, F.; Menafro, M.; Iavarone, M.L.; Napoli, A.S.L.A.; Centro, N.O.d.N. Impact of sport training on healthy behavior in a group of 108 adolescents: A pilot study using SMART questionnaire. *Well-being Educ. Syst.* **2019**, *1*, 43–47.
22. Ferraro, F.V.; Ambra, F.I.; Iavarone, M.L. Evaluation of Health-Habits with the S.M.A.R.T. Questionnaire: An Observational Study. *Educ. Sci.* **2020**, *10*, 285. [CrossRef]

23. Landry, M.; Turner, M.; Vyas, A.; Wood, S. Social Media and Sexual Behavior Among Adolescents: Is there a link? *JMIR Public Health Surveill.* **2017**, *3*, e28. [[CrossRef](#)] [[PubMed](#)]
24. Endendijk, J.J.; Groeneveld, M.G.; Bakermans-Kranenburg, M.J.; Mesman, J. Gender-Differentiated Parenting Revisited: Meta-Analysis Reveals Very Few Differences in Parental Control of Boys and Girls. *PLoS ONE* **2016**, *11*, e0159193. [[CrossRef](#)]
25. Stonard, K.E. Technology-assisted adolescent dating violence and abuse: A factor analysis of the nature of electronic communication technology used across twelve types of abusive and controlling behaviour. *J. Child Fam. Stud.* **2019**, *28*, 105–115. [[CrossRef](#)]
26. Gao, J.; Zheng, P.; Jia, Y.; Chen, H.; Mao, Y.; Chen, S.; Wang, Y.; Fu, H.; Dai, J. Mental health problems and social media exposure during COVID-19 outbreak. *PLoS ONE* **2020**, *15*, e0231924. [[CrossRef](#)]
27. Sarabia, I.; Estévez, A. Sexualized behaviors on Facebook. *Comput. Hum. Behav.* **2016**, *61*, 219–226. [[CrossRef](#)]
28. Peris, M.; de la Barrera, U.; Schoeps, K.; Montoya-Castilla, I. Psychological risk factors that predict social networking and internet addiction in adolescents. *Int. J. Environ. Res. Public Health* **2020**, *17*, 4598. [[CrossRef](#)]
29. Frost, R.L.; Rickwood, D.J. A systematic review of the mental health outcomes associated with Facebook use. *Comput. Hum. Behav.* **2017**, *76*, 576–600. [[CrossRef](#)]
30. Leena, K.; Tomi, L.; Arja, R. Intensity of mobile phone use and health compromising behaviours—How is information and communication technology connected to health-related lifestyle in adolescence? *J. Adolesc.* **2005**, *28*, 35–47. [[CrossRef](#)] [[PubMed](#)]
31. Crawford, J.; Butler-Henderson, K.; Rudolph, J.; Malkawi, B.; Glowatz, M.; Burton, R.; Magni, P.; Lam, S. COVID-19: 20 countries’ higher education intra-period digital pedagogy responses. *J. Appl. Learn. Teach.* **2020**, *3*, 1–20.
32. Ambra, F.I.; Ferraro, F.V.; Girardi, F.; Iavarone, M.I. Distanced learning between educational and technological barriers: A survey in the Campania Region (Italy) with secondary school students. *Attual. Pedagog. Dec.* **2020**.
33. Ambra, F.I.; Ferraro, F.V.; Girardi, F.; Iavarone, M.I. Towards a teaching that reduces the distance: First results of a survey of the effects of distance learning on secondary school students. *Excell. Innov. Teach. Learn.* **2020**. under review.
34. Symonds, E. A practical application of SurveyMonkey as a remote usability-testing tool. *Library Hi Tech* **2011**, *29*, 436–445. [[CrossRef](#)]
35. Mulya, A.P.; Lukman, M.; Yani, D.I. Correlation of Media and Parents Role to Adolescent Sexual Behavior. *J. Nurs. Care* **2020**, *3*. Available online: <http://jurnal.unpad.ac.id/jnc/article/download/26747/13868> (accessed on 27 November 2020).
36. Mayhew, A.; Weigle, P. Media engagement and identity formation among minority youth. *Child Adolesc. Psychiatr. Clin.* **2018**, *27*, 269–285. [[CrossRef](#)]
37. Hernandez-de-Mendoza, M.; Díaz, C.A.E.; Morales-Menendez, R. Educational experiences with Generation Z. *Int. J. Interact. Des. Manuf. (IJIDeM)* **2020**, *14*, 847–859. [[CrossRef](#)]
38. Strauss, W.; Howe, N. *Generations: The History of America’s Future, 1584–2069*; William Morrow: New York, NY, USA, 1991.
39. PrakashYadav, G.; Rai, J. The Generation Z and their social media usage: A review and a research outline. *Glob. J. Enterp. Inf. Syst.* **2017**, *9*, 110–116.
40. Twenge, J.M.; Spitzberg, B.H.; Campbell, W.K. Less in-person social interaction with peers among US adolescents in the 21st century and links to loneliness. *J. Soc. Pers. Relatsh.* **2019**, *36*, 1892–1913. [[CrossRef](#)]
41. Thomas, L.; Orme, E.; Kerrigan, F. Student loneliness: The role of social media through life transitions. *Comput. Educ.* **2020**, *146*, 103754. [[CrossRef](#)]
42. Rajamohan, S.; Bennett, E.; Tedone, D. The hazards and benefits of social media use in adolescents. *Nursing* **2019**, *49*, 52–56. [[CrossRef](#)] [[PubMed](#)]
43. Cilliers, E.J. The challenge of teaching generation Z. *PEOPLE Int. J. Soc. Sci.* **2017**, *3*, 188–198. [[CrossRef](#)]
44. Lenihan, A. Investigating language policy in social media: Translation practices on Facebook. In *The Language of Social Media*; Springer: Berlin/Heidelberg, Germany, 2014; pp. 208–227.
45. Tække, J.; Paulsen, M. Distraction and digital media: Multiplexing, not multitasking in the classroom. *Læring Og Medier* **2019**, *21*, 1–14.
46. Posselt, J.R.; Lipson, S.K. Competition, anxiety, and depression in the college classroom: Variations by student identity and field of study. *J. Coll. Stud. Dev.* **2016**, *57*, 973–989. [[CrossRef](#)]



47. Downing, V.R.; Cooper, K.M.; Cala, J.M.; Gin, L.E.; Brownell, S.E. Fear of negative evaluation and student anxiety in community college active-learning science courses. *CBE Life Sci. Educ.* **2020**, *19*, ar20. [[CrossRef](#)]
48. Barraket, J. Teaching Research Method Using a Student-Centred Approach? Critical Reflections on Practice. *J. Univ. Teach. Learn. Pract.* **2005**, *2*, 3.
49. Lobb, H. A student-centred approach to teaching. *Agora* **2020**, *55*, 23.
50. Al-Balushi, S.M.; Ambusaidi, A.K.; Al-Balushi, K.A.; Al-Hajri, F.H.; Al-Sinani, M.S. Student-centred and teacher-centred science classrooms as visualized by science teachers and their supervisors. *Teach. Teach. Educ.* **2020**, *89*, 103014. [[CrossRef](#)]
51. Kember, D. Promoting student-centred forms of learning across an entire university. *High. Educ.* **2009**, *58*, 1–13. [[CrossRef](#)]
52. Lucisano, P. Fare ricerca con gli insegnanti. I primi risultati dell'indagine nazionale SIRD "Per un confronto sulle modalità di didattica a distanza adottate nelle scuole italiane nel periodo di emergenza COVID-19". *Lifelong Lifewide Learn.* **2020**, *16*, 3–25.
53. Gewin, V. Five tips for moving teaching online as COVID-19 takes hold. *Nature* **2020**, *580*, 295–296. [[CrossRef](#)] [[PubMed](#)]

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



© 2020 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<http://creativecommons.org/licenses/by/4.0/>).

Article

# Primary Teacher Attitudes towards Productive Struggle in Mathematics in Remote Learning versus Classroom-Based Settings

James Russo <sup>1,\*</sup>, Janette Bobis <sup>2</sup>, Ann Downton <sup>1</sup>, Sharyn Livy <sup>1</sup> and Peter Sullivan <sup>1</sup>

<sup>1</sup> Faculty of Education, Monash University, Clayton, VIC 3800, Australia; Ann.Downton@monash.edu (A.D.); sharyn.livy@monash.edu (S.L.); peter.sullivan@monash.edu (P.S.)

<sup>2</sup> Sydney School of Education and Social Work, University of Sydney, Camperdown, NSW 2006, Australia; janette.bobis@sydney.edu.au

\* Correspondence: james.russo@monash.edu

**Abstract:** Given what is known about the importance of productive struggle for supporting student learning of mathematics at all levels, the current study sought to examine teacher attitudes towards student struggle when students learn mathematics in remote learning settings compared with classroom settings. Eighty-two Australian early years primary teachers involved in a professional learning initiative focused on teaching mathematics through sequences of challenging tasks completed a questionnaire inviting them to compare the two settings. Drawing on a mixed-methods approach, we found that teachers were more positive about the value of student struggle in classroom-based settings compared with remote learning settings. Qualitative analysis of open-ended responses revealed four themes capturing why teachers viewed efforts to support productive struggle in a remote learning setting as potentially problematic: absence of a teacher-facilitated, synchronous, learning environment; parents' negative attitudes towards struggle when learning mathematics; lack of social connection and peer-to-peer collaboration; and difficulties accessing learning materials. Suggestions for mitigating some of these challenges in the future are put forward.

**Keywords:** COVID-19; mathematics education; online teaching; parent attitudes; primary education; productive struggle; remote learning; teacher attitudes

**Citation:** Russo, J.; Bobis, J.; Downton, A.; Livy, S.; Sullivan, P. Primary Teacher Attitudes towards Productive Struggle in Mathematics in Remote Learning versus Classroom-Based Settings. *Educ. Sci.* **2021**, *11*, 35. <https://doi.org/10.3390/educsci11020035>

Academic Editor: Palitha Edirisingha  
Received: 5 January 2021  
Accepted: 14 January 2021  
Published: 21 January 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

As was the case across the world, 2020 was an unusual year for Australian schools due to the COVID-19 pandemic. Schools in most states, including New South Wales, shifted to remote learning for the majority of Term 2, whilst schools in Victoria relied on remote learning for a far longer period, including the majority of Term 2, all of Term 3, and the beginning of Term 4—totaling around half of the school year. The current study uses a professional learning project involving teaching with sequences of challenging tasks as an opportunity to compare early years primary mathematics teachers' (Foundation, Year 1, Year 2) attitudes towards student struggle when learning mathematics in a remote learning setting with a classroom-based setting [1].

### 1.1. The Importance of Productive Struggle in Learning Mathematics

Productive struggle is fundamental to successful mathematics learning [2]. The National Council of Teaching Mathematics listed productive struggle as one of eight essential teaching practices and noted that "effective mathematics teaching supports students in struggling productively as they learn mathematics" [3] (p. 48). They defined productive struggle as students "struggling at times with mathematics tasks but knowing that breakthroughs often emerge from confusion and struggle" [3] (p. 52). Struggle provides students with opportunities to grapple with important mathematical ideas [4] and can be viewed as a natural part of learning mathematics [5].

Moreover, engaging with cognitively demanding tasks that allow for genuine struggle is something that all learners should be afforded. Indeed, it has been argued that an “essential component of equitable classrooms is providing all students with opportunities to engage in productive struggle” [6] (p. 196), and that “all students need to struggle with challenging problems if they are to learn mathematics deeply” [7] (p. 6). Such experiences can support students to develop “mathematical resilience” [8] (p. 217), and are congruent with a growth mindset, where students believe that they can develop mastery through sustained effort, practice, and support [9].

Livy et al. argued that productive struggle connects directly to “productive classrooms” [10] (p. 19), where students are given opportunities to work on complex problems and are supported to take risks, even if they do not ultimately solve the problem they are working on. This is affirmed by evidence that mathematics learning is not contingent on successful completion of tasks, but on having opportunities to engage with complex tasks before teacher instruction and to deeply contemplate the underlying mathematics, and on being encouraged to persist through challenge [11].

Perhaps not surprisingly given the emphasis placed on struggle in the mathematics education research and teacher professional learning communities, teachers in Australian primary schools tend to hold positive attitudes towards the value of student struggle when learning mathematics [12]. Moreover, there is evidence that exposure to pedagogies that view productive struggle as integral to mathematics learning, such as problem-based approaches to learning mathematics, can further enhance teacher attitudes. Livy and Downton presented evidence that pre-service teachers can become more aware of the value of student struggle through exposure to a lesson structure that facilitates student exploration of a problem prior to instruction [13]. Likewise, Russo et al. found that teachers who had been exposed to professional learning around such problem-based approaches to learning mathematics had more positive attitudes towards struggle than teachers who had not participated in such professional learning [12]. This is consistent with other research that suggests that teacher endorsement of student struggle is potentially malleable if they are given opportunities to observe such approaches being effectively employed [14].

In other words, the consensus in the literature is that finding ways to prompt and support productive struggle can support student learning of mathematics, and that teachers exposed to relevant professional learning tend to hold positive attitudes towards struggle, at least in classroom settings.

### *1.2. The Influence of Learning Settings on Teacher Attitudes towards Struggle in Mathematics*

Attitudes capture how individuals think, feel, and act when expressing a view, either positive or negative, about a given topic. They have been described as more stable and cognitive than emotions, but less stable and cognitive than beliefs [15].

It is important to note that prior research into Australian primary teacher attitudes towards student struggle when learning mathematics through problem solving has taken place in the context of classroom-based learning environments; such positive attitudes may not translate to remote learning settings. In fact, we contend that there are at least four interrelated reasons as to why we would expect attitudes towards student struggle of primary school teachers, particularly early years teachers, to be less positive in a remote learning setting compared with a classroom-based setting. These reasons include the following: low teacher control over the learning environment; parents’ negative attitudes towards struggle when learning mathematics; the lack of social connection and peer-to-peer collaboration; and the relative emphasis on asynchronous learning in remote settings. These reasons are elaborated below.

First, holding a positive attitude towards student struggle when teaching mathematics through challenging tasks depends on maintaining a high level of control, which in this instance refers to a teacher’s confidence and self-belief in their capacity to effectively facilitate student learning of mathematics [16]. It is likely that remote learning settings

undermine this sense of control because much of the student's environment is beyond the scope of the teachers' influence.

Second, and related to this, parents of children in early years of school are likely to be central to shaping remote learning environments, frequently playing the role of a pseudo-teacher [17]. Parents may be reluctant to allow students to struggle and feel the need to provide immediate support to students [18]. This is likely due to a variety of reasons, including the comparative lack of pedagogical skill and knowledge of parents as educators [19]; parents prioritizing "doing over learning" in a remote learning environment as parents of young children juggle learning support with other responsibilities, including their own employment [20]; and parents being more likely to hold traditional attitudes towards learning mathematics, such as a preference for direct instruction followed by practice [21]. Teachers may anticipate (or experience) parents "pushing back" if they encourage student struggle in remote learning settings, leading to teachers being more reluctant to allow students to struggle in the first instance.

Third, although there is strong evidence that students often enjoy learning mathematics through problem solving and generally embrace challenge, it is also the case that the social component of learning mathematics and opportunities to learn collaboratively are important for supporting student engagement and for ensuring that students feel supported when engaging with challenging tasks [22]. One of the key components to students persisting through challenge is the reassurance that all students are simultaneously in the "zone of confusion" [23] (p. 9) or the "learning pit" [24]. Undermining this dynamic will likely result in teachers being less positive about struggle. Indeed, there is evidence that a lack of social support and opportunities to work with, and learn from, peers is a significant obstacle to learning mathematics through inquiry-based approaches in a remote learning setting [25].

Finally, although synchronous learning opportunities are possible in remote learning settings through various technology-facilitated platforms (e.g., Zoom, Webex) and likely to be a component of many school mathematics programs, Sullivan et al. argue that online learning is particularly conducive to asynchronous learning, specifically the preparation of instructional videos followed by independent practice [26]. Attempting to facilitate episodes of productive struggles in an online asynchronous learning context will likely amplify the three aforementioned issues compared with doing so in an online synchronous learning context; for example, teachers would have even less capacity to shape the learning environment, and students would likely feel even more socially isolated.

The current study examined teacher attitudes towards student struggle in a remote learning setting compared to a classroom-based setting, in a context of teachers being exposed to professional learning around the value of reform-oriented pedagogies. The two research questions investigated were:

1. Do attitudes towards the value of struggle when learning mathematics amongst early years primary teachers differ depending on the educational setting (remote versus classroom) being considered?
2. What are the factors that early years teachers attribute to differences in the role of struggle in a remote learning setting compared with a classroom-based setting?

## 2. Materials and Methods

### 2.1. Context, Participants, and Procedure

We have been supporting generalist, early years (Foundation–Year 2; 5–8-year-old students), primary school teachers across two school systems in Australia in the adoption of a student-centered pedagogical approach to mathematics teaching that can be characterized as structured inquiry [27]. This approach to teaching encourages students to engage in sequences of problem-solving tasks that are connected, cumulative, and challenging, and generally aligns with pedagogical principles of reform-oriented mathematics instruction [1,26]. The project was piloted in 2018 and began formally in 2019.

The final project day for each site was held remotely in November of 2020, and teachers were invited to complete a post-program questionnaire describing their experiences of implementing the learning sequences in 2020. Eighty-two teachers across two sites (New South Wales,  $n = 39$ ; Victoria,  $n = 43$ ) completed the post-program questionnaire. One section of this questionnaire, the focus of the current paper, included three questions specifically developed to invite teachers to compare the role that struggle plays in learning in a remote learning setting as compared to a classroom-based setting.

- Q1. Teachers completed the six Attitude Towards Struggle items (see Section 2.2) following the prompt: "Thinking about students in a remote learning setting. Please indicate your level of agreement on each of the following statements".
- Q2. Teachers completed the six Attitude Towards Struggle items (see Section 2.2) following the prompt: "Thinking about students in a classroom setting. Please indicate your level of agreement on each of the following statements".
- Q3. Teachers completed the open-ended item: "In your view, what is the role of struggle in mathematics in remote learning settings compared with classroom-based settings? Please describe your view of similarities and differences in as much detail as possible".

### 2.2. Measures: Attitudes towards Struggle

Teachers' attitudes towards student struggle were assessed using an instrument previously developed by the authors, Attitude Towards Struggle [16]. The six items from the measure included in the current study were assessed on 5-point Likert scales, ranging from strongly disagree (1) to strongly agree (5). Three of the items were reverse scored (denoted by \*). The six items were:

- Most students can't begin a challenging task without the teacher first explaining the maths. \*
- There is value in "throwing them in the deep end", and having students tackle a task before the teacher explains the maths.
- Experiencing struggle is an important part of students doing mathematics.
- If a student doesn't get it, it is the teachers responsibility to "set them right" straight away. \*
- Student confusion in the mathematics classroom amounts to a waste of instructional time. \*
- Getting stuck but not giving up is key to students learning mathematics.

The maximum score on this measure is 30 and the minimum score is 6. The measure has been previously shown to have acceptable reliability ( $\alpha = 0.74$ ), and to be moderately correlated with enjoyment of teaching mathematics and being in a mathematics leadership role (see Russo et al. for further information about the measure's development) [16]. Examinations of histograms, skewness, and kurtosis statistics in relation to both administrations of the Attitude Towards Struggle measure in the current study suggested that scores tended to approximate a normal distribution.

### 2.3. Approach to Data Analysis

This study adopted a mixed-methods approach, drawing on both quantitative and qualitative analysis to answer the two research questions. Mixed-method researchers advocate the use of "whatever methodological tools are required to answer the questions under study" [28] (p. 7). As a result, the paradigm of pragmatism frequently underlies studies adopting mixed-method approaches, including the current study. Pragmatism has been described as:

A deconstructive paradigm that debunks concepts such as "truth" and "reality" and focuses instead on "what works" as the truth regarding the research questions under investigation. Pragmatism rejects the either/or choices associated with the paradigm wars, advocates for the use of mixed methods in research, and

acknowledges that the values of the researcher play a large role in the interpretation of results [29] (p. 713).

In order to address the first research question, attitudes towards student struggle data were analyzed quantitatively, using SPSS Statistics, Version 25. Data were analyzed using a paired samples t-test, in order to compare scores on the remote learning and classroom-based versions of the Attitude Towards Struggle measure. In addition, a follow-up analysis using an independent samples t-test was undertaken to examine whether differences in attitudes towards struggle across settings was related to site (Victoria versus New South Wales). This additional analysis seemed prudent given that Victorian schools spent substantially more time in lockdown compared with New South Wales schools, and may have had more opportunities to consider how to adjust to a remote learning context.

To address the second research question, data from the open-ended survey response were analyzed thematically, combining “theoretical thematic analysis” with “inductive thematic analysis” [30] (p. 84). Specifically, we began the analysis by familiarizing ourselves with the data and generating an initial list of codes. We then endeavored to match this initial list of codes, and the associated data extracted, to one of the four themes identified from the literature that would suggest that teachers may view struggle in remote settings as problematic: low teacher control over the learning environment [16]; parents’ negative attitudes towards struggle when learning mathematics [18–21]; the lack of social connection and peer-to-peer collaboration [22,25]; and the relative emphasis on asynchronous learning in remote settings [26]. The remaining codes and codable extracts of data that could not be connected to one of these four a priori themes were then analyzed inductively, with additional themes identified and described. This resulted in a fifth theme, difficulties accessing learning materials, being identified. The final stage of our analysis involved reviewing, refining, and defining the full list of themes using an iterative process of moving between the data, the codes, and the themes. In part this involved refining the description of the four a priori themes identified in the literature so that they better reflected the data and codes. It was during this final phase that it was decided to combine the a priori theme concerning learning environment with the theme concerning synchronous and asynchronous learning. This seemed a more parsimonious and useful interpretation of the data, due to the difficulties distinguishing between codes belonging to these two themes. This combined theme was labelled: absence of a teacher-facilitated, synchronous, learning environment. It is worth noting that although for the sake of consistency this theme was framed in the negative (i.e., the relative inferiority of the remote learning environment), many teachers presented their response in the positive (i.e., emphasizing what was afforded in a classroom-based setting).

The final four themes that described the difficulties that teachers anticipate encountering when allowing students to struggle in remote learning settings were:

1. absence of a teacher-facilitated, synchronous, learning environment
2. parents’ negative attitudes towards struggle when learning mathematics
3. lack of social connection and peer-to-peer collaboration
4. difficulties accessing learning materials

Some participant responses were coded to multiple themes. For example, one particularly extensive, thoughtful response was coded to all four themes. We present this response with codable extracts italicized, and the relevant theme to which the extract was coded to in parentheses. Note also that despite having multiple codable extracts relevant to a particular theme, any participant response was only counted once towards any given theme:

*Struggle in the classroom setting may see a lower level of student anxiety and therefore more student risk taking when finding solutions as errors are seen as important reflection points and learning opportunities (1). The classroom culture supports students through resources such as anchor charts, concrete materials (4), peers’ thinking and reasoning, gallery walks and fish bowls (3) which all act as enabling prompts/strategies*

for students to access (1,3). It is unlikely students would have the same access to these in a remote learning setting. Parents may not have been exposed to multiple solutions/strategies when solving mathematical problems (2). In the classroom setting students are expected and encouraged to share their mathematical thinking and reasoning guided by targeted teacher questioning compared to parents and carers who may not feel confident with the mathematics required for the tasks or seeing their child struggle without jumping in to do it for them (2). Teacher Number 35 (T35)

### 3. Results

#### 3.1. Research Question 1: Does Attitude towards the Value of Struggle When Learning Mathematics amongst Early Years Primary Teachers Differ Depending on the Educational Setting (Remote Versus Classroom) Being Considered?

The paired samples t-test revealed that teacher attitudes towards struggle when considering students in a classroom-based setting ( $M = 24.4$ ,  $SD = 3.58$ ) were significantly more positive than attitudes towards struggle when considering students in a remote learning setting ( $M = 23.7$ ,  $SD = 3.55$ ),  $t(81) = 2.773$ ,  $p < 0.01$ ,  $d = 0.31$ . A follow-up analysis revealed that differences in attitude towards struggle across settings were independent of whether teachers were from New South Wales schools ( $M = 0.97$ ,  $SD = 2.35$ ) or Victorian schools ( $M = 0.44$ ,  $SD = 2.20$ ),  $t(80) = 1.062$ ,  $p > 0.05$ .

We can conclude that teachers are more likely to hold positive attitudes towards allowing students to struggle when students are learning mathematics in classroom-based settings compared with remote learning settings, although the magnitude of the difference (as indicated by the effect size) is small. This finding is consistent with other research discussing how facilitating inquiry-based learning in mathematics is problematic in a remote learning setting [25]. We now consider our analysis of teacher responses to the open-ended item asking them to elaborate on similarities and differences of the role of struggle across the two settings.

#### 3.2. Research Question 2: Does Attitude towards the Value of Struggle When Learning Mathematics amongst Early Years Primary Teachers Differ Depending on the Educational Setting Being Considered?

Teachers were asked to respond to an open-ended item asking them to describe the similarities and differences between the roles of struggle in a remote learning setting as compared to a classroom-based setting. A small group of teachers (12%) described the importance of struggle in general terms, without making any explicit reference to educational setting. It may be that these teachers view the role of struggle as similar across the two settings, or it may be that they did not interpret the question as intended. The remaining teachers highlighted differences in the role of struggle across settings, with the broad consensus being that encouraging productive struggle was far more problematic in a remote learning setting compared with the classroom. Our analysis produced four themes that capture these differences. The frequency with which data responses were classified to each of these themes is summarized in Table 1, with an illustrative quotation provided. As is apparent from Table 1, the two themes, absence of a teacher-facilitated, synchronous, learning environment and parents' negative attitudes towards struggle when learning mathematics, were the most prevalent, with over half of teachers having their responses coded to at least one of these themes.



**Table 1.** Summary of thematic analysis: Challenges associated with allowing students to struggle in remote learning settings.

Theme	N = 77 <sup>1</sup> (Percentage)	Illustrative Quotation
Absence of a teacher-facilitated, synchronous, learning environment	42 (55%)	At school we understand the struggle and the learning pit and encourage the struggle and not to give up in the classroom. We know when to come in and provide a prompt and we know when to hold a prompt back. We know when to extend students and we know when to support students. We have the knowledge and background in the teaching and know each individual student and how they learn. (T14)
Parents' negative attitudes towards struggle when learning mathematics	40 (52%)	In remote learning settings there was minimal struggle observed as many parents jumped in and assisted their children if they were experiencing any problems. Some parents had difficulty with letting their children struggle. They tended to "spoon feed" their children, wanting them to have instant success. The actual "learning" was greatly diminished as the students did not do anything for themselves. (T12)
Lack of social connection and peer-to-peer collaboration	16 (21%)	In a remote setting students are on their own and not able to work with their peers as such. Feeling isolated may create anxiety and the feeling that they are the only ones that may be struggling. (T11)
Difficulties accessing learning materials	12 (16%)	In a classroom students have many resources to use to assist their thinking and working out. However at home, they may not have access to useful resources. (T17)
Described importance of struggle, no reference to remote or classroom settings	9 (12%)	The role of struggle is to teach students how to problem solve and how to connect students to their prior knowledge and different learning. If the student is explicitly taught for every question they'll never be able to connect bigger learning and concepts to different tasks. You want them using learnt skills to solve a range of problems. Struggle allows them to develop that. (T23)
Described struggle/problem-based learning as more difficult in remote learning settings, but did not elaborate on why	3 (4%)	The remote learning situation made the struggle phase difficult- not being face to face, but we tried to overcome it by including topics and activities that students were able to work through with some parent support. (T60)

Note: <sup>1</sup> Five participants did not respond to the open-ended item (Q3).

### 3.2.1. Absence of a Teacher-Facilitated, Synchronous, Learning Environment

The majority of teachers (55%) described the absence of teacher-facilitated, synchronous learning as an impediment to allowing students to struggle productively in a remote learning environment vis-à-vis the classroom. This was often described in the positive—that is, that classroom-based settings allow teachers to closely monitor students as they are grappling with a task, and to support them as required:

I think struggle in a classroom setting is fine as the teacher monitors and knows the students and is able to prompt and reflect along the way with students so they know they are okay and supported. (T10)

The role of struggle in remote learning settings is different to the role of struggle in the classroom. This is because the teacher is able to facilitate and cater for the learning needs of every student in a more efficient and interactive way when they are in the classroom. (T27)

Other teachers framed their response in the negative—that is, by describing a relative lack of synchronous learning opportunities in remote settings that made monitoring difficult whilst students were exploring the mathematics:

It was harder to allow 'struggle' during remote learning due to limited time doing face-to-face lessons. (T45)



The role of struggle in mathematics during remote learning was very hard to monitor as once the instructional time was over children worked off screen to complete tasks. (T51)

Interestingly, even when the students were given opportunities to work on mathematical tasks in “real-time” during a virtual learning session, teachers still noted the difficulties with knowing how much support to provide students. This highlights how interacting with students through virtual platforms (e.g., Zoom, WebEx) only provides limited information to the teacher:

I feel in the classroom teachers are able to see students’ body language better and therefore understand their true emotions quicker than online learning. (T32)

[It is] much more difficult to get that sense of how students are performing or feeling during remote learning, [and] therefore [more] difficult to ‘jump in’ when students may need the support of the teacher. (T37)

This issue is amplified by students’ relative reluctance to communicate how they are feeling about their learning during a virtual learning session, perhaps highlighting the increased self-consciousness and difficulties building rapport over a virtual platform:

If students did struggle, they were a bit reluctant to share their ideas during online lessons compared to a classroom setting. (T39)

I found that some students just assumed they could do the task and then didn’t speak up or let the teacher know what was happening. (T47)

Again, this can be contrasted with a classroom-based setting:

Students have the opportunity to discuss their struggle with the teacher and assistance is more available than for students in remote learning settings. (T4)

Finally, several teachers described how it was the emphasis on growth mindset that normalizes struggle in the classroom setting, something directly attributed to the professional knowledge of the teacher:

The big difference would be at school we have posters that refer to the learning pit . . . and teachers who have been given professional development (PD) about growth mindset. (T3)

Whereas at school, teachers have the background knowledge and understand the rationale of challenging tasks. We are aware of when to intervene and when to take a step back and allow the students to have a go. Therefore, this allows students to develop a growth mindset and not feel so anxious about attempting these tasks. (T15)

This anticipates our next theme, which considers the role of parents in shaping how much to encourage student struggle in remote learning settings.

### 3.2.2. Parents’ Negative Attitudes towards Struggle When Learning Mathematics

Again, the majority of teachers (52%) also described how it was parents’ and carers’ negative attitudes towards struggle when learning mathematics that undermined this pedagogical approach in a remote learning setting. As one teacher stated:

*Unfortunately many parents do not share this view of struggling in maths and would lead their children through the task. This made it difficult to both plan and implement. (T61)*

This led to teachers not pursuing tasks that would result in students struggling, in part to reduce the anxiety experienced by parents in their role as remote learning facilitators. This suggests that teachers were cognizant that the COVID-19 lockdown was a difficult period for families as they struggled to balance competing priorities [20]:

The explore phase was always easy. Parents required tasks that were quick and easy for students to complete independently. (T1)

During home learning, it was hard to allow students to ‘struggle’ as parents weren’t confident with home learning. Therefore, we provided them with straight-forward open-ended tasks to ease anxiety and stress of parents more than children. (T19)

During remote learning we did not want to increase anxiety in the home for students and parents. Children were not all in an environment where they had support/or parents who are confident in teaching mathematics. Students were given ‘more’ of the content during remote learning. (T24)

However, the most frequently provided explanation connected to this theme is that parents, due to both their limited pedagogical knowledge and mathematical content knowledge, and their own educational background [21], often did not see the value in allowing students to struggle when learning mathematics:

Struggle at home can be problematic as parents often don’t get this... They don’t necessarily see it as learning or a pathway to learning. They think if they don’t get it straight away it is ‘too hard’ or the teacher hasn’t taught them properly. It can undo the good done at school in raising the ‘challenge’ bar. (T10)

It was harder to achieve as the parents tended to intervene . . . Parents themselves struggled with this type of mathematics, it was commented on/questioned in nearly all of our parent teacher interviews. (T28)

Parents may not have been exposed to multiple solutions/strategies when solving mathematical problems [during their own schooling]. In the classroom setting students are expected and encouraged to share their mathematical thinking and reasoning guided at times by targeted teacher questioning, compared to parents and carers who may not feel confident with the mathematics required for the tasks, or seeing their child struggle without jumping in to do it for them. (T35)

A further explanation provided by teachers as to why struggle was difficult to manage in remote learning settings, which has already been alluded to, was the different relationship dynamics between children and their parents, compared with a teacher [19]. Either the student or parent (or both) might find it difficult to tolerate the student struggling:

[Students] asking their parents to help start them on the right track, crying about the task, not understanding the question and giving up. (T9)

I feel as though parents also have different relationships with their children compared to a teacher and student. I have found parents are more likely to step in and help their children. (T32)

Regardless of how much you explicitly explain a task to a parent and encourage them to let their child think for themselves, for a lot of parents, it would be their immediate instinct to help their child so that they don’t struggle. (T15)

Our next theme considers an additional issue of interpersonal dynamics that explains difficulties facilitating struggle in a remote learning setting; that is, a lack of social connection and peer-to-peer collaboration.

### 3.2.3. Lack of Social Connection and Peer-to-Peer Collaboration

Around one-fifth of teachers (21%) noted the lack of opportunities to connect to and collaborate with peers as an obstacle to student willingness to struggle in a remote learning setting. We know from prior research that the social isolation brought on by remote learning was one of the most significant challenges identified by students [25], so the confirmation of this theme was not surprising. A key aspect of learning through challenging tasks in classrooms is the expectation that all students will be in the “zone of confusion” [23] (p. 9) or “learning pit” together [24]. The relative isolation experienced by students during remote learning, even during synchronous virtual sessions, would undermine this shared experience:

In a remote setting students are on their own and not able to work with their peers as such. Feeling isolated may create anxiety and the feeling that they are the only ones that may be struggling. (T11)

In the remote setting it would be difficult to discuss a task. Students chat with each other in the classroom setting and discuss possible strategies. Remote learning students may feel alone and in the pit and not know how to get out. (T13)

Some teachers noted that it was the interactive aspect of being in the classroom and discussing ideas with other students and the teacher that was key to episodes of struggle becoming productive:

Facilitating conversations between myself and their peers, the struggle becomes productive and often results in more meaningful learning. (T12)

I think that struggle in mathematics is much more beneficial to students in a classroom setting because they have each other to bounce ideas off. (T64)

Indeed, building a community of learners where students can learn from, and be supported by, other students is a central aspect of a problem-solving classroom more generally:

Remote teaching is [students] by themselves whereas the classroom setting [learning] is everyone's responsibility and that is where you see the students help each other and reflect on their learning. (T41)

In the classroom it is a lot easier to have the students work collaboratively allowing students who find maths challenging to learn from and listen to those more competent students. (T62)

The final theme to be considered is the difficulties accessing learning materials remotely.

#### 3.2.4. Difficulties Accessing Learning Materials

The emergent theme not anticipated from our review of the literature was the difficulties accessing learning materials and resources in remote learning settings, noted by around one-sixth of teachers (16%). This theme is notably less complex than the others discussed so far. Teachers noted that when struggling with a task in a classroom, students would tend to access concrete materials as a means of trying to better make sense of the mathematics. The lack of access to such materials in their home environment meant that a student was less likely to be successful with their learning:

Materials weren't as accessible at home as school. (T58)

Students may not have any concrete materials they are allowed to use to assist with their understanding of maths. (T46)

In a classroom students have many resources to use to assist their thinking and working out. However at home, they may not have access to useful resources. (T17)

## 4. Discussion

The COVID-19 pandemic resulted in shifts to remote learning in many countries around the world, including Australia, for large periods in 2020. Given the importance of productive struggle for facilitating mathematics learning [2,4], the current study examined teacher attitudes towards student struggle when learning mathematics in a remote learning setting compared with the classroom. It was found that teachers were more positive about the value of student struggle in classroom-based settings. Four themes captured why teachers viewed efforts to support productive struggle in a remote learning setting as potentially problematic: absence of a teacher-facilitated, synchronous, learning environment; parents' negative attitudes towards struggle when learning mathematics; lack of social connection and peer-to-peer collaboration; and difficulties accessing learning materials. Difficulties

facilitating productive student struggle was likely one of several interconnected reasons why the learning of mathematics in Australian primary schools was anticipated to be less effective during remote learning compared with classroom-based settings [26].

Although both the quantitative and qualitative analyses revealed that teachers considered struggle to be more challenging in remote learning settings compared with classroom-based settings, the qualitative data emphasized this point far more emphatically. Whereas comparing scores on the Attitudes Towards Struggle measure suggested only a small impact of setting on teacher attitudes ( $d = 0.31$ ) when responding to the qualitative item, the vast majority of participants (87%) emphasized how much more difficult it was to support student struggle in a remote learning setting. This issue of Likert scale data and analysis of open-ended items being in tension has been noted elsewhere in other areas of mathematics education research, and was described by Bragg as a “methodological dilemma” [31]. This “methodological dilemma” may point to limitations with trying to operationalize complex psychological constructs such as teacher attitudes towards student struggle using Likert scales, even if the psychometric properties of such measures are ostensibly sound. It highlights the value of qualitative approaches to educational research, including thematic analysis, which allow for more direct and nuanced inquiry into an issue of interest.

Methodological limitations notwithstanding (e.g., a relatively small sample of teachers involved in a single professional learning initiative), the current study contributes to our understanding of the difficulties pursuing constructivist, inquiry-oriented approaches to mathematics learning in remote learning settings [19,25]. Moreover, our findings suggest several practical areas of focus to mitigate the challenges identified, particularly if remote learning were to continue into the future as an important aspect of primary mathematics instruction. First, schools should consider how they might continue to innovatively incorporate technology-facilitated platforms to allow for more synchronous discussion and interaction when students engage in mathematics lessons. For example, one project school decided during the second lockdown to treat two synchronous half-hour learning sessions split across two days as a single mathematics lesson, to maximize opportunities for follow-up discussion that reflected students’ actual experience of working on a challenging task and incorporated student work samples (see Downton et al. for the detailed case study) [18]. Second, schools should be supported to provide professional learning to parent communities to emphasize the value of constructivist approaches to learning mathematics, including the importance of allowing students to struggle productively. Third, schools should be funded to provide necessary materials (e.g., concrete manipulatives) to support learning mathematics in the home environment. Finally, policy makers might consider allowing parents of school-aged children to participate in “learning bubbles” with one or two other families. In addition to removing some stress for parents associated with remote learning, this would allow students to work collaboratively on mathematical tasks, increasing their sense of social connectedness, furthering opportunities for them to explain their mathematical thinking, and increasing their willingness to embrace productive struggle, secure in the knowledge that another student is (or other students are) having a similar experience.

In terms of future research directions, it is notable that our study found no differences between teachers in New South Wales and Victoria, despite the time they spent facilitating remote learning being notably different. This was somewhat surprising, and the issue warrants further, more systematic, investigation. Future studies may consider analyzing whether there are differences in the perception of online teaching and remote learning amongst teachers with different levels of experience in this modality of teaching. It may be postulated that teachers more experienced with facilitating remote learning would hold more positive attitudes towards this modality, and adopt more ambitious pedagogical approaches, such as teaching mathematics through inquiry and encouraging students to struggle productively.

To summarize, we found that teachers did indeed have more positive attitudes towards allowing students to struggle in classroom-based settings compared with remote learning settings, although this was borne out more emphatically in our qualitative analysis. It appears that a teacher-facilitated, synchronous learning environment and opportunities to work collaboratively with peers are paramount to facilitating productive struggle in mathematics. Moreover, parents lack of willingness to allow their children to struggle and difficulties accessing learning materials serve as further barriers to teachers allowing productive struggle in remote learning environments.

**Author Contributions:** J.R. was responsible for conceptualizing the paper, developing the methodology, analyzing the data, writing the first draft of the paper and finalizing revisions. J.R., J.B., A.D., S.L. and P.S. all contributed to conceptualizing the overall project, securing funding, designing and administering the teacher questionnaire, and revising and redrafting the paper. J.B., A.D., S.L., and P.S. contribution to the validation of the data analysis, and provided feedback on early drafts of the paper. All authors have read and agreed to the published version of the manuscript.

**Funding:** The research that formed the basis of this article was funded by the Australian Research Council, Catholic Education Diocese of Parramatta, and Catholic Education Melbourne (LP 180100611). The views expressed are the opinions of the authors who take full responsibility for the ethical conduct of the research and preparation of the report.

**Institutional Review Board Statement:** The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of Monash University (Project 10791).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** Data is available from the authors on request.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

- Sullivan, P.; Bobis, J.; Downton, A.; Hughes, S.; Livy, S.; McCormick, M.; Russo, J. Ways that relentless consistency and task variation contribute to teacher and student mathematics learning. In *For the Learning of Mathematics Monograph 1: Proceedings of a Symposium on Learning in Honour of Laurinda Brown*; Coles, A., Ed.; FLM Publishing Association: Edmonton, AB, Canada, 2020; pp. 32–37.
- Murawska, J.M. Seven billion people: Fostering productive struggle. *Math. Teach. Middle Sch.* **2018**, *23*, 208–214. [[CrossRef](#)]
- National Council of Teachers of Mathematics (NCTM). *Principles to Actions: Ensuring Mathematical Success for All*; NCTM: Reston, VA, USA, 2014.
- Warshauer, H.K. Strategies to support productive struggle. *Math. Teach. Middle Sch.* **2015**, *20*, 390–393. [[CrossRef](#)]
- Smith, M.S. Redefining success in mathematics teaching and learning. *Math. Teach. Middle Sch.* **2000**, *5*, 378–382. [[CrossRef](#)]
- Lynch, S.D.; Hunt, J.H.; Lewis, K.E. Productive struggle for all: Differentiated instruction. *Math. Teach. Middle Sch.* **2018**, *23*, 194–201. [[CrossRef](#)]
- Hiebert, J.; Wearne, D. Instructional tasks, classroom discourse, and students' learning in second-grade arithmetic. *Am. Educ. Res. J.* **1993**, *30*, 393–425. [[CrossRef](#)]
- Townsend, C.; Slavitt, D.; McDuffie, A.R. Supporting all learners in productive struggle. *Math. Teach. Middle Sch.* **2018**, *23*, 216–224. [[CrossRef](#)]
- Dweck, C.S. *Mindset: The New Psychology of Success*; Random House Digital, Inc.: New York, NY, USA, 2008.
- Livy, S.; Muir, T.; Sullivan, P. Challenging tasks lead to productive struggle! *Aust. Prim. Math. Classr.* **2018**, *23*, 19–24.
- Kapur, M. Productive failure in mathematical problem solving. *Instr. Sci.* **2010**, *38*, 523–550. [[CrossRef](#)]
- Russo, J.; Bobis, J.; Downton, A.; Hughes, S.; Livy, S.; McCormick, M.; Sullivan, P. Elementary teachers' beliefs on the role of struggle in the mathematics classroom. *J. Math. Behav.* **2020**, *58*, 100774. [[CrossRef](#)]
- Livy, S.; Downton, A. Exploring experiences for assisting primary pre-service teachers to extend their knowledge of student strategies and reasoning. *J. Math. Behav.* **2018**, *51*, 150–160. [[CrossRef](#)]
- Russo, J.; Hopkins, S. Teachers' perceptions of students when observing lessons involving challenging tasks. *Int. J. Sci. Math. Educ.* **2019**, *17*, 759–779. [[CrossRef](#)]
- Philipp, R. Mathematics teachers' beliefs and affect. In *Second Handbook of Research on Mathematics Teaching and Learning*; Lester, F.K., Jr., Ed.; Information Age Publishing: Charlotte, MV, USA, 2007; Volume 1, pp. 257–315.
- Russo, J.; Bobis, J.; Sullivan, P.; Downton, A.; Livy, S.; McCormick, M.; Hughes, S. Exploring the relationship between teacher enjoyment of mathematics, their attitudes towards student struggle and instructional time amongst early years primary teachers. *Teach. Teach. Educ.* **2020**, *88*, 102983. [[CrossRef](#)]

17. Di Pietro, G.; Biagi, F.; Costa, P.; Karpinski, Z.; Mazza, J. *The Likely Impact of COVID-19 on Education: Reflections Based on the Existing Literature and Recent International Datasets*; Publications Office of the European Union: Luxembourg, 2020.
18. Downton, A.; Hughes, S.; Russo, J.; Bobis, J.; Livy, S.; Sullivan, P. From confusion to clarity: Learning from a COVID-19 experience. under review.
19. Schuck, R.K.; Lambert, R. "Am I doing enough?" Special educators' experiences with emergency remote teaching in Spring 2020. *Educ. Sci.* **2020**, *10*, 320. [[CrossRef](#)]
20. Schieman, S.; Badawy, P.J.; Milkie, M.A.; Bierman, A. Work-Life Conflict During the COVID-19 Pandemic. *Socius* **2021**. [[CrossRef](#)]
21. Lubienski, S.T. Traditional or standards-based mathematics? The choices of students and parents in one district. *J. Curric. Superv.* **2004**, *19*, 338–365.
22. Russo, J.; Minas, M. Student attitudes towards learning mathematics through challenging, problem solving tasks: "It's so hard—in a good way". *Int. Electron. J. Elem. Educ.* **2020**, *13*, 225–235. [[CrossRef](#)]
23. Clarke, D.; Roche, A.; Cheeseman, J.; Sullivan, P. Encouraging students to persist when working on challenging tasks: Some insights from teachers. *Aust. Math. Teach.* **2014**, *70*, 3–11.
24. Nottingham, J. *The Learning Challenge: How to Guide Your Students through the Learning Pit to Achieve Deeper Understanding*; Corwin Press: Thousand Oaks, CA, USA, 2017.
25. Kalogeropoulos, P.; Roche, A.; Russo, J.; Vats, S.; Russo, T. Learning mathematics from home during COVID-19: Insights from two inquiry-focussed primary schools. under review.
26. Sullivan, P.; Bobis, J.; Downton, A.; Feng, M.; Hughes, S.; Livy, S.; Russo, J. Threats and opportunities in remote learning of mathematics: Implication for the return to the classroom. *Math. Educ. Res. J.* **2020**, *32*, 551–559. [[CrossRef](#)]
27. Alfieri, L.; Brooks, P.J.; Aldrich, N.J.; Tenenbaum, H.R. Does discovery-based instruction enhance learning? *J. Educ. Psychol.* **2011**, *103*, 1–18. [[CrossRef](#)]
28. Teddlie, C.; Tashakkori, A. *Foundations of Mixed Methods Research: Integrating Quantitative and Qualitative Approaches in the Social and Behavioral Sciences*; Sage: Thousand Oaks, CA, USA, 2009.
29. Tashakkori, A.; Teddlie, C. *Handbook of Mixed Methods in the Social and Behavioural Science*; Sage: Thousand Oaks, CA, USA, 2003.
30. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [[CrossRef](#)]
31. Bragg, L. Students' conflicting attitudes towards games as a vehicle for learning mathematics: A methodological dilemma. *Math. Educ. Res. J.* **2007**, *19*, 29–44. [[CrossRef](#)]



Article

# Teaching during COVID-19: The Decisions Made in Teaching

Liina Lepp, Triinu Aaviku \*, Äli Leijen, Margus Pedaste and Katrin Saks

Institute of Education, University of Tartu, 50103 Tartu, Estonia; liina.lepp@ut.ee (L.L.); ali.leijen@ut.ee (Ä.L.); margus.pedaste@ut.ee (M.P.); katrin.saks@ut.ee (K.S.)

\* Correspondence: aavikut@gmail.com

**Abstract:** The emergency caused by COVID-19 and the transition to distance learning has made teachers face novel decision-making situations. As the teachers' pedagogical decisions have an impact on the students' learning experience, the aim of this study was to describe and explain what influenced the teachers' teaching-related decisions and how these decisions were reflected in the teaching process during distance learning. The study was based on semi-structured interviews with 16 Estonian basic school science teachers. The data were analyzed using qualitative thematic analysis. The results show that teachers' teaching-related decisions were influenced by factors that were related to the existence of digital tools as well as to the ability to use them purposefully in the home settings of teachers and students. Teachers' teaching decisions were mostly motivated by short-term goals, such as maintaining students' social interaction and supporting student motivation. The desire of teachers to keep students' and teachers' own workload affordable was also considered as a factor influencing teachers' teaching-related decisions. According to the interviews, the switch of focus to workload and well-being and valuing socialization and student motivation over subject matter competences seems to be unique for this new situation.

**Keywords:** distance learning; COVID-19; teaching and learning in emergencies; science teachers; qualitative research

**Citation:** Lepp, L.; Aaviku, T.; Leijen, I.; Pedaste, M.; Saks, K. Teaching during COVID-19: The Decisions Made in Teaching. *Educ. Sci.* **2021**, *11*, 47. <https://doi.org/10.3390/educsci11020047>

Academic Editors: Lindsay

Clare Matsumura and

Palitha Edirisingha

Received: 29 December 2020

Accepted: 26 January 2021

Published: 28 January 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

Due to the wide spread of a new Coronavirus called SARS-Cov-2 [1], school buildings around the world were closed in 2020 to protect students and teachers from the spread of the disease [2] and learning was reorganized for distance learning. This change in the organization of education put teachers, students and their parents in a new situation. Although it is too early to assess the long-term impact of COVID-19 in education, various COVID-19 education-focused studies have been conducted in recent months. For example, studies by Cullinane and Montacute [3] and Schuck and Lambert [4] confirmed that the availability of technological facilities in students' homes is a major concern in the transition to distance learning. It was found that economic inequality in the home hindered students' ability to participate effectively in their studies. Moreover, the preparation of schools for the use of technology has also influenced the success of distance learning. In schools where digital learning platforms and digital tools were used before COVID-19, the transition to distance learning was also easier [5,6].

In addition to distance learning research related to the existence of technology, COVID-19 research in the field of education has also focused on preparing teachers to cope with distance learning. For example, Gudmundsdottir and Hathaway [7] found in a study of 574 Norwegian and 239 US teachers that teachers had little previous (pre-distance) online teaching experience. Specifically, 67% of Norwegian teachers and 92% of US teachers did not have previous online teaching experience. The lack of adequate preparation for online teaching was also highlighted. At the same time, teachers expressed a positive attitude and readiness to make an effort to cope successfully with the transition to distance learning in new circumstances, or as Gudmundsdottir and Hathaway [7] p. 244 say "they were willing



to go the extra mile to move teaching to online platforms”, meaning teachers were willing to “take an agentic stance” to find ways to cope with a challenging new distance learning situation. Moreover, in a survey of 325 US K-12 teachers, Trust and Whalen [8] found that teachers lacked both preparation and support in using technology to design quality instruction during the transition to distance learning. At the same time, 61% of teachers felt overwhelmed with all the online learning tools and resources available. According to the study, it was difficult for teachers to find suitable digital tools to support learning and communication with students during the distance learning period.

Besides technological and pedagogical readiness, teacher well-being and work-related stress have also been addressed in previous studies. It has been found that uncertainty about how long-distance learning lasts and in what way distance learning should be taught (lack of clarity around the plans) is stressful for teachers. Teachers in the study by Kim and Asbury [9] (p. 1070) have described insecurity at the beginning of a distance learning period as “like a rug had been pulled from under you”. In addition to the general uncertainty, a study of 600 language teachers [10] shows that for teachers, increased workload (workload as a stress factor) was the most stressful during distance learning (mentioned as the main source of stress). The study also showed that the loss of control over work (rated above 3 out of 4) blurred lines between home and work, and irregular working hours (rated above 2.5 out of 4) were stressful for teachers during the distance learning period. Besides, a study by Trust and Whalen [8] found that teachers’ perceived work stress is related to both insufficient preparation for online teaching and a lack of support for teachers’ online teaching.

Thus, previous research shows that the availability of appropriate technological solutions [3] as well as the experience of schools in their implementation [5] affect students’ learning experiences during distance learning. Moreover, pedagogical readiness and preparedness for distance learning in general and online teaching more specifically [7,8], and teacher wellbeing and coping with uncertainty seem to be important [8–10]. This means that various individual and environmental factors have been identified as important in this new context, while the traditional/long-term purposes of education (see also [11]) seem to have much less focus. Moreover, it is not clear how exactly these are diverse factors considered by teachers while making decisions related to teaching in the context of distance learning due to COVID-19 and which of the factors have more weight in the decision-making process. Teachers’ pedagogical decisions have an impact on the students’ learning experience and thus the study of decision-making processes is very relevant in the changed circumstances. Consequently, it is important to find out how the transition to distance learning due to COVID-19 has influenced teachers’ decision-making processes and how teachers themselves justify their teaching decisions. Thus, the aim of the current study is to describe and explain what influenced the teachers’ teaching-related decisions and how these decisions were reflected in the teaching process during distance learning. The study is conducted in Estonia where the K-12 students have shown very high results in international comparison tests such as PISA [12]. Furthermore, previous studies have indicated that teachers in Estonia are highly educated (the teacher’s qualification requirement is a master’s degree), very experienced and possess a high level of knowledge about teaching (e.g., [12,13]). Therefore, it is an interesting context to explore teachers’ decision-making in more detail and to inform international community of researchers.

In the following chapters, we firstly concentrate on the decision-making of teachers and present the research questions. Next, the context of distance learning in Estonia is described. Subsequently, the qualitative research methodology is introduced, followed by the presentation of the research results, discussion of the main results and the conclusion.

### *1.1. Teachers’ Teaching-Related Decision-Making*

Teaching is essentially a thinking practice [14], a complex activity that involves continuous decision-making processes in the teaching planning stage, the interaction phase in teaching and in the analysis following the teaching process. It means that teachers are

supposed to have a high degree of decision-making autonomy while planning the teaching activities as well as during teaching situations. Therefore, the students' learning experience, or as Vanlommel, Van Grasse, Vanhoof and Petegem [15] (p. 75) say "the progress of pupils' educational trajectories", depends on teachers' decisions.

The basis for teachers' teaching-related decisions lies in their professional knowledge, which is divided into content knowledge (teacher's subject-specific knowledge), pedagogical content knowledge (understanding how to teach a subject-specific topic to students) and general pedagogical knowledge (knowledge about learners and learning, principles of classroom management and educational purposes in general) [16]. To effectively support student development, it is important that teachers have knowledge of students' cognitive functioning, including emotional, social, and behavioral development [17,18]. Moreover, teachers' knowledge of student motivation and their ability to create conditions that promote students' self-motivation are essential [18]. In addition, Mishra and Koehler [19] combined technology knowledge into the TPACK model (Technological Pedagogical Content Knowledge Framework) with the aforementioned teachers' professional knowledge and its components. In other words, how to teach a specific subject with the help of technology plays an important role in teachers' knowledge, as well as teachers' ability to make the available technological tools suitable for the learning process [19]. The elaborated use of technological, pedagogical and subject knowledge enables teachers to decide on the general approach to teach the whole class and each individual student and to make decisions to support student learning in the most effective way possible [16,18,19].

Besides teachers' professional knowledge, their teaching-related decisions are influenced by their own beliefs [20,21]. According to previous studies, the teachers' pedagogical beliefs are based on their own experience as students, experience in teacher training and are also influenced by daily teaching practices. Teachers prefer what they believe is valuable, in their choice of learning objectives and content [22]. In addition to the teachers' knowledge and personal experience, the expression of beliefs in practice is also influenced by students' characteristics, school environment, and broader social and pedagogical background (e.g., pedagogical traditions in the country) [23,24]. However, research also shows inconsistencies between teachers' beliefs and practices. For example, a survey conducted among Estonian science teachers revealed that although teachers highlight the value of constructivist learning and practical activities in the lesson, it is not always reflected in their teaching practice [25].

On top of professional knowledge and beliefs, teachers' decision-making is influenced by their purposes. These could be individual or collective (shared among colleagues) long- and short-term purposes. For example, research on collective efficacy [26] has indicated the shared visions being related to students' learning outcomes. Biesta [11] suggests distinguishing between three broad (long-term) purposes of education: qualification, socialization and subjectivation. Qualification entails ensuring that students completing a certain level of education have reached a certain level of competences, e.g., they are qualified for the next stage of education. Socialization means that students need to be prepared for successful functioning in society, this would entail good social skills and finding one's position in society. The third purpose means that education should support each student to find out who they are and what they would like to do in their life. This purpose is often closely related to supporting individual students' strengths and talents. The described long-term purposes also guide teachers' short-term goals related to teaching. For example, decisions related to classroom management, supporting students' motivation and finding best practices for explaining complex subject matter content.

Furthermore, teachers' teaching decisions (as already mentioned in the section on beliefs) are influenced by environmental factors. Aho, Haverinen, Juuso, Laukka and Sutinen [27] (p. 400) aptly stated that "A teacher cannot escape the world outside when closing the classroom door. Teaching is influenced by the surrounding society, culture and traditions". For example, teachers' decision-making is influenced by educational policies and various framework documents that guide the organizing of teaching, as well as more

narrowly by the community—school management and colleagues—enforcing or hindering activities [28,29]. In addition, cooperation with students' parents and the wider community is also important. A well-functioning relationship with parents allows the teacher to set common goals with the parents to support the children [30]. Lastly, teaching decisions are also influenced by different material resources (e.g., classroom sizes, school furniture; availability of technical equipment).

To sum up, teachers' decisions are related to their individual resources (including teachers' knowledge of students and learning) and their long- and short-term purposes. On the other hand, external environmental factors influence the decision-making processes (see also [31]). It is essential to consider that the process of teaching and learning is very complex and its different parts interact with each other in a dynamic way. Therefore it is also important to find out how exactly these diverse factors are considered by teachers while making decisions related to teaching in the context of distance learning due to COVID-19, which of the factors have more weight in the decision-making process and how it could influence teaching and learning processes. Consequently, the following research questions were posed for the current study:

1. What do teachers point out as important factors influencing their teaching-related decisions during distance learning?
2. How were these decisions reflected in the teaching process during distance learning based on teachers' explanations?

The starting positions of the transition to distance learning due to COVID-19 differ in countries and the context is also known to influence teaching decisions. For that reason, we will move on to the Estonian context, in which we briefly introduce the transition to distance learning and describe the background factors that influenced the transition.

### *1.2. The Context of Distance Learning in Estonia*

In March 2020, an emergency was imposed in Estonia, a country that has just 1.3 million people, in connection with the spread of COVID-19. Teachers were given one day (the last school day of the week, Friday) to agree on further activities and tasks with students and students were given a chance to get necessary tools (e.g., laptops) and materials (e.g., books, workbooks) from school. Starting from 16 March 2020 all schools in Estonia were closed down by the order of the government with a purpose to prevent people from gathering and reduce the spread of the virus. Therefore, with one workday of advance notice, 153,155 students of general education schools (grades 1–12) and 15,843 teachers from 516 schools [32] started with distance learning. According to the Basic Schools and Upper Secondary Schools Act [33] as well as curricula regulations [34], distance learning is guided learning (including e-learning) that is focused on acquiring knowledge and skills, but is not carried through in the school building. Thus, it was the government's command that teachers were obliged to continue working towards goals set in the curriculum in conditions where learning takes place from a distance instead of classroom training—that meant that the students as well as teachers were working from home and keeping in touch through digital means. When distance learning first came into force, it was for the period of two weeks, which was then extended up until the end of the school year (June 2020). The improved situation of COVID-19 has allowed the students to go to school in small groups since mid-May of 2020, which was mainly to help the students who had not participated in distance learning during the lockdown. In the new situation, the teachers were expected to continue working with both the students in distance learning conditions and support those in need of individual tutoring in classroom conditions.

During the period of switching over to distance learning, The Ministry of Education and Research [35] provided the teachers as well as school leaders with several kinds of guidelines on how to teach as well as support teachers during the distance learning period. For example, teachers were advised to avoid numerical grading in the first two weeks and use verbal grading to give feedback and motivate students. It was also suggested to give the students more time to complete their tasks and the teachers were encouraged to think

about the possibilities for supporting the students' social interaction [35]. The ministry recommended keeping the number of different digital environments and resources used for exchanging information and schoolwork to a minimum. In a formal notice to the teachers, it was also said that "students, their learning habits and ability to work independently as well as the opportunities of the parents are different—take that into account when setting up learning goals" [35] (p. 1). Specific choices on learning methods and environments were up to decide on for the teachers and school leaders. However, it was recommended to gather systematic feedback from the students and their parents and take it into account while planning and conducting the teaching. Overall, the guidelines focused more on preserving the well-being of students and encouraged teachers to consider the well-being of the parents as well. The well-being of teachers was primarily discussed over social media (according to the authors) where on the one hand, parents criticized teachers for too little guidance and feedback, and on the other hand, teachers justified their actions with the increase of workload due to the distance learning conditions. However, on the international level, the importance of providing emotional support to faculty as well as students during distance learning was emphasized in the OECD framework [36], which aims to support educational decisions in order to implement effective responses to the COVID-19 pandemic in education.

Similarly to other countries' education systems, the transition to distance learning in Estonia also meant putting the digital capabilities of the country to the test. Estonia is often brought out as an example of a digitally capable society where the IT-infrastructure as well as national e-services are one of the best in the world (considering both the amount as well as quality) [37]. Furthermore, the transition to distance learning was supported by the Estonian Lifelong Learning Strategy 2020 [38] agenda where one of the highlighted priorities is "A digital focus on lifelong learning". Already in 2014, one of the goals in that strategy was to use modern digital technology to learn and teach more effectively and efficiently, to improve the digital skills of the whole population and to ensure access to the new generation of digital infrastructure. Therefore, on a national level, efforts in the name of students as well as teachers being digitally competent have been made for years.

In the following, two of the greatest educational technology solutions are presented, which, according to the authors, supported the transition to distance learning in Estonia. Of the functioning digital technologies, Estonian schools have been using web applications eKool (eSchool, <https://ekool.eu>) or Stuudium (studium.com) or similar solutions for over a decade. These aforementioned applications enable information exchange between homes and the school—the information is shared by teachers, students and parents. All of the students' homework, grades and feedback are added onto eSchool/Stuudium; messages are sent to learners, teachers and parents personally, as well as to groups of them. It is also possible to upload documents to the site, for example assignments. Therefore, when entering the distance learning period, Estonia was already well-equipped with a platform for information exchange with the students and parents.

E-Schoolbag, as the second educational technology solution supporting both teachers and students during the distance learning period, is an online library or repository with hundreds of educational resources. In that portal teachers can create and share materials (e.g., presentations, worksheets, tests) and the portal also has a collection of digital learning materials from different publishing houses. Therefore, all in all, teachers had the possibility to use free e-books and e-workbooks as well as resources created by other teachers already from the beginning of the distance learning period. The Estonian Lifelong Learning Strategy 2020 [38] also focuses on ensuring digital learning resources in schools, meaning that teachers and students are given access to high-quality e-books, e-workbooks and web-based grading tools as well as open source learning materials. Thus, the development of the E-Schoolbag has been one of the national educational priorities in Estonia.

Therefore, several conditions for using technological solutions in teaching have been provided, nevertheless, there are a number of issues in the usage of digital tools in the field of education. For example, when looking at previous research done on the topic of teachers

using digital resources in their work, it can be said that teachers use digital resources less rather than more [39]. The research (although, the research was conducted more than three years ago) found that 89% of the teachers used the e-Schoolbag digital resources once a month or even less. Estonian teachers mostly use their own worksheets as digital resources (87% of those who replied) and create slideshows (78% of those who replied) but are rather modest about sharing them publicly.

When using different digital solutions, teachers' attitude towards using digital tools as well as their own digital competence is of great importance. It emerged from the Teaching and Learning International Survey TALIS 2018 conducted by OECD [40] that only 52% of teachers in Estonia who have graduated university in the last five years feel prepared to use ICT tools to teach their subject and just over a half of the teachers (53.1%) marked that they are able to support their students through digital technology. According to the same survey, only a little over a half (63.1%) of the school principals in Estonia believe that most of the teachers in their school feel confident using ICT tools in teaching. Furthermore, the results of the Leppik et al. [39] research show that teachers perceive their digital competences as rather poor. Then again, the Teacher Professional Qualification Standards [41] clearly state that Estonian teachers are expected to use digital technology in a meaningful way as well as to support students in their use of digital technologies.

Therefore, in addition to being digitally competent themselves, the teachers are expected to develop the digital competence of their students. The importance of developing students' digital competences is brought out in the National curriculum for basic schools [34] (p. 3) as "a general competence—a competence whose establishment is monitored and guided by the teachers' cooperation as well as the home-school partnership". On the other hand, Leppik et al. [39] found that the organizing of how digital skills are taught in Estonian general education schools is uneven—digital skills are already taught in the first school level (grades 1 to 3, ages 7 to 9) in about one fifth of the schools and in about half of the schools digital skills are taught as a separate subject in the 2nd and 3rd school levels (grades 4 to 9). Although, the same research acknowledges that a quarter of the teaching workforce does not agree with the statement that using digital tools should be a natural part of all subjects. According to Tire et al. [42], Estonian teachers guide their students to use digital tools to do their homework rather than using the tools in school lessons.

In the context of science education, which is the scope of the current study, use of digital tools was studied in 2016. More specifically, a cross-sectional study of Adov et al. [43] revealed that about half of the students aged 12 to 15 belong to a group that does not use smartphones and tablets (the digital devices that 97% of learners have at their hand) regularly in learning science or math. In contrast, there is only a small group of learners (5%) that uses them on a daily basis in different learning assignments, for searching information, communication, and content creation. About one fifth of the students use their devices in learning only for information retrieval. In related studies it has been shown that the students' use of digital tools could be predicted strongly by teachers' attitudes towards technology [44]. Thus, teachers' attitudes and decision-making processes are extremely important in guiding learners towards effective use of technology and it cannot be underestimated in the COVID-19-related distance education settings, either.

The students think, according to the PISA questionnaire that was conducted among 15-year old Estonian students in 2018 [42], that they are in general satisfied with their digital skill set and their opportunities to use digital tools; 93% of Estonian students use a mobile phone as their primary digital tool and 73% use a laptop, almost all homes have access to the internet and only 3–5% of the students said they have no access to the internet at home. However, if teachers do not guide students to use their devices for learning, they are mainly used for other purposes, e.g., entertainment and socialization.

To sum up, it can be said that Estonia had a rather good starting position with eSchool/Stuudium as information exchange environments and the chance to use digital learning materials of eSchoolbag as well as with the fact that students had good access to internet connection and digital technologies. Then again, although previous studies

have shown that Estonian teachers possess a high level of knowledge about teaching (e.g., [12,13]), they are not that confident about their digital competences and their habits of using information and communication technology. It is interesting how the described background influenced teachers' teaching decisions when switching to distance learning.

## 2. Methods

### 2.1. Sample

This study was based on semi-structured interviews with 16 Estonian basic school science teachers. Four participants were found by sending a letter to the mailing list of Estonian science teachers. The remaining 12 science teachers were found through personal contacts with researchers using a convenience sampling strategy. Basic school level science teachers with a minimum of 0.5 workload were involved in the study. Potential participants were contacted via email or phone.

The teachers involved in the study taught the following subjects (sometimes one teacher taught more than one) at basic school level: science, biology, chemistry, geography, physics. In most cases, teachers taught three subjects in grades 6–9 (students are usually aged 12–16 in these grades). Participants worked in a total of 18 schools (during the interview period), including two teachers teaching in several schools; two teachers from the same school participated. Among the schools there were large schools (with more than 800 students) as well as small schools (fewer than 100 students) and also two private schools. Class sizes varied from classes with 6 students to classes with 26 students. In most cases, the teachers who participated taught in classes with 20–24 students. Of the 16 teachers who participated in the study, 9 were women and 7 were men. The average work experience of the teachers was 13 years, further background information of the teachers is presented in Table 1 using pseudonyms.

**Table 1.** Background information of the teachers participating in the study.

Interviewee	Age	Years of Experience as a Teacher	Duration of the Interview (In Minutes)
Tania	54	28	44
Martin	31	7	59
Mary <sup>1</sup>	34	12	57
Mark	31	6	54
Leo	37	7	48
Elisa	28	2	56
Henry	23	1	80
Evie <sup>1</sup>	54	35	51
Eric	39	15	35
Ella	34	10	65
Alma	39	16	29
Alan	63	19	90
Hilary	28	4	73
Harriet	28	5	60
Aron	30	7	47
Alla	55	30	80

<sup>1</sup> Work in the same school.

### 2.2. Data Collection and Analysis

The data were collected during the period of April–May 2020 using semi-structured interviews. By that time, teachers had been teaching from a distance for at least one month (from 16 March 2020) and it was known that distance learning would continue until the end of the school year (beginning of June in Estonia). Before conducting the interviews, the interview plan was discussed among the experienced researchers and a pilot interview was conducted with one of the science teachers who met the sampling criteria (the interviewee Tania). As no significant changes were made to the interview plan, the data of the pilot interview were included in the main dataset of the study.



The interview plan with open-ended questions consisted of the following parts: (1) introductory warm-up questions (e.g., how has distance learning gone? Why so?); (2) background information questions (e.g., work experience as a teacher, classes taught, and subjects); and (3) a description of the process of planning and conducting the teaching with justifications (including factors influencing the decision-making) (e.g., how do you teach in a distance learning situation? Why did you make such a choice(s)? What influenced your decisions?). Finally, the interviewees were offered the opportunity to add more about distance learning and teaching at their own request (question: what else do you want to say about distance learning and teaching?) The main questions of the interview were supplemented with follow-up questions (e.g., an explanatory question: can you expand this a little further?) depending on the interview situation.

As there was an emergency situation (due to COVID-19) in Estonia during the interview period and it was recommended to keep the contacts to a minimum, the interviews were conducted in agreement with the interviewees using the web-based video conferencing tool Zoom. Firstly, the interviewees were introduced to the purpose of the interview and ethical issues were explained (confidentiality, data retention and further use), the structure of the interview was introduced as well. The interviewees were then asked for permission to record the interview. All interviews were recorded with the consent of the subjects. The interviews were conducted by five researchers and lasted from 29 to 90 min (average 58 min). All the interviews were transcribed verbatim. To protect the participants' identities, participants and their schools were given pseudonyms.

The data analysis relied on the techniques of qualitative thematic analysis [45] and was supported by the web based interactive software package QCMap ([www.qcmap.org](http://www.qcmap.org)). QCMap made it possible to mark the thematic units, add themes next to thematic units and to later categorize themes. In addition, the environment made it possible to extract data from coded and categorized data. The data analysis environment also allowed the use of an Inter-Coder function, which allowed two researchers to perform separate coding, discuss coding and categorization decisions.

After uploading the data, the first two authors of the article read the interviews repeatedly in order to map the initial themes—thematic units (the themes/parts of the text that conveyed the whole idea, which could be a paragraph, sentence or part of a sentence) that were related to the research question. The researchers added initial themes next to the marked part of the text. After the initial coding, the researchers then moved back to the beginning of the dataset and analyzed each previously marked section in more detail, generating primary labeled theme(s). After the initial analysis, the researchers reviewed the labeled themes and, if necessary, clarified the scope of marking as well as the names of the themes. For example, the text in the transcript of the interview “I am in a very good situation, as I went to the school’s computer teacher and they set up a second monitor for me, so I work from home with two screens and I also have a document camera. I am not complaining, I have the technical tools (Tania)” was highlighted in the QCMap environment and the thematic unit was labeled as the theme tools to conduct distance learning. The interview transcript section “I have not done many video lessons. Maybe I should. I think I have not been brave enough or have not known how to do it. I do not know how, or do not know how to do it on my own, I do not know how it works. And well, the thing is that I am not sure how to prepare a normal video lesson, in a way that it actually has a point too (Elisa)” was labeled as the theme teachers digital competence. The differences were discussed between researchers until a consensus was reached.

In the next stage, building hierarchies of themes took place—the themes with a similar content were grouped into larger units. For example, the themes tools to conduct distance learning and teachers digital competence (outlined above), together with the theme internet connection quality were grouped under the main theme “The existence of digital tools, their use and digital competences” (sub-theme teacher-related factors). Themes such as the number of computers per child, internet connection quality and students’ digital competences, were also grouped under the main theme “The existence of digital tools,

their use and digital competences” (sub-theme student-related factors). In the further analysis of the thematic units within the topic, the factors related to students and teachers were differentiated. These were divided into two sub-themes: teacher-related factors and student-related factors (examples above). Similar to the example above, two other themes, “Supporting social interaction and motivation” and “Students’ and teachers’ workload and well-being”, were formed by merging similar thematic units and labeled themes. As both student-related factors and teacher-related factors were differentiated in the thematic units for the second and third theme, the themes were further divided into sub-themes within the topics. In the results chapter, the results of each theme are presented in two divisions (student-related factors and teacher-related factors).

To ensure consistency in the interpretation of the analyzed text, two authors undertook parallel coding and theme-building. There was a continuous reflective discussion between the researchers in order to reach consensus on disagreements and thus increase the quality of the study.

During the data analysis process, the authors compiled a compact transcript of sub-themes and themes, as recommended by Braun and Clarke [46], into the researchers’ diary. The summaries supported the researchers’ discussions in categorization and also in writing the results.

### 2.3. Ethical Considerations

A researcher is always obliged to protect the people participating in their research [47,48]. Hence, researchers should follow a number of key principles when designing and conducting a study, as well as presenting the results. For example, to minimize the risk and harm, to respect individuals’ rights and dignity, to ensure that participation is voluntary and that the participant is adequately informed about the study, and also to conduct the study impartially, transparently and honestly [47]. The authors of this article followed these principles when designing, conducting and presenting the results of the study. Participants in the study were informed about the purpose of the study both by arranging a time for the interviews and before the start of the interview. Prior to the start of the interview, data retention and further use were explained. The structure of the interview was also introduced. In addition, subjects were offered the opportunity to ask additional questions and were informed that they had the right to refrain from answering the questions at any time during the interview and to end the interview at their own request. Participants were asked for permission to record interviews. Informed consent was obtained from all the subjects involved in the study.

In addition, to protect the privacy of the subjects and to ensure that the subjects were not identifiable when presenting the results, the names of all subjects and the names of the schools they named were replaced by pseudonyms during the transcription process. Names and pseudonyms were stored as a separate document and only two researchers (the authors responsible for data analysis) had access to the document. Pseudonyms were also used in the communication between the researchers during the analysis of the interviews. We also considered that the audio recordings and transcripts of the interviews would be available only to the researchers who performed the data analysis. Although the study was funded by the Estonian Research Council (ERC), it did not affect the results of this study. The researchers were independent throughout the study and there were no conflicts of interest brought on by the funding.

### 3. Results

The presented results follow the identified themes and sub-themes and are supported by extracts from the interviews. To illustrate and confirm the results, the pseudonym of the interviewed teacher is added after the attached extracts. Before presenting the results of the study, we consider it important to point out that the results are presented based on teachers’ descriptions of the teaching experience during the distance learning period.



It emerged from the interviews that in general, three main themes influenced the teachers' decisions regarding their teaching:

- The existence of digital tools, their use and digital competences;
- Supporting social interaction and motivation;
- Students' and teachers' workload and well-being.

Of the themes that emerged in data analysis, it in turn became evident that it was possible to distinguish (1) student-related factors and (2) teacher-related factors. Therefore, the results of each theme are presented in two divisions and next to the factors influencing teaching-related decisions, the ways these decisions were reflected in the teaching process during distance learning (based on teachers' explanations) are presented.

### 3.1. The Existence of Digital Tools, Their Use and Digital Competences

Student-related factors. Distance learning was preceded by a day of classroom training where teachers had the chance to give students guidelines regarding the distance learning period. According to the teachers who participated in the research, they also tried to figure out if the students had necessary technological means (especially a computer) at home already on the last classroom training day as well as the first distance learning week. Computers or tablets were lent out by the school if needed.

The number of computers per child was an important factor that influenced the teachers' decisions. When making decisions regarding teaching during distance learning, the participants considered that in some families, many children used the same computer (or that there was only one computer in the family). That means that it was important to try and avoid coinciding video lessons, because it might have not been possible for several children of the same family to participate in online lessons at the same time. Very strict deadlines of tasks were also brought out in the interviews as a concern. It was explained that such deadlines were given up on based on the feedback from both students as well as parents, because students might have not always had the chance to submit their work by the given time if they had to share a computer with other family members.

*We thought of the situation where for example a family has three children, but only one computer. We cannot assume that everyone has a computer. In that case it is very hard to organize things in a way that everyone can submit their tasks by a certain time. Sometimes the children slept longer and maybe did their tasks at 8 PM, or however it was expected at home. We did not set any punctual deadlines. (Anita)*

It also emerged from the interviews that the internet connection quality at the students' homes affected the teachers' teaching-related decisions during distance learning. It was said that there were students who could not participate in video lessons due to an unstable internet connection at home. For this reason, video lessons were implemented less rather than more at the beginning of the distance learning, teachers also brought up that they tried to reduce the students' screen time. Thus, alternative learning materials and ways (e.g., textbook/workbook tasks) were provided according to the participants.

*Right when the first week had passed, feedback was asked from both parties and students brought out they did not want punctual deadlines. Many students did not have good digital solutions, for example their internet connection was bad. (Harriet)*

*Just that if the child really has to be in a video lessons for three-four hours straight. That is quite tiring as well. (Elisa)*

No direct changes were made concerning the learning plan when considering students' digital competences. Participants found the students' digital competence to be rather good, but made sure to offer different environments to submit homework. However, teachers explained that at the beginning of distance learning it was necessary to give feedback to messages containing homework in order to identify whose work was received. It was pointed out that students needed some guidance on different digital environments at first.

*Well, one student sent me a letter containing just some picture of a workbook, nothing more. Then I sent them back a polite letter about how they had sent me this letter and if it was junk mail. The next time, the same student sent me a better version, one where they started with a "Hello" and "I am . . . ", which was a bit better. (Anita)*

Teacher-related factors. Most of the teachers participating in the research found they had the necessary tools to conduct distance learning as well as sufficient internet connection quality and digital competences already at the beginning of the distance learning period. Many teachers pointed out they had just recently had training on the topic of digital skills and that now they could put what they had learned into practice. It was also said that the schools' IT specialists were happy to show how to use sites for communication (e.g., Zoom, Teams) or would provide digital tools. Therefore, when it came to making decisions about teaching, the teachers' possibilities to use digital tools and their digital competences were not brought out as a constraint. It was said that the teachers were given free choice to use digital environments and technology during distance learning.

*I am in a very good situation, as I went to the school's computer teacher and they set up a second monitor for me, so I work from home with two screens and I also have a document camera. I am not complaining, I have the technical tools. (Tania)*

*Well, the school's management did not put any restrictions on us. When distance learning started then they said that tasks have to be doable for the students. That we should give a longer deadline in order not to overburden the students and to give them a chance to do things with their own pace. (Mary)*

However, it became evident that, in two cases, teachers felt that their teaching-related decisions were restricted by either their digital competences or internet connection quality. One teacher explained that she decided not to implement video lessons because of being insecure in using digital environments or of being in front of the camera. Another teacher justified not implementing video lessons by avoiding the pressure on herself due to an unstable internet connection at home.

*I have not done many video lessons. Maybe I should. I think I have not been brave enough or have not known how to do it. I do not know how, or do not dare to do it on my own, I do not know how it works. And well, the thing is that I am not sure how to prepare a normal video lesson, in a way that it actually has a point too. (Elisa)*

### 3.2. Supporting Social Interaction and Motivation

In addition to digital tools (including their use and digital competences), the interviewed teachers said they considered supporting student motivation and social interaction as a part of it, when making teaching-related decisions during the distance learning period. The participants understood as teachers that students had limited possibilities for physical contact with other people in distance learning conditions, which is why opportunities for students' socializing were considered important. When it came to motivating students, it was perceived more or less the same as it would have been in a classroom setting. Although, the participants said they were more aware of motivating students and found themselves to be more intense about it during distance learning.

Student-related factors. It emerged from the interviews that teachers started carrying out video lessons in order to support students' social interaction (and motivation). It was explained that it was very important for the teachers that students could see and hear each other. Some of the participants described having breaks during the video lessons, just to talk on everyday topics—in this case, students' interactions with each other were perceived more important than reaching learning goals. In addition, several teachers were said to have allowed their students to talk to each other at the beginning and end of the lesson (similar to lesson breaks at school). The participants who also work as class teachers offered students separate times for interacting (homeroom in Zoom, Teams or Google Meet).

*Usually about 10 to 15 min before class I give my students a link where they can log in. Then I say it is break time now so you can speak. It is just so cool—oh, what do you have*

*there? Show me as well! And then this kind of a social life starts to happen and after the lesson ends, I also say they have a 15 min break. This shows that even online lessons allow such socializing to happen. (Tania)*

Then again, some teachers described situations where students did not want to switch on their cameras, making the teachers unsure if these students were actually participating. In these situations, supporting social interaction was perceived to be more difficult as well. There were teachers who encouraged students to switch on their cameras, but there were also those who came to terms with the fact that some students preferred to participate without a video picture.

*Some switch their camera off, some mute themselves, how will I know what they are actually doing. If I ask them personally like hey, what do you think of this or that thing, just to get a discussion going, it is actually an obstacle. Some classes are completely silent, and I do not know if the students are even there, if they are listening or playing a game at the same time. So it is sort of an obstacle. (Tania)*

To keep the students motivated and to support them, putting together methodologically diverse tasks and giving students a choice about how to submit their tasks were also brought out. The participants found that the learning materials as well as the learning activities expected from students had to be more diverse. For example, some teachers gave the students an option to do pair or group work, with the aim of supporting those who would be motivated by working together with someone else. In regards to learning materials, teachers offered the chance to learn the current topic through video material (e.g., YouTube learning videos), reading material or electronic materials, for all students to have a chance to find a learning path that suits them. Moreover, most of the teachers were said to have offered submitting students' homework in different forms (either on paper, as a picture, by email, e-School/Stuudium or any other site).

*When putting together worksheets, I tried to put interesting things into the introduction, for the student not to lose interest, for them to have something to inspire them. In class, it is possible to do the introduction at the beginning of the lesson, to tell them why we are doing certain things. But being at home, if they are not able to participate in the Zoom class, they still need to be motivated. (Hilary)*

*I have given a free choice whether you do it on a paper, in Word or onto a homepage. It is more about me getting the completed task, rather than not getting it at all from the student. It might be the way that I have left it open for the students. (Aron)*

Furthermore, teachers gave in a bit when it came to study results and graded students less strictly than usual. The teachers explained that in the context of distance learning it was more important that the students were motivated to work rather than just get good grades, which is why they were graded less strictly or the grading threshold was lowered. However, giving feedback to students was perceived to be more important than during classroom learning. The teachers said they understood that students needed motivating feedback for all of their actions during the distance learning period in order to study effectively. Private lessons were carried out with the students in need of extra support in learning as well.

*For example, there was an agreement on the grading that there could definitely be a graded test on those topics that were studied before distance learning started. But during distance learning teachers were advised to be a bit less strict, maybe not grade everyone so much and rather give formative feedback. (Martin)*

Lastly, teachers said they took students' opinions into account more during distance learning. Students' feedback about used study methods and ways of teaching was considered when planning the teaching in order to come up with solutions best suited for the students. For example, classes were asked if they wanted video lessons or whether they preferred digital solutions, tasks from their books or workbooks. According to the participants, the majority vote in the class was taken into account and if possible, the expectations

were met. It was pointed out that several schools also asked for the feedback of the parents in order to consider their opinions during the distance learning period as well.

*Now I ask the students more about how the lessons went, what to do again, what seems exciting, what they liked and what not. There is more feedback than in usual school lessons. They either write it down or we discuss it in Zoom lessons. (Harriet)*

Teacher-related factors. Several teachers brought out that the decisions regarding the support of social interaction were not only prompted by the student-related factors as they themselves missed the face-to-face communication with their students as well. On the other hand, one of the participants felt that his own lack of motivation restricted supporting the students' social interaction and motivation. Therefore, the reasons why, for example, video lessons were conducted, also derived from the teachers' own preferences.

*It is hard to work from home like that. Well, I do not live alone, I have a partner and to organize life like this right now is rather difficult, because my partner does not currently work and being together here like this, I just do not know. I could do these things [video lessons, individual tutoring], I have thought about it, but for some reason I cannot start doing it. I do not know, my own motivation has decreased. (Henry)*

### 3.3. Students' and Teachers' Workload and Well-Being

Student-related factors. According to the participants, when making teaching-related decisions during distance learning, taking the students' workload into account was of higher importance than beforehand, during classroom learning. They explained that distance learning was a new experience for the students and the society was more anxious as well. Feedback about students' workload was gathered systematically school-wide or by teachers. The feedback revealed that students' workload had increased during distance learning—it was decided to reduce their workload to improve their general well-being.

*I had a hunch about how the students' workload might increase during distance learning, which is why I organized my teaching in a way that the students did not have to do something every day, I gave assignments they had to complete by the end of the week, or next week. (Henry)*

The participants said they had freedom about which digital environments to use and in general there were no within-school agreements about that. As a result, the teachers found that students needed extra time in the first few weeks to get used to the different environments, which in turn increased the students' workload. It became clear during the first weeks of distance learning that students' work pace and abilities to independently study were very different, which is why their workload was reduced, their work pace was slowed down, and smaller goals were set. A few of the participants, however, mentioned having virtual meetings to discuss and agree on which sites (e.g., Zoom, Teams, Google Meet, Google Classroom) to use within-school or just to give each other tips and tricks.

*We have different meetings for different subject fields at our school. We talk about what we use with which class. We show things that work well with some classes and then give tips to each other about what should be changed and what not. (Harriet)*

Only a few interviewees said that they cooperated with other teachers in their subject when giving tasks, for example during one school day or week or in general giving intertwined tasks. However, the interviewees expressed that they kept it in mind that students had other subjects besides their own as well. Several teachers mentioned that in natural sciences (in comparison to for example mathematics) it is easier to acquire the missing topics when classroom teaching resumes, which is why reducing learning outcomes was not perceived to be critical. It was also found that if students are not in their senior year and the same students continued with the same teacher next year, then it is possible to know exactly what was not learned and it is possible to add the necessary topics into the work plan.

*I considered the fact that students are people as well and they have other subjects too. If they only had my subject, I would have given them more to do. But well, let us be realistic and look at their abilities. (Evie)*

Teacher-related factors. In addition to students' workload and general well-being, the teachers' own workload and well-being influenced their teaching-related decisions. All the teachers who were interviewed said that their own workload affected the decisions they made about teaching during the distance learning period.

Most teachers claimed they started distance learning with enthusiasm and tried to be there for the students at all times, including giving individual feedback. They communicated with students through e-School/Stuudium early in the morning as well as late at night—the main thing was that the students would understand the topic they were learning and would feel that the teacher was there for them.

*Some send their homework in at half past 7 PM, some send theirs at half past 10 and add a comment about if what they are sending is correct and if they need to make any changes. I usually replied instantly, because maybe later on they will not bother to do it anymore. I could not do it in any other ways, this seemed right to me. (Tania)*

The participants explained that after working like this for a few weeks it was clear that it was not possible to continue that way. Such active teaching and thorough feedback for students increased their workload and there was a danger of burnout. Because of this, teachers tried to teach in a way that would let them “survive”, but so that the minimum goals would still be met even during distance learning. They tried to find the balance between the learning process and preserving themselves. Many participants started doing video lessons during that period to explain topics that were more difficult face-to-face and through that reduce individual feedback and the need for teaching something over again.

*I thought that it is important to give students a lot of good feedback and in the first weeks we heard back that getting quick feedback was appreciated. At some point though I felt that I am not capable of working like this anymore. (Harriet)*

According to the teachers who participated in the research, in order to reduce their workload (for self-care), they reduced the work pace and workload in general. They taught topics that were feasible for the students, the goal was to just teach the most important topics and/or the topics were not taught in that great of a detail. They also found a way to reduce workload by assigning pair or group work, which decreased the amount of completed tasks that needed feedback. It was brought out that teachers started giving more general feedback instead of individual feedback, for example feedback for the whole class (e.g., in a Zoom class). Teachers who created study videos said they reduced the amount of videos and instead encouraged students to acquire the topic through reading material. Students were given long-term tasks to reduce the papers teachers had to check.

*At some point I felt I also needed my own personal time. I realized I had put the deadlines too close to each other and started spreading them out a bit. (Marion)*

*One day I counted I had given different classes about 140 papers. I discussed it with the head teacher and we concluded that it is not wise to give individual feedback to all the papers. The students need to have some responsibility as well. (Aron)*

One of the participants had their students do group work for weeks during distance learning and did not conduct any video lessons. As a result of that, the teacher perceived his workload to be significantly lower. Among other reasons, he justified his decision with the thought that teachers were given a lot of freedom regarding their teaching during distance learning, which enabled this little communication with the students.

*It seemed easier for both the students and me. As I did not have this everyday contact with them anymore, I found it really hard to work from home. I was a little mentally drained from all the work in school as well and needed time for myself too. (Henry)*

The results of both research questions are concluded in the following Table 2, which therefore presents what teachers pointed out as important factors influencing their teaching-related decisions during distance learning and how were these decisions reflected in the teaching process.

**Table 2.** The factors influencing teachers' teaching-related decisions and how were these decisions reflected in the teaching process.

What do Teachers Point Out as Important Factors Influencing Their Teaching-Related Decisions during Distance Learning?	How Were These Decisions Reflected in the Teaching Process during Distance Learning?	
Number of computers per child	<ul style="list-style-type: none"> <li>• mapping the students' digital needs</li> <li>• lending out computers/tablets from school</li> <li>• avoiding strict deadlines</li> <li>• avoiding coinciding video lessons</li> </ul>	
The existence of digital tools, their use and digital competences	Students' digital competences	<ul style="list-style-type: none"> <li>• guiding students in their homework submissions</li> <li>• guiding students in using new digital environments</li> <li>• offering choices on the environments for submitting homework</li> </ul>
	Internet connection quality	<ul style="list-style-type: none"> <li>• providing alternative study materials and ways of learning (e.g., reading, watching videos)</li> <li>• keeping the number of video lessons low</li> <li>• allowing the participation in video lessons without using a camera</li> </ul>
Supporting social interaction and motivation	Students' and teachers' social interaction	<ul style="list-style-type: none"> <li>• conducting video lessons</li> <li>• providing the students with an environment to communicate in before and after video lessons</li> </ul>
	Student motivation	<ul style="list-style-type: none"> <li>• putting together methodically diverse tasks</li> <li>• identifying students' preferences and needs</li> <li>• if possible, considering students' preferences and needs when planning the teaching</li> <li>• lowering the grading criteria</li> <li>• offering private lessons to support the students</li> <li>• providing timely and individual feedback</li> </ul>
Students' and teachers' workload and well-being	Students' workload and well-being	<ul style="list-style-type: none"> <li>• reducing the amount of topics studied</li> <li>• postponing the topics of higher complexity</li> <li>• grazing the surface of the topics studied (not going into depth)</li> </ul>
	Teachers' workload and well-being	<ul style="list-style-type: none"> <li>• assigning pair and group work</li> <li>• assigning long-term tasks</li> <li>• assigning individual tasks instead of conducting video lessons</li> <li>• providing general feedback (e.g., in video lessons) instead of individual feedback</li> </ul>

In conclusion, it can be said that the teachers' teaching-related decisions in the context of distance learning were influenced by factors connected to both students and teachers themselves. Teachers had to consider which digital tools were needed to teach, as well as to study and they had to think of how different families dealt with sharing those tools with each other and whether the internet connection quality made it possible to use them.

The existing equipment and solutions allowed teachers to teach, but there were some teachers whose own digital competence and their lack of courage to use the camera or the quality of their internet connection put some limits on their teaching-related decisions. The participants said that their teaching-related decisions were also influenced by their wish to motivate students and offer them a chance to socialize face-to-face even in conditions of distance learning. In addition, the wish to reduce students' workload (and through that increase their overall well-being), as well as the teachers' workload in the name of self-care were brought out as important factors that influenced teaching-related decisions. To ensure both student motivation and well-being, the number of topics covered in teaching was reduced and teachers did not aim to go as deeply into the topics as they would have done in traditional classroom contact teaching.

#### 4. Discussion

The aim of this study was to describe and explain what influenced the teachers' teaching-related decisions and how these decisions were reflected in the teaching process during distance learning (according to teachers themselves). In the following, we discuss some of the main results in the perspective of previous research.

Contrary to findings from several other studies [3,4,7,8], teachers' and students' digital competences were not perceived as a restriction on teaching-related decisions by the teachers in the current study. The teachers found (with two exceptions) they had the necessary tools and skills to conduct distance learning effectively and perceived their students' digital competence as rather good. Thus, from the viewpoint of students' digital competences, the results are in accordance with previous studies. For example, the results of the PISA survey show that Estonian children are in general satisfied with their digital skill sets [42].

The results of the current study also clearly support that "A digital focus in lifelong learning" in Estonian Lifelong Learning Strategy 2020 [38] has successfully been implemented in the Estonian education system. However, these results are surprising since previous research has indicated a more modest level of Estonian teachers digital competences. For example, Leppik et al. [39] research shows that Estonian teachers perceive their digital competences as rather poor and the (author(s)) [43] study also showed that smartphones and tablets have not been used very often in learning science. Furthermore, the results contradict the findings of the Teaching and Learning International Survey TALIS 2018 conducted by OECD [40], according to which only a little over a half (63,1%) of the Estonian school principals believe that most of their teachers feel confident using ICT tools in teaching their subject. One possible explanation for such a positive result could be the fact that the teachers themselves (and also school leaders) have been too critical of teachers' digital skills and that the actual level of skills is better than previously perceived and enables teachers to cope well with distance learning using digital tools. Another possible explanation could be the fact that the teachers had been teaching at a distance for more than a month at the time of data collection. Thus, by that time, their digital competences may indeed have been sufficient for putting technology in good use for learning. Another interpretation is related to the teachers' autonomy of making decisions regarding the use of different digital solutions in distance learning conditions. It is possible that the teachers decided in favor of the digital solutions (and environments) they felt confident using and excluded the ones for which they did not have sufficient skills, even if learning and giving feedback could have been more effective through the solutions unfamiliar to the teachers. As the results of this study also show that the teachers were concerned about providing individual feedback to students (related to their workload), there may still be a need to analyze teachers' digital competences in this matter and if necessary, to support teachers in their ability to make the available technological tools suitable for the learning process as has also been pointed out in previous studies (e.g., [7,8]). The elaborate use of technological, pedagogical and subject knowledge as brought out by Mishra and Koehler [19], enables teachers to use digital solutions for learning in the most effective way possible.



The results also showed that teachers asked students for feedback on both the study methods used and the ways of teaching, and took the students' opinions into account (according to themselves) more than before, in the case of classroom learning. In teachers' estimation, students were also given more choices in the ways of learning (individual-pair work) as well as in the submission of their tasks (through different environments). Identifying students' preferences and giving choices is certainly supportive of students' learning motivation and at the same time important in supporting students' self-management skills [18]. Thus, a positive impact of distance learning can too be seen on teachers' teaching-related decisions (and the accompanying activities). The reason why teachers are said to have taken students' feedback into account more than usual may be because by seeing students face-to-face in a classroom situation, the teacher directly perceives (based on previous experience and knowing his/her students in this situation) the study methods preferred by students and apprehends which of those is appropriate to use in that specific moment. However, in the distance learning conditions, the possibility for visual contact was decreased and thus the teachers' data for making pedagogical decisions reduced as well, which may have increased the need for more extensive direct feedback from students. This raises the question of whether asking students directly for feedback, as well as giving them more choices, is something that should be included in further teaching, by systematically combining the teachers' experiences and interpretations from classroom observations with systematically gathered feedback from the students. It would be interesting to find out, from the perspective of both teachers and students, whether the attitudes and activities regarding these aspects changed after returning to classroom learning after the end of distance learning caused by COVID-19.

Maintaining social interaction between students and teachers was also considered while making teaching-related choices in distance learning conditions. The participants considered socializing to be of higher importance than reaching subject matter related to learning goals in some situations. The results are in good accordance with the guidelines provided at a national level at the beginning of distance learning, which emphasized the need for supporting students' social interaction [35]. In most cases, the teachers who participated in the study tried to support the students' need for social interaction through video lessons, where students had the opportunity to see each other. However, it was also described that not all students switched on their cameras during video lessons. Such situations were described as uncomfortable for the teacher because on the one hand, it was insecure (the teacher could not see who was behind the screen), but on the other hand the lack of control over the students' activities was pointed out. Rannastu-Avalos and Siiman [49] have also stated that video lessons lose a significant part (presumed advantages for establishing social presence) if students do not turn on their cameras. It is possible that explaining and discussing why participation in this way is important for both students and teachers could help to change students' behavior.

As of interesting results, we also point out the ingenuity of teachers to create opportunities for students to communicate in between lessons in the conditions of distance learning—the so-called distance learning lesson breaks. This could be an idea that could be recommended to teachers when teaching at a distance. At the same time, it is important to keep the issue of privacy and security in mind for both the lessons and the "distance learning lesson breaks". Although digital security is considered as an important issue in teachers' digital competencies and is addressed in Estonian teacher training as well as in in-service training, legal solutions on how distance learning would work correctly from a data protection point of view have been rather delayed and sometimes controversial. For example, a letter from the Data Protection Inspectorate to schools (October 2020) states that "in our opinion, observing students through real-time video images is justified, so that the teacher can conduct the lessons, including checking the students' participation in the lesson. Thus, the teachers are allowed to oblige the students to share their video images" [50] (p. 2). At the same time, from a lawyer's point of view, Krookmaa [51] has outlined (December 2020) a number of reasons related to data protection laws as to why keeping the camera on



for an entire lesson is an infringement of private law and should not be required. Therefore, from the point of view of both students and teachers, it would be important to clearly state the appropriate behavior in relation to the nuances of data protection and cyber security, while considering how the benefits of students and teachers seeing each other in learning situations can be provided. This should be followed by training and/or informing teachers of the behaviors agreed on in a timely and comprehensible manner.

Lastly, we discuss the results in terms of workload and well-being. According to the participants, both students' and teachers' workload and well-being were considered while making teaching-related choices. Previous research in the context of COVID-19 has also shown that uncertainty [9], the workload of teachers [6,49] and general teachers' work-related stress [8,10] has increased in distance learning settings, and this has also affected teachers' teaching practice. According to the teachers themselves, they applied a number of activities to reduce the workload of the students during the distance learning period (e.g., reducing the amount of topics studied, postponing more difficult topics to next year, just grazing the surface of the topics studied, giving long-term assignments), because it was understood that it takes more time for the students to learn independently and also that the students' learning skills are different. The teachers perceived the well-being of the students to be of higher importance than reaching the maximum learning outcomes related to subject matter prescribed in the curriculum, especially since the emergency situation (due to COVID-19) had already caused a lot of anxiety among people. In this regard, the teachers who participated in the study have considered the guidelines provided by the Ministry of Education and Research [35] rather well at the beginning of distance learning. For example, such guidelines as giving students more time to complete their tasks and considering that students' learning habits and abilities to work independently are different were taken into account by the participants when making teaching-related choices. In the short-term perspective, where in the spring of 2020 the situation of distance learning lasted for a rather short period of time (under three months), such an approach was understandable in the opinion of the authors. However, while COVID-19 continues to show no significant signs of regression (at the end of 2020), it is important to analyze which learning outcomes should be achieved according to the curriculum, regardless of the form of learning in schools and furthermore, at a national level. As the current situation in education also affects students' options for further education (e.g., entry to the next level of education) as well as their compliance with the expectations of future employers, a basic level of knowledge should be agreed on that is required and achievable in distance learning conditions. This is related to reconsidering the long-term purposes of education as proposed by Biesta [11] and specifying more clearly how to reach them.

The teachers who participated in the study pointed out that as their own workload increased during the transition to distance learning (similar to the study by Rannastu-Avalos and Siiman, [49]), students were given, for example, pair or group work, the deadlines of assignments were extended, and the amount of individual feedback was reduced. Thus, the students and factors related to them were no longer behind the teaching-related decisions, but instead the well-being of the teachers themselves were. On the one hand, however, such an outcome can be seen as positive, since pair and group work supports the development of students' social skills and long-term assignments allow students to develop self-management skills, as pointed out by Eggen and Kauchack [18]. It is certainly important that, in addition to the students' emotional well-being, the teachers' well-being is taken into account as well in teaching and teaching-related choices. For example, Reimes and Schleicher [36] have pointed to the need to support and think of the teachers' emotional well-being in the context of COVID-19. At the same time, the question arises as to what is the good balance between ensuring the well-being of the teacher and ensuring that the teachers' pedagogical decisions support each student's development to the maximum in distance learning conditions.

Finally, results from the current study confirm findings from a previous study showing that teachers tend to focus on short-term goals in their teaching and more rarely consider

the long-term purposes of education [21], in this sense the findings are not so different from the data collected from regular (pre-COVID) teaching times. However, what seems to be unique for this new situation is the switch of focus to workload and well-being and valuing socialization and student motivation over subject matter competences. Although this indicates student-centeredness, which is genuinely valued in today's education [18], this might also have serious implications for student learning outcomes in the long run. Continuing with the organization of education in such a way might increase inequalities in education as it could become even harder for students from disadvantaged backgrounds to develop their academic competences. Therefore, it is very important not to lose sight from the third important aim of education, qualification [11] for the next level of education or for working life and to ensure that different students have more equal opportunities for this. It is important to take all this into account in teaching decision-making processes, regardless of where or in what form learning and teaching take place.

## 5. Conclusions

In this article we described and explained what influenced science teachers' teaching-related decisions and how learning activities were adjusted based on these decisions during distance learning (according to teachers themselves). The results show that teachers' teaching-related decisions were influenced by factors that were related to the existence of digital tools as well as the ability to use them purposefully in the home settings of teachers and students. Teachers' teaching decisions were mostly motivated by short-term goals, such as maintaining students' social interaction and more broadly, supporting student motivation in this irregular situation. In addition, the desire of teachers to keep students' and teachers' own workloads affordable, for the purposes of well-being, was also considered as a factor influencing teachers' teaching-related decisions. In brief, this study contributes to the understanding of teachers' decision-making processes during distance learning, introduces the adjustments made in learning activities and discusses potential implications for such practices. In further research, it would be important to use method triangulation, collecting observational data in addition to interviews for example, to understand further how teachers' decision-making is reflected in teaching and learning activities and its outcomes. Data on students' views could also be valuable additional information to further understand the changed teaching and learning.

**Author Contributions:** Conceptualization, T.A., L.L., Ä.L. and M.P.; methodology, L.L., Ä.L., M.P. and K.S.; formal analysis, T.A. and L.L.; investigation, T.A., L.L., Ä.L., M.P. and K.S.; resources, L.L., Ä.L., M.P. and K.S.; data curation, T.A. and L.L.; writing—original draft preparation, T.A. and L.L.; writing—review and editing, T.A., L.L., Ä.L., M.P. and K.S.; supervision, L.L.; project administration, M.P.; funding acquisition, M.P. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded by the ESTONIAN RESEARCH COUNCIL (ERC) through the institutional research funding project "Smart technologies and digital literacy in promoting a change of learning", grant number IUT34-6.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

**Acknowledgments:** The authors would like to thank all of the participants who took their time to take part in this research.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. World Health Organization. Coronavirus Disease (COVID-19). Available online: <https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/coronavirus-disease-covid-19> (accessed on 5 January 2021).

2. UNESCO. COVID-19 Impact on Education. Available online: <https://en.unesco.org/covid19/educationresponse> (accessed on 5 January 2021).
3. Cullinane, C.; Montacute, R. COVID-19 and Social Mobility Impact Brief #1: School Closures. Available online: <https://www.suttontrust.com/wp-content/uploads/2021/01/School-Shutdown-Covid-19.pdf> (accessed on 4 January 2021).
4. Schuck, R.K.; Lambert, R. “Am I Doing Enough?” Special Educators’ Experiences with Emergency Remote Teaching in Spring 2020. *Educ. Sci.* **2020**, *10*, 320. [CrossRef]
5. Bubb, S.; Jones, M.A. Learning from the COVID-19 home-schooling experience: Listening to pupils, parents/carers and teachers. *Improv. Sch.* **2020**, *23*, 209–222. [CrossRef]
6. Kaden, U. COVID-19 School Closure-Related Changes to the Professional Life of a K–12 Teacher. *Educ. Sci.* **2020**, *10*, 165. [CrossRef]
7. Gudmundsdottir, G.B.; Hathaway, D.M. ‘We Always Make It Work’: Teachers’ Agency in the Time of Crisis. *J. Tech Teach. Educ.* **2020**, *28*, 239–250. Available online: <https://www.learntechlib.org/primary/p/216242/> (accessed on 4 January 2021).
8. Trust, T.; Whalen, J. Should Teachers be Trained in Emergency Remote Teaching? Lessons Learned from the COVID-19 Pandemic. *J. Technol. Teach. Educ.* **2020**, *28*, 189–199. Available online: <https://www.learntechlib.org/primary/p/215995/> (accessed on 4 January 2021).
9. Kim, L.E.; Asbury, K. ‘Like a rug had been pulled from under you’: The impact of COVID-19 on teachers in England during the first six weeks of the UK lockdown. *Br. J. Educ. Psychol.* **2020**, *90*, 1062–1083. [CrossRef]
10. MacIntyre, P.D.; Gregersen, T.; Mercer, S. Language teachers’ coping strategies during the Covid-19 conversion to online teaching: Correlations with stress, wellbeing and negative emotions. *System* **2020**, *94*, 102352. [CrossRef]
11. Biesta, G. Good education in an age of measurement: On the need to reconnect with the question of purpose in education. *Educ. Assess. Eval. Account.* **2009**, *21*, 33–46. [CrossRef]
12. Schleicher, A. PISA 2018: Insights and Interpretations. Available online: <https://www.oecd.org/pisa/PISA%202018%20Insights%20and%20Interpretations%20FINAL%20PDF.pdf> (accessed on 4 January 2021).
13. Sonmark, K.; Révai, N.; Gottschalk, F.; Deligiannidi, K.; Burns, T. Understanding Teachers’ Pedagogical Knowledge: Report on an International Pilot Study. Available online: [http://www.oecd.org/education/ceri/EDU\\_WKP\(2017\)8.pdf](http://www.oecd.org/education/ceri/EDU_WKP(2017)8.pdf) (accessed on 5 January 2021).
14. Lampert, M. Studying teaching as a thinking practice. In *Thinking Practices in Mathematics and Science Learning*; Greeno, J.G., Goldman, S.V., Eds.; Lawrence Erlbaum Associates, Inc: Mahwah, NJ, USA, 1998; pp. 53–78.
15. Vanlommel, K.; Van Gasse, R.; Vanhoof, J.; Van Petegem, P. Teachers’ decision-making: Data based or intuition driven? *Int. J. Educ. Res.* **2020**, *83*, 75–83. [CrossRef]
16. Shulman, L. Knowledge and teaching: Foundations of the new reform. *Harv. Educ. Rev.* **1987**, *57*, 1–23. [CrossRef]
17. Shavelson, R.J.; Stern, P. Research on teachers’ pedagogical thoughts, judgments, decisions, and behavior. *Rev. Educ. Res.* **1981**, *51*, 455–498. [CrossRef]
18. Eggen, P.; Kauchak, D.P. *Educational Psychology: Windows on Classrooms*, 9th ed.; Pearson Education: Upper Saddle River, NJ, USA, 2013.
19. Mishra, P.; Koehler, M.J. Technological pedagogical content knowledge: A framework for teacher knowledge. *Teach. Coll. Rec.* **2006**, *108*, 1017–1054. [CrossRef]
20. Borg, S. Teacher cognition in language teaching: A review of research on what language teachers think, know, believe, and do. *Lang. Teach.* **2003**, *36*, 81–109. [CrossRef]
21. Biesta, G.; Priestley, M.; Robinson, S. The role of beliefs in teacher agency. *Teach. Teach.* **2015**, *21*, 624–640. [CrossRef]
22. Fives, H.; Buehl, M.M. Spring cleaning for the “messy” construct of teachers’ beliefs: What are they? Which have been examined? What can they tell us? In *Educational Psychology Handbook, Vol. 2: Individual Differences and Cultural and Contextual Factors*; Harris, K.R., Graham, S., Urdan, T., Eds.; American Psychological Association: Washington, DC, USA, 2012; pp. 471–499.
23. Lepik, M.; Elvisto, T.; Oder, T.; Talts, L. Õpetajate üldpedagoogiliste uskumuste struktuur ja tüüpiprofiilid. *Opet. Prof. Areng Ja Selle Toetamine* **2013**, 248–273. Available online: <https://www.digar.ee/arhiiv/et/raamatud/22182> (accessed on 4 January 2021).
24. Raymond, A.M. Inconsistency between a beginning elementary school teacher’s mathematics beliefs and teaching practice. *J. Res. Math. Educ.* **1997**, *28*, 550–576. [CrossRef]
25. Henno, I.; Granström, S. Ülevaade aineõpetajate ja koolijuhtide veebiküsitlusest “Uutest riiklikest õppekavadest lähtuv kooliõppekavade arendus ja rakendamine”. Available online: [https://dspace.ut.ee/bitstream/handle/10062/40934/Uld\\_Koolijuhid\\_Veeb.pdf?sequence=1&isAllowed=y](https://dspace.ut.ee/bitstream/handle/10062/40934/Uld_Koolijuhid_Veeb.pdf?sequence=1&isAllowed=y) (accessed on 3 September 2020). (In Estonian)
26. Sun, J.; Zhang, S.; Przybylski, R. Conceptualizing the Critical Path Linked by Collective Teacher Efficacy. In Proceedings of the Annual Meeting of the American Educational Research Association (AERA), San Antonio, TX, USA, 27 April–1 May 2017.
27. Aho, E.; Haverinen, H.L.; Juuso, H.; Laukka, S.J.; Sutinen, A. Teachers’ principles of decision-making and classroom management: a case study and a new observation method. *Procedia. Soc. Behav. Sci.* **2010**, *9*, 395–402. [CrossRef]
28. Eischmidt, E.; Reiska, E.; Oder, T. Novice teachers’ perception of senior management support and its connection with involvement in school development and collegial co-operation. *Est. J. Educ.* **2015**, *3*, 148–172. [CrossRef]
29. Kosko, K.W.; Herbst, P. Evaluating Teachers’ Decisions in Posing a Proof Problem. In Proceedings of the 34th Annual Meeting of the North American Chapter of the International Group for the Psychology of Mathematics Education (PMENA), Kalamazoo, MI, USA, 1–4 November 2012.

30. Epstein, J.L.; Sheldon, S. The importance of evaluating programs of school, family and community partnerships. *Aula Abierta* **2019**, *48*, 31–42. [CrossRef]
31. Leijen, Ä.; Pedaste, M.; Lepp, L. Teacher agency following the ecological model: How it is achieved and how it could be strengthened by different types of reflection. *Br. J. Educ. Stud.* **2020**, *68*, 295–310. Available online: <https://www.tandfonline.com/doi/full/10.1080/00071005.2019.1672855> (accessed on 4 January 2021). [CrossRef]
32. Haridussilm. Külalstatud Aadressil. Available online: <https://www.haridussilm.ee/> (accessed on 22 August 2020).
33. Basic Schools and Upper Secondary Schools Act. Available online: <https://www.riigiteataja.ee/en/eli/ee/530102013042/consolide/current> (accessed on 19 August 2020).
34. National Curriculum for Basic Schools. Available online: [https://www.hm.ee/sites/default/files/est\\_basic\\_school\\_nat\\_cur\\_2014\\_general\\_part\\_1.pdf](https://www.hm.ee/sites/default/files/est_basic_school_nat_cur_2014_general_part_1.pdf) (accessed on 19 August 2020).
35. Haridus- ja Teadusministeerium Soovitab Vähemalt Esimesel Kahel Nädalal Hoiduda Õpilaste Numbrilisest Hindamisest. Available online: <https://www.hm.ee/et/uudised/parandatud-teade-haridus-ja-teadusministeerium-soovitab-vahemalt-esimesel-kahel-nadalal-0> (accessed on 18 March 2020). (In Estonian).
36. Reimers, F.M.; Schleicher, A. A Framework to Guide an Education Response to the COVID-19 Pandemic of 2020. OECD. Available online: [https://oecd.dam-broadcast.com/pm\\_7379\\_126\\_126988-t63lxosohs.pdf](https://oecd.dam-broadcast.com/pm_7379_126_126988-t63lxosohs.pdf) (accessed on 9 August 2020).
37. We Have Built a Digital Society and We Can Show You How. Available online: <https://e-estonia.com/> (accessed on 19 August 2020).
38. The Estonian Lifelong Learning Strategy 2020. Available online: [https://www.hm.ee/sites/default/files/estonian\\_lifelong\\_strategy.pdf](https://www.hm.ee/sites/default/files/estonian_lifelong_strategy.pdf) (accessed on 19 August 2020).
39. Leppik, C.; Haario, H.S.; Mägi, E. *IKT-haridus: Digioskuste õpetamine, Hoiakud ja Võimalused Üldhariduskoolis ja Lasteaias*; Poliitikauuringute Keskus Praxis: Tallinn, Estonia, 2017. Available online: [http://www.praxis.ee/wp-content/uploads/2016/08/IKT-hariduse-uuring\\_aruanne\\_mai2017.pdf](http://www.praxis.ee/wp-content/uploads/2016/08/IKT-hariduse-uuring_aruanne_mai2017.pdf) (accessed on 3 September 2020). (In Estonian)
40. Taimalu, M.; Uibu, K.; Luik, P.; Leijen, Ä. Õpetajad ja koolijuhid elukestvate õppijatena. OECD rahvusvahelise õpetamise ja õppimise uuringu TALIS 2018 tulemused. 1. osa. Tallinn: Haridus- ja Teadusministeerium ja SA Innove. Available online: [https://www.hm.ee/sites/default/files/talis\\_eesti\\_raporti\\_1\\_osa.pdf](https://www.hm.ee/sites/default/files/talis_eesti_raporti_1_osa.pdf) (accessed on 4 January 2021).
41. Kutsesstandardid: Õpetaja, Tase 7. Available online: [https://www.kutseregister.ee/ctrl/et/Standardid/vaata/10824233?from=viimati\\_kinnitatud](https://www.kutseregister.ee/ctrl/et/Standardid/vaata/10824233?from=viimati_kinnitatud) (accessed on 24 August 2020). (In Estonian)
42. Tire, G.; Puksand, H.; Lepmann, T.; Henno, I.; Lindemann, K.; Täht, K.; Lorenz, B.; Silm, K. PISA 2018 EESTI TULEMUSED Eesti 15-Aastaste Õpilaste Teadmised ja Oskused Funktsionaalses Lugemises, Matemaatikas ja Loodusteadustes. Available online: [https://www.hm.ee/sites/default/files/pisa\\_2018-19\\_raportweb.pdf](https://www.hm.ee/sites/default/files/pisa_2018-19_raportweb.pdf) (accessed on 8 September 2020). (In Estonian)
43. Pedaste, M.; Must, O.; Leijen, Ä.; Mäeots, M.; Siiman, L.; Kori, K.; Adov, L. Profiles of students who use mobile devices for the purposes of learning science and mathematics. *Estonian J. Educ.* **2017**, *5*, 99–129.
44. Adov, L.; Pedaste, M.; Leijen, Ä.; Rannikmäe, M. Does it have to be easy, useful, or do we need something else? STEM teachers' attitudes towards mobile device use in teaching. *Technol. Pedagog. Educ.* **2020**, *29*, 511–526. [CrossRef]
45. Ryan, G.W.; Bernard, H.R. Techniques to identify themes. *Field Methods* **2003**, *15*, 85–109. [CrossRef]
46. Braun, V.; Clarke, V. Using thematic analysis in psychology. *Qual. Res. Psychol.* **2006**, *3*, 77–101. [CrossRef]
47. ESRC Framework for Research Ethics Updated January 2015. Available online: <https://esrc.ukri.org/files/funding/guidance-for-applicants/esrc-framework-for-research-ethics-2015/> (accessed on 4 January 2021).
48. World Medical Association. World Medical Association Declaration of Helsinki: Ethical Principles for Medical Research Involving Human Subjects. *JAMA* **2013**, *310*, 2191–2194. [CrossRef] [PubMed]
49. Rannastu-Avalos, M.; Siiman, L.A. Challenges for Distance Learning and Online Collaboration in the Time of COVID-19: Interviews with Science Teachers. In Proceedings of the 26th International Conference on Collaboration Technologies and Social Computing (CollabTech), Tartu, Estonia, 8–11 September 2020; pp. 128–142. [CrossRef]
50. Andmekaitse Inspektsioon. Ringkiri Koolidele. Available online: [https://www.aki.ee/sites/default/files/seired/ringkiri\\_koolidele\\_distantsope\\_jm\\_07.10.20\\_1.pdf](https://www.aki.ee/sites/default/files/seired/ringkiri_koolidele_distantsope_jm_07.10.20_1.pdf) (accessed on 7 October 2020). (In Estonian)
51. Kookmaa, T. Advokaat: Kas Distantsope Annab Õiguse Õpilaste Lausjalgimiseks? Available online: <https://forte.delfi.ee/news/varia/advokaat-kas-distantsope-annab-oguse-opilaste-lausjalgimiseks?id=91966669> (accessed on 14 December 2020). (In Estonian)



Article

# #Mathathome during the COVID-19 Pandemic: Exploring and Reimagining Resources and Social Supports for Parents

Frances K. Harper \*, Joshua M. Rosenberg, Sara Comperry, Kay Howell and Sierra Womble

Department of Theory and Practice in Teacher Education, University of Tennessee, Knoxville, TN 37996, USA; jmrosenberg@utk.edu (J.M.R.); scomperry@vols.utk.edu (S.C.); kadhlowe@vols.utk.edu (K.H.); swomble1@vols.utk.edu (S.W.)

\* Correspondence: francesharper@utk.edu

**Abstract:** During the COVID-19 pandemic, schools abruptly transitioned to emergency remote instruction. Consequently, expectations for parental involvement in school mathematics rose to unprecedented levels. We sought to understand the experiences of parents to reimagine possibilities for engagement in mathematics during and beyond the pandemic. Leveraging data from tweets using #mathathome and survey responses from parents, we identified who supported continued mathematics learning at home and explored the nature of the mathematics taught there. We found that Twitter and survey data sources described two largely distinct groups of those supporting parents to continue mathematics education at home, but similar findings emerged from analyses of each data source, suggesting that themes were common among different groups. Namely, we saw a commitment to continued mathematics learning and engagement with a range of mathematics topics. These topics mostly focused on elementary-level content, especially counting, through everyday activities/objects and mathematical sense-making. Most parents used resources provided by the school alongside resources they identified and provided on their own. School responses to emergency remote instruction were mostly asynchronous, and parents expressed a need for more opportunities to interact directly with their children's teachers. We discuss what the mathematics education community might learn from these experiences to support parental engagement during and beyond periods of remote emergency instruction.

**Keywords:** parental involvement; home-school relationships; Twitter; social media; remote learning; COVID-19; mathematics education

**Citation:** Harper, F.K.; Rosenberg, J.M.; Comperry, S.; Howell, K.; Womble, S. #Mathathome during the COVID-19 Pandemic: Exploring and Reimagining Resources and Social Supports for Parents. *Educ. Sci.* **2021**, *11*, 60. <https://doi.org/10.3390/educsci11020060>

Academic Editor: Palitha Edirisingha  
Received: 29 December 2020  
Accepted: 2 February 2021  
Published: 5 February 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

In 2019, a novel coronavirus outbreak was first identified in Wuhan, China, and by early 2020, the outbreak was a global pandemic, with confirmed cases in countries throughout the world. On 11 February 2020, the World Health Organization announced an official name for the disease caused by the novel coronavirus, COVID-19 [1]. In the first quarter of 2020, infection and mortality rates rose to alarming levels across the world [2]. Social distancing, self-isolation, and travel restrictions led to a reduced workforce across all economic sectors. Jobs were lost; schools were closed down; and, financial insecurity and collapse loomed. Healthcare facilities faced shortages in space and medical supplies and the food sector faced an increase in demand due to the panic-buying and stockpiling of food products. Accordingly, citizens all over the world were emotionally and physically affected by COVID-19 during this unprecedented time of uncertainty and fear.

The impact on education was also felt around the world. In an attempt to slow the spread of COVID-19, schools abruptly transitioned to emergency remote instruction, impacting 1.5 billion students worldwide in the first quarter of 2020 [3]. Educators strove to support continued mathematics learning at home in a time of crisis, and parents and caregivers haphazardly assumed the role of teacher. Threats of deepening educational inequality rose in under-resourced schools and communities marginalized in and by mathematics.

In response to these educational crises, we sought to understand the experiences of parents and caregivers during the initial shift to emergency remote instruction. In doing so, we hoped to help the mathematics education community to (re)imagine ways to support families in mathematics during and beyond the COVID-19 pandemic. In early 2021, at the time of writing, the COVID-19 outbreak continued to cause significant disruptions for families (e.g., physical and mental health, financial security, childcare availability) and society (e.g., economic stability, healthcare systems). This work is timely and important because education continues to experience significant disruptions, and remote instruction remains vital in many countries.

In summer and fall 2020, schools were beginning to move beyond emergency remote instruction by considering ways to more effectively support mathematics learning remotely, and we wondered what might be learned from the initial emergency transition to mathematics education in students' homes to inform broader access to and support for high-quality remote mathematics instruction. To (re)imagine mathematics education during a global crisis, we analyzed the various online or otherwise remote (from the school) resources that families and educators utilized to further support engagement in mathematics at home. Accordingly, we asked:

RQ1: What was the nature of available resources (e.g., source, mathematical focus) for continued mathematics education at home? Which did parents use during emergency remote instruction, and how did they use them?

RQ2: Who were allies for parents (e.g., teachers, friends) in supporting continued mathematics education during emergency remote instruction, and how were they offering support?

Looking across findings from these two research questions, we considered implications for the types of resources and supports that might prove useful as schools and families continue to manage mathematics education remotely and how to broaden access to those resources and supports.

### 1.1. Background

Educators doubtlessly play a critical role in mathematics learning. Accordingly, efforts to broaden opportunities largely focus on school mathematics. School-based initiatives, however, often overlook how parents are uniquely positioned to advocate for and support children's mathematics education across educational contexts. For example, within the United States (U.S.), a recent campaign to "catalyze change" in mathematics mentions parents only four times [4,5]. This is worrisome because parental involvement is strongly linked to children's mathematics achievement [6–8]. Moreover, all the adults in children's lives shape children's mathematics identities—how children see themselves as learners and doers of mathematics—by endorsing or challenging cultural stereotypes about who is "good" at mathematics [9]. Those from privileged backgrounds have long used parental involvement as a form of social capital to ensure their children's achievement [8]. Parents of students historically marginalized on the basis of race, gender, and class, however, face unique challenges to involvement in mathematics education. For example, they must navigate stereotypes that position them as disinterested in or incapable of supporting mathematics learning because of low educational attainment. These stereotypes, paired with under-recognized forms of involvement, overlook how parents from marginalized groups deliberately advocate for and support their children's mathematics education [10,11].

Parents from marginalized groups value their children's mathematics education and are committed to supporting it [12]. Direct invitations, inclusion in decision making, and re-engagement with mathematics can mediate increased parental involvement [13–15]. Re-engagement with mathematics is especially promising because differences between parents' own mathematics education, which likely emphasized rules and procedures [11], and the curriculum and instruction experienced by their children present barriers to parental involvement, even in early elementary levels [16]. Helping parents understand the evolution of school mathematics can build parents' capacity to support their own children's mathe-



matics education and also allow them to be allies for other parents [17]. To support parental involvement in our local community, Harper launched family workshops in Fall 2019 in an effort to support parents from marginalized groups to act—more effectively—as “intellectual resources” in mathematics education [15]. As these efforts were just beginning to ramp up, the COVID-19 global pandemic disrupted life within the U.S. Countries around the world had already felt the devastating impacts of the pandemic as hospitals were overwhelmed and illness and death rates surged. In response, universities and schools across the U.S. closed and/or transitioned to emergency remote instruction [18].

Parents were suddenly thrust into unprecedented levels of engagement with school mathematics as they became responsible for ensuring their children’s continued mathematics learning. Within our context, we recognized that the pandemic created additional challenges to parental engagement—such as parents working outside the home, caring for sick family members, and managing racially based disparities. For example, African American communities were facing alarmingly and disproportionately high rates of infection and death from COVID-19 [1]. Structural inequities make Black Americans less likely to work jobs possible from home or to have medical insurance, but more likely to have medical conditions that increase risk [19]. Furthermore, Black and Latinx households in the U.S. are less likely to have the technology necessary to engage with online instruction offered by schools [20], and as educational responsibilities increased for parents, mothers experienced a disproportionate rise in unpaid care work [21]. Individuals from groups marginalized on the basis of race, gender, and class felt the impacts of the pandemic more heavily and consequently reported higher rates of major negative mental health impacts [21,22].

We were worried about long-term impacts and the potential for deepening educational inequality with respect to mathematics but found ourselves less able to connect with families in our community. The need for support was heightened, but parents’ access to resources and allies became more limited. In addition to our canceled workshops, other supplemental academic programs (e.g., tutoring, after-school programs) at schools and community organizations vanished. Accordingly, we undertook this study with the hope of discovering ways both for our team and other mathematics educators to address the greatest needs of parents in a time of significant disruption to the educational system.

### 1.2. Theoretical Framework

A traditional view of parental engagement focuses on what parents do to support their own child’s educational development and how often they participate in activities organized by the schools, such as parent conferences and school events [23]. In contrast, we recognize that parental engagement extends beyond individual families and school-initiated activities and, instead, frame parental engagement as “a set of relationships and actions that cut across individuals, circumstances, and events that are produced and bounded by the context in which that engagement takes place” ([10]; p. 6). In other words, parental engagement must be understood through both *what* parents engage in and *how* they manage to do so. This framing problematizes a linear view of parental engagement (i.e., parents → mediation (e.g., parent conferences) → involvement), instead emphasizing relational aspects and parents’ agency.

Drawing on cultural-historical activity theory and critical race theory, Calabrese Barton and colleagues [10] proposed an ecological model for parent participation in education. Applying this model to our current study allowed us to understand mathematics education as it was happening in different spaces. This was especially useful given that COVID-19 pushed mathematics education out of the typical school context and into home and online spaces. Emergency remote instruction also significantly changed the roles and division of labor among teachers and parents, rules for parents’ participation in school mathematics, the tools and artifacts used for mathematics learning, and the communities and other individuals who parents relied on to mediate engagement. Our chosen theoretical framework provided a powerful way to consider how each of these changes allowed for a unique type of parental engagement during COVID-19 emergency remote instruction, un-



derstood as parents' mediation of space (e.g., home, online) and capital (i.e., human, social, and material resources and supports) in relation to others in school settings (e.g., teachers). Figure 1 shows an adaptation of the original ecologies of parental engagement model [10] for our study of parents' role in mathematics education during COVID-19 emergency remote instruction.

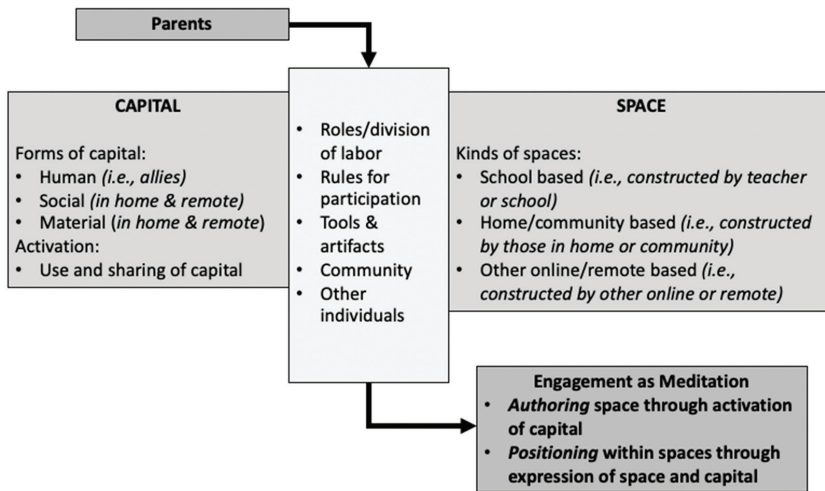


Figure 1. Adaptation of Ecologies of Parental Engagement Framework for COVID-19 Emergency Remote Instruction.

Across both research questions, we sought to understand parent engagement as authoring space (i.e., continued mathematics education in the home) through activation of various forms of capital. More specifically, with RQ1, we explored the nature of available spaces for authoring emergency remote mathematics instruction, including spaces constructed by teachers/schools (e.g., worksheets, learning management systems), by parents/communities (e.g., games, informal learning), and by other online or remote sources (e.g., social media). We aimed to identify the forms of capital available within each space and to better understand parents' activation of that capital. The second research question focused specifically on parents' activation of human and social capital, given the significant disruption to both due to the unique social isolation required during COVID-19 emergency remote instruction.

## 2. Materials and Methods

This study drew on a parallel convergent mixed methods research design, in which qualitative and quantitative data generation and analysis occurred simultaneously but independently [24]. The different methods were weighted equally, and results were interpreted together to describe how parents mediated different spaces and forms of capital to support the continuation of mathematics education in the home during emergency remote instruction.

### 2.1. Data Sources and Measures

To explore what spaces and forms of capital (RQ1), especially allies (RQ2), parents had available and used, we relied on two primary data sources: (1) data generated from posts on social media, namely Twitter, that promoted mathematics at home during COVID-19 emergency remote instruction and (2) data generated from a survey of parents about their experiences with emergency remote instruction. Use of these two different data sources was important because, taken together, they provided a wider snapshot of experiences with mathematics at home during emergency remote learning. The first data source of-

ferred a look into social media spaces, which provided social and human capital through access to expert educators and other parents and material capital in the form of mathematics activities and content. The second data source was important for identifying the forms of capital available in more traditional spaces, such as school-constructed spaces and the home/community setting. Moreover, survey data helped us to understand the ways in which parents activated the various forms of capital across the three different available spaces (school, home/community, online) in order to author their engagement with continued mathematics education in the home during emergency remote instruction.

### 2.1.1. Twitter Data Generation

We first completed an exploratory review of various social media platforms (e.g., Facebook, Twitter) before we narrowed our data generation to Twitter because data were readily available and most relevant to our research questions (i.e., focused on parents, not teachers). Twitter is a common social media platform for people of all ages across the world to interact and connect with each other. Twitter allows users to hear and see what other individuals are talking about through videos, images, and text, known as *tweets*. Users can post their own tweets or comment on other users' tweets to share advice, their thoughts and opinions, or ask questions. Users can also share tweets posted by others (i.e., *retweets*) on their own profile pages. Twitter users customize and personalize their timeline (the tweets that show up when they log into Twitter) by following other users that have similar interests through sharing insights, ideas, or methods. Twitter also utilizes *#hashtags* throughout the platform. Users can add a *#hashtag* to their tweets, and *#hashtags* organize discussions that users are having on Twitter and allow for other users to join the conversation. Users can look for a topic specifically by searching a *#hashtag* in the search bar.

Several *#hashtags* are popular among mathematics educators (inclusive of researchers, teachers, teacher educators) in the U.S. and beyond. For example, *#iteachmath* and *#MTBoS* are widely used. Anyone can create a new *#hashtag*, and mathematics educators sometimes create specific *#hashtags* to facilitate discussion on Twitter at specific dates and times. The Twitter platform provides resources for parents and educators to connect. Parents and educators can see what other educators are implementing in their classrooms, methods they use for teaching, activities, and various materials that can be helpful to promote mathematics learning. By using tweets from organizations, educators, or other parents, parents can find ways to support their children in mathematics in school and at home. This potential use of the Twitter platform became especially salient during COVID-19 emergency remote instruction.

We decided to focus on the forms of capital provided through *#mathathome* (a subset of the Twitter space) in this study. This specific *#hashtag* allows users and parents to see how educators and other parents are collaborating and supporting mathematics learning at home. By seeing what other users are doing with mathematics at home, parents could model and incorporate the same practices and activities in their home. If parents needed further support, they could leave a comment on the tweet or message the user. Twitter opens a virtual world full of information that can help to provide support for parents in their child's learning.

To analyze Twitter data using *#mathathome*, Harper used NCapture (NVivo 12 Version 12.6.0) [25] to generate a dataset of *#mathathome* tweets from 13–23 April 2020, which included 160 unique tweets, along with the content of tweets and additional information (e.g., username, biography, location) for each tweet. Harper exported tweet content into a document for qualitative analysis in Dedoose (Version. 8.3.17) [26], a web-based platform. To collect additional tweets, Rosenberg set up automatic data generation of tweets containing *#mathathome* from 22 April through 21 May 2020 using a Twitter Archiving Google Sheet (TAGS) [27] ( $n = 246$  tweets) for quantitative analyses. These timeframes were chosen because families and schools were involved in emergency remote instruction.

Due to the different ways in which we generated data, we then used the *rtweet* package [28] for the R statistical software [29] to further process the tweets from the two sources for use in subsequent analyses. This step resulted in a combined dataset with 406 tweets and 90 variables for each tweet (including the text of tweet, screen name and profile for user, date, and other information, such as the number of retweets). These tweets were sent by 228 individuals, with 46 individuals posting two or more tweets. Additionally, we constructed a number of measures from these data, described as follows.

### 2.1.2. Survey Data Generation

The research team collaboratively developed a survey of parents' experiences with mathematics at home during COVID-19 emergency remote instruction. We framed questions based on previous experiences with families, on conversations with parents since schools had closed, and on preliminary analyses of Twitter data. The survey included four sections: (1) the transition to emergency remote instruction; (2) doing mathematics at home, generally; (3) social and human capital (i.e., allies) for mathematics at home; and (4) demographic information (Table 1). Most questions involved multiple-choice options, but also included an option to write in a response. Each section included at least one open-ended question to provide opportunities for parents to elaborate on their experiences.

**Table 1.** Overview of measures used across the four sections of the survey: (1) the transition to emergency remote instruction; (2) doing mathematics at home, generally; (3) social and human capital (i.e., allies) for mathematics at home; and (4) demographic information.

Section	Measure 1	Measure 2	Measure 3	Measure 4
1	School or district supports	Use of school-provided resources	Use of online learning systems	Additional supports needed (open-ended)
2	Confidence with math education	Parent-provided resources	Presence of math at home	Types of math at home (open-ended)
3	Allies in supporting math (e.g., teacher, friend)	Social media engagement (platform, frequency)	Additional comments (open-ended)	
4	Child's grade level and school type	Parent's education level and current employment status	Age, gender, and race/ethnicity	Global region

We piloted our survey with three parents and refined questions, especially demographic questions, to be inclusive of diverse experiences [30]. We made all survey questions optional so as to place the least amount of burden on parents during an already challenging time. The survey was distributed through Google Forms using a convenience, snowball sampling approach [31], which is appropriate given that pandemic conditions made parents a "hard-to-reach" population.

### 2.2. Participants

Participants included two groups corresponding to the two data sources, Twitter users and survey respondents. The tweets were posted by 228 unique participants. While some #mathathome participants were very active (posting more than 40 tweets in one case), on average, participating individuals posted around two tweets ( $M = 1.78$ ,  $SD = 3.33$ ). Survey respondents included 101 parents; 81 were from North America, 17 from Australia/New Zealand, and one each from Europe, Asia, and unspecified. Table 2 displays remaining demographic information of the participants in our survey sample, including participants' race/ethnicity, highest education attained, and age; we provide this information to aid in interpreting (and contextualizing) our findings. Though both purposefully selected (and non-probability-based), these samples allowed us to understand the experiences of a select group of individuals—mostly parents, especially those in the U.S. Thus, findings

from this study generalize only in a limited way: primarily to parents (and others, in the case of the Twitter) in the United States sharing salient features with those in our samples.

**Table 2.** Self-reported demographic information of survey participants ( $n = 101$ ). Note: Shading indicates participants belonging to the larger group of people of Color.

Gender	Woman: 92			Man: 7		Prefer Not to Say (PNS): 2	
	White	Black	Two or more races	Asian	Hispanic/Latinx (any race)	PNS or other	
Race/Ethnicity	73	9	5	5	4	5	
Highest Education	Masters	Doctorate	Bachelors	High School	Other	PNS	
	42	26	22	8	2	1	
Age	18–35	36–40	41–45	46–50	51+	PNS	
	13	28	37	11	10	2	

### 2.3. Data Analysis

We first describe the independent qualitative and quantitative analyses for the Twitter and survey data, followed by a summary of how the analyses and the resulting findings were weighed and interpreted equally together to describe how parents mediated different spaces and forms of capital to support the continuation of mathematics education in the home during emergency remote instruction.

#### 2.3.1. Qualitative Analysis of Tweets

To understand the nature of the resources (i.e., human and social capital) available on Twitter (i.e., the space) for supporting mathematics at home (RQ1), we categorized the tweet content through iterative rounds of qualitative analysis [32]. Harper, Comperry, Howell, and Womble analyzed the first twenty unique tweets to develop a codebook that described the nature of resources (i.e., material capital) provided in each tweet by mathematics topics (e.g., number, algebra), mathematics practices (e.g., justifying; multiple strategies), and grade level (e.g., elementary/primary, high school/secondary). Codes were exhaustive but not mutually exclusive. For example, some tweets addressed multiple mathematics topics, and we only applied grade level codes when users explicitly indicated a target grade. Analysis began with each researcher applying codes separately. Next, we met to reach consensus on definitions and applications of codes. We then repeated this process to finalize coding of tweets.

In the next phase, Comperry, Howell, and Womble independently applied codes to different sets of twenty-five unique tweets (total  $n = 75$ ). We also added participants' professional role and parent (described below in quantitative analysis of tweets) to the codebook in order to address who was providing support for mathematics at home (RQ2; i.e., human and social capital), after which Harper applied these codes retroactively to the first twenty-five tweets. Then, we reached consensus and discussed necessary additions to the codebook. In a final round of analysis, Comperry, Howell, and Womble reviewed the previously coded tweets for (dis)agreement and divided up the next thirty tweets for independent coding. Finally, we met to reach consensus on all coding. As no additional codes were necessary in the last round, we assumed data saturation (i.e., our codebook sufficiently described the content of tweets), and the remaining thirty tweets were not coded.

#### 2.3.2. Quantitative Analysis of Tweets

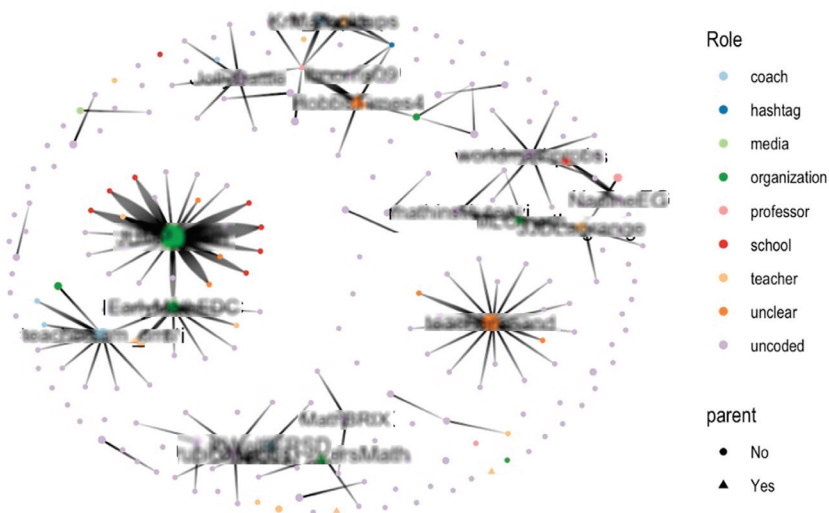
To understand the forms of social and human capital available through Twitter, we first geocoded individuals' self-reported locations (from Twitter profiles) using the mapsapi R package [33]. We could obtain locations for 194 of the individuals who participated in #mathathome using a geocoding method determined to be sufficiently accurate for identifying the state (and therefore the country) participants are from [34]. We created a map with the geocodes of users' locations (see details in Results), and then used this map

to aid our interpretation of the geographic location of active participants, as well as these users’ professional roles.

To determine users’ professional roles, we used a coding frame (for the professional role of participants in state-based educational Twitter hashtags) that was previously developed and applied to study educational networks [35]. This coding frame included codes for teachers, instructional coaches, researchers, and other roles. As an example of applying this coding frame, a participant with the following biography was coded as a teacher: “K/Gr.1 teacher at [name removed] School. Math coach. Focusing on playful math & literacy instruction.” As another example, the following participants’ profile was coded as an organization: “[name removed] is a #nonprofit building understanding & love of #math in students and educators. Follow us for #mathed news + resources!”.

Rosenberg applied these codes to profile descriptions of all individuals who posted two or more tweets, as those who posted only a single tweet were likely less critical to our understanding of #mathathome. Of the 46 individuals who posted two or more tweets, seven were unable to be coded (because individuals’ profile descriptions provided limited information or individuals’ professional roles were unclear). We also coded professional roles alongside qualitative coding of tweet content (as described above). Finally, we used individuals’ profile descriptions and content of their tweets to determine whether they identified as a parent.

From users’ professional role and data on the interactions that took place through #mathathome, Rosenberg calculated the number and proportion of individuals in each role and location and carried out social network analysis, using the resulting visualizations (Figure 2) to aid in our interpretation of which professional roles were most active (and with whom they were interacting). In this visualization, the size of the nodes (the circles or triangles) represents the number of tweets the user sent to #mathathome, with larger nodes representing a greater number of tweets sent. The nodes also represent users’ professional role (through color) and parental status (through the shape of the node, with a triangle representing a user with a particular professional role who also identified as a parent). Edges, or lines between users, represent interactions, with more heavily weighted (wider) lines representing a greater number of interactions between any pair of individuals.



Only those who posted one or more original tweets are included

**Figure 2.** Sociogram (Network Visualization) of #mathathome Interactions for Key Users. Note: We added a distortion to the above figure for inclusion in this manuscript to protect the privacy of participants.

The resulting sociogram provides some insight into the activation of social and human capital available through the #mathathome space by other Twitter users. Accordingly, we calculated a network statistic, namely the degree *centrality*, which represents the number of interactions—replies, retweets, quotes, and mentions—an individual initiated and received, of participants, and we explored the posts of the three most central participants in greater depth by examining themes from qualitative analysis of their tweets.

### 2.3.3. Qualitative Analysis of Survey

Harper, Comperry and Womble worked separately to analyze the open-ended responses through iterative rounds of qualitative coding in Dedoose. All researchers used the existing codebook when possible to allow for comparisons across data sources. Harper analyzed responses to questions on the social media platforms used ( $n = 30$  responses; RQ2—who is providing support; i.e., human and social capital via social media) and to a request for general comments ( $n = 34$  responses; RQ1 & 2). Analysis required new coding categories for type of social media resource (e.g., hashtag; blog; RQ1—source of resources; i.e., online space). Comperry analyzed responses to a question about mathematics topics and activities ( $n = 89$  responses; RQ1—nature of resources; i.e., material capital). This analysis largely relied on existing codes with a new category for different types of activities (e.g., cooking). Womble analyzed responses to a question about what supports would be helpful ( $n = 84$  responses) to help us (re)imagine spaces and forms of capital for remote mathematics education based on findings. This analysis rarely overlapped with the codebook, and Womble created a category for teacher and school supports (e.g., offline materials, synchronous instruction; RQ1—source and type of resources; i.e., human and social supports in different spaces). All researchers discussed each independent analysis in order to identify broader themes.

### 2.3.4. Quantitative Analysis of Survey

Rosenberg and Howell analyzed survey responses quantitatively using Microsoft Excel and R. We calculated descriptive statistics on who is engaging children in at-home mathematics activities in order to understand the demographics of respondents (RQ2), and the grade level of children to provide insight into the ages of students. This information provided insight into the nature of mathematics topics appropriate for at-home learning (RQ1; i.e., material capital). Additionally, based on our knowledge of prior research recognizing the ubiquity of math at-home activities amongst underrepresented groups, we analyzed questions on doing mathematics at home and parents' educational levels attained and their race/ethnicity. To do so, we cross-tabulated responses to the question on doing mathematics at home with demographic responses for parents' educational level and race/ethnicity. This analysis was aimed at identifying any differences in the mediation of space and capital by different groups of parents.

## 2.4. Interpreting Results

To interpret results together, we created data displays from all analyses. Quantitative data displays included sociograms, maps, charts, and tables, and qualitative data displays included tables showing code frequency by data source, co-occurrence of codes, and illustrative excerpts and tweets. Comparing findings from the two data sources (i.e., Twitter, survey) was essential to our broader understanding of the parental engagement with COVID-19 emergency remote mathematics instruction, namely, the unique mediation of spaces and capital during a time of global crisis. Interpreting findings from both data sources together allowed us to confirm and disconfirm themes about engagement with mathematics at home that emerged from each data source and types of analyses. For example, the mathematical nature of resources (i.e., material capital from school or home spaces) described in surveys was often vague (i.e., naming a broad domain of mathematics), but data from tweets provided specific mathematics tasks (i.e., material capital from online space). We used the survey analysis to identify which broad mathematics domains parents



identified as important (i.e., which forms of material capital they sought to activate) and the Twitter analysis to identify more specific mathematics topics within those broader domains most likely addressed at home. We further discussed and compared data displays in relation to our research questions and theoretical framework to arrive at the broader themes presented next. Overall, we aimed to provide qualitative, descriptive insights into how parents mediated various forms of capital across different spaces for engagement with mathematics at home during emergency remote instruction. We certainly do not claim that our findings generalize to all parents, but we feel confident that the findings describe experiences that reflect common successes and challenges in parental engagement during emergency remote instruction.

### 3. Results

We found that Twitter and survey data sources described two largely distinct groups of allies (i.e., forms of human and social capital) supporting parents to continue mathematics education during COVID-19 emergency remote instruction. #mathathome tweets came mostly from teacher and educational organization allies, while survey respondents primarily named allies working offline (RQ2). As this study is descriptive (not inferential), we see these differences as a strength that captured broader perspectives across multiple stakeholders in emergency remote mathematics instruction. Despite differences in participants across online and offline spaces, similar findings emerged from analyses of each group's activity (i.e., the activation of capital). Broader themes about the nature and use of resources for remote mathematics instruction (RQ1) showed:

- Engagement with a range of mathematics topics, which mostly focused on elementary-level content, especially counting;
- A commitment, across demographic groups, to supporting children's continued mathematics education through everyday activities/objects and mathematical sense-making;
- A combination of resources provided by the school alongside resources parents identified and provided on their own;
- Reliance on mostly asynchronous instructional resources.

#### 3.1. Who Was Involved in Mathematics at Home

Findings in this section provide insights into who (parents and allies) supported the continued mathematics education of children during the COVID-19 emergency remote instruction (RQ2). As mentioned above, our two data sources provided insights into the various forms of human and social capital leveraged by parents during emergency remote mathematics instruction. First, we present our findings about the human and social capital available to parents across both online (Twitter) and offline (school-constructed, home/community) spaces. We provide additional details about the teachers and other educational allies accessible to parents through Twitter. Then, we discuss what the survey results revealed about parents' activation of various forms of human and social capital in continuing mathematics education in the home.

##### 3.1.1. Twitter Users

Across social media posts to #mathathome on Twitter, for participants who sent two or more tweets, teachers made up the plurality of participants ( $n = 12$ ; 21%), followed by accounts for schools ( $n = 7$ ; 15%) and educational organizations ( $n = 7$ ; 15%). Instructional coaches and administrators ( $n = 6$ ; 13%), faculty at universities ( $n = 3$ ; 7%), and accounts for mathematics education-related hashtags ( $n = 1$ ; 2%) and a media outlet ( $n = 1$ ; 2%) made up the remaining accounts that were able to be coded. While teachers made up the largest group of users, the social network analysis revealed that the most active users were two educational organizations ( $centrality = 296$  and  $56$ , representing the numbers of replies, retweets, quotes, and mentions that each user received) as well as a teacher ( $centrality = 82$ ), suggesting that although there were fewer organizations than teachers involved in #mathathome, these organizations were central, and therefore potentially

influential to others. Only three users were identified as parents on the basis of their profile information.

Twitter participants were located in North America (U.S. ( $n = 101$ ), Canada ( $n = 49$ ), and Mexico ( $n = 5$ )), as well as Europe (The U.K. ( $n = 6$ ), France ( $n = 5$ ), Germany ( $n = 3$ )), India ( $n = 8$ ), and Australia ( $n = 2$ ). Six other countries had a single participant (Figure 3). As is depicted by the size of the circles in Figure 3 (with larger circles representing a greater number of tweets posted by individuals), the most active participants were located in the U.S., Canada, and India.



**Figure 3.** Geographic locations and professional roles of #mathathome participants. Note: Circles represent individual users who posted to #mathathome. The size of the circles depicts the number of tweets they sent to the hashtag.

Qualitative analysis of Twitter data showed that the mathematical content of posts was overwhelmingly targeted to an audience of parents of elementary-aged children. Explicit references to grade level primarily mentioned early ( $n = 21$ ) and late elementary ( $n = 14$ ) grades and preschool ( $n = 8$ ) but only a few for middle ( $n = 3$ ) or secondary ( $n = 1$ ) grade levels.

### 3.1.2. Survey Respondents

Quantitative analysis of survey responses provided insights into who was engaging children in mathematics at home, where a similar trend regarding grade level emerged. Most respondents were parents of elementary-aged children ( $n = 73$ ), compared to middle grades ( $n = 20$ ), secondary ( $n = 4$ ), and preschool ( $n = 7$ ). Children largely enrolled in public schools (81%), with only 14% enrolled in private schools and 5% enrolled in other types of schools, often those receiving public funding (e.g., Catholic).

Ninety percent of parents reported doing mathematics at home with their children, and most parents reported that they were very confident ( $n = 60$ ) or confident ( $n = 22$ ) in supporting their children's mathematics learning. Some parents explained in open-ended responses that they felt confident supporting mathematics at home because they were mathematics educators themselves, but other mathematics educators identified challenges (shared with other, non-educator parents) faced in ensuring continued mathematics learning during COVID-19. For example, one teacher-parent explained: "Doing math with my



child is painful and has led to frustrations and melt-downs . . . Until COVID-19, I typically avoided helping her with the occasional math homework . . . doing math at home has been brutal." Parents, teachers, and non-teachers alike identified a lack of familiarity with school-based methods or developmentally appropriate mathematics as reasons they felt less confident in supporting mathematics learning at home: "I have taught middle school math for 15 years, but don't necessarily know what is developmentally appropriate for my Kindergartener," and, "they don't teach addition like I used to do it at school and I don't want to interfere in his method".

When we divided respondents into two groups by education level (high, representing the attainment of a Bachelor's degree or an advanced degree, and low, representing graduating from high school or reporting another educational credential) and race/ethnicity (white; people of Color), we found that, overall, 91% of respondents are highly educated and 22% are people of Color (see gray highlights in Table 2 above). Only nine parents made up the group of respondents with low levels of education, and 55% ( $n = 5$ ) were also people of Color (i.e., over half of the individuals from lower educated backgrounds are people of Color). Above, Table 2 shows the percentage of parents by education level and race/ethnicity who reported engaging in mathematics at home with their children.

Descriptions of parents' confidence in and willingness to support mathematics at home varied. One parent noted: "I am very involved in my child's math education. My own level of math education is a [high school graduate] level, therefore, I am capable in providing any support necessary," while another parent shared, "My children are in primary. I'm already struggling to remember and keep up." We concluded, however, that race and education level did not help to explain differences in parents' confidence or willingness to support mathematics at home.

Survey responses concerning parents' social media use bolstered the case for #mathathome users and survey respondents reflecting different uses of social and human capital, as just over two-thirds—64%—of parents said they never used social media for mathematics education. As one parent described, "I was not aware this was a thing people do. Interesting . . .". Moreover, those who reported using social media for mathematics at home did so only occasionally (26%), with 10% reporting monthly, weekly and daily use.

Responses provided insights into parents' allies (RQ2; social and human capital) and resources (RQ1; material capital; spaces) for engaging with mathematics at home. YouTube was the most popular resource ( $n = 20$ ), followed by Facebook ( $n = 12$ ), Pinterest ( $n = 8$ ), and Twitter ( $n = 6$ ), suggesting that when parents used social media and related resources, they were likely to turn to spaces other than Twitter. Qualitative analysis showed that parents tended to identify specific blogs or sites by individuals or educational organizations over social media hashtags or groups. Some examples included: Math Mamas (<https://blogs.ams.org/mathmamas> (accessed on 9 October 2020)), Khan Academy, and YouCubed (<https://www.youcubed.org/> (accessed on 9 October 2020)). Parents did not mention #mathathome among Twitter hashtags; hashtags mentioned included: #MT-BoS, #iteachmath, and #MathArtChallenge (mentioned 2–3 times by respondents) and #WODB, #unitchat, #mathforkids, and #tmwyk (each mentioned once).

Finally, parents overwhelmingly reported turning to their child's teacher as an ally ( $n = 76$ ). Other allies included a partner or spouse ( $n = 57$ ), a child's older sibling ( $n = 29$ ), other adults at child's school ( $n = 26$ ), other parents ( $n = 21$ ), and other family members ( $n = 19$ ). Less common allies included tutors, community organizations, and members of professional networks. Only seven parents said they did not feel like they had any allies for mathematics education.

### 3.2. Nature of Mathematics at Home

Mathematics content emphasized through both #mathathome tweets and in parents' survey responses provided a way to understand the nature of continued mathematics education in the home during COVID-19 (RQ1; how capital was mediated in different spaces). In this section, we present results from comparing findings across the two data

sources (i.e., Twitter, survey). Accordingly, findings are organized by broader themes about families' experiences with COVID-19 emergency remote mathematics instruction, namely the mathematical focus and responses to and resources during COVID-19. In the discussion section, we further elaborate on the importance of interpreting results from both data sources together in order to understand families' experiences with mathematics at home during the early stages of the pandemic. For example, parents named only broad mathematics topics (i.e., naming a broad domain of mathematics), but data from tweets provided insight into specific mathematics activities at home related to those topics.

### 3.2.1. #Mathathome Mathematical Focus

We found opportunities for engagement with a range of broad mathematics topics, including (in order of frequency): number and quantity; data and statistics; geometry; four operations; fractions; algebra; measurement; and calculus (i.e., material capital). Those tweets focused on *number and quantity*—the most common topic for #mathathome tweets—overwhelmingly presented opportunities for counting, with less—but still some—attention to counting by multiples, place value, money value, and estimation. Sometimes, users prompted families to count using a picture provided directly through a post on Twitter. For example, families were asked to count how many in an image of a bridge and describe how they counted (Figure 4, left). Oftentimes, users encouraged family members to count physical objects found in the household or in everyday activities. For example, users challenged families to find their own pictures to post and count (Figure 4, left) and encouraged families to count small toys (Figure 4, right).

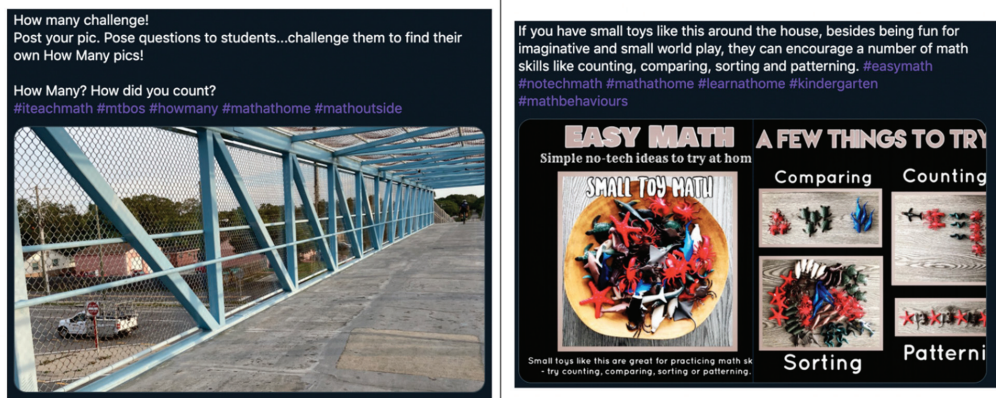


Figure 4. Tweets focused on counting using images and home-based objects.

Tweets about *data and statistics*, the second most common topic of #mathathome tweets, largely emphasized categorizing and comparing, with some references to collecting and analyzing data or interpreting charts and tables online. A common activity prompted children to look at a set and decide which objects do not belong. Such activities, especially when accompanied with a press for justification, can encourage the development of comparing objects based on similarities and differences, and categorizing based on different criteria (Figure 5, left and Figure 4, right). Similar to counting, tweets about data and statistics offered opportunities for using resources directly available on Twitter or at home. For example, one parent leveraged the unique context of the pandemic to encourage data collection and analysis of personal protective equipment (mask-wearing) behavior (Figure 5, right).

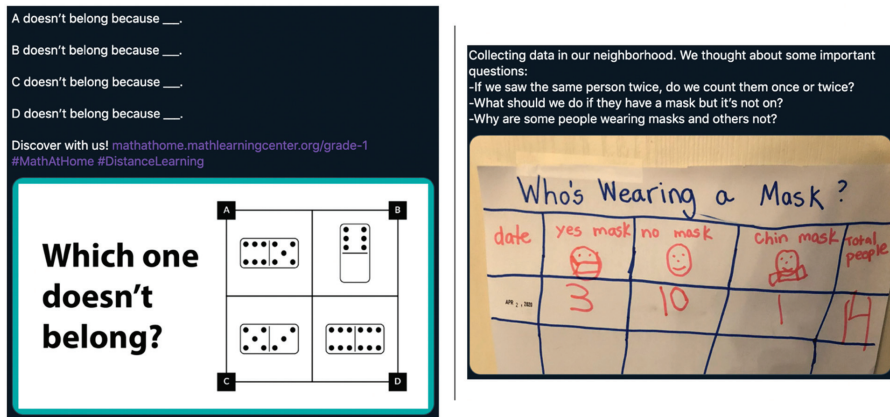


Figure 5. Tweets emphasizing categorizing, comparing, and statistics.

We describe only the most prominent subtopics for remaining content areas to provide insight into the nature of #mathathome content (i.e., material capital). In *geometry*, tweets attended mostly to properties of two-dimensional shapes. For example, one tweet stated, “Caregivers, try some art with your children today using just triangles! Experiment with ‘congruent’ triangles (same shape and size), ‘similar’ triangles (same shape, diff size), or use completely different triangles!” Tweets about *four operations* mostly included addition and subtraction, many with videos or photographs of teacher-led activities (Figure 6, top left); and the focus on *fractions* mostly emphasized the part-whole relationship and equivalence (e.g., “How many ways can you show  $\frac{3}{8}$ ?; and Figure 6, top right). In *algebra*, opportunities overwhelmingly emphasized generalizing patterns of growth. For example, using multiplicative reasoning to predict the number of petals on 3, 4, ... 10 flowers (Figure 6, bottom center). *Measurement* tweets encouraged both standard and non-standard units to measure length (Figure 6, bottom left), temperature, time, volume, and weight (especially in cooking). Finally, only one tweet addressed calculus (Figure 6, bottom right).

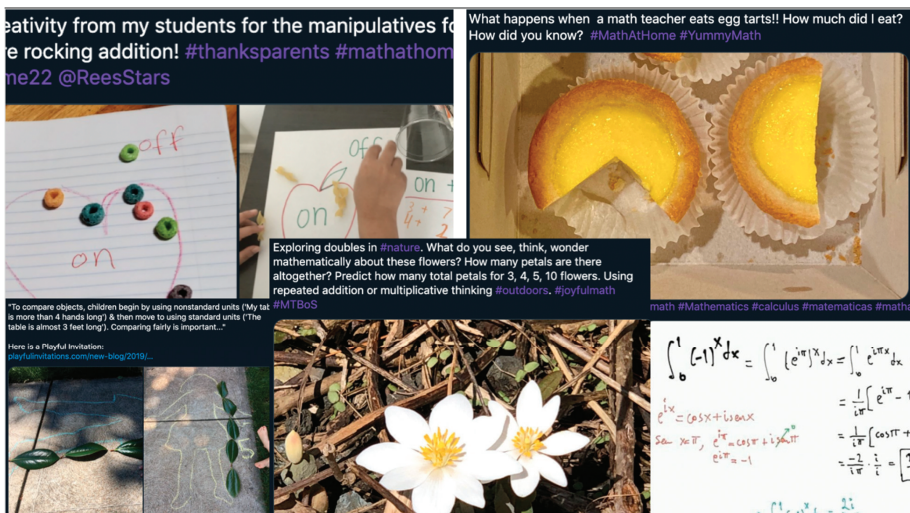


Figure 6. Examples Addition, Fractions, Measurement, Algebraic Reasoning, and Calculus.

Many tweets encouraged the use of everyday objects or activities as opportunities to engage with a range of mathematics topics. For example, one of the most active educational organizations (with a *centrality* of 296, indicating this organization initiated or received this many interactions through #mathathome) supported data and statistics, four operations, fractions, geometry, measurement, and number through activities such as doing physical activity, estimating and measuring everyday objects, playing shop, and counting, sorting and describing groceries. Moreover, many tweets emphasized developing mathematical practices necessary for sense-making (beyond straightforward procedures). Such practices included explanation and justification, such as justifying categorizations (Figure 5, left) and answering, “How did you know?” (Figure 6, top right). In other cases, the open-ended nature of problems encouraged students to engage multiple strategies; for example, defining units and counting in different ways (Figure 4, left), categorizing based on different criteria (Figure 4, right and Figure 5, left), and using different strategies to generalize growth patterns (Figure 6, bottom center).

### 3.2.2. Mathematical Focus in Survey

In response to a question about mathematics activities (i.e., material capital), parents shared a myriad of ways they supported mathematics at home. Similar to what we found from our analysis of #mathathome tweets, parents emphasized cooking, budgeting, solving real-world problems, and incorporating everyday experiences into their child’s mathematics learning. Named activities included several mathematics topics: measurements (e.g., time, volume, temperature), operations with money (e.g., addition, subtraction, money value), and counting (mainly counting manipulatives or objects). Lists such as these were typical: “Cooking measurements/fractions, shopping prices and percent, measuring length [with] sewing/crafts,” and “Fractions, baking, counting money.” Identified mathematics topics overlapped with those addressed by tweets. Moreover, parents discussed how they asked for justification and multiple solutions when doing mathematics. For example, one parent shared, “Often effective is getting my child to explain what he is learning to me. If he can tell me what he’s trying to do, then sometimes I can ask clarifying questions.” In contrast to tweets, some mathematics topics were underrepresented in survey responses. For example, only two replies highlighted geometry: “Cutting things into pieces . . . naming shapes,” and “Naming shapes properly when playing with his blocks/toys.” Moreover, only one response indicated using statistics as a way of supporting mathematics learning at home: “We talk about stats and maths as part of daily life but I don’t deliberately have maths conversations with [my children]”.

### 3.2.3. Responses to and Resources during COVID-19

Survey responses shed light on the types of resources provided by both schools (i.e., capital within school space) and parents (i.e., capital within home/community space) to support continued mathematics education at home (RQ1). The most common school/district emergency response to COVID-19 (according to our respondents) was online instruction completed asynchronously and without a teacher ( $n = 86$ ), including online activities and instructional videos. The next most common response involved instruction through offline worksheets ( $n = 47$ ). As these responses indicated, some schools provided multiple forms of emergency remote instruction. Opportunities for synchronous instruction were less common: online class with teacher and classmates ( $n = 42$ ) and opportunities to learn with a teacher online or by phone ( $n = 39$ ). Only one parent indicated receiving no instructional support from their child’s school.

Schools used a range of online learning management systems or applications used in-part or entirely for providing emergency remote instruction. Google Classroom ( $n = 60$ ) and Zoom ( $n = 31$ ) were the most commonly used. Other notable platforms included: SeeSaw ( $n = 22$ ), Class Dojo ( $n = 17$ ), and Flipgrid ( $n = 9$ ). Parents also reported receiving a range of resources from schools to support mathematics learning, and most said they used the provided resources at least sometimes ( $n = 98$ ). As instructional responses suggest, the most



common resources included online activities ( $n = 71$ ), mathematics instructional videos for children ( $n = 47$ ), and offline worksheets ( $n = 36$ ). Other resources included: laptops, tablets or other devices ( $n = 37$ ), books ( $n = 12$ ), mathematics manipulatives ( $n = 11$ ), mathematics instructional videos for parents ( $n = 9$ ), internet access ( $n = 8$ ), and calculators ( $n = 4$ ). Only four parents reported receiving no resources from the school. Parents supplemented school-based instruction and resources (i.e., material capital in home/community space) by providing necessary laptops or other devices ( $n = 72$ ) and internet access ( $n = 80$ ) for continued mathematics education. Parents also provided: mathematics manipulatives ( $n = 44$ ), calculators ( $n = 36$ ), online resources that helped them and their children understand mathematics ( $n = 32$  and  $n = 36$ , respectively), additional worksheets or problems ( $n = 29$ ), and books ( $n = 20$ ). Six parents reported providing no additional resources.

Survey responses addressed what parents most needed to continue mathematics education at home (i.e., to mediate different forms of capital across spaces). For some parents, emergency remote instruction worked well. For example, one parent elaborated:

My son's math teacher did an outstanding job working remotely with him during lockdown. This is by far his weakest subject . . . Once I reached out to [the teacher] about the amount of time I was spending with him—she upped her individual tutorials with him . . . Since then, he's been able to work virtually independently . . . I think that the mini-tutorials [synchronous video] have been an outstanding success.

Other parents, however, described drastically different experiences: "I feel abandoned by . . . my husband and I work full-time. We are not equipped to try to teach a 7 year old math, reading, etc. The worksheets didn't cut it".

Almost every parent (of the 84 who wrote an open-ended response) mentioned desiring greater synchronous instructional time with their children's teacher. For example, one respondent said they would like, "structured online learning at a set time with teachers trained to teach online." Moreover, parents wanted more "set math lessons rather than just activities" and more guidance to help them aid their child's mathematics learning at home. For example, one respondent wanted teachers to "provide clear, concise instructions so that parents and students are not trying to solve a puzzle of complicated, not-comprehensive instructions to complete math assignments." Some parents suggested video tutorials to aid both their own and their child's understanding of the mathematics concepts (which some but not all teachers provided). Finally, a few parents requested differentiated assignments, noting, "Some of the work is too easy for [my child] and some is too hard for him." Next, we look across and discuss the implications of these and our other key findings in the next section.

#### 4. Discussion

Findings from this mixed methods study support the emerging notion that COVID-19 acted as a mediating event that changed the nature of parental engagement in mathematics education [36]. Parental engagement in mathematics at home during emergency remote instruction was high, and the transition to school mathematics at home prompted some parents to increase involvement (e.g., "Until COVID-19, I typically avoided helping her . . ."). Such an increase is likely explained by the fact that most schools and districts initially responded to COVID-19 by providing mathematics activities done without direct involvement from children's teachers.

We must view findings with some caution, however, given that those already engaged in mathematics on Twitter and those who volunteered to respond to a survey about mathematics at home are more likely to indicate high levels of involvement. Moreover, survey respondents were highly educated and included mathematics educators because of the sampling methods. In this way, the individuals we studied were a select group, which, in this case, may indicate that what we found may be closer to an upper-bound (rather than an average) level and type of parental engagement with mathematics at home during the pandemic. Nonetheless, interpreting findings in relation to existing literature

suggests that the experiences of parents described by our analyses likely provide insights into typical mathematics experiences during COVID-19 emergency remote instruction. Moreover, studies from around the world (e.g., Norway, Indonesia, Nigeria), which focused on broader educational experiences, showed a similar increase in parental involvement in schooling during the initial transition to remote instruction [23,37–40]. Looking across findings from recent studies on parents' experiences with emergency remote instruction during the early stages of COVID-19 suggests that our findings have broader implications despite the large number of participants from the United States.

When parents are explicitly invited to engage in school mathematics, research suggests that they do so, regardless of race/ethnicity or education attainment level [11,13,14,41,42], and our findings confirmed a similar response from parents in the face of emergency remote instruction—which increased expectations for school mathematics at home. Such findings prompt initial optimism about the potential for sustaining high levels of parental engagement in school mathematics, which can promote higher levels of mathematics achievement [8], beyond the COVID-19 crisis [36]. Researchers in Norway also reported that emergency remote instruction provided greater opportunities for creative tasks within the school curriculum, especially for younger students; for teacher feedback through digital platforms; and for student independence to develop [38].

While optimism is important during such a challenging moment, findings also point to the significant barriers that parents faced (e.g., “I feel abandoned . . .”)—and still face. Parents in our study and others reported struggling to manage the increased responsibilities [23,43]. Higher levels of parental engagement and the transition of school-based materials and resources into the home—out of necessity—may not be sustained throughout or beyond the pandemic and may result in widening inequities in mathematics opportunities and achievement. Disparities in access to digital technology especially threaten to widen educational inequality [37,44]. Moreover, as our study also confirmed (given the large number of women respondents in our survey) and as others have noted [21,39], women largely took on the added responsibilities of continuing education in the home during emergency remote instruction. Implications from these findings must be acknowledged and addressed in order to disrupt potentially deepening educational and social disparities.

In the context of our key finding about the different ways in which parents and caregivers became involved with children's education at home, we next discuss implications and offer some recommendations for more effectively supporting parental engagement during and beyond the COVID-19 pandemic. Given the lack of attention to parental engagement in e-learning [23] and the limited focus in mathematics education, specifically, this study contributes new insights into sustaining increased parent engagement in mathematics education, easing the burden of managing emergency remote instruction in the home, and addressing the potential for rising educational inequality due to COVID-19.

#### 4.1. *Renewing to Efforts to Engage Parents*

A tradition of excluding parents from conversations about school mathematics plagues mathematics education [45]. The result often pits schools, teachers, and parents against each other rather than fostering partnerships for children's mathematics learning (e.g., “math wars” [46]). Differences between parents' own mathematics education (which for many emphasized rules and procedures [11]) and the curriculum and instruction experienced by their children present barriers to parental involvement [16], and this challenge was only intensified by COVID-19. Parents and children alike experienced increased anxiety during emergency remote instruction [37,47], and likely even more so in mathematics. For example, consider these memes from our initial exploratory data generation (Figure 7), which show parents' frustration with supporting their children with unfamiliar problem-solving approaches.

Day 1 with a 6th grader and 4th grader and I need google to help them with their Math 😩😩 #homeschooling



Home school teacher don't play that. #TuesdayMotivation

**All these kids been learning Common Core math, bout to learn how to "Carry the One" from their new homeschool teachers.**

Figure 7. Memes during early transition to emergency remote instruction.

Survey responses provided insights into sources of frustration (e.g., “Doing math at home has been brutal”). For example, 86 of 101 (85%) respondents indicated expectations for children to complete work without teachers’ direct involvement. This finding suggests, and other studies confirm [39,40], that parents were largely expected to bear the burden of continuing students’ mathematics learning, but in ways that aligned with school-provided materials. Some schools provided additional support to help parents understand how mathematics education has evolved (e.g., online resources for parents’ mathematics understanding,  $n = 32$ ), but most parents in our study reported limited support. Limited understanding of school mathematics caused some parents to restrict their involvement, even during emergency remote learning (e.g., “I don’t want to interfere in his method”). Even parents who are also mathematics teachers reported little familiarity with specific grade-level mathematics (e.g., I “don’t necessarily know what is developmentally appropriate for my Kindergartener”). During a time of such disruption to children’s education, a history of devaluing parental engagement in the evolution of mathematics education left parents feeling “abandoned.”

As an implication of these circumstances, the mathematics education community must take more seriously commitments to include parents in the process of evolving and even revolutionizing school mathematics. Renewed efforts are needed to bridge parents’ and children’s experiences with mathematics education. Research suggests that parents benefit from developing mathematics content and pedagogical knowledge much in the same way that teachers do [7] and that opportunities to re-engage with mathematics can bolster parental engagement [12,16]. Helping parents understand the evolution of school mathematics would support their own children’s mathematics education and also allow them to be allies for other parents [17] and teachers who may be over-extended during times of crisis (e.g., creating instructional videos, providing one-on-one tutorials). In the next section, we discuss possibilities for how we can build bridges for necessary conversations.

#### 4.2. Reimagining How Parents Engage

While some attention has been paid to the importance of inviting multiple stakeholders to participate in conversations about teaching, learning, and educational systems [48,49], parents’ input and voices are not commonly recognized. In light of disruptions to mathematics education due to the COVID-19 pandemic, parental engagement may be more important than ever—particularly for parents from marginalized groups [10,11]. Social media (and other digital spaces) present new opportunities for parents to mediate their engagement in multiple ways (e.g., accessing announcements and resources posted by teachers, schools, and districts; sharing resources they create for children). However—as

we found in this study—such opportunities may be under-utilized by (or not widely known to) parents.

We see social media and other online platforms as a particularly promising way to include parents in conversations about mathematics education because parents are already relying on online resources to support emergency remote instruction. COVID-19 triggered a notable increase in demand for online learning resources (four times more compared to pre-pandemic) [44], and parents sought out both school-sanctioned online platforms and supplemental resources (as shown in our findings). Searches for online educational resources, however, increased as family socioeconomic status increased, which is alarming because parent searches for such online resources correlated with students' mathematics progress [44].

Promoting educational resources on more widely available online platforms may help address disparities by creating a widely available space for parents to mediate human, social, and material capital for engagement. Yet, our survey findings suggested that most parents were not aware of opportunities for mathematics education on social media (e.g., "I was not aware this was a thing people do"). This finding is bolstered by those from our analysis of the #mathathome hashtag on Twitter: Parents comprised a very small proportion of those actively using the hashtag (3 of 46, or 6%), with most participants instead identifying as educational organizations, teachers, and instructional coaches or administrators. These findings, then, collectively point to a potential missed opportunity to involve parents in their children's education through technology-based platforms—especially social media, which is purported to be open and accessible to a range of those invested in children's education [50,51].

In this way, this study invites greater attention to the role and potential importance of involving a key stakeholder—parents—in mathematics education on social media platforms, which we consider to be one implication of our analysis of both Twitter- and survey-based data related to mathematics at home. One way to involve parents in conversations about mathematics education using online platforms would be for teachers to explicitly invite them to participate [13,41]. Findings suggest that YouTube, Facebook, and Pinterest, followed by Twitter are platforms that parents already use, and which therefore may be suitable targets for such invitations. Failing to involve parents may contribute to conversations about the evolution of mathematics education taking place without their input, as teachers and others increasingly use social media as a space for engaging in discussions about educational change and transformation efforts [52]. Additionally, continuing to talk *at*, rather than *with*, parents, in spaces like Twitter can be compared to how teachers withhold physical resources (e.g., textbooks) from Black families with low-income backgrounds due to racial stereotypes about families' interest in parental engagement and ability to care for materials [11]. Though parents from low-income and racial minorities may have more limited access to technology in the home [20,37,53], educators should resist stereotypes about parents' willingness and ability to engage in mathematics education in online spaces.

Lastly, we note that in the midst of the widespread use of social media [54], instead of turning to social media-based online resources and allies, parents overwhelmingly reported turning to their child's teacher as an ally, with 76 of our 101 (75%) of survey respondents indicating that they had done so. This suggests that despite the social distancing required in response to COVID-19, parents turned to those with whom they had already-established relationships, and, potentially, trust, which may be more important—rather than less so or irrelevant in light of ample use of social media [54]—during times of crisis. High-income families reported increased use of online educational resources [44] and a general satisfaction with school support [43] during COVID-19 emergency remote instruction. This suggests that increasing access to various forms of human and social capital is especially salient for supporting families marginalized in and by mathematics in both times of crisis and in general.



### 4.3. Broadening Mathematical Focus

Finally, findings point to a need to broaden opportunities for the types of mathematics engagement accessible to parents and families. Across Twitter and survey data, elementary mathematics content was emphasized. Other researchers also noted that parental engagement during emergency remote instruction was especially high among parents of younger children [23,38,43]. The over-emphasis on elementary mathematics suggests that limited opportunities for parental engagement are available in online spaces, such as Twitter. Although we found a range of mathematics topics across tweets, hashtags familiar to parents in our survey echoed the dominance of counting (#unitchat) and categorizing/comparing (#WODB). Research on parental engagement also focuses heavily on parents of elementary-aged children, e.g., [7,11,16]. Consequently, much of what is known about supporting parents to understand the evolution of school mathematics [7] or to bridge school mathematics and home/community mathematics [55] is useful only for engaging parents of young children. Broadening opportunities for parents of older students to engage in mathematics education is important because the correlation between parental involvement and academic achievement is stronger in upper grade levels [23]. As the mathematics education community renews commitments to include educators and parents in conversations about school mathematics, attention must be paid to welcoming involvement from parents of older students, and students themselves.

In addition to broadening mathematical focus by grade level, a need also exists to broaden the nature of mathematics in which parents and children engage together. Attempts to artificially separate the school space of remote instruction from the context in which it occurred (the home), positioned parents as learning managers, tasked with creating distinct spaces for play and for learning within the home [40]. This positioning of parents is problematic because parental control (versus engagement) has been linked to low mathematics performance, task persistence, and mathematics self-concept [56]. Instead of positioning parents as learning managers, schools and educators might seek to support parents as they author a hybrid space that promotes learning school mathematics topics through home-based activities, e.g., [55]. Our findings from both the survey responses and Twitter analysis provide some examples from emergency remote learning (e.g., cooking; Figure 6). In other words, the human, social, and material capital necessary for parents to navigate their own experiences with mathematics compared to contemporary instructional approaches exist, and parents made promising efforts to leverage those resources to author a productive home-school space during emergency remote learning. A next step might focus on how teachers and schools can foster and develop these initial efforts. Successful models from emergency remote instruction that directly involved schools, for example, could provide useful insights into promoting creative mathematics engagement that aligns with the school curriculum at home, e.g., [38].

A final implication of our findings is the need to consider which digital tools best support creativity and problem solving when school mathematics occurs within the home. In addition to social media as a way for parents to engage in conversations with educators, researchers, and others about the evolution of school mathematics (i.e., social and human capital) and to access home-based mathematics activities (i.e., material capital), a range of digital tools exist that make mathematics more accessible to a wide audience (i.e., material capital). Extant research focuses on how these digital tools support mathematics teaching and learning in the classroom setting, e.g., [57–60]. This research emphasizes the importance of matching the digital tool to the educational application, which demands flexibility in the design and use of these tools [57]. Moreover, research shows the importance of synthesizing the instruction provided by the teacher and by the digital tool [58]. In other words, the digital tools that are effective in the classroom may not promote the same type of creativity and problem solving in mathematics within the home setting, especially if parents' instruction contradicts instruction from teachers and/or digital tools.

Looking to some especially promising and flexible models of digital tools might help teachers and parents reimagine and co-author a hybrid space that connects home- and

school-based ways of doing mathematics. For example, the Digital Mathematics Environment is an online environment that would allow teachers to customize mathematics activities based on the unique home-based resources and experiences of their students [57]. Other models show how digital tools can support gamification in mathematics (e.g., escape rooms), which can also promote creativity, motivation, and achievement for both primary [38] and secondary students [59,60]. Future research is needed to explore the possibilities for using digital tools, that have shown effective in the classroom, to support creativity and problem-solving in school mathematics at home.

## 5. Conclusions

As we were analyzing the data for this manuscript, protests against police brutality and racial injustice erupted in over 140 U.S. cities and in displays of solidarity around the world [61,62]. These protests highlighted how many communities live in a perpetual state of crisis in addition to and in amplification of those crises due to the COVID-19 pandemic. Although a public health crisis presents unique challenges, some of which this study shed light on—families already marginalized in and by mathematics and women felt the weight of the disruptions caused by COVID-19 disproportionately. In other words, for many families, mathematics education during a time of crisis will persist even as and after the pandemic fades, and this demands attention in future research and educational initiatives. Our study provided only limited understanding of the unique lived experiences of mothers and caregivers from marginalized groups, and we urge the community to continue to imagine new possibilities for learning and doing mathematics beyond the possibilities we have suggested to value the voices of parents and families—particularly those shunned in and excluded from education and society. With such widespread parental engagement and disruptions in educational systems due to COVID-19, new doors have opened for both educational inequality and educational reform, and the time to choose the path of evolving and revolutionizing mathematics education is now.

**Author Contributions:** Conceptualization, F.K.H.; Methodology, F.K.H. and J.M.R.; Validation, F.K.H., J.M.R., S.C., K.H., S.W.; Formal Analysis, F.K.H., J.M.R., S.C., K.H., S.W.; Investigation, F.K.H., J.M.R., S.C., K.H., S.W.; Data Curation, F.K.H. and J.M.R.; Writing—Original Draft Preparation, F.K.H., J.M.R., S.C., K.H., S.W.; Review and editing, F.K.H. and J.M.R.; Visualization, F.K.H. and J.M.R.; Supervision, F.K.H.; Project Administration, F.K.H.; Funding Acquisition, F.K.H. The third, fourth, and fifth authors contributed equally to the manuscript. Their names are listed alphabetically to reflect equal contribution. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded, in part, by the Office of Community Outreach and Engagement, the 1794 Scholars Program, and the Office of Undergraduate Research at the University of Tennessee, Knoxville.

**Institutional Review Board Statement:** The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Institutional Review Board of University of Tennessee, Knoxville (protocol IRB-20-05859-XM; 14 May 2020).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** Data are available by request from the corresponding author.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

- Center for Disease Control and Prevention. Coronavirus Disease 2019 (COVID-19): Frequently Asked Questions. Available online: <https://www.cdc.gov/coronavirus/2019-ncov/faq.html> (accessed on 18 September 2020).
- Coronavirus Resource Center. New Cases of COVID-19 in World Countries. Available online: <https://coronavirus.jhu.edu/data/new-cases> (accessed on 6 October 2020).
- UNESCO. COVID-19 Impact on Education. Education: From Disruption to Recovery. Available online: <https://en.unesco.org/covid19/educationresponse> (accessed on 9 October 2020).
- National Council of Teachers of Mathematics (NCTM). *Catalyzing Change in High School Mathematics: Initiating Critical Conversations*; NCTM: Reston, VA, USA, 2018; ISBN 978-1-68054-014-7.

5. NCTM. *Catalyzing Change in Middle School Mathematics: Initiating Critical Conversations*; NCTM: Reston, VA, USA, 2020; ISBN 978-1-68054-044-4.
6. Henderson, A.T.; Mapp, K.L. *A New Wave of Evidence: The Impact of School, Family, and Community Connections on Student Achievement*; Southwest Educational Development Lab: Austin, TX, USA, 2002.
7. Knapp, A.; Landers, R.; Liang, S.; Jefferson, V. We all as a family are graduating tonight: A case for mathematical knowledge for parental involvement. *Educ. Stud. Math.* **2017**, *95*, 79–95. [CrossRef]
8. Yan, W.; Lin, Q. Parent involvement and mathematics achievement: Contrast across racial and ethnic groups. *J. Educ. Res.* **2005**, *99*, 116–127. [CrossRef]
9. Copping, K.E.; Kurtz-Costes, B.; Rowley, S.J.; Wood, D. Age and race differences in racial stereotype awareness and endorsement. *J. Appl. Soc. Psychol.* **2013**, *43*, 971–980. [CrossRef] [PubMed]
10. Barton, A.C.; Drake, C.; Perez, J.G.; St. Louis, K.; George, M. Ecologies of Parental engagement in urban education. *Educ. Res.* **2004**, *33*, 3–12. [CrossRef]
11. Jackson, K.; Remillard, J.T. Rethinking parent involvement: African American mothers construct their roles in the mathematics education of their children. *Sch. Community J.* **2005**, *15*, 51–73.
12. Martin, D.B. Mathematics learning and participation as racialized forms of experience: African American parents speak on the struggle for mathematics literacy. *Math. Think. Learn.* **2006**, *8*, 197–229. [CrossRef]
13. Civil, M.; Planas, N.; Quintos, B. Immigrant parents' perspectives on their children's mathematics education. *ZDM Int. J. Math. Educ.* **2005**, *37*, 81–89. [CrossRef]
14. Smith, J.; Wohlstetter, P.; Kuzin, C.A.; De Pedro, K. Parent involvement in urban charter schools: New strategies for increasing participation. *Sch. Community J.* **2011**, *21*, 71–94.
15. Civil, M.; Guevara, C.; Allexsaht-Snider, M. Mathematics for parents: Facilitating parents' and children's understanding in mathematics. In Proceedings of the 24th Psychology of Mathematics Education North American Meeting (PMENA 24), Athens, GA, USA, 26–29 October 2002; pp. 1755–1766.
16. Muir, T. Numeracy at Home: Involving Parents in Mathematics Education. *Int. J. Math. Teach. Learn.* **2012**, *25*, 1–13.
17. Civil, M.; Bernier, E. Exploring images of parental participation in mathematics education: Challenges and possibilities. *Math. Think. Learn.* **2006**, *8*, 309–330. [CrossRef]
18. Hodges, C.; Moore, S.; Locke, B.; Trust, T.; Bond, A. The Difference between Emergency Remote Teaching and Online Learning. Available online: <https://er.educause.edu/articles/2020/3/the-difference-between-emergency-remote-teaching-and-online-learning> (accessed on 1 April 2020).
19. Eligon, J.; Burch, A.D.S.; Searcey, D.; Opper, R.A. Black Americans Face Alarming Rates of Coronavirus Infection in Some States. *The New York Times* [Online] (7 April 2020). Available online: <https://www.nytimes.com/2020/04/07/us/coronavirus-race.html> (accessed on 9 October 2020).
20. Wang, J.; Moghadam, S.H. Diversity barriers in K-12 computer science education: Structural and social. In Proceedings of the 48th ACM Technical Symposium on Computing Science Education (SIGCSE 2017), Seattle, WA, USA, 8–11 March 2017; pp. 615–620.
21. Power, K. The COVID-19 pandemic has increased the care burden of women and families. *Sustain. Sci. Pract. Policy* **2020**, *16*, 67–73. [CrossRef]
22. Panchal, N.; Kamal, R.; Orgera, K.; Cox, C.; Garfield, R.; Hamel, L.; Muñana, C.; Chidambaram, P. The Implications of COVID-19 for Mental Health and Substance Use. Available online: <https://www.kff.org/coronavirus-covid-19/issue-brief/the-implications-of-covid-19-for-mental-health-and-substance-use/#:~:text=Research%20shows%20that%20job%20loss,substance%20use%20disorder%20and%20suicide> (accessed on 21 August 2020).
23. Panaoura, R. Parental involvement in children's mathematics learning before and during the period of COVID-19. *Soc. Educ. Res.* **2020**, *2*, 65–74. [CrossRef]
24. Fetters, M.D.; Curry, L.A.; Creswell, J.W. Achieving integration in mixed methods designs—principles and practices. *Health Serv. Res.* **2013**, *48*, 2134–2156. [CrossRef]
25. *NCapture for NVivo 12 for Mac*; QSR International: London, UK, 2020.
26. Lieber, E.; Weisner, T.S.; Taylor, J. *Dedoose*; SocioCultural Research Consultants, LLC: Manhattan Beach, CA, USA, 2020.
27. Hawkey, M. Need a Better Twitter Archiving Google Sheet? TAGS v6.0 is Here! Available online: <https://mashe.hawkeye.info/2014/10/need-a-better-twitterarchiving-google-sheet-tags-v6-0-is-here/> (accessed on 9 October 2020).
28. Kearney, M. rtweet: Collecting and analyzing Twitter data. *J. Open Source Softw.* **2019**, *4*, 1829. [CrossRef]
29. R Core Team. *R: A Language and Environment for Statistical Computing*; R Foundation for Statistical Computing: Vienna, Austria, 2020.
30. Formplus. Eleven Demographic Survey Questions You Must Not Ask. Available online: <https://www.formpl.us/blog/demographic-survey-questions>. (accessed on 15 April 2020).
31. Baltar, F.; Brunet, I. Social research 2.0: Virtual snowball sampling method using Facebook. *Internet Res.* **2012**, *22*, 57–74. [CrossRef]
32. Miles, M.B.; Huberman, A.M.; Saldaña, J. *Qualitative Data Analysis: A Methods Sourcebook*; Sage: Thousand Oaks, CA, USA, 2014; ISBN 9781506353074.

33. Dorman, M. Mapsapi: Sf-Compatible Interface to Google Maps APIs; R Package Version 0.4.5. Available online: <https://CRAN.R-project.org/package=mapsapi> (accessed on 9 October 2020).
34. Greenhalgh, S.P.; Staudt Willet, K.B.; Rosenberg, J.M.; Koehler, M.J. Tweet, and we shall find: Using digital methods to locate participants in educational hashtags. *TechTrends* **2018**, *62*, 501–508. [\[CrossRef\]](#)
35. Rosenberg, J.M.; Greenhalgh, S.P.; Koehler, M.J.; Hamilton, E.; Akcaoglu, M. An investigation of State Educational Twitter Hashtags (SETHs) as affinity spaces. *E-Learning and Digital Media* **2016**, *13*, 24–44. [\[CrossRef\]](#)
36. Bakker, A.; Wagner, D. Pandemic: Lessons for today and tomorrow? *Educ. Stud. Math.* **2020**. [\[CrossRef\]](#)
37. Azubuikwe, O.B.; Adegboye, O.; Quadri, H. Who gets to learn in a pandemic? Exploring the digital divide in remote learning during the COVID-19 pandemic in Nigeria. *Int. J. Educ. Res. Open* **2021**. [\[CrossRef\]](#)
38. Bubb, S.; Jones, M. Learning from the COVID-19 home-schooling experience: Listening to pupils, parents/carers and teachers. *Improv. Sch.* **2020**, *23*, 209–222. [\[CrossRef\]](#)
39. Greenhow, C.; Lewin, C.; Staudt Willet, K.B. The educational response to Covid-19 across two countries: A critical examination of initial digital pedagogy adoption. *Technol. Pedagog. Educ.* **2020**. [\[CrossRef\]](#)
40. Novianti, R.; Garzia, M. Parental engagement in children’s online learning during COVID-19 pandemic. *J. Teach. Learn. Elem. Educ.* **2020**, *3*, 117–131. [\[CrossRef\]](#)
41. Anderson, K.J.; Minke, K.M. Parent involvement in education: Toward an understanding of parents’ decision making. *J. Educ. Res.* **2007**, *100*, 311–323. [\[CrossRef\]](#)
42. Ortiz Lopez, C.; Donovan, L. Involving Latino Parents With mathematics through family math nights: A review of the literature. *J. Lat. Educ.* **2009**, *8*, 219–230. [\[CrossRef\]](#)
43. Garbe, A.; Ogurlu, U.; Logan, N.; Cook, P. COVID-19 and remote learning: Experiences of parents and children during the pandemic. *Am. J. Qual. Res.* **2020**, *4*, 45–65. [\[CrossRef\]](#)
44. Bacher-Hicks, A.; Goodman, J.; Mulhern, C. Inequality in household adaptation to schooling shocks: Covid-induced online learning engagement in real time. *J. Public Econ.* **2021**, *193*, 1–17. [\[CrossRef\]](#)
45. Allexsant-Snyder, M. Urban parents’ perspectives on children’s mathematics learning and issues of equity in mathematics education. *Math. Think. Learn.* **2006**, *8*, 187–195. [\[CrossRef\]](#)
46. Schoenfeld, A.H. The math wars. *Educ. Policy* **2004**, *18*, 253–286. [\[CrossRef\]](#)
47. Davis, C.R.; Grooms, J.; Ortega, A.; Rubalcaba, J.A.A.; Vargas, E. Distance learning and parental mental health during COVID-19. *Educ. Res.* **2020**. [\[CrossRef\]](#)
48. Coburn, C.E.; Stein, M.K. *Research and Practice in Education: Building Alliances, Bridging the Divide*; Rowman & Littlefield Publishers: Lanham, MD, USA, 2010; ISBN 0742564061.
49. Peurach, D.J.; Cohen, D.K.; Yurkofsky, M.M.; Spillane, J.P. From mass schooling to education systems: Changing patterns in the organization and management of instruction. *Rev. Res. Educ.* **2019**, *43*, 32–67. [\[CrossRef\]](#)
50. Greenhow, C.; Galvin, S.M.; Staudt Willet, K.B. What should be the role of social media in education? *Policy Insights Behav. Brain Sci.* **2019**, *6*, 178–185. [\[CrossRef\]](#)
51. Macià, M.; García, I. Informal online communities and networks as a source of teacher professional development: A review. *Teach. Teach. Educ.* **2016**, *55*, 291–307. [\[CrossRef\]](#)
52. Rosenberg, J.M.; Reid, J.W.; Dryer, E.B.; Koehler, M.J.; Fischer, C.; McKenna, T.J. Idle chatter or compelling conversation? The potential of the social media-based #NGSSchat network for supporting science education. *J. Res. Sci. Teach.* **2020**, *57*, 1322–1355.
53. Warschauer, M.; Matuchniak, T. New technology and digital worlds: Analyzing evidence of equity in access, use, and outcomes. *Rev. Res. Educ.* **2010**, *34*, 179–225. [\[CrossRef\]](#)
54. Pew Research Center. Social Media Fact Sheet. Available online: <https://www.pewresearch.org/internet/fact-sheet/social-media/> (accessed on 9 October 2020).
55. Civil, M. Everyday mathematics, mathematicians’ mathematics, and school mathematics: Can we bring them together? *J. Res. Math. Educ. Monogr.* **2002**, *11*, 40–62. [\[CrossRef\]](#)
56. Silinskaskas, G.; Kikas, E. Parental involvement in math homework: Links to children’s performance and motivation. *Scand. J. Educ. Res.* **2019**, *63*, 17–37. [\[CrossRef\]](#)
57. Drijvers, P. Digital tools in Dutch mathematics education: A dialectic relationship. In *National Reflections on the Netherlands Didactics of Mathematics: Teaching and Learning in the Context of Realistic Mathematics Education*; Van den Heuvel-Panhuizen, M., Ed.; Springer: Cham, Switzerland, 2020; pp. 177–195. [\[CrossRef\]](#)
58. Viberg, O.; Grönlund, Å.; Andersson, A. Integrating digital technology in mathematics education: A Swedish case study. *Interact. Learn. Environ.* **2020**. [\[CrossRef\]](#)
59. Jiménez, C.; Arís, N.; Magreñán Ruiz, A.A.; Orcos, L. Digital escape room, using Genial.Ly and a breakout to learn algebra at secondary education level in Spain. *Educ. Sci.* **2020**, *10*, 271. [\[CrossRef\]](#)
60. Curto Prieto, M.; Orcos Palma, L.; Blázquez Tobías, P.J.; Molina León, F.J. Student assessment of the use of Kahoot in the learning process of science and mathematics. *Educ. Sci.* **2019**, *9*, 55. [\[CrossRef\]](#)

61. Cai, W.; Love, J.; Marsh, B.; Patel, J.K.; Parshina-Kottas, Y.; Ward, J. Protests over Racism and Police Violence. *The New York Times* [Online]. 31 May 2020. Available online: <https://www.nytimes.com/2020/05/31/us/george-floyd-protests-live-updates.html> (accessed on 9 October 2020).
62. Rahim, Z.; Picheta, R. Thousands Around the World Protest George Floyd's Death in Global Display of Solidarity. *CNN* [Online]. 1 June 2020. Available online: <https://www.cnn.com/2020/06/01/world/george-floyd-global-protests-intl/index.html> (accessed on 9 October 2020).

Article

# The Perception of Slovak Students on Distance Online Learning in the Time of Coronavirus—A Preliminary Study

Petra Poláková<sup>1</sup> and Blanka Klímová<sup>2,\*</sup>

<sup>1</sup> Department of Language Pedagogy and Intercultural Studies, Constantine the Philosopher University in Nitra, Trieda Andreja Hlinku 1, 94974 Nitra, Slovakia; petra.polakova@uhf.sk

<sup>2</sup> Department of Applied Linguistics, University of Hradec Králové, 500 03 Hradec Králové, Czech Republic

\* Correspondence: blanka.klimova@uhk.cz

**Abstract:** Teaching and learning at educational institutions in Slovakia has been based on traditional education, consisting of face-to-face classes until it was disrupted by the spread of the Coronavirus disease. A sudden lockdown caused massive changes, which presented challenges not only for teachers, but also for students who were forced to adapt their learning in a very short time, without any previous preparation. Since various educational institutions were forced to remain closed, they had no option but to shift from a traditional educational approach to distance learning. This form of education requires a form of online learning. The main purpose of this study was to explore what technical equipment students had at their disposal, to understand the students' perception of distance learning, and to ensure better learning conditions in case of future lockdowns. In order to investigate student readiness for distance learning, a questionnaire survey was conducted at the Secondary Vocational School of Tourism and Gastronomy in Nitra, Slovakia. The findings of this study revealed that the majority of students from the Secondary Vocational School of Gastronomy and Tourism are ready for distance online learning. The results also indicate that a great percentage of students have Internet access and are the owners of technological devices that can be used for educational purposes. Furthermore, students are able to work individually on their own and do not require any help from other people while working on assignments. Although they prefer different teaching methods, the synchronous online courses are their priority because it enables them to have direct contact with their teachers and peers. Overall, this research shows that distance online learning is possible provided that both teachers and students are familiarised with this new learning environment and are ready to cooperate.

**Citation:** Poláková, P.; Klímová, B. The Perception of Slovak Students on Distance Online Learning in the Time of Coronavirus—A Preliminary Study. *Educ. Sci.* **2021**, *11*, 81. <https://doi.org/10.3390/educsci11020081>

Academic Editors: Eleanor Dommett and Palitha Edirisingha  
Received: 23 December 2020  
Accepted: 9 February 2021  
Published: 19 February 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

**Keywords:** distance learning; online learning; coronavirus disease

## 1. Introduction

The interruption of traditional, face-to-face study due to the spread of Coronavirus, required the use of a distant form of education. Suddenly, students were separated from their teachers and peers and began to start learning remotely. There was no other choice than solitary study at home. Therefore, learning had become more individualised and varied, more dependent on speed and timeline according to each individual student and their attitude and willingness to try distance learning.

Keegan [1], who developed a definition of distance learning, defines it is a form of education whose main elements are the separation of teachers and learners, the influence of educational institutions, the two-way communication between teachers and learners, the possibility of occasional meetings, the industrial model of providing education, and the use of technical media. Keegan [2] claimed that the evolution of education at a distance can be characterised as a move from distance learning to online learning. It would not be possible in a society that has not yet achieved an adequate level of industrialisation. Fortunately, technologies are becoming increasingly ubiquitous and can be creatively used



in different areas, including education [3]. The development of new technologies opened the way to the net and web, which made it possible to teach face-to-face at a distance and to restore eye-to-eye contact online. The wide distribution of computers and communication technologies has made the learning process easier, changed the nature of distance learning, and ensured a smooth transition into online distance learning as pictures, audio, video, and virtual realities can be used in order to facilitate the process of education. In that sense, distance learning is a subset of online learning [2,3].

Before the onset of Coronavirus, online learning has been only used as a supplement for teachers in their courses. In other words, it was used in order to create a blended learning environment in the classroom. Things have changed and online learning has become extremely important, regarding the fact that distance learning relies on its educational tools [4].

New circumstances have made educational institutions recognise the importance of online learning since it appears to be an effective tool for ensuring students' education in the time of Coronavirus crisis. This form of education brings many advantages as it is considered to be easily accessible and relatively cheaper, in comparison with the institution-based learning. Another interesting aspect of online learning is its flexibility since learners can schedule or plan their learning. In this term, online learning can be defined as an asynchronous learning experience with the Internet access [5]. The asynchronous instruction means that teachers and learners are not demanded to have synchronous sessions because students have access to the course content through the Internet at any time. In this case, communication occurs mainly through email and online forums and is typically moderated by teachers. The disadvantage of such a learning environment is that response and immediate feedback are not possible [6]. On the other hand, the synchronous learning environment offers live lectures, real-time interactions between teachers and students, and a possibility of instant feedback. In addition, the synchronous online learning can provide a lot of opportunities for social interaction, so vital in times of social isolation [5].

We assume that a combination of synchronous and asynchronous online learning is important in order to create a balanced learning environment for students. In a time of a crisis, when learners face new challenges, it is essential to create conditions providing personalised learning, an individualised work pace, and the possibility of feedback on students' learning at the same time. After the spread of the Coronavirus, many institutions all over the world, including Slovakia, realised a necessity of such a blended learning model providing quality education. One of the institutions that switched from offline learning to online learning, and decided to use both a synchronous and asynchronous online learning environment, was the Secondary Vocational School of Tourism and Gastronomy in Nitra, Slovakia. Since the situation was new for both students and teachers, and many questions related to distance online education occurred, the school management decided to conduct a questionnaire survey in order to examine students' perception of online distance learning, and on this basis, ensure quality education in case of further lockdowns. Thus, the main purpose of this study was to explore what technical equipment students had at their disposal, to understand students' perception of distance learning, and to ensure better learning conditions in case of future lockdowns.

## **2. Materials and Methods**

In order to investigate student readiness for distance learning and their perception of such an experience, which was the main purpose of this study, a questionnaire, as the main research method, was conducted at the Secondary Vocational School of Tourism and Gastronomy in Nitra, Slovakia. A total of 86 students, both males and females, of the tourism study program were asked to fill in the questionnaire. However, only 72 participants have completed it. The sample size therefore represents 83.72% of the total number of students from the mentioned study program. The age of students ranged between 15 and 19 years. A convenience sample was used for the purpose of the current study since respondents happened to be available at the time of the research procedure. As one of



the authors of the current paper teaches at the secondary vocational school where the questionnaire was revealed, the authors chose a research sample consisting of the students from this institution. Only students attending the school on the day when the questionnaire was distributed answered the questions. The questionnaire was developed by the school management in order to understand the learning needs of their students. It contained 15 questions describing 6 constructs/variables, such as technology equipment, students' technological skills, learning environment, difficulty level of learning, methods of teaching, and objective evaluation (see Table 1 below). Student responses were collected at the beginning of the first semester of the academic year 2020/2021. Before students were given the questionnaire, they had been presented with the purpose of the study. The survey was anonymous, it was not obligatory, and students were informed they were allowed to stop completing the questionnaire at any time they wished.

**Table 1.** Summary of measurement scales.

Constructs/Variables	Measured Items
Technology equipment	1. Do you have the Internet access at home?
	2. Do you have a device which you can use in order to complete electronically assigned tasks?
	3. Can you recharge your device regularly?
	4. Do you have a telephone connection?
Students' technological skills	1. Do you have necessary skills to work with new technology?
	2. Are you able to complete assignments without direct help of an adult person?
Learning environment	1. Can you focus on your studies while being at home?
	2. Do you have enough time to complete the tasks?
Difficulty level of learning	1. To what extent and complexity do teachers give you a new curriculum for self-study?
	2. Are the tests adapted to the appropriate level of your knowledge?
Teaching methods	1. In what form do teachers assign exercises to practice the curriculum?
	2. Does teaching through the ZOOM application help you understand the subject matter?
	3. What activities help you understand the new curriculum?
	4. Which method of learning is the most suitable for you in order to complete the assignments?
Objective evaluation	1. Is the evaluation of your acquired knowledge objective?

Despite the fact that modern technologies have become an integral part of students' lives [7], the authors of this study find it essential to understand whether students are ready to use technologies that are also in the process of distance online learning. The authors believe that students' perception of the online distance learning can help provide a better educational environment in case of future lockdowns or other unexpected situations. In order to meet the objective of this study, six variables mentioned above were explored.

### 2.1. Technology Equipment

The distance online education system depends on a number of factors that affect its success or failure. These include the influence of students' technology equipment and information delivery system which must be accessible to all participants in distance online learning in order to provide continual updated courses and to keep the subject matter current and relevant [8]. It is obvious that without supplied course materials and learner support from teachers, students would not be able to work on their own and enhance

their learning. Thus, the authors aimed to examine whether students had the necessary technology equipment at their disposal.

### *2.2. Students' Technological Skills*

When participating in distance education courses, it is vital to consider students' technical skills which can help them achieve their learning goals. Students in distance online education are supposed to have at least basic knowledge of computer and Internet skills allowing them to work on their own. Otherwise, they could possibly meet barriers that lead to academic problems [9]. Hence, the question is whether students were able to work on their own.

### *2.3. Learning Environment*

Learning environment is one of the most important factors that affect student learning. An ideal learning environment is a space where students are able to work, learn from their own mistakes, and achieve their academic goals. A positive learning environment helps improve student attention, reduce anxiety, and enhance productivity. In this space, the process of learning becomes something that students easily adapt to and look forward to. To achieve such an environment, students need to be nurtured with care and support. In a positive and nurturing environment, students show their authentic curious self. When educators foster a positive learning culture, learners are more likely to acquire higher motivation that leads to wonderful learning outcomes [10]. Based on this, the authors are interested whether students worked under favourable conditions.

### *2.4. Difficulty Level of Learning*

When planning learning, it is important to understand the level at which learning occurs as this will underpin appropriate approaches to teaching and assessing. It is essential to provide information that is right for both student learning expectations and teacher expectations. Regarding this, according to Bloom's taxonomy, when designing learning, teachers should consider students' cognitive, affective, and psychomotor skills. Those include students' knowledge and understanding, feelings, and attitudes, as well as their physical skills [11]. Therefore, it is important to know whether students were assigned the tasks of appropriate level.

### *2.5. Teaching Methods*

Teaching methods refer to the way of information transition to learners. A method describes the instructional process, that is, not only how information is transferred from the teacher to students, but also how students use it, interact with it, and receive guidance and feedback. There are many variables that affect the choice of methods, including the level of learning, time available, or facilities. Using the right methods is important because the quality of student learning depends on the effectiveness of the approach used [12]. Thus, the authors aimed to explore whether appropriate methods of teaching were used.

### *2.6. Objective Evaluation*

Evaluation plays an enormous role in the process of education since it is considered a systematic process of data collection and further analysis that is done in order to understand student learning outcomes. Understanding of students' development can help teachers improve the learning process [13]. Regarding this, we consider an individual work of students important when distance online learning is implemented. We considered it important to find out whether each student worked individually on their own and to evaluate student outcomes as an objective.

### 3. Results and Discussion

A main objective of the current study is to understand students' readiness for the use of modern technologies in the process of distance online learning. Student responses in the questionnaire revealed a diverse amount of information and are provided below.

Regarding technology equipment, 100% of participants indicated they had the Internet access. In fact, 82% of students are the owners of the devices which can be used in order to complete electronically assigned tasks, 14% had to share devices with other members of their household, and only 4% stated they had no device suitable for online distance learning. The findings showed that 96% of the participants had had the necessary technology at their disposal. Therefore, they could use them in the process of education. To get an overall picture of the technology use, according to the survey conducted by the Statistical Office of the Slovak Republic [14], only 73.5% of the respondents have mobile devices, 18.2% have a laptop, 11.5% have a tablet, and 3% are the owners of different devices. However, the data showed that technological devices were widespread. On the other hand, only 81% of the households in the Slovak Republic have access to the Internet, which can cause the problems with course materials delivery in the time of distance online learning.

In addition, 72% of students stated they had the skills necessary for their work with new technologies, but 96% of them claimed they had been able to work on their own, without any direct help of adults. Although teachers and students are increasingly using ICT, there is still a large group of those who do not have sufficient skills. Most of them gradually feel the need to develop their competences in this area as it is important for all who want to improve their use of ICT and to increase information literacy [15].

The results also revealed that 98% of students had claimed they could work under conditions where they had the opportunity to fully focus on their studies. On a slightly controversial point is that 24% of the participants stated they had not had enough time to complete the tasks given by their teachers, which could possibly have something to do with the teachers' high expectations. On the contrary, according to the study conducted by Wilson-Fleming and Wilson-Younger [16], it is essential for teachers to have high expectations in order to ensure an atmosphere of success. Teachers also need to explain the importance of expectations to students and their parents, who should be allowed and encouraged to be involved in the process of education. The authors of the study claim that parental involvement in their child's education is one of the factors that play a crucial role in having positive learning environment and successful learning outcomes.

Jacobson [17] maintains that only a portion of students in schools are regularly given grade appropriate assignments to be completed. She believes that educators need to improve equity in school and make sure they are always listening to their students' needs because it was found that almost three-fourths of the time, students are doing the work given by teachers, but less than a fifth of the assignments meet learning standards. In the current study, 73% of the respondents found the difficulty level of learning appropriate and 25% found it inappropriate in the case of the tasks assigned by the Slovak language teacher. From this point of view, we can assume they did not have any problems with the difficulty level of the tasks assigned by the teachers of different subjects.

Furthermore, the research conducted by Marušić and Sliško [18] revealed the importance of the use of different methods, which increase students' level of thinking. They claimed it was important to challenge students and thus encourage them to a higher level of learning, reaching better academic outcomes. At the Secondary Vocational School of Gastronomy and Tourism, students were given homework in many forms, including worksheets and online exercises, as well as individual projects. In the time of the Coronavirus crisis, many teachers decided to use the combination of synchronous and asynchronous online teaching and learning. That is to say that 97% of students stated they had understood a new curriculum thanks to ZOOM classes and direct online contact with their teachers. Students also considered the EduPage, an educational online platform, the most suitable method in order to complete assignments. The remaining students found email the most

suitable way of communication and learning. Based on this information, appropriate and suitable teaching methods were used in the process of distance online learning.

Regarding evaluation, before a fair assessment process, it is essential to clearly identify what we are looking for [19]. In this study, the main criteria for objective evaluation of students' outcomes was their individual work. Therefore, it can be said that an evaluation of students, while using distance online learning, was mostly objective since 75% of them stated they had worked individually on their own and the rest of the students worked mostly on their own, and only in some cases did they require help from their peers or parents.

The findings of this study revealed that the majority of the students from the Secondary Vocational School of Gastronomy and Tourism are ready for distance online learning. Furthermore, the results indicate that a great percentage of students have Internet access and are the owners of technological devices that can be used for educational purposes. A great number of students claim that they are able to work on their own. In fact, they do not require any help while working on assignments. Although teachers use different teaching methods, it can be said that students prefer synchronous online courses because they enable them to have direct contact with their teachers and peers. This helps them understand the new curriculum better. It also testifies their readiness for the use of the Internet and technological devices in the process of education.

Overall, this research shows that distance online learning is possible provided that both teachers and students are familiarised with this new learning environment and are ready to cooperate.

#### 4. Conclusions

The Coronavirus disease, which has spread all over the world, has affected many areas of life, including education. According to a study conducted by Hebebcı, Bertiz, and Alan [20], more than 91% of the world's student population have been affected since educational institutions were temporarily closed. In order to continue to provide education, institutions were forced to switch from traditional, face-to-face learning to distance online learning.

The results of this study showed that today's students are ready to use technological devices not only in their common life, but also in the process of education. However, in order to provide quality education, Fidalgo, Thormann, Kulyk, and Lencastre suggest [6] assessing readiness to take distance learning through a survey, provide pre-distance learning courses, train instructors to develop distance online courses that help overcome obstacles, and offer courses in a blended learning format to familiarise students with online learning. Considering that distance education has an important place in education, we agree. Furthermore, students in our study stated they had relevant skills necessary for online learning. Only a small number of them did not feel confident in using technology.

This study provides some background information that may help educational institutions to offer distance online learning. However, we are aware of its limitations, especially the small sample size. Therefore, additional research about students' preferences related to distance online learning should be conducted and extended to the whole country, possibly to other European countries.

**Author Contributions:** Conceptualization, P.P.; Data curation, P.P. and B.K.; Formal analysis, B.K.; Investigation, P.P. and B.K.; Methodology, P.P.; Resources, P.P.; Supervision, B.K.; Validation, B.K.; Visualization, P.P.; Writing—original draft, P.P.; Writing—review & editing, B.K. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** Not applicable.

**Acknowledgments:** This paper was supported by the research project SPEV 2021, run at the Faculty of Informatics and Management, University of Hradec Kralove, Czech Republic. The authors thank Aleš Berger for his help with data collection and management of the Secondary vocational school of gastronomy and tourism in Nitra for their help with data collection.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. Keegan, D.J. On the Nature of Distance Education. *ZIFF Pap.* **1980**, *33*, 1–48.
2. Keegan, D.J. The future of learning: From eLearning to mLearning. *ZIFF Pap.* **2002**, *119*, 1–172.
3. Alqahtani, M.; Mohammad, H. Mobile Applications' Impact on Student Performance and Satisfaction. *TOJET Turk. Online J. Educ. Technol.* **2015**, *14*, 102–112.
4. University of the People. What Is Distance Learning? The Benefits of Studying Remotely. Available online: [Uopeople.edu/blog/what-is-distance-learning/](https://uopeople.edu/blog/what-is-distance-learning/) (accessed on 12 December 2020).
5. Shivangi, D. Online Learning: A Panacea in the Time of Covid-19 Crisis. *J. Educ. Technol. Syst.* **2020**, *49*, 5–22. [CrossRef]
6. Fidalgo, P.; Thormann, J.; Kulyk, O.; Lencastre, J.A. Students' perceptions on distance education: A multinational study. *Int. J. Educ. Technol. High. Educ.* **2020**, *17*, 1–18. [CrossRef]
7. Poláková, P.; Klímová, B. Mobile Technology and Generation Z in the English Language Classroom—A Preliminary Study. *Educ. Sci.* **2019**, *9*, 203. [CrossRef]
8. Sherry, L. Issues in Distance Learning. *Int. J. Educ. Telecommun.* **1995**, *1*, 337–365.
9. Galusha, J.M. Barriers to Learning in Distance Education. *ERIC* **1988**, 1–23. Available online: <https://files.eric.ed.gov/fulltext/ED416377.pdf> (accessed on 19 December 2020).
10. Verma, G. The Importance of a Positive Learning Environment. 2019. Available online: <https://www.linkedin.com/pulse/importance-positive-learning-environment-geeta-verma#:~:text=A%20positive%20classroom%20environment%20helps,leads%20to%20wonderful%20learning%20outcomes> (accessed on 19 December 2020).
11. Federation University. Levels of Learning. Bloom's Taxonomy. 2020. Available online: <https://federation.edu.au/staff/learning-and-teaching/teaching-practice/learning/levels-of-learning> (accessed on 19 December 2020).
12. Bajah, S.; Bunyi, G.; Knott, M.; Matiru, R.; Mulusa, T.; Muriuki, G.; Mutunga, P. Methods of Teaching and Learning. In *Teach Your Best: A Handbook for University Lecturers*; Institute for Socio-Cultural Studies: Kassel, Germany, 1995; p. 387. ISBN 3-88939-076-5.
13. Poláková, P.; Klímová, B. Assessment of vocabulary knowledge through a mobile application. *Procedia Comput. Sci.* **2020**, *176*, 1523–1530. [CrossRef]
14. Statistical Office of the Slovak Republic. Survey on Information and Communication Technologies Usage in Households. 2018; pp. 1–46. Available online: [https://slovak.statistics.sk/wps/wcm/connect/3fa87945-8bf1-47e0-a9d21451ae938f0/Zistovanie\\_o\\_vyuzivani\\_informacnych\\_a\\_komunikacnych\\_tehnologii\\_v\\_domacnostiach\\_2018.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-3fa87945-8bf1-47e0-a9d2-1451ae938f0-my4tPeD](https://slovak.statistics.sk/wps/wcm/connect/3fa87945-8bf1-47e0-a9d21451ae938f0/Zistovanie_o_vyuzivani_informacnych_a_komunikacnych_tehnologii_v_domacnostiach_2018.pdf?MOD=AJPERES&CACHEID=ROOTWORKSPACE-3fa87945-8bf1-47e0-a9d2-1451ae938f0-my4tPeD) (accessed on 20 December 2020).
15. Bobot, V.; Jakubeková, M.; Rurák, R. Využívanie Informačné-Komunikačných Technológií vo Vyučovaní. 2012, pp. 1–67. Available online: [https://lms.umb.sk/pluginfile.php/70133/mod\\_resource/content/1/IKT\\_vo\\_vyucovani.pdf](https://lms.umb.sk/pluginfile.php/70133/mod_resource/content/1/IKT_vo_vyucovani.pdf) (accessed on 20 December 2020).
16. Willson-Fleming, L.; Wilson-Younger, D. Positive classroom environments = positive academic results. *ERIC* **2012**, 1–5. Available online: [Files.eric.ed.gov/fulltext/ED536465.pdf](https://files.eric.ed.gov/fulltext/ED536465.pdf) (accessed on 20 December 2020).
17. Jasobson, L. The Importance of Grade-Appropriate Assignments. *GivingCompass* **2020**. Available online: [Givingcompass.org/article/the-importance-of-grade-appropriate-assignments/](https://givingcompass.org/article/the-importance-of-grade-appropriate-assignments/) (accessed on 20 December 2020).
18. Marušić, M.; Sliško, J. Influence of Three Different Methods of Teaching Physics on the Gain in Students' Development of Reasoning. *Int. J. Sci. Educ.* **2011**, *34*, 301–326. [CrossRef]
19. A NSW Government Website—Education. Evaluation Criteria, n.d. Available online: <https://education.nsw.gov.au/teaching-and-learning/professional-learning/evaluation-resource-hub/evaluation-design-and-planning/setting-the-scope-of-an-evaluation/evaluation-criteria> (accessed on 20 December 2020).
20. Hebecci, M.T.; Bertiz, Y.; Alan, S. Investigation of Views of Students and Teachers on Distance Education Practices during the Coronavirus (COVID-19) Pandemic. *Int. J. Technol. Educ. Sci.* **2020**, *4*, 267–282. [CrossRef]



Article

# The Impact of COVID-19 on Learning: Investigating EFL Learners' Engagement in Online Courses in Saudi Arabia

Iman Oraif <sup>1,\*</sup> and Tariq Elyas <sup>2,\*</sup>

<sup>1</sup> Department of English Language and Literature, College of Languages and Translation, Al-Imam Muhammad Ibn Saud Islamic University, Riyadh 3204, Saudi Arabia

<sup>2</sup> Department of European Languages and Literature, Faculty of Arts and Humanities, King Abdulaziz University, Jeddah 21589, Saudi Arabia

\* Correspondence: IMOraif@imamu.edu.sa (I.O.); telyas@kau.edu.sa (T.E.)

**Abstract:** As a result of the COVID-19 pandemic, most learning around the world has been transferred online. Learners who previously engaged in traditional learning now face a new challenge, a distinctive rise in e-learning. This drastic change could impact their learning behavior and acceptance of the change. As a result, their learning engagement could be affected massively. The present study therefore explores learners' level of engagement in online courses using a designated school platform within the context of Saudi Arabia. A reliable measure was implemented in the study based on the Student Course Engagement Questionnaire (SCEQ). A survey was consequently conducted in a high school in Saudi Arabia, with a sample of 379 female English as a foreign language (EFL) learners studying a general English language course. The results revealed a high level of engagement among EFL Saudi learners. This helped to generate recommendations to improve EFL practices, primarily through the use of an online environment either at the national level in the Saudi context or the international level.

**Citation:** Oraif, I.; Elyas, T. The Impact of COVID-19 on Learning: Investigating EFL Learners' Engagement in Online Courses in Saudi Arabia. *Educ. Sci.* **2021**, *11*, 99. <https://doi.org/10.3390/educsci11030099>

**Keywords:** COVID-19; EFL learners; engagement; student course engagement questionnaire; Madraști; platform; online learning

Academic Editor: Palitha Edirisingha

Received: 22 January 2021

Accepted: 22 February 2021

Published: 2 March 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

COVID-19 has resulted in schools being closed all across the world. Globally, over 1.2 billion students between elementary up to university level are off school [1]). While countries are at different points in their COVID-19 infection rates, there are currently more than 186 countries affected by school closure due to the pandemic [1]. Therefore, as a result of COVID-19, education has changed dramatically, with a distinctive rise in e-learning, whereby teaching is undertaken remotely or virtually and on digital platforms. The closure of all educational institutions in Saudi Arabia, due to the COVID-19 outbreak, has caused an unplanned rapid shift from the customary 'traditional' learning approach [2] to the new government-endorsed approach, namely, online learning. Saati claims that 'without the outbreak of the pandemic, our schools and universities would not have practiced distance learning in such a fluent way' [3]. The Saudi government has ensured that all sectors work together in a network, cooperating to prevent the spread of COVID-19. Thus, closure across all educational sectors in Saudi Arabia was decided by the Ministry of Education (MoE), on the recommendation of the Ministry of Health (MoH). According to Elyas, regarding the current educational shift 'the Ministry of Education was in a dilemma. However, remarkably they managed to control the situation by introducing the new official way of learning and creative way of online learning [4]. The first step towards this significant shift has been to design a platform to ensure continuity in learning.

Since the beginning of the period of school suspension in Saudi Arabia, the MoE has worked hard to efficiently adapt the educational system to distance learning. In fact, distance learning is not new to Saudi Arabia [5]; since community colleges and open



universities were first established in the Kingdom in 2002 [5]. For example, King Abdulaziz University adopted a home study system 30 years ago, which only required physical attendance of final exams. This was deemed to be a form of online/distance learning. In light of the current status of distance learning in Saudi Arabia, and in consideration of these efforts, learners could display a negative attitude and resist the change. For example, they could find the learning experience challenging and consider that it failed to meet their needs. Thus, they might not engage with the course. Building on Handelsman et al. definition of engagement and focusing on the micro-level of 'what happens in and immediately surrounding class' [6] (p. 185), the present study attempts to answer the following questions:

1. What is the level of engagement in English classes among high school EFL learners when online learning is adopted?
2. How do EFL learners feel towards receiving instruction in English classes in an online environment?

## 2. Literature Review

### 2.1. The Technological Shift

Many aspects of life, including education, have entered a 'new phase'. This is because of the impact of technology on communication, which converts it to a digital form. Technology has altered human interaction through the adoption of virtual worlds, which provide such advantages as enabling people to get to know each other or communicate without having to travel' [7]. It also implies that classrooms have the potential to become dynamic virtual worlds. Such dynamism is due to the non-restrictive aspects of these virtual worlds that can be easily modified and adopted based on the needs for learners. People from different cities and regions can also conveniently converge inside a virtual space, allowing for unique and very diverse classrooms within one country or even a multiple countries. With the spread of COVID-19, people have become physically 'distant', but have also become digitally 'close' in many cases. This increased engagement could be regarded as an opportunity to translate physical aspects of life into a digital dimension. During the pandemic, Kantar reported that social media engagement had increased by 61% over normal usage rates [8] (paragraph. 2).

Particularly with education, the digital world has the potential to transform the classroom with its accessibility, vastness, expansive digital environs, and ability to interact with classmates/instructors from different countries. Digital education or remote learning may therefore be described as open. Collectif de Chasseneuil defines this openness as:

[A]n organized and targeted educational environment which takes account of the learner's uniqueness in [ . . . ] his or her individual and collective dimensions supported by complementary learning situations in terms of places, timing, educational resources, human and technological mediations [9] (p. 185).

This openness in the digital world could make education increasingly accessible, enabling it to be tailored to individual needs. The way that each person accesses content is different and therefore, the acquisition of information should also be possible using different methods, whether through video, audio, text or another medium. The individuals choose what suits them according to their needs, which also affects how the acquired information is manifested to illustrate the knowledge gained. Learners can create various types of content from what they have learned, using videos, images or text, provided that they have the suitable means [10] (for more information about COVID-19).

### 2.2. Covid-19 and Education in the Saudi Context

This new remote form of education has its own culture, ideologies and mechanisms, which might not be familiar to all, regardless of whether they are teaching staff, students, or members of students' families [11]. Accordingly, this 'sudden shift from regular traditional classes to online classes [has presented students and teachers with] massive challenges [12].

Consequently, they have raised several issues such as problems with various online teaching platforms, a lack of prior experience in using these platforms, poor Internet connectivity, etc. [12]. Hamad bin Mohammed al-Sheikh, the Saudi Minister of Education, has declared that Saudi Arabia first began providing distance education services years ago, but the systems were recently upgraded in response to the coronavirus pandemic [13]. Since the beginning of this shift, the MoE has introduced several learning strategies to facilitate distance learning for students. For example, the Ministry has applied mechanisms and solutions for distance learning; established the 'Ien (عن) TV Channel', a 'Ien YouTube Channel', a 'Ien Virtual Gate', and other electronic platforms to provide eight million teaching hours, three million items of digital content, and three and a half million virtual classrooms [13]. Ziaul Hoq also mentions that the MoE is transmitting educational content for all grades via TV, as well as via social media networks, while nominating around 127 teachers and administrators to offer regular teaching in 112 enlightening courses across several TV channels (transmitting nationwide from a classroom in Riyadh) [14].

By the beginning of the current academic year in 2020, the MoE was ready to launch the new Madrasati platform. This ('My School' (Madrasati) platform is a new platform created during the COVID-19 in Saudi Arabia that serves over six million male and female students and their parents, and 525,000 people in education posts. The platform has various features such as visual communication; and uploading assignments, enrichment materials, recorded lessons, tests, and examinations, among others) (see Appendix A, Figure A1). In addition, there are 23 TV channels with a specific channel for each level. This would complement what had been prepared for the benefit of each student such as 'Future Gate', 'the Saudi Virtual School', and the 'Virtual Kindergarten' [13,14]. The MoE has implemented numerous educational policies to enable students to maximize these electronic and educational possibilities effectively. Thus, morning hours are assigned to intermediate and secondary school students, and afternoon hours are assigned to elementary school students, so that parents can follow up with their children to help them with their distance online learning in the evening.

Al-Mayman points out that the MoE is working closely with other ministries to ensure that each student has the necessary tools and resources to efficiently complete the school year via distance learning. The aim is to broadcast during school time to accommodate students who lack Internet access, or who have no devices to access the platform [13]. Even though as many as six million students and half a million teachers across Saudi Arabia have registered to join daily virtual classes on the new Madrasati platform, many students have their own financial burdens, to the extent that they cannot afford to buy computers or pay for stable Internet access. Commenting on the Ministry's pledge that students who cannot afford computers will not be left behind, 'there are a number of initiatives and collaborations between the ministry and other organizations such as Takaful to help students who cannot afford the basic equipment to access the platform' [14]). Takaful which is a charity foundation established to support financially disadvantaged students in Saudi public schools to continue and succeed in receiving proper education. The enterprise system and regulations of Takaful were approved in 2010 and it was officially registered in the Ministry of Social Affairs. Takaful receives generous support from The Custodian of the Two Holy Mosques which is around half a billion Saudi Riyal per year. Moreover, the MoE has been successful in providing six outstanding educational platforms, through which three million students have already benefitted. Equally, some educational television channels have received 61 million views, while the Ien national educational gateway offers 45,000 courses and 2000 digital school course books, and the Ien YouTube channel has 750,000 subscribers for 5400 recorded lessons and 4000 live teaching hours [15].

Hitherto, distance learning in Saudi Arabia has consequently provided many educational courses and recorded lessons, which students can engage with at any time to advance their learning, without being restricted to a classroom or timetable. The current complete shift towards online learning has encouraged students to explore new technologies and learn new ways of obtaining information. Online learning has harnesses a wide range of

educational styles based on Information Technology (IT), which helps students to interact in positive ways, resulting in the potential for massive innovation [16]. Nowadays, online learning enables parents to supervise their children's educational activities. Al-Mayman points out that 'Madrasati, a free educational platform which has been operating since August, will facilitate learners' evaluation and communication between teaching staff and students as well as their parents' [13]. Others adds that 'online learning diversifies learning strategies and contributes to the development of students' thinking skills through the use of technology that they love and use on a daily basis' [13,14].

Conversely, despite acceptance among many Saudis, the culture of remote learning still presents a considerable challenge that must be addressed. There is major controversy surrounding online learning and its benefits for Saudi students. Some Saudis have the preconception that this kind of learning does not require any effort to succeed. They also protest that the means of supervising students during their tests are still weak [16]. Also, Ziaul Hoq points out that 'special attention needs to be given [to] matters related to plagiarism' [13]. Meanwhile, some students might think that as they are not in school, they can do what they want, and so it is no longer important to study. Barakat states that 'distance learning does not support the idea of direct communication between the teacher and the student which may result in making the student lazy in his/her learning process because he/she is not under the domination of the teacher and the school administration' [17]. In the same vein, other scholars have suggested that 'we may need to explore methods [that are incorporated] with online teaching to enhance students' engagement [18] (p. 995).

Further to the above, Moawad investigated the stress caused by online learning during the COVID-19 pandemic among Saudi university students, studying 2271 male and female students at King Saud University [19]. He observed that 514 students were extremely stressed and anxious at the sudden shift from traditional face-to-face classes to online classes. Bao affirms that the success of an online course largely depends on an 'elaborate lesson plan design, creative and interactive teaching materials such as audio and video content' [20]. Since teachers and students have faced several difficulties due to the sudden shift from traditional to online classes, creative and innovative teaching in online courses is more imperative at this time than ever before.

Nevertheless, during the period of the pandemic, universities and educational institutions in Saudi Arabia have proved their effectiveness in education provision, especially in university education. A study carried out at King Khalid University aimed to assess the satisfaction of academic staff with the suspension of traditional teaching, and the shift towards online education, revealing that 55.9% of the participants 'agreed' or 'strongly agreed' that the sudden shift to web-based education took place smoothly, and 57.6% 'agreed' or 'strongly agreed' that giving lectures remotely was more flexible than delivering them face to face [21]. AlSalih points out that 'the MoE is working in cooperation with experts in international organizations to conduct an extensive validating assessment study on distance learning in universities and schools, during and after the pandemic [15]. Therefore, online learning is not just a temporary solution for this period. The Saudi Minister of Education, Dr. Hamad bin Mohammed Al Al-Sheikh has declared that online learning could eventually become a strategic choice for Saudi Arabia and not just an alternative in response to the coronavirus crisis [22].

### 2.3. Engagement in an Online EFL Course

Learner engagement is an important element to consider in the development of an effective course, especially with a view to enhancing learning outcomes [22,23]. Regarding Handelsman et al., identifying the level of learners' engagement is helpful for teachers when they work with individual students or are engaged in designing the classroom environment [6]. The above scholars state that there are already numerous studies examining engagement at 'macro-level', for example, the National Survey of Student Engagement (NSSE) at Indiana University, which examined whether the institution's program and practices were having the desired effect on the learners' activities, outcomes, and expe-

rience. Handelsman et al. further add that '[t]he NSSE focuses on active learning and other educational experiences but does not focus on individual courses; rather, it assesses students' overall perceptions' [6] (p. 184). On this basis, the above scholars constructed a scale for measuring what happens around and in class, since the teacher will have an immediate effect on learners' behavior and feelings in class. Thus, the above-mentioned study would suggest that students spend less time studying outside class. Regarding the current situation in Saudi Arabia, the need to examine learners' engagement in online classes was identified as urgent because it is a new phenomenon, marking a sudden change in education, in contrast to the education landscape before the COVID-19 pandemic [24].

The term 'engagement' has been addressed in different ways throughout the literature. This variation is due to the way in which engagement is viewed in specific contexts, as well as the way that it can be affected by and relates to the educational environment. For example, Bundick et al. included in their review that engagement can be affected by the interaction between primary elements in the classroom environment—the student, teacher, and content. They, therefore, proposed a conceptual framework using a previous model of classroom instruction and learning to conceptualize how student engagement could be promoted in the classroom [25]. The questionnaire used in the above study was derived from Diemer et al.'s [26] student engagement questionnaire. Thirty-five participants from two college-level Arabic language classes in a university in the south-west of the USA were involved. The data analysis showed that the students believed iPads had an important impact in their learning engagement, promoting active learning in the classroom and enhancing their achievement [25]. Al-Bogami and Elyas [27] studied the use of iPad and other handheld devices in classrooms for EFL students' engagement. Their study endeavored to illumine the extent to which a selection of iPad applications, used as a pedagogical tool, augment young learners' engagement and learning in EFL environments. The data revealed, based on the statistical evidence, that learners exhibited highly positive attitudes toward the use of the apps in their EFL classes (reading and vocabulary) as they found the apps bolstering their level of engagement and learning compared to traditional teaching paradigms [27].

Furthermore, Handelsman et al. state that engagement is a multidimensional phenomenon, adding that most definitions include behavioral and affective components [6]. The above authors cite Skinner and colleagues' in defining engagement as 'children's initiation of action, effort, and persistence on schoolwork, as well as their ambient emotional states during learning activities' [6] (p. 185). In light of these various factors, due to the recent technological advancement and the current pandemic, change has been forced in traditional education, especially in Saudi Arabia. In turn, the use of portable devices and an online environment may bring about change in an EFL learner's feelings and interaction with a course, hence, in his or her engagement with that course. Learners would therefore become more involved with the material and more encouraged to assume a role in their own learning. In particular, Handelsman et al.'s [6] division of engagement factors is drawn upon in this study to examine EFL learners' engagement in their English classes during the current pandemic in Saudi Arabia.

### 3. Research Methodology

#### 3.1. Study Design

This research follows a quantitative research approach because it can give a broader view of the sample's perception of a topic, rather than specifying a limited number of participants [28]. The quantitative data was acquired through random sampling, whereby a questionnaire was sent to the target sample and each member of that sample was given the opportunity to participate [29]. For the quantitative data, the questionnaires were translated into Arabic for the learners. Moreover, one item was modified from 'Going to the professor during office hours to review assignments or tests or to ask questions', to 'Going to the teacher during her free hours to review assignments or tests or to ask questions', because the latter would be more comprehensible to the participants at their

level of education. The translated items were then checked by a translation expert in the field. Before distribution, the researchers showed the survey to an expert and tested it with teachers who were part of the sample, in order to reveal any confusing items. Then, a pilot study was subsequently carried out, after which, the questionnaire was sent out to collect the data.

To test the reliability of the questionnaire, an internal consistency test was conducted using SPSS software for the whole scale, except for the demographic section. The Cronbach's alpha was found to be 0.913 (see Appendix D, Table A2), which is within the desired range [30]. Regarding the survey sample's responses to the tool, 50 respondents were involved in a pilot study. These respondents had similar characteristics to those of the study sample. It is evident from the data tabulated in (Appendix D, Table A1) that all items related to their corresponding dimension, at a level of significance of 0.01. This result indicates the validity of the instrument's internal consistency. It also demonstrates that the items had a statistically significant correlation to the dimension to which they belonged.

For the main data collection and due to the restrictions, the survey was created electronically using Google Forms, and then sent to the teachers via multiple methods, for example, through the Head of Graduate Studies, who had access to the sample population's contact information. Snowballing techniques, as per Emerson [29], were also implemented, where the survey was sent to a teacher with the request to forward it to her colleagues, thus ensuring that the survey reached the entire intended sample population. Finally, the data was coded and analyzed with SPSS version 26 and Microsoft Office Excel to derive the descriptive data. Normally distributed quantitative variables were presented as means and standard deviations (SD), and qualitative variables were expressed as frequency and percentages. ANOVA was then conducted to explore the statistical significance of the learning engagement, and the learners' feelings about their experience of attending online English classes. Pearson's correlation was likewise applied to discover the significance of the association between quantitative variables, with a  $p$ -value of  $<0.05$  being considered statistically significant. The study variables consisted of engagement (an independent variable) and the learners' feelings about their experience (the dependent variable).

Hence, this study was conducted to investigate a single existing case in an all-female High School in Jeddah, Saudi Arabia. Questionnaires were the main instrument used for the purpose of this study, since such a design would allow the phenomenon to be investigated in depth [31]. It would also enable a better understanding to be gained of an existing case, relating to the use of a special teaching and learning platform provided by the MoE: a platform known as 'Madrasati'.

In the current study, Handelsman et al.'s Student Course Engagement Questionnaire (SCEQ) was adopted [6]. This questionnaire was originally developed to measure engagement in specific college courses. In particular, the above authors sought to develop a reliable scale for measuring such engagement, which few researchers had previously attempted. This scale was included in the present study to measure engagement with a High School English language course (see Appendix C). Handelsman et al. [6] constructed the measure mainly for use at micro-level, concerning what happens in and immediately surrounding a class [6]. They explained that they were looking at engagement from this perspective because they believed it to be the level where the practitioner had most control. Thus, it was where most changes could be made. According to Ab Rahman et al. [32], no other existing scale evaluates learners' engagement on an individual course, rather than a whole program—as in the case of the National Survey of Student Engagement (NSSE). The SCEQ has been validated in several studies [33].

In their 23-item measure, Handelsman et al. [6] divided engagement into four factors. The measure demonstrated high internal consistency in their study, with a coefficient alpha of between 0.76 and 0.82. The above authors labeled the first factor, 'Skills engagement' since it reflects student engagement through skills practice. Meanwhile, the second factor was labeled 'Emotional engagement', relating student engagement to emotional involvement with the class material. The third construct, 'Participation/interaction engagement',

identifies learner engagement through classroom participation, as well as through interaction with instructors and peers. Finally, the fourth factor relates student engagement to performance in class, referred to as 'Performance engagement'.

Based on the outcomes of this case study, recommendations were drawn up to develop a current EFL online educational program. The study concentrated solely on measuring engagement among EFL learners in English classes, without looking at other courses. The researchers asked permission for access from the Saudi MoE, and this permission was granted. Several ethical considerations were addressed, such as obtaining approval from all the students before starting the research. Approval from the School Principal in Jeddah was also obtained. It was emphasized that all data would be kept confidential and would not be disclosed except for the purposes of this study.

### 3.2. Study Population

Between October and December 2020, all learners in the 68th High School for Girls in the city of Jeddah were invited through their English teachers to join the study. As mentioned earlier, an electronic questionnaire was subsequently distributed to all the female students at the 68th High School, and each participant was asked to sign the consent (see Appendix B). According to the characteristics presented in Table 1, below, 379 female students agreed to participate in the case study, comprising 96% of the study community.

**Table 1.** Characteristics of the participants (n = 379).

	Categories	N	%
School Grade	Grade 10	123	32%
	Grade 11	193	51%
	Grade 12	63	17%
Age	<15 years	25	7%
	16–17 years	315	83%
	>17 years	39	10%
City	Jeddah	379	100%
	Other	-	-
Gender	Female	379	100%
	Male	-	-
	Total	379	100%

## 4. Results

To answer the first question, 'What is the level of engagement in English classes among High School EFL female learners when online learning is adopted?', it was found that engagement in English classes among female High School EFL learners, when online learning was adopted, was generally at a high level of 'Characteristic of me' (mean = 4.08, SD = 0.547). Here, 'Performance engagement' was ranked first (mean = 4.53, SD = 0.542), indicated as 'Very characteristic of me'; 'Skills engagement' was ranked second (mean = 4.09, SD = 0.564), indicated as 'Characteristic of me'; 'Emotional engagement' was ranked third (mean = 3.88, SD = 0.799), indicated as 'Characteristic of me', and 'Participation/interaction engagement' was ranked fourth (mean = 3.81, SD = 0.713), indicated as 'Characteristic of me'.

### 4.1. Skills Engagement

In Table 2, it can be observed that skills engagement in English classes among female High School EFL learners, when online learning was adopted, was generally at the level: 'Characteristic of me' (mean = 4.09, SD = 0.564) for the level of engagement. This illustrates that the learners had skills engagement in the EFL course they were receiving via an online environment.

**Table 2.** Descriptive data for the students' skills engagement.

No.	Item	Mean	SD	Arrangement	Level of Engagement
1	Making sure to study on a regular basis	3.91	0.873	7	Characteristic of me
2	Exerting effort	4.15	0.841	4	Characteristic of me
3	Doing all homework problems	4.56	0.704	2	Very characteristic of me
4	Staying up to date with the readings	3.38	1.100	9	Moderately characteristic of me
5	Looking over class notes between classes to make sure I understand the material	3.81	1.019	8	Characteristic of me
6	Being organized	4.06	0.981	5	Characteristic of me
7	Taking good notes in class	4.01	0.936	6	Characteristic of me
8	Listening carefully in class	4.19	0.845	3	Characteristic of me
9	Coming to class every day	4.77	0.503	1	Very characteristic of me
	Skills engagement	4.09	0.564		Characteristic of me

'Coming to class every day' was indicated as 'Very characteristic of me' and ranked first (mean = 4.77, SD = 0.503); 'Solving all homework problems' was likewise indicated as 'Very characteristic of me' and ranked second (mean = 4.56, SD = 0.704), while 'Staying up to date with the readings' was ranked third (mean = 3.38, SD = 1.100), indicated as 'Moderately characteristic of me'. The results indicate that the learners had skills engagement (mean = 4.09, SD = 0.564).

#### 4.2. Emotional Engagement

In Table 3, it can be observed that the emotional engagement in English classes among female High School EFL learners, when online learning was adopted, was generally at the level: 'Characteristic of me' (mean = 3.88, SD = 0.799). As the results reveal, the learners were emotionally engaged in the classroom environment, since they responded positively to these elements in the scale, whereupon the scale indicated the participants' emotional engagement as emotional involvement with the class material. For example, 'Really desiring to learn the material' was ranked first (mean = 4.26, SD = 0.893), with a level of engagement indicated as 'Very characteristic of me'. Meanwhile, 'Finding ways to make the course interesting for me' was ranked second (mean = 4.06, SD = 1.002), with a level of engagement indicated as 'Characteristic of me', and 'Thinking about the course between class meetings' was ranked third (mean = 3.13, SD = 1.275).

**Table 3.** Descriptive data for the students' emotional engagement.

No.	Items	Mean	SD	Arrangement	Level of Engagement
1	Finding ways to make the course material relevant to my life	4.02	1.034	3	Characteristic of me
2	Applying the course material to my life	3.95	1.058	4	Characteristic of me
3	Finding ways to make the course interesting for me	4.06	1.002	2	Characteristic of me
4	Thinking about the course between class meetings	3.13	1.275	5	Moderately characteristic of me
5	Really desiring to learn the material	4.26	0.893	1	Very characteristic of me
	Emotional engagement	3.88	0.799		Characteristic of me

#### 4.3. Participation/Interaction Engagement

In Table 4, the participation/interaction engagement in English classes among female High School EFL learners, when online learning was adopted, was generally at the level: 'Characteristic of me' (mean = 3.81, SD = 0.713). For example, the learners responded to the following points: 'Helping fellow students' was ranked first (mean = 4.25, SD = 0.838), with a level of engagement indicated as 'Very characteristic of me'; 'Raising my hand in



class' was ranked second (mean = 4.13, SD = 0.931), with a level of engagement ranked as 'Characteristic of me', and 'Going to the teacher during her free hours to review assignments or tests or to ask questions' was ranked third (mean = 3.08, SD = 1.250), with a level of engagement indicated as 'Moderately characteristic of me'. The results indicate that the learners had participation/interaction engagement (mean = 3.81, SD = 0.713).

**Table 4.** Descriptive data for the students' participation/interaction engagement.

No.	Items	Mean	SD	Arrangement	Level of Engagement
1	Helping fellow students	4.25	0.838	1	Very characteristic of me
2	Raising my hand in class	4.13	0.931	2	Characteristic of me
3	Participating actively in small-group discussions	3.99	0.947	3	Characteristic of me
4	Having fun in class	3.92	0.991	4	Characteristic of me
5	Asking questions when I don't understand the instructor	3.50	1.139	5	Characteristic of me
6	Going to the teacher during her free hours to review assignments or tests or to ask questions	3.08	1.250	6	Moderately characteristic of me
	Participation/interaction engagement	3.81	0.713		Characteristic of me

#### 4.4. Performance Engagement

In Table 5, it may be seen that performance engagement in English classes among female high school EFL learners, when online learning was adopted, was generally at the level: 'Characteristic of me' (mean = 4.08, SD = 0.547). It should be considered that one of the main aims of any educational program is to instill and foster a sense of needing to succeed on a course. The following statements elicited the most agreement from the learners: 'Doing well in the tests' was ranked first (mean = 4.58, SD = 0.635), with a level of engagement indicated as 'Very characteristic of me'; 'Getting a good grade' was ranked second (mean = 4.53, SD = 0.663), with a level of engagement indicated as 'Very characteristic of me', and 'Being confident that I can learn and do well in class' was ranked third (mean = 4.48, SD = 0.721), with a level of engagement indicated as 'Very characteristic of me'. A correlation test was also conducted (see Appendix D, Table A3), where it may be observed that the correlation analysis revealed a relationship between all student engagement factors. The results indicate that the learners had a performance engagement (mean = 4.53, SD = 0.542).

**Table 5.** Descriptive data for the students' performance engagement.

No.	Items	Mean	SD	Arrangement	Level of Engagement
1	Getting a good grade	4.53	0.663	2	Very characteristic of me
2	Doing well in tests	4.58	0.635	1	Very characteristic of me
3	Being confident I can learn and do well in class	4.48	0.721	3	Very characteristic of me
	Performance engagement	4.53	0.542		Very characteristic of me

To answer the second question, 'How do female EFL learners feel towards receiving instruction in English classes in an online environment?', it was found that 59% of the students were 'Satisfied' with their experience of attending English classes, 37% were 'Somewhat satisfied', and just 4% were 'Not satisfied' (see Table 6). More than half of the learners were positive about their experience of studying online, thereby indicating their engagement with the course. Further analysis was then conducted on these data.

**Table 6.** Descriptive data for students' feelings about their online learning experience.

Variables	Categories	N	%
How do you feel about attending English classes virtually?	Satisfied	223	59%
	Somewhat Satisfied	140	37%
	Not Satisfied	16	4%

On conducting a one-way ANOVA test, it may be seen from Table 7 that there was a relationship between the learners' engagement and their feelings about their experience of attending online English classes ( $p < 0.01$ ).

**Table 7.** Relationship between the learners' engagement and their feelings about their experience of attending online English classes.

Variables		N	Mean	SD	f	p-Value *
Skills engagement	Dissatisfied	16	3.8463	0.47991	20.204	0.01
	Somewhat satisfied	140	3.8881	0.62211		
	Satisfied	223	4.2401	0.48107		
Emotional engagement	Dissatisfied	16	3.6375	0.76322	9.864	0.01
	Somewhat satisfied	140	3.6743	0.82735		
	Satisfied	223	4.0323	0.75172		
Participation/interaction engagement	Dissatisfied	16	3.6044	0.67122	20.058	0.01
	Somewhat satisfied	140	3.5396	0.71460		
	Satisfied	223	3.9950	0.65770		
Performance engagement	Dissatisfied	16	4.5831	0.35586	8.484	0.01
	Somewhat satisfied	140	4.3840	0.61389		
	Satisfied	223	4.6190	0.48397		

\* One-way ANOVA.

Furthermore, an open-ended question was added to the questionnaire, with the potential to gain more understanding from the learners, as they would be able to give reasons for their satisfaction or dissatisfaction with their experience of learning in an online environment. Content analysis was used to organize the themes in the responses given [31]. By examining the valid responses, the frequency of certain themes was noted in the texts (see Tables 8 and 9).

**Table 8.** The responses given by the learners for being dissatisfied with their experience of learning English in an online learning environment.

Reasons for Not Being Satisfied with the Online Environment	No. of Responses	%	Examples
Problems in understanding	6	46%	"Difficulties in understanding"
Poor connection	1	8%	"Because sometimes, I have a bad connection and that affects my learning"
Pressures	1	8%	"I prefer to attend normal classes; I noticed difficulties in my ability to learn, and pressures"
Difficulties in concentration	2	15%	"I cannot concentrate . . . too noisy . . . I didn't get my chance to participate"
Lack of real interaction	2	15%	"No real interaction"
Accepting the online environment	1	8%	"I don't like studying online"
Total	13	100%	

**Table 9.** Responses given for being satisfied with the experience of learning English in an online environment.

Reasons for Being Satisfied in the Online Environment	Numbers of Responses	Percentage	Examples
Easier to understand	81	49.4%	"The information is delivered in a simple way" "Very satisfied, because I understand the syllabus better" "The teacher delivers the information simply and clearly"
The role of the teacher	19	11.6%	"I love the English language and my teacher helps us to speak and work during class" "The teacher is cooperative"
Learning the language in the right way	12	7.3%	"Enjoying learning the language in the right way"
Giving more opportunities for learners to participate	9	5.5%	"I can participate more and understand more"
Multiple resources	9	5.5%	The 'Ain' channel and WhatsApp
Helping us to concentrate more	6	3.7%	"So, I have enough free time to learn how to read and write in English"
To limit the spread of the virus	6	3.7%	"Satisfied with the experience in helping to stop the spread of the virus"
Efficacy of the strategies used	5	3.0%	"The strategies used, and the online teaching are nice"
New experience	5	3.0%	"New method of education which suits my age and mentality" "Exciting and a good way to learn"
Improving language skills	3	1.8%	"Private lesson, feeling comfortable and safe"
Independency in learning	3	1.8%	"Being more independent in learning"
Saving time and effort	2	1.2%	"Online learning helped save me time and effort"
Reducing negative feelings (anxiety and stress)	2	1.2%	"I am a shy person, and online learning gave me a chance to participate and not be afraid of making mistakes, and motivated me to answer"
Using technology for description	1	0.6%	"Using technology to describe the content" "I love technology"
Using dictionary and translation	1	0.6%	"Learning and translation are easier because we are using multiple means"
Total	164	100.0%	

It was found from the descriptive data provided by the respondents (see Appendix D, Table A4) that 72% of the students used the enrichments and links that were available on the Madrasati platform, relating to English as a school subject. Using an online environment helped the learners to be more independent in that they put the course material into practice and accessed the enrichments for themselves. Moreover, they indicated that the experience was beneficial, as they were able to participate more during class and avail themselves of multiple resources. The collected responses to this question indicate the various levels of learner engagement in a classroom environment, as defined by Handelsman et al. [6]. From these results, it can be seen that the learners displayed engagement in their online English classes. Due to their engagement, they described their experience as satisfactory.

## 5. Discussion

Based on the results presented in this paper, the sampled learners showed engagement with their online English classes in relation to several constructs of engagement with their course. Specifically, it was evident in the survey responses that the learners showed engagement through classroom participation; engagement through interaction with instructors and peers; engagement through skills practice; engagement through their emotional involvement with the class material, and engagement through their performance in class. In addition, a positive correlation was found between their satisfaction and engagement. Therefore, based on the learners' engagement, it was deduced that they were satisfied

with receiving instruction via an online environment. Another study, conducted by Graham [34], tested the impact of social media on Humanities students at a British university, when learning outside the classroom. From the questionnaire results, it was found that the students' engagement with learning outside the classroom was enhanced by using social media for learning purposes. Similarly, Rose et. al found that by using videos with chemistry students, the learners showed engagement with the learning material outside the classroom and achieved better exam results [34]. In the same vein, Al-Bogami and Elyas study on EFL classes found the apps bolstering their level of engagement and learning compared to traditional teaching paradigms which helped to foster more active learning in the classroom [27]. From the results of this current and previous studies and by adopting a robust research approach, it could be claimed that using an online environment with other technological tools like videos and links could support learners' engagement both within and outside the classroom, whether emotionally or in terms of participation, skills and performance.

As mentioned previously, these findings indicate that a move toward online courses can be effective. They support that the different types of engagement considered in this study may be enhanced in various ways as a result of studying online, in comparison with traditional teaching. To elaborate on this, traditional teaching methods that have continuously hindered change [3,35] were examined, even though it could be asserted that change is what the educational setting desperately needs. Traditional methods often give teachers immense control, which they exert over their students [36,37]. Consequently, students have not been given sufficient capacity to create or express themselves, with the result that they can be lacking in some areas at later stages of their learning. Moreover, given that online learning skills are necessary in modern educational environments, together with skills in academic writing and research (thereby promoting learners' development), practical training is essential [38].

However, many high school students appear to be barely acquainted with computers and academic writing, let alone versed in research methods. This introduces paradoxes into the university setting: what is expected in university settings contradicts what is cultivated in the schools. Classroom materials appeared to rely heavily on a teacher-delivery-teacher-centered approach, whereby the students mainly received or were spoon-fed information [39,40]. On the implementation of e-learning, as indicated by the survey results, the learners felt satisfied because they found the approach to be suitable for their age group and mindset. Moreover, they found the course fun, and described their teacher as cooperative. Consequently, they were able to take control of their own learning, displaying skills engagement. To an even greater extent, the learners exhibited performance engagement, finding themselves able to learn and keen to succeed in their exams. Furthermore, they showed that they were using the available enrichments to help them study during their free time.

Another example of the shortcomings of traditional methods is the way that schools often emotionally inhibit students, where these students are not sufficiently exposed to emotional care in the school setting. Growing up with such assumptions could compromise their communicative abilities, as well as preventing trust from developing between students and teachers [40]. This could be a reason why some students are inactive in certain classes [41,42]; their emotions are continuously suppressed and their ability to express themselves might be ruptured. Schools have traditionally tended to focus primarily on providing information, while other human factors such as emotions have been neglected. These are some of the many issues originating in the nature of the traditional classroom. However, in this current study, online learning appeared to enhance the learning situation, as indicated in the survey results. The learners seemed to be more confident and motivated to participate, interacting with each other and with their teacher. They even offered to help their peers, as well as demonstrating they were trying to apply what they had learned in the classroom to their everyday lives, as displayed in their emotional engagement.

However, in the circumstances created by COVID-19, another dimension has been introduced, in that traditional methods have simply become impossible to implement. Arguably, however, the physical medium that previously gave presence to the teacher and students, along with ways of enacting authority and control, was in any case gradually becoming obsolete [39]. The need for social distancing during the pandemic has further shifted the physical classroom environment to something different, remote. As a result, some of the control has been taken from one hand and placed in the other. Remote learning has brought to light the years of classroom imbalances now manifesting in conflict and alienation [38–40]. It has revealed how Saudi education was previously advancing very slowly in conceptual terms. This slow progress has been exhibited as incompatibility with the online medium. Consequently, teachers are struggling to cope with the change.

What has occurred in practice is that the teacher's role has been supplemented with appropriate changes to reflect general societal advancement. The spread of the COVID-19 pandemic has forced such change onto unfamiliar ground, but it is not COVID-19 itself that renders the ground unfamiliar; it is rather the actual role of the teacher that has been stuck in a loop for generations, neglecting the potential for necessary change [43]). This has left teachers incapacitated, struggling to cope with the new medium [39]. Whereas society itself has adopted different technologies and became acquainted with their use, education has heavily controlled how students receive information, and continue to impose traditional methods [39]. However, this contradicts the free nature of remote learning. As the results of this present study indicate, the learners showed to have participation/interaction engagement with their online learning. For example, timid learners felt more confident about interacting and expressing their thoughts freely. Furthermore, most of the learners found the experience to be fun and engaging.

Nevertheless, the medium of remote-learning places students and teachers on almost equal levels of control, which is where conflict and alienation can arise. Without a physical presence, students can deviate from classroom expectations; they may either oppose instructions or refuse to comply [39,40,44,45]. In the present study, the teacher's role included expectations of compliance that could not be enforced through the current medium, due to its virtual nature. This potentially creates a big gap for those who identify themselves with traditional teaching methods, but now find themselves suddenly having to use a medium that demands a different approach. Being without a suitable approach can alienate teachers by making them feel that their presence is no longer necessary [46]. As their role has hitherto been associated with a high level of control, the backlash could also be immense. Nevertheless, this previous control rendered the learning environment less than dynamic, which can be seen in the transition itself. Because the traditional classroom relies heavily on teachers' involvement, teachers have sometimes felt excluded by the new medium [39].

## 6. Conclusions

This study has demonstrated that a solution should not include either dispensing with the teacher or forcibly re-adopting traditional methods; instead, it should be more about relaxing the teacher's control, involving the students, and adjusting the new medium to suit the needs of both sides. The teacher's role consequently needs to change from being authoritative to being cooperative and engaging. In a cooperative classroom, teachers are part of an interactive environment that focuses on aural and visual stimulation [27]). The teacher's role here does not solely consist of presenting the material, but also of introducing students to creative new learning methods. Thus, students become creators, designers, and authors, independently shaping their own experiences, and actively contributing to the learning environment of a classroom. This, can be achieved through visual and aural guidance, while the teacher acts as a creative guide, enhancing the students' experiences through constructive feedback [27,45].

In conclusion, a whole range of needs have called upon an imperative reform for educational change worldwide and in 'Saudi Arabia' [46,47]. However, to involve students in the new medium, it is essential to understand what they are already familiar with

and why [48]. This will contribute towards the classroom a meaningful experience by transforming familiarity into something new and beneficial [48]. Given the abundant ways in which remote learning enables interaction, it is possible to create a dynamic environment that shapeshifts according to students' individual differences, reflected in the cooperative efforts of teachers and students [9]. We can argue that the sole benefit offered by COVID-19 is to highlight the usefulness and potential of this new method of teaching and learning, and its activation in the current education system worldwide. In any case, traditional learning has already been affected by the rapid global development of technology, which has especially impacted Saudi Arabia [35,49]. These abrupt changes in education are linked with teachers' teaching-related decisions that were influenced by factors that were related to the existence of digital tools as well as the ability to use them purposefully in the home settings of teachers and students [50]. Ultimately, we are left with an imperative need for better-designed programs that are suitable for online learning, not only in the current crisis, but for the near and distant future [51]. In fact, this move is needed globally, which may enable stakeholders to face such situations more specifically in consideration with language teaching and learning. Online and/or distance learning has become an urgent necessity for higher education institutions, imposed by the nature of emergency conditions in which we live [52]. We, trust that the learning process will never be the same, making learning more interactive, fun, and engaging than ever. Thus, educators need to welcome these new changes with open arms and open minds.

Based on the current research, the following procedure is recommended: 1. Statistical examination of the relationship between engagement and learning outcomes: due to the limited time available for conducting this study, and because of the COVID-19 quarantine conditions, it was not possible to examine the change in EFL learners' performance in this study, or to relate that change to their engagement, 2. Application of the study to male High School students as well: a limitation of this current study was its exclusively female sample, due to limited accessibility and the short time period available to the researchers for data collection, 3. Follow-up interviews conducted with the participants to gauge a more comprehensive understanding of their feelings: conducting more in-depth interviews using semi structured or open interviews could help gain a deeper understanding of the impact and reception of online education.

**Author Contributions:** Conceptualization, I.O. and T.E.; methodology I.O. and T.E.; software, I.O. and T.E.; validation, I.O. and T.E.; formal analysis, I.O. and T.E.; investigation, I.O. and T.E.; resources, I.O. and T.E.; data curation, I.O. and T.E.; writing—original draft preparation, I.O. and T.E.; writing—review and editing, I.O. and T.E.; visualization, I.O. and T.E.; supervision, I.O. and T.E.; project administration, I.O. and T.E.; funding acquisition, I.O. and T.E. Both authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author. The data are not publicly available due to the policy of data security given by the Ministry of Education in KSA.

**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A



Figure A1. A screenshot of Madrasati in Saudi MoE.

## Appendix B

### Consent Form

You are kindly invited to participate in a short survey, consisting of this online questionnaire. It contains around 23 items and will not need more than 10 min to complete. The questionnaire is designed to discover your attitude to online learning and measure your engagement in online English classes. You have the right to withdraw from the survey at any stage. The data you provide will only be used for the purpose of this research and will not affect your grades. Every effort will be made to ensure the confidentiality of the collected data.

Your consent to participate in this survey will be greatly appreciated, making an essential contribution to my research.

Thank you for your cooperation.

Yours sincerely,

For further details, please feel free to contact the researchers, at any time on:

Email: e.oraif@gmail.com

Statement of consent:

I hereby agree to take part in this survey. I understand that the data will be protected and sign accordingly,

Participant's signature

Agree Do not agree



### Appendix C

#### Questionnaire

##### Part 1:

1. Year in school: Year 10 Year 11 Year 12
2. Age: Less than 15 years 16–17 Years More than 18 Years
3. City . . . . .
4. Gender: Female Male
5. Do you use the enrichments and links available for the English subject on the 'Madrasti' platform?  
Yes No  
If your answer is No, please specify . . . . .
6. If yes, do you rely solely on these enrichments and links to develop your English language skills?  
Yes No  
If your answer is No, please specify . . . . .
7. How do you feel about attending English language classes through the online environment?  
Satisfied Somewhat satisfied Dissatisfied  
Kindly, add your reasons . . . . .

##### Part 2:

- A. To what extent do the following statements describe your behavior and feelings while studying online for your English course? On the scale provided, please select the statement that best describes your feelings and behavior:
- 5 = Very characteristic of me  
4 = Characteristic of me  
3 = Moderately characteristic of me  
2 = Not really characteristic of me  
1 = Not at all characteristic of me
1. . . . . .Making sure to study on a regular basis
  2. . . . . .Putting forth effort
  3. . . . . .Doing all the homework problems
  4. . . . . .Staying up on the readings
  5. . . . . .Looking over class notes between classes to make sure I understand the material
  6. . . . . .Being organized
  7. . . . . .Taking good notes in class
  8. . . . . .Listening carefully in class
  9. . . . . .Coming to class every day
  10. . . . . . Finding ways to make the course material relevant to my life
  11. . . . . .Applying course material to my life
  12. . . . . .Finding ways to make the course interesting to me
  13. . . . . .Thinking about the course between class meetings
  14. . . . . .Really desiring to learn the material
  15. . . . . .Raising my hand in class
  16. . . . . .Asking questions when I don't understand the instructor
  17. . . . . .Having fun in class
  18. . . . . .Participating actively in small group discussions
  19. . . . . .Going to the teacher during her free hours to review assignments or tests, or to ask questions
  20. . . . . .Helping fellow students
  21. . . . . .Getting a good grade
  22. . . . . .Doing well in the tests
  23. . . . . .Being confident that I can learn and do well in class

## Appendix D

**Table A1.** Pearson's correlation coefficient between the item and the factor to which it belongs.

Skills Engagement		Emotional Engagement		Participation/Interaction Engagement		Performance Engagement	
No.	R	No.	R	No.	R	No.	R
1	0.759 **	10	0.857 **	15	0.595 **	21	0.785 **
2	0.765 **	11	0.761 **	16	0.773 **	22	0.849 **
3	0.626 **	12	0.816 **	17	0.661 **	23	0.760 **
4	0.671 **	13	0.761 **	18	0.600 **		
5	0.868 **	14	0.744 **	19	0.567 **		
6	0.673 **			20	0.502 **		
7	0.736 **						
8	0.625 **						
9	0.364 **						

\*\* Correlation is significant at the 0.01 level (2-tailed).

**Table A2.** Cronbach's alpha.

Factors	No. of Items	
Skills engagement	9	0.860
Emotional engagement	5	0.830
Participation/interaction engagement	6	0.673
Performance engagement	3	0.710
Overall	23	0.913

**Table A3.** Correlations and descriptive data for the student engagement factors.

Factors	Mean	SD	Skills Engagement	Emotional Engagement	Participation/Interaction Engagement	Performance Engagement
Skills engagement	4.09	0.564		0.584 **	0.728 **	0.580 **
Emotional engagement	3.88	0.799			0.595 **	0.544 **
Participation/interaction engagement	3.81	0.713	0.728 **	0.595 **		0.531 **
Performance engagement	4.53	0.542	0.580 **	0.544 **	0.531 **	
Overall	4.08	0.547	0.860 **	0.830 **	0.673 **	0.710 **

\*\* Correlation is significant at the 0.01 level (2-tailed).

**Table A4.** Descriptive data for the resources used by students on the online platform.

Variables	Categories	N	%
Do you use the enrichments and links available for the English subject on the 'Madrasti' platform	YES	274	72%
	NO	105	28%

## References

1. Rahman, R.A.; Ahmad, S.; Hashim, U.R. A study on gamification for higher education students' engagement towards education 4.0. In *Intelligent and Interactive Computing*; Piuri, V., Balas, V.E., Borah, S., Syed Ahmad, S.S., Eds.; Springer: Singapore, 2019; pp. 491–502.
2. Affouneh, S.; Salha, S.N.; Khlaif, Z. Designing Quality E-Learning Environments for Emergency Remote Teaching in Coronavirus Crisis. *Interdiscip. J. Virtual Learn. Med. Sci.* **2020**, *11*, 1–3.
3. Al Arabiya (English). Distance Learning amid Coronavirus to Help School Dropouts in Saudi Arabia. Al Arabiya News. 2020. Available online: <https://english.alarabiya.net/en/coronavirus/2020/05/15/> (accessed on 26 July 2020).

4. Al-Bogami, B.; Elyas, T. Promoting Middle School Students' Engagement through Incorporating iPad Apps in EFL/ESL Classes. *SAGE Open* **2020**, *10*. [CrossRef]
5. Al-Mayman, H. Saudi E-Learning Portal Ushers in New Normal with Virtual Classrooms. 512 Arab News. Available online: <https://www.arabnews.com/node/1730541/saudi-arabia> (accessed on 6 September 2020).
6. Al-Sheikh, H. Online Learning after CORONA for the Better. Al Arabiya. Available online: <https://www.alarabiya.net/ar/saudi-today/2020/04/20/> (accessed on 22 October 2020).
7. Alamer, O. The Culture of Distance Learning. Al-Jazirah Newspaper. Available online: <https://www.al-jazirah.com/2020/20200324/ar3.htm> (accessed on 24 March 2020).
8. Aldwaihi, A. Available online: <https://www.okaz.com.sa/articles/authors/2034871> (accessed on 26 July 2020).
9. Alfifi, A. After Coronavirus: Our Education towards the Best. Alriyadh Newspaper. Available online: <http://www.alriyadh.com/1816856> (accessed on 20 April 2020).
10. AlHamid, S. Distance Learning. Okaz Newspaper. Available online: <https://www.okaz.com.sa/articles/people-voice/2034184> (accessed on 23 July 2020).
11. Almaghaslah, D.; Alsayari, A. The Effects of the 2019 Novel Coronavirus Disease (COVID-19) Outbreak on Academic Staff Members: A Case Study of a Pharmacy School in Saudi Arabia. *Health Policy Politi Sante* **2020**, *13*, 795–802. [CrossRef]
12. AlSalih, K. Saudi Study for Assessment of Remote Learning Process. Alwatan Newspaper. Available online: <https://www.alwatan.com.sa/article/1048932> (accessed on 20 June 2020).
13. AlShehri, Y.A.; Mordhah, N.; Alsibiani, S.; Alsobhi, S.; Alnazzawi, N. How the Regular Teaching Converted to Fully Online Teaching in Saudi Arabia during the Coronavirus COVID-19. *Creat. Educ.* **2020**, *11*, 985–996. [CrossRef]
14. Annetta, L.A.; Minogue, J.; Holmes, S.Y.; Cheng, M.-T. Investigating the impact of video games on high school students' engagement and learning about genetics. *Comput. Educ.* **2009**, *53*, 74–85. [CrossRef]
15. Barakat, R. Extension of Distance Learning in Saudi Arabia. Mhtwyat. Available online: <https://bit.ly/35gxtPG> (accessed on 11 August 2020).
16. Barata, G.; Gama, S.; Jorge, J.; Goncalves, D. Engaging Engineering Students with Gamification. In Proceedings of the 2013 5th International Conference on Games and Virtual Worlds for Serious Applications (VS-GAMES), Piscataway, NJ, USA, 11–13 September 2013.
17. Basalamah, O.; Elyas, T. Conceptualizing the virtual learning space(s) in Saudi Arabia: A Foucauldian panoptic approach. *Int. J. Engl. Lang. Teach.* **2014**, *2*, 1–15.
18. Basalamah, O.; Elyas, T. Conceptualizing virtual learning space(s) in Saudi Arabia: A Foucauldian panoptic approach. In *Beyond the Postmodern: Reconceptualization of Space and Place for the Early 21st Century*; Brelow, H., Ziethen, A., Eds.; Inter-Disciplinary Press: Oxford, UK, 2015; pp. 63–78. ISBN 978-1-84888-319-2.
19. Bao, W. COVID-19 and online teaching in higher education: A case study of Peking University. *Hum. Behav. Emerg. Technol.* **2020**, *2*, 113–115. [CrossRef]
20. Black, T.R. *Doing Quantitative Research in the Social Sciences: An Integrated Approach to Research Design, Measurement and Statistics*; Sage: Thousand Oaks, CA, USA, 1998.
21. Bundick, M.J.; Quaglia, R.J.; Corso, M.J.; Haywood, D.E. Promoting Student Engagement in the Classroom. Available online: <http://www.tcrecord.org> (accessed on 26 July 2014).
22. Cujba, S. How to Engage Students in Learning? Racon Gang. Available online: <https://racongang.com/blog/how-engage-students-learning/> (accessed on 26 July 2017).
23. Diemer, T.T.; Fernandez, E.; Streepey, J.W. Student perceptions of classroom engagement and learning using iPads. *J. Teach. Learn Technol.* **2012**, *1*, 13–25.
24. Dörnyei, Z. *Research Methods in Applied Linguistics: Quantitative, Qualitative, and Mixed Methodologies*; Oxford University Press: Oxford, UK, 2007.
25. Elyas, T. Exploring the Challenges and Solutions of Web-Based Education on the Learners' Experiences during COVID-19 Pandemic: A Cognitive Psychological Approach. In Proceedings of the ASIA TEFL 2020 Conference, Goyang City, Korea, 13–15 July 2020.
26. Elyas, T. The Rise of Remote (Neo)Pedagogy in the Time of 21st Pandemic Era: Juxtaposing between Panoptic and Cognitive Approach in the Learners' Experiences. In *Applied Linguistics & Language Teaching (ALLT)*; Zayd University: Zayd, United Arab Emirates, 2020.
27. Emerson, R.W. Convenience Sampling, Random Sampling, and Snowball Sampling: How Does Sampling Affect the Validity of Research? *J. Vis. Impair. Blind.* **2015**, *109*, 164–168. [CrossRef]
28. González, M.A.; Santos, B.S.N.; Vargas, A.R.; Martín-Gutiérrez, J.; Orihuela, A.R. Virtual Worlds. Opportunities and Challenges in the 21st Century. *Procedia Comput. Sci.* **2013**, *25*, 330–337. [CrossRef]
29. Graham, M. Social Media as a tool for increased student participation and engagement outside the classroom in Higher Education. *J. Perspect. Appl. Acad. Pr.* **2014**, *2*, 16. [CrossRef]
30. Hamdan, M. حراك المؤتمرات العلمية الطالبي. Saudi Opinions. Available online: <https://www.saudiopinions.org/ar/30987/> (accessed on 29 August 2020).
31. Handelsman, M.M.; Briggs, W.L.; Sullivan, N.; Towler, A. A Measure of College Student Course Engagement. *J. Educ. Res.* **2005**, *98*, 184–192. [CrossRef]

32. Heflin, H.; Shewmaker, J.; Nguyen, J. Impact of mobile technology on student attitudes, engagement, and learning. *Comput. Educ.* **2017**, *107*, 91–99. [CrossRef]
33. Jézégou, A. The influence of the openness of an e-learning situation on adult students' self-regulation. *Int. Rev. Res. Open Distrib. Learn.* **2013**, *14*, 182–201. [CrossRef]
34. Kantar. COVID-19 Barometer: Consumer Attitudes, Media Habits and Expectations. Available online: <https://www.kantar.com/Inspiration/Coronavirus/COVID-19-Barometer-Consumer-attitudesmedia-habits-and-expectations> (accessed on 26 July 2020).
35. Khalid, T. Distance Learning amid Coronavirus to Help School Dropouts in Saudi Arabia: Minister. Al Arabiya (English). Available online: <https://english.alarabiya.net/en/coronavirus/2020/05/15/Distance-learning-amid-coronavirus-to-help-school-dropouts-in-Saudi-Arabia-Minister> (accessed on 14 May 2020).
36. Lalani, F.; Li, C. The COVID-19 has Changed Education Forever. This is How. World Economic Forum. Available online: <https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning/> (accessed on 29 April 2020).
37. Mahboob, A.; Elyas, T. English in the Kingdom of Saudi Arabia. *World Engl.* **2014**, *33*, 128–142. [CrossRef]
38. Lepp, L.; Aaviku, T.; Leijen, Ä.; Pedaste, M.; Saks, K. Teaching during COVID-19: The Decisions Made in Teaching. *Educ. Sci.* **2021**, *11*, 47. [CrossRef]
39. Lassoued, Z.; Alhendawi, M.; Bashitialshaaer, R. An Exploratory Study of the Obstacles for Achieving Quality in Distance Learning during the COVID-19 Pandemic. *Educ. Sci.* **2020**, *10*, 232. [CrossRef]
40. Mann, S.J. Alienation in the learning environment: A failure of community? *Stud. High. Educ.* **2005**, *30*, 43–55. [CrossRef]
41. McNamee, D. What are the Adult Health Consequences of Childhood Bullying? *Medical News Today*. Available online: <https://www.medicalnewstoday.com/articles/283042> (accessed on 25 September 2014).
42. Moawad, R.A. Online Learning during the COVID-19 Pandemic and Academic Stress in University Students. *Rev. Rom. Pentru Educ. Multidimens.* **2020**, *12*, 100–107. [CrossRef]
43. MOE. ومعلميهم الطلاب بين افتراضية وفصول متنوعة إلكترونية بأدوات بُد عن تقاطعي تعليم 'مدرستي' منصة. Available online: <https://www.moe.gov.sa/ar/news/pages/mn-2020-876.aspx> (accessed on 26 July 2020).
44. Montague, B. Needing Change, Changing Needs. *The Ecologist*. Available online: <https://theecologist.org/2019/apr/03/needing-change-changing-needs> (accessed on 26 July 2019).
45. Naar, I. Saudi Arabia Coronavirus: Distance Learning for First 7 Weeks of New Academic Year. Al Arabiya (English). Available online: <https://english.alarabiya.net/en/coronavirus/2020/08/15/Saudi-Arabia-Distance-learning-for-first-7-weeks-of-new-academic-year-amid-COVID-19> (accessed on 15 August 2020).
46. Nasir, M.A.M.; Janikowski, T.; Guyker, W.; Wang, C.C. Modifying the Student Course Engagement Questionnaire for use with online courses. *J. Educ. Online* **2020**, *17*, n1.
47. Obaid, R. Saudi Students, Educators take on Virtual Education Challenge Amid Coronavirus Suspension. Arab News. Available online: <https://www.arabnews.pk/node/1640211/saudi-arabia> (accessed on 26 July 2020).
48. Rose, J.; Pennington, R.; Behmke, D.; Kerven, D.; Lutz, R.; Paredes, J.E.B. Maximizing Student Engagement Outside the Classroom with Organic Synthesis Videos. *J. Chem. Educ.* **2019**, *96*, 2632–2637. [CrossRef]
49. Saati, A. Distance Learning and Coronavirus Crisis. Aleqt. Available online: [https://www.aleqt.com/2020/04/05/article\\_1797576.html](https://www.aleqt.com/2020/04/05/article_1797576.html) (accessed on 5 April 2020).
50. Shereen, M.A.; Khan, S.; Kazmi, A.; Bashir, N.; Siddique, R. COVID-19 infection: Origin, transmission, and characteristics of human coronaviruses. *J. Adv. Res.* **2020**, *24*, 91–98. [CrossRef] [PubMed]
51. Skinner, E.A.; Wellborn, J.G.; Connell, J.P. What it takes to do well in school and whether I've got it: A process model of perceived control and children's engagement and achievement in school. *J. Educ. Psychol.* **1990**, *82*, 22–32. [CrossRef]
52. Thomas, G. *How to Do Your Research Project: A Guide for Students*; Sage: Thousand Oaks, CA, USA, 2017.



## Article

# Local and External Stakeholders Affecting Educational Change during the Coronavirus Pandemic: A Study of Facebook Messages in Estonia

Piret Luik \* and Marina Lepp

Institute of Computer Science, University of Tartu, 51009 Tartu, Estonia; marina.lepp@ut.ee

\* Correspondence: piret.luik@ut.ee

**Abstract:** Education worldwide was affected by the coronavirus pandemic when many countries, including Estonia, had to switch to distance learning. It was an unexpected change in education and required a response from relevant stakeholders. This study aims to understand the activities of different stakeholders as revealed in the messages of the Facebook group ‘Homeschooling with technology’ from 6 March to 26 April 2020. A mixed method study design was used, including quantitative and qualitative content analysis of 872 messages posted by members of the Facebook group, which were divided into eight role groups. Teachers, educational technologists, principals and parents represented local stakeholders while external stakeholders included members from government institutions, supporters, teacher educators and members with other roles. The analysis covered activeness of each role group, emotional expressions, speech acts and topics represented in messages. The results indicate that educational technologists played a key role in handling the coronavirus pandemic situation in education. However, local stakeholders also received support from external stakeholders. The results help capture the roles, experiences and views of different stakeholders during the educational change caused by the coronavirus pandemic in order to learn from this and to be prepared for such situations in the future.

**Citation:** Luik, P.; Lepp, M. Local and External Stakeholders Affecting Educational Change during the Coronavirus Pandemic: A Study of Facebook Messages in Estonia. *Educ. Sci.* **2021**, *11*, 113. <https://doi.org/10.3390/educsci11030113>

Academic Editor: Palitha Edirisingha

Received: 15 February 2021

Accepted: 6 March 2021

Published: 10 March 2021

**Publisher’s Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

**Keywords:** stakeholders; Facebook; COVID-19; content analysis; educational change

## 1. Introduction

Education worldwide was affected by the pandemic of coronavirus disease 2019 (COVID-19) when all levels of education were transferred to distance learning. This transition was not smooth and required tremendous efforts from all stakeholders—teachers, students, parents, school principals, and government. As reported in different cases, it was not so much the technology but a lack of planning, coordination, communication and management that placed a heavy burden on students, parents and teachers [1]. Different roles at various levels of the education system had distinct needs, opinions, perspectives, and experiences during the pandemic. In addition, different stakeholders did various things to shape change in addressing their needs and priorities. It is important to provide information about this unanticipated situation due to the pandemic, ideally from different actors’ perspectives [2]. By investigating that, we can learn from this and be prepared for such situations in the future.

### 1.1. Theoretical Framework

There are many different theories and models of educational change [3,4]. A critical theory of change caused by educational innovation is the Concerns-Based Adoption Model (CBAM), which shows how change affects people [5]. Another significant theory is Fullan’s educational change theory, which focuses on human participants of the change process, such as teachers, students, parents, and policymakers, and offers a theoretical underpinning to understand how they can affect change [6]. Ellsworth [3] pointed out that Fullan’s model

helps to answer the questions of what the implications of change are for people or organizations promoting or opposing it at particular levels, and what can different stakeholders (e.g., teachers, district administrators, parents) do to promote change that addresses their needs and priorities. Fullan [6] proposed that there are four phases in the change process: initiation, implementation, continuation, and outcome. The implementation phase usually includes the first 2 or 3 years of use and involves the first experiences of attempting to implement a change. Fullan [7] identified nine factors affecting implementation, which can be organized into three main categories: characteristics of change (need of change, clarity about goals and needs, complexity of change, quality and practicality of the program), local factors (school district, community, principal, teacher) and external factors (government and other agencies). In the current article, Fullan's educational change theory is used as a theoretical framework to capture how the different parties of the educational system influenced the changes in education caused by the coronavirus pandemic. This model was chosen because it focuses on how a person affects the change, unlike the CBAM model [5], which looks at how change affects a person.

### 1.2. Literature Review

The unforeseen change in teaching during the coronavirus pandemic can be characterized as a colossal and complex issue, with many different things to take into consideration, and even well-experienced teachers felt that they had to learn what and how to teach [8,9]. Teachers, their attitudes and perspectives are the major subjects of investigation during the educational changes [4] as educational change depends on what teachers do and think [7]. Similarly, teachers, their preparedness and experiences were targeted exploring the changes in teaching and learning due to the COVID-19 pandemic [8,10]. Teachers have used various applications and tools to facilitate distance teaching and learning. Previous research has found that no single application/tool is preferable to others and various technologies, used adequately and with purpose, can contribute to providing the education [1]. The most common tools were applications that enabled real-time videoconferencing, pre-recorded seminars, communication and collaboration, sharing materials, digital learning resources, learning management systems, and live broadcasting features of social networking sites [1,8]. Subject teachers used special tools for teaching their subjects during the COVID-19 pandemic, for example, science teachers liked the tools that help create free interactive science simulations [11]. While choosing a suitable tool, issues with General Data Protection Regulation (GDPR) and cybersecurity should be taken into account [1,8]. Another issue during distance learning was the pedagogy of using various digital tools because, previously, the main emphasis has been on the technical aspects of tools rather than the pedagogical dimension [10]. As a result, teachers lacked the pedagogical strategies necessary in distance learning [8]. In addition, teachers were unsure of how to conduct diagnostic tests in distance learning as there was a lack of tools to support secure digital examination [8]. There have been hundreds of online webinars to upskill teachers in distance education [1,12].

Individual teachers are necessary, but insufficient for a wide change [7]. Accordingly, principals' actions should serve to support teachers both psychologically and with resources. School districts and countries with their histories of changes and positive or negative experiences can facilitate or incapacitate the change. School boards and communities should actively work together and develop strong parent-school relationships for achieving the change. Policymakers should not be preoccupied with policy and programs and should be aware of the problems and the process of implementation of the change by the practitioners. The different local and external stakeholders, e.g., respectively, students, parents and school leaders on the one hand and teacher educators and members of the school support system on the other, as well as their opinions, views and perceptions were also studied during the coronavirus pandemic [2,12,13]. Both school principals and teachers were waiting for the governments to provide clear guidance, guidelines and clarity for the organization of distance learning [12]. However, even teacher educators felt



that they were moving from knowingness to knowing-less and shared uncertainty about well-established practices and guidelines [13]. Non-teaching staff (e.g., parental) support was needed by teachers and played an important role in students' learning efforts and outcomes [2]. Different organizations provided digital content and materials, for example, book publishers gave free access to their textbooks [1,12]. However, using technology, students and teachers can access specialized materials beyond textbooks [14].

An important channel of communication among students, parents, educators, and school administrators during the coronavirus pandemic was social media, such as Facebook groups, forums, blogs [1,15]. Social media is publicly available data, which can be used to collect information and to capture public attention during a crisis [16,17]. Facebook has all the tools necessary to create an online community to share resources and experiences, interact with each other and provide support from experts desperately needed by struggling teachers [18]. With this intention, different professional Facebook groups have been created during the COVID-19 pandemic (e.g., [1,15]). It has been suggested that teacher collaboration can be an alleviating factor that reduces the perceived degree of stress of school staff, as opposed to the stress perceived by students and school leaders who may not have such cooperation [2]. Social media makes it possible to analyze different things, for example, speech functions and acts used in posts that can show what different stakeholders do and how they affect the implementation of the change. From the four primary speech functions ('statement', 'question', 'offer' and 'command'), teachers engaging in self-organized Facebook groups tend to use 'questions' and 'offers' [19]. Social media is used for sharing information and opinions, but also emotions and negative responses prevail after unpredictable calamities [20]. The same was found during the school closure in Chicago in 2012, where the capture of social media posts, describing the impact of the closure on students and their families, showed that two-thirds of posts expressed negative sentiment [16]. Social media topics and emotional expressions during the COVID-19 epidemic have been analyzed as well in order to grasp the public's subjective ideas and provide decision support for relevant departments [21]. However, social media data produced by different roles of the educational system have been underused for educational research during the coronavirus pandemic.

### 1.3. Aim and Research Questions

The review of recent literature reveals that there are studies on how teachers affect the change related to the COVID-19 situation. There are few studies about the role of the principals and other stakeholders handling this emergency situation. However, there is a lack of studies analyzing how different stakeholders affect and promote change during the COVID-19 situation. It is important because people are a crucial variable in the change process [6] and studies on educational change, such as Fullan's [7], deal mostly with planned changes undertaken to enhance learning. In spring 2020, the COVID-19 situation was an unexpected, forced and temporary change in education, in which we have had to learn how different stakeholders reacted at the beginning of the implementation phase of this change. Existing research has shown that public information in social media (e.g., Facebook) can reflect the situation during the crisis [16,17]. Therefore, this paper aims to understand the activities of different stakeholders as revealed in the messages of the Facebook group 'Homeschooling with technology' from 6 March to 26 April 2020.

Three research questions were posed. As previous studies [16,20] indicate that emotions and negative responses tend to prevail in social media after unpredictable calamities, but during change, all stakeholders take part in it by promoting or opposing the change [7], and the activeness of posting messages indicates the degree of interest in those topics at this time period [22], the first research question was: How active were the members in different roles and what sentiments were expressed in their messages?

As all stakeholders have their own roles and responsibilities in change and have to support some other counterparts [7], and some stakeholders can promote and others oppose the change [3], the two other research questions were: What did members with

different roles write about in the Facebook group? Who were the addressees of the messages in the Facebook group written by different roles?

## 2. Methods

Mixed methods quantitative-dominant design was used in this study to explore the Facebook group messages in detail. It promotes a deeper, more contextual understanding of content. Both quantitative and qualitative content analysis was used in this study.

### 2.1. Sample

The sample of the study consisted of members, who posted at least one message in the open Facebook group ‘Homeschooling with technology’. The group was created by three members of the Estonian Union of Educational Technologists on 6 March when the first school in Estonia switched to distance learning after one student had been diagnosed with the COVID-19 virus. With more than 8000 members, this group became the largest Facebook group in Estonia, providing support for schools and homes alike. The number of members in the group increased sharply on 12 March, when the emergency situation was announced and all schools were required to switch to distance learning by 16 March [15].

Of all members, 348 posted at least one message in the group. Among these posters, 67 were (19.3%) male and 276 (79.3%) female. Five members (1.4%) posted from their organization’s Facebook account. Each member was assigned a role based on Google search results and Facebook data. In total, eight different roles were determined: teacher, principal, educational technologist, teacher educator (university academic staff, who educates pre-service teachers), parent, supporter (people who work in institutions providing learning materials or tools for education), government (members from a ministry or a ministerial agency) and others. Others include members whose role could not be identified, but also members who do not work in schools or enterprises providing support (librarians, psychologists, secretaries, medical doctors etc.) and we did not find any evidence that they are parents. According to Fullan [7] teachers, educational technologists, principals and parents represent local factors, while members from governmental institutions, supporters and teacher educators are external factors in terms of affecting change. A description of the different roles is presented in Table 1.

Table 1. Description of the sample.

Name of the Role Group	Number of Members with This Role	Number of Males	Number of Organizations
	<i>n</i>	<i>n</i> (%)	<i>n</i> (%)
Teacher	133	18 (13.5)	
Other	55	9 (16.4)	
Supporter	51	17 (33.3)	4 (7.8)
Educational technologist	30	5 (16.7)	
Teacher educator	28	7 (25.0)	
Parent	23	8 (34.8)	
Government	18	1 (5.6)	1 (5.6)
Principal	10	2 (20.0)	
Total	348	67 (19.3)	5 (1.4)

### 2.2. Data Collection and Quantitative Analysis

As the first step, deductive quantitative content analysis was used for analyzing 872 messages, which were posted between 6 March to 26 April 2020, in the Facebook group ‘Homeschooling with technology’. For coding the content of the messages, a quantitative content analysis was conducted using the elaborated coding manual with definitions, descriptions and decision-making guidance for encoders. Quantitative content analysis was used, because it uses exact words from the text and describes only the visible and obvious in the text [23] and therefore is more systematic and less subjective [24]. A unit of

meaning at this stage was one whole message. The following variables were determined for each message:

- Sentiments: the message was coded as expressing a negative sentiment if it included words with a negative connotation like ‘problem’, ‘bad’, ‘failed’, etc. Positive sentiments included words such as ‘good’, ‘happy’, ‘succeeded’, ‘satisfied’, etc., and neutrally written messages were coded as neutral sentiments.
- Speech acts: in this study, only messages without comments were coded and therefore, an adapted coding schema from previous studies [25,26] was used. All messages were coded using six codes of speech acts: providing resources (sharing hyperlinks, citations, files, research objects as sources without any comments, suggestions or information), informing (information based on facts or experiences), expressing an opinion (opinion(s), subjective assertions to other users), asking (direct questions seeking information or discussion), recommending (suggestion, advise, attempt to cause action), and inviting (invitation to join something, do something together). A more detailed description of the speech act codes is given in our previous study [27].
- Topics: nine codes (tool, learning material, webinar, collection, management, methodological idea, tool guide, cyber risk, and other) were used for identifying the topics in the messages.
- Addressees: the coding of message addressees was based on the explicit wording used in the message. Six codes (everyone, teachers, principals, schools, parents, and students) were defined.

To test the coding procedure, 91 (10.4%) of all messages were coded by two independent researchers and their codes were compared. The agreement between the researchers was at 0.80. After that, the messages were divided and coded independently by the two researchers. However, the researchers met and coded together each week to make sure that the degree of agreement between the coding judgments had not decreased in the meanwhile. In the case of coding differences between the researchers, a consensus was reached via negotiations. Also, whenever a researcher had doubts about a particular message, they reviewed that message together with the other researcher.

Quantitative data were analyzed using SPSS version 26.0. Descriptive statistics were used to describe the data. For comparing activeness of different roles, Welch’s analysis of variance (ANOVA) with a Games–Howell post hoc test was used. The Welch test was used because groups had unequal variances. For comparing sentiments in messages, which were on an ordinal scale (coded  $-1, 0, 1$ ), the Kruskal–Wallis test as a one-way ANOVA on ranks was used. If the Kruskal–Wallis test was significant, then the Mann–Whitney U-test (the non-parametric version of the Student *t*-test) was used to identify differences between individual role groups. The Chi-square test was used for comparing distributions.

### 2.3. Qualitative Content Analysis

Inductive qualitative content analysis was used for deeper exploration of the content of the messages by different roles in order to answer the second research question. Inductive content analysis is used if the phenomenon has not been previously studied or the previous studies are fragmented [28].

The second, qualitative stage of the study was largely guided by the results of quantitative content analysis. At first, based on quantitative content analysis, all messages were divided into groups according to the topic. The resulting nine groups were all coded separately.

As recommended by Elo and Kyngäs [28], first, the transcripts were read several times to immerse ourselves in the data; this was followed by the analytical process, which included open coding, creation of categories, and abstraction. The first step, familiarization with the data, started with quantitative coding and taking preliminary notes. The codes included names of the tools or learning materials, phrases that expressed the issue discussed in a message, etc. It was possible for each message to have several codes. The codes (words, phrases) that shared the same meaning were grouped under categories. For exam-

ple, the category of ‘assessment’ included messages about student assessment tools and codes like ‘formative assessment’, ‘numerical assessment’, ‘focus on assessment’. In the abstraction phase, a general description of the research topic was formulated by generating and regenerating categories and subcategories.

The internal validity of content analysis was assessed by using two coders and re-coding. At first, one researcher coded the messages and a co-coder coded the text using the codes created by the first coder, with the possibility to add new codes if she wanted to. After coding the text by the co-coder, the result was reviewed together and, as there were no significant differences in coding, there was no need to change the codes after co-coding. One month later, the entire material was re-coded by one researcher to see if the codes entered seemed reasonable and meaningful after some time had passed. The second coding did not differ significantly from the first coding, so it could be assumed that the selected codes covered the selected meaningful units and were suitable for the analysis of the results.

### 3. Results

The results section is organized according to the research questions, presenting quantitative data. In the case of the second research question, quantitative results are explained in detail with qualitative data.

Of the members who posted at least one message, teachers constituted the largest group and posted the highest percentage of all messages (Table 2). However, taking into account the number of messages per member, there was a statistically significant difference in activeness of posting between the role groups (asymptotically distributed  $F = 2.479$ ,  $p < 0.05$ ). The Games–Howell post hoc test revealed that the most active members were educational technologists (difference from all other role groups  $p < 0.05$ ). As mentioned in the methodology part, the Facebook group was initiated by members from the Estonian Union of Educational Technologists and the three initiators were the most active posters, with 127 messages in total. There were no other differences between the role groups in terms of activeness in postings ( $p > 0.05$ ).

**Table 2.** Descriptive statistics of activeness of different roles in writing messages.

Name of the Role Group	Number of Members with This Role <i>n</i>	Number of Messages from This Role (% of All Messages)	Number of Messages per Member <i>n</i>
Teacher	133	259 (29.7)	2
Educational technologist	30	237 (27.2)	7.9
Supporter	51	108 (12.4)	2.1
Other	55	93 (10.7)	1.7
Teacher educator	28	67 (7.7)	2.4
Government	18	58 (6.7)	3.2
Parent	23	32 (3.7)	1.4
Principal	10	18 (2.1)	1.8
Total	348	872	2.5

The Kruskal–Wallis test indicated that there was a statistically significant difference in the tonality of statements by authors’ roles ( $H = 30.229$ ,  $p < 0.01$ ). The Mann–Whitney U-test revealed that parents posted more messages with negative sentiments compared with other roles (all  $p < 0.01$ ), except principals (see also Figure 1).

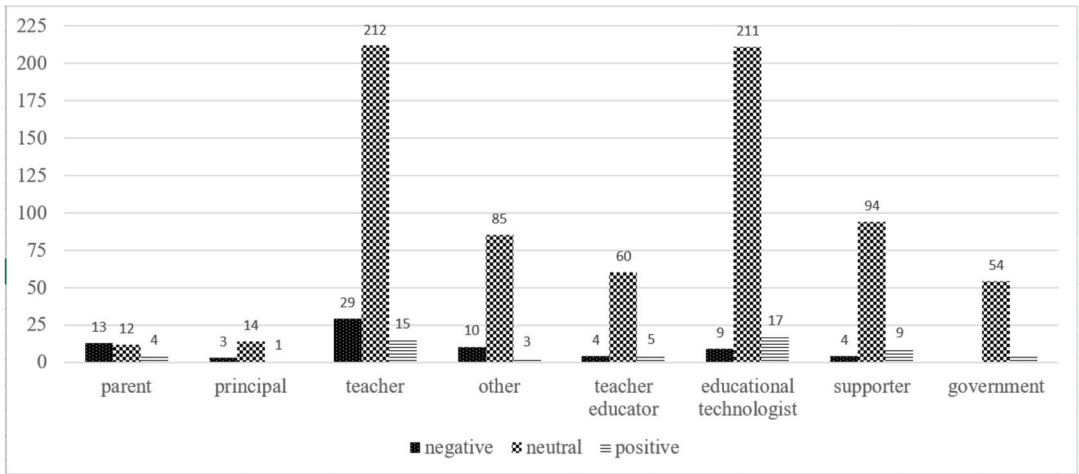


Figure 1. Positive, neutral and negative sentiments in the messages, by role.

There was a statistically significant difference in speech acts expressed in messages ( $p < 0.01$ ) in different role groups, except principals and parents (see also Table 3). The Chi-square test revealed the most used acts by role (see also Table 3). There was one predominant speech act in the case of educational technologists and supporters. The greatest percentage of the messages by educational technologists (43.5%) were with the speech act of ‘providing resources’, whereas supporters mostly informed other members in the group (42.6% of their messages). In messages by teachers and members with other roles, the more prevalent acts included asking (34.0% and 29.0%, respectively) and providing resources (32.8% and 30.1%, respectively). Two distinguishing speech acts by members from government institutions and teacher educators were informing (29.3% and 28.4%, respectively) and providing resources (respectively 25.9% and 28.4% of their messages). All coded speech acts were represented in messages posted by different roles, except for principals whose messages never included invitations to participate in some activities.

Table 3. Speech acts represented in messages, by authors’ role.

Name of the Role Group	Providing Resources	Informing	Asking	Recommending	Inviting	Expressing Opinion	Chi-Square <sup>a</sup>
Teacher	85	39	88	33	8	6	150.552 **
Educational technologist	103	62	17	31	18	6	169.658 **
Supporter	18	46	6	23	11	4	66.556 **
Other	28	13	27	13	7	5	31.194 **
Teacher educator	19	19	8	16	3	2	27.478 **
Government	15	17	5	9	11	1	18.759 **
Parent	4	7	10	6	1	4	8.875
Principal	6	4	2	4		2	3.111

Note: Predominating speech acts are in bold. <sup>a</sup>—In the cases where the expected frequency was less than 5, Fisher’s exact test was used. \*\*  $p < 0.01$ .

Again, there was a statistically significant difference in the topics represented in messages according to the chi-square test in each of the role groups (see also Table 4). All topics were represented in messages by teachers, educational technologists and members with other roles. Only four of the nine topics were identified in the messages posted by principals: tool, management, methodological idea, and other.

Table 4. Topics represented in different messages, by author's role.

Name of the Role Group	Tool	Learning Material	Webinar	Management	Methodological Idea	Other	Collection	Tool Guide	Cyber Risk	Chi-Square <sup>a</sup>
Teacher	107	46	8	17	20	41	6	11	3	302.718 **
Educational technologist	43	21	59	20	8	50	17	11	7	114.619 **
Supporter	21	26	8	10	7	28	6		2	54.556 **
Other	16	16	9	11	6	30	2	1	2	67.548 **
Teacher educator	21	12	6	5	5	12		2	3	34.364 **
Government	8	4	20	5	1	14	4		2	41.586 **
Parent	4	5	1	16	3	1			2	36.250 **
Principal	2		7		1	8			2	8.222 *

Note: Predominating topics are in bold. <sup>a</sup>—In the cases where the expected frequency was less than 5, Fisher's exact test was used. \*  $p < 0.05$ . \*\*  $p < 0.01$ .

Teachers and teacher educators posted mostly (respectively 41.3% and 31.8% of their messages) about tools. Teachers were the role group, whose messages were about various tools (mind maps, screencasting, photo editors and sharing, web-boards, e-learning platforms, web-conferencing tools etc.) but mostly about assessment tools (e.g., Kahoot, Quizlet, LearningApps etc.). Assessment tools were mentioned in messages by all roles, except parents. Messages by educational technologists and teacher educators about tools mostly referred to some web-conferencing tools. More fun tools, like music composition or learning games, were presented in messages by teachers and supporters. Tools, which are not so commonly used in schools, like audio editors, social bookmarks and programming, could be found in messages by educational technologists.

Members from ministerial agencies and educational technologists shared more webinars (34.5% of their messages). Educational technologists and supporters posted messages with varied content. However, one-quarter of the messages by educational technologists (25.0%) were about webinars. Also, the content of webinars shared in the Facebook group by educational technologists was varied, including the use of different tools, but also management at schools and at home, and health issues. Nevertheless, the management at school was the dominant topic in webinars distributed by educational technologists. Members from government institutions invited the other members mostly to participate in webinars about learning management systems and management at schools. More than one-third of the messages about webinars by teachers and teacher educators referred to webinars, where methodological ideas were introduced.

Almost a quarter of the messages by supporters (24.1%) were about learning materials. Also, in the case of learning materials, different assessments prevailed and learning material about assessments was posted by each role group at least once. Teachers and students were supported also with e-lessons and videos, which were distributed in this Facebook group. Only teacher educators did not post any e-lessons, and members from government institutions did not post any videos. E-lessons prevailed among the messages with the topic of 'learning material' by educational technologists, whereas supporters posted actively both e-lessons and videos. Again, less common and newer technological possibilities, like virtual reality, were introduced by educational technologists.

Half of the messages by parents (50.0%) were about management issues and this was one of the main topics of principals, too (38.9% of their messages). Principals, teachers and educational technologists from different schools posted mostly about their experiences of how to manage distance education in an emergency situation and gave suggestions for others. The content of the messages by parents on the topic coded as 'management' was also mostly about their experiences, how they cope with homeschooling, juggling their own work and supporting their children, and they gave tips for other parents, too. However, homeschooling was also mentioned in messages by all other roles, and parents gave suggestions to schools on how to manage teaching. Assessment issues were represented in the messages with the topic 'management' by all role groups, except principals. The need to reduce the diversity of digital tools used and to lower the workload was pointed out by parents, teachers, supporters and members with other roles. All role groups, but especially principals, supporters and members with other roles posted messages, which were coded as 'other' topics. These included different cartoons, jokes, wishes, thanks, etc.

Messages representing the topics coded as 'tool', 'management', 'methodological idea' and 'other' were posted by each role group. The category of methodological ideas included tips by teachers and educational technologists on how to use web-conferencing tools like Zoom. For example, it was explained how to use these tools for group work by creating breakout rooms. Supporters shared different websites (art, virtual museums, etc.) and offered ideas on how to use these in lessons. Parents shared methodological ideas, which had been given to their children and which the parents really liked.

Tool guides were shared only by teachers, educational technologist, teacher educators and members with other roles. In most cases, it was guidance on how to use web conferencing tools or learning management systems. Also, teachers and educational technologists



shared with others instructions on creating videos, including screencasts, and on using web-boards. It was also interesting that all roles discussed cyber risks, except principals. Cyber risk issues related to Zoom were pointed out by educational technologists, supporters, teacher educators and members with other roles. Supporters and members from government institutions also distributed general suggestions on how to avoid cyber risks. As children spent more time at their computers, educational technologists pointed out the health problems, while teachers and supporters warned about cyberbullying.

Members of different roles posted messages for different target groups. All role groups posted messages for everyone, schools and teachers (see Table 5). Messages for everyone were prevalent among the messages by educational technologists, supporters, parents and members with other roles. In addition to writing messages to everyone, teachers also wrote for other teachers. Members from government institutions addressed their messages mostly to teachers. There was no statistically significant difference in the case of teacher educators and principals.

**Table 5.** Addressees of the posted messages, by authors' role.

Name of the Role Group	Everyone	Schools	Teachers	Principals	Parents	Students	Chi-Square <sup>a</sup>
Teacher	<b>93</b>	58	<b>93</b>		4	11	142.525 **
Educational technologist	<b>91</b>	44	75	6	10	11	170.570 **
Supporter	<b>58</b>	11	23		3	13	86.074 **
Other	<b>53</b>	8	24		4	4	94.151 **
Teacher educator	30	17	19				4.455
Government	11	12	<b>29</b>	3	2	1	57.862 **
Parent	<b>19</b>	5	5	1	1		33.000 **
Principal	9	3	5	1			7.778

Note: Predominating speech acts are in bold. <sup>a</sup>—In the cases where the expected frequency was less than 5, Fisher's exact test was used.

\*\*  $p < 0.01$ .

Interestingly, principals were the addressee only in messages posted by educational technologists, parents, principals themselves, and members from government institutions. Principals were the group with the lowest number of messages addressed to them.

#### 4. Discussion

This study aimed to understand different stakeholders' activities, as revealed in the messages of the Facebook group 'Homeschooling with technology' from 6 March to 26 April 2020. The results are discussed according to the local and external factors and different roles because success in changes depends on both local and external factors, and the people involved in the change process, and how they affect the change, is a crucial variable [7].

##### 4.1. Local Stakeholders Affecting the Change

All roles representing local factors (teachers, principals, educational technologists, and parents) posted about their experiences of how to manage distance education in an emergency situation at school and at home and gave suggestions to others. Also, it was found that all these role groups addressed most of their messages to everyone.

**Teachers** can work with or oppose change, and it is important that teachers know the goal of the change [7]. Like previous studies about teaching in an emergency situation [8,9], indicating that even highly experienced teachers tend to have doubts about what and how to teach, our results also demonstrated that the share of questions was higher in messages posted by teachers. This result ties well with the findings of Liljekvist et al. [19], according to which teachers in Facebook groups used mostly 'questions' and 'offers', and indicates that teachers were not well informed in this unexpected change. However, only a little over one-tenth of the messages by teachers was with negative sentiments. Besides the messages for everyone, messages for other teachers were also prevalent among the messages by teachers. Teachers also provided resources to other members in the group

and such messages were predominantly about tools. Teachers wrote about varied tools, but mostly about assessment tools. Previous studies have also indicated that teachers can be unsure about how to conduct tests and assessments in distance learning and how to find suitable tools for that [8].

**Principals** should take a leading role in the change [7], however, principals were quite passive in the observed Facebook group. It might be that they were busy managing changes in their own school and were silently waiting for guidelines as has been found in previous studies [12]. Like teachers, principals shared both positive and negative statements. It was interesting that principals did not invite others to participate in any activities, whereas all other roles used this speech act in their messages. As with some of the coded speech acts that were not found even once in the content of messages by principals, there were some topics that were similarly absent. Only four of the nine topics—tool, management, methodological idea, and other—were represented in their messages. Management was one of the main topics for principals and they shared their own experiences and discussed the rules they had established. Fullan [7] points out that principals' actions should also provide teachers with psychological support. As principals also posted messages coded by topic as 'other'—a category containing cartoons, jokes, thanks, etc.—it seems that they wanted to support others emotionally and help them overcome the difficulties in handling the unexpected and unwanted change. However, it was interesting that all roles discussed cyber risks and assessment issues, except principals.

**Educational technologists** were the most active members of this Facebook group. Of course, one reason might be that the group was initiated by members with this role. However, as the change was heavily geared towards using more digital tools and environments, educational technologists were the most competent as local factors in this field. Educational technologists shared and suggested tools, which are not so commonly used in schools, like audio editors, social bookmarks and programming. In terms of learning materials, they shared mostly e-lessons. Previous studies have also indicated that technology makes it possible to use different specialized tools and materials, not only textbooks [11,14]. As educational technologists usually belong to the school management team in Estonia, it seems that they took the leading role in this change instead of principals. The share of negative messages from educational technologists was less than 5%, whereas it was a little over one-tenth in the case of teachers and one-sixth in the case of principals, indicating that educational technologists were more successful in coping with this unexpected change. In terms of speech acts, educational technologists provided mostly different resources and, as the analysis of message topics indicates, most of the information about webinars was posted by them. These webinars were mainly about management at schools. Previous studies have also indicated that there is no clarity on the management of distance learning in the case of unexpected change [12] and Fullan [7] notes that management issues are important in the case of change.

Keeping **parents** informed and involved is an important part of managing change and strong parent–school relationships are required to achieve the change [7]. The result that parents posted more messages with negative sentiments than any other roles, except principals, indicates that in our study parents were more opposed to the change. This result is in line with Rainey et al. [16] who claim that two-thirds of posts by students and their families expressed negative sentiment. Messages by parents were mostly coded under the topic of 'management'. Parents wrote about their experiences, how they cope with homeschooling, juggling their own work and supporting their children. They gave tips for other parents, but they also wrote about a lot of problems they faced supporting their children at home. Like teachers, they had several questions, which indicates that parents, too, were not well informed and, similarly to teachers, they felt the need to reduce the range of digital tools used and to lower the workload. However, as indicated in the previous study during the coronavirus pandemic [2], teachers need support from parents and this support plays an important role in students' learning efforts and outcomes.

#### 4.2. External Stakeholders Affecting the Change

Our results demonstrate that the speech act of informing was more used by the roles representing external factors (members from government institutions, teacher educators, supporters).

**Members from government institutions** should be in touch with the process of implementation of the change by the practitioners [7] and being a member in this Facebook group gave them awareness of the experiences of local stakeholders. In our study, members from ministerial agencies informed and provided resources, which is important because, as has been found before, both principals and teachers were waiting for the governments to provide guidelines for the organization of distance learning during the pandemic [12]. Members from governmental institutions wrote mostly for teachers, but some messages were addressed to schools as well. Their messages were mainly about webinars with the intention to educate schools about learning management systems. Previous studies have also mentioned that learning management systems can contribute to providing education [1]. Members from governmental institutions were the only role group that did not post any messages with negative sentiments, indicating that they work with the change.

As with teachers, tools were the dominant topic in the messages by **teacher educators**. However, unlike teachers who wrote mostly about assessment tools, teacher educators shared more web-conferencing tools. The importance of web-conferencing tools has also been mentioned in previous studies [8] and teacher educators have more experiences with this tool. Surprisingly, there were only a few messages by teacher educators on the topic of methodological ideas. Previously, it has been observed that teachers were aware of digital tools and there is a lack of a pedagogical dimension [8,10]. It seems that teacher educators were unsure about well-established practices, theories and pedagogies, as has been observed in an earlier study [13]. However, more than one-third of the messages about webinars by teacher educators referred to webinars presenting methodological ideas. It was interesting that teacher educators only posted messages addressed to everyone, schools or teachers.

Outside support, from other external partners like R&D laboratories and centers, philanthropic foundations, etc., is needed to perform better during the change [7]. As has been mentioned previously [1,12], book publishers, IT companies, museums, etc., gave free access to their materials in Estonia as well, and **supporters** shared mostly this type of learning materials, including e-lessons and videos, different websites (art, virtual museums etc.) and more fun tools like music composition or learning games. Supporters also posted messages coded as 'other', which included different cartoons, jokes, wishes, thanks, etc.

Among the external stakeholders, **members with other roles** posted more negative statements. The difference was not statistically significant, but more than a tenth of the messages by this role group was with negative sentiments. Unlike other external stakeholders, members with other roles provided more resources and, like teachers, they had more questions. In terms of topics, messages coded as 'other' prevailed in their posts.

#### 5. Conclusions

Change can come when it is forced upon us or when we voluntarily participate in, or even initiate it, being dissatisfied with the current situation. The outcome of change depends on how the people involved affect the change. This study tried to understand the stakeholders' roles in education during the coronavirus pandemic in Estonia, which was an unexpected and unwanted change. The results indicate that among local stakeholders, educational technologists were the catalysts of change instead of the principals. They suggested and shared tools, educated teachers, students and even principals through webinars and e-lessons. External stakeholders supported local stakeholders psychologically and created learning materials and webinars.

Some unexpected results also emerged. Principals in our study offered more psychological support and did not talk so much about the essential topics that emerged during the crisis in this Facebook group. Also, it is worth mentioning that, as teachers were confused

about how to teach, the teacher educators focused more on tools. This indicates that teacher training institutions were also not prepared for this unexpected change. Additionally, it was interesting that members from the governmental institutions wrote mostly for teachers, not so much for principals. It is an important finding because the leadership should go from the bottom upwards and it is more logical if the government communicates with principals who forward these messages to teachers and other local stakeholders. Maybe during this unexpected change addressing teachers directly was the right decision because then the information quickly reached the teaching process. However, it was important that all stakeholders were aware of the implementation process and, therefore, this kind of Facebook community can be beneficial.

The novelty of this study lies in the analysis of Facebook messages by different stakeholders based on real data collected during the actual pandemic. These messages indicate what was relevant and important at that time. However, our study has some limitations, too. First, the data were based on one Facebook group in Estonia and, therefore, the results are not generalized. Also the results are not generalized in Estonia as the data are based only on one Facebook group and the sample is not representative. Second, we only analyzed messages, leaving out comments. In future studies, it would be interesting to analyze comments as well. Also, as this study covers only the situation at the beginning of the coronavirus pandemic, and it would be interesting to analyze how these stakeholders affected the change in the autumn period, too.

**Author Contributions:** Conceptualization, M.L. and P.L.; methodology, P.L.; formal analysis, P.L.; investigation, P.L. and M.L.; resources, M.L.; data curation, P.L. and M.L.; writing—original draft preparation, P.L. and M.L.; writing—review and editing, P.L. and M.L. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Consent was waived due to the retrospective nature of the analysis based on existing data from open social media platform.

**Data Availability Statement:** Data is available from the authors on request.

**Acknowledgments:** We thank administrators of the Facebook group ‘Homeschooling with technology’ Siret Lahemaa, Ingrid Maadvere and Diana Veskimägi for support.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

- Bozkurt, A.; Jung, I.; Xiao, J.; Vladimircsi, V.; Schuwer, R.; Egorov, G.; Lambert, S.; Al-Freih, M.; Pete, J.; Olcott, D., Jr.; et al. A global outlook to the interruption of education due to COVID-19 pandemic: Navigating in a time of uncertainty and crisis. *Asian J. Distance Educ.* **2020**, *15*, 1–126. Available online: <https://asianjde.org/ojs/index.php/AsianJDE/article/view/462> (accessed on 28 September 2020).
- Huber, S.G.; Helm, C. COVID-19 and schooling: Evaluation, assessment and accountability in times of crises—Reacting quickly to explore key issues for policy, practice and research with the school barometer. *Educ. Assess. Eval. Account.* **2020**, *32*, 237–270. [[CrossRef](#)] [[PubMed](#)]
- Ellsworth, J.B. *Surviving Changes: A Survey of Educational Change Models*; ERIC Clearinghouse: Syracuse, NY, USA, 2000.
- Gundy, M.S.; Berger, M.J. Towards a Model Supporting Educational Change. *Int. J. Inf. Educ. Tech.* **2016**, *6*, 232–236. [[CrossRef](#)]
- Hall, G.E.; Wallace, R.C.; Dossett, W.A. *A Developmental Conceptualization of the Adoption Process within Educational Institutions*; Research and Development Center for Teacher Education: Austin, TX, USA, 1973.
- Fullan, M. *The Meaning of Educational Change*; Teachers College Press: New York, NY, USA, 1982.
- Fullan, M. *The Meaning of Educational Change*, 4th ed.; Teachers College Press: New York, NY, USA, 2007.
- Bergdahl, N.; Nouri, J. Covid-19 and Crisis-Prompted Distance Education in Sweden. *Technol. Knowl. Learn.* **2020**. [[CrossRef](#)]
- Zhang, W.; Wang, Y.; Yang, L.; Wang, C. Suspending Classes Without Stopping Learning: China’s Education Emergency Management Policy in the COVID-19 Outbreak. *J. Risk Financ. Manag.* **2020**, *13*. [[CrossRef](#)]
- Gudmundsdottir, G.B.; Hathaway, D.M. “We Always Make It Work”: Teachers’ Agency in the Time of Crisis. *J. Tech. Teach. Educ.* **2020**, *28*, 239–250. Available online: <https://www.learntechlib.org/primary/p/216242/> (accessed on 14 August 2020).

11. Al Darayseh, A.S. The Impact of COVID-19 Pandemic on Modes of Teaching Science in UAE Schools. *J. Educ. Pract.* **2020**, *11*, 110–115. [CrossRef]
12. Burke, J.; Dempsey, M. Covid-19 Practice in Primary Schools in Ireland Report. *Maynooth Irel.* **2020**, *16*, em1872. [CrossRef]
13. Murray, C.; Heinz, M.; Munday, I.; Keane, E.; Flynn, N.; Connolly, C.; Hall, T.; MacRuaric, G. Reconceptualising relatedness in education in ‘Distanced’ Times. *Eur. J. Teach. Educ.* **2020**, *43*, 488–502. [CrossRef]
14. Schleicher, A. *The Impact of COVID-19 on Education—Insights from Education at a Glance*; OECD: Paris, France, 2020. Available online: <https://www.oecd.org/education/the-impact-of-covid-19-on-education-insights-education-at-a-glance-2020.pdf> (accessed on 21 September 2020).
15. Luik, P.; Lepp, M. Activity of Estonian Facebook Group During Transition to e-Learning due to COVID-19. In Proceedings of the 19th European Conference on e-Learning, a Virtual Conference hosted by University of Applied Sciences HTW, Berlin, Germany, 28–30 October 2020; pp. 308–316.
16. Rainey, J.J.; Kenney, J.; Wilburn, B.; Putman, A.; Zheteyeva, Y.; O’Sullivan, M. Online Work Force Analyzes Social Media to Identify Consequences of an Unplanned School Closure—Using Technology to Prepare for the Next Pandemic. *PLoS ONE* **2016**, *11*, e0163207. [CrossRef] [PubMed]
17. Zhao, Y.; Xu, H. Chinese Public Attention to COVID-19 Epidemic: Based on Social Media. *medRxiv* **2020**, *20*. [CrossRef]
18. Staudt, D.; Clair, N.S.; Martinez, E.E. Using Facebook to Support Novice Teachers. *New Educ.* **2013**, *9*, 152–163. [CrossRef]
19. Liljekvist, Y.E.; Randahl, A.; van Bommel, J.; Olin-Scheller, C. Facebook for Professional Development: Pedagogical Content Knowledge in the Centre of Teachers’ Online Communities. *Scand. J. Educ. Res.* **2020**. [CrossRef]
20. Li, L.; Wang, Z.; Zhang, Q.; Wen, H. Effect of anger, anxiety, and sadness on the propagation scale of social media posts after natural disasters. *Inf. Process. Manag.* **2020**, *57*. [CrossRef]
21. Zhu, B.; Zheng, X.; Liu, H.; Li, J.; Wang, P. Analysis of spatiotemporal characteristics of big data on social media sentiment with COVID-19 epidemic topics. *Chaos Solitons Fractals* **2020**, *140*. [CrossRef] [PubMed]
22. Anwar, M.M.; Liu, C.; Li, J. Discovering and tracking query oriented active online social groups in dynamic information network. *World Wide Web* **2019**, *22*, 1819–1854. [CrossRef]
23. Bengtsson, M. How to plan and perform a qualitative study using content analysis. *Nurs. Open* **2016**, *2*, 8–14. [CrossRef]
24. Rose, S.; Spinks, N.; Canhoto, A.I. *Management Research: Applying the Principles*; Routledge: New York, NY, USA, 2014.
25. Herring, S.C.; Das, A.; Penumathy, S. CMC Act Taxonomy. 2005. Available online: <http://ella.slis.indiana.edu/~herring/cmc.acts.html> (accessed on 4 October 2020).
26. Jeng, W.; DesAutels, S.; He, D.; Li, L. Information exchange on an academic social networking site: A multidiscipline comparison on ResearchGate Q&A. *J. Assoc. Inf. Sci. Technol.* **2017**, *68*, 638–652. [CrossRef]
27. Luik, P.; Lepp, M. Changes in Activity and Content of Messages of an Estonian Facebook Group During Transition to Distance Learning at the Beginning of the COVID-19 Pandemic. *J. Comput. Assisted Learn.* (under review).
28. Elo, S.; Kyngas, H. The qualitative content analysis process. *J. Adv. Nurs.* **2008**, *62*, 107–115. [CrossRef] [PubMed]

Review

# A Scoping Review of Organizational Responses to the COVID-19 Pandemic in Schools: A Complex Systems Perspective

Puspa Khanal, Fabio Bento \* and Marco Tagliabue

Department of Behavioural Sciences, Faculty of Health Sciences, OsloMet—Oslo Metropolitan University, NO-0130 Oslo, Norway; puspakha@oslomet.no (P.K.); marco.tagliabue@oslomet.no (M.T.)

\* Correspondence: fabben@oslomet.no

**Abstract:** This study is a scoping review of the literature on organizational adaptation in school settings during the early stages of the COVID-19 pandemic. Dramatic and unexpected environmental changes raise questions about the capacity of schooling organizations to adapt to in response to the pandemic. Different management practices have implications for the selection of organizational behaviors, electively in school settings. The research literature on school responses is analyzed from a selectionist perspective. The aim of this study is to identify and describe three constituting elements of this perspective: variation, interaction, and selection. An additional element is considered in this analysis and comprises the mechanisms of exploration and exploitation in the context of organizational adaptation. Sixteen studies met the selection criteria of describing emergent processes in schools. The findings highlight the emergence of exploration, as teachers actively experimented with a range of strategies and methods in order to maintain educational activities in the complex and uncertain context of the COVID-19 pandemic. However, several questions are raised regarding the effects and maintenance of new practices in the post-pandemic scenario. Management practices that facilitate variation and open communication about learning processes can contribute to the process of organizational adaptation.

**Keywords:** education; school; COVID-19; adaptation; complex systems

**Citation:** Khanal, P.; Bento, F.; Tagliabue, M. A Scoping Review of Organizational Responses to the COVID-19 Pandemic in Schools: A Complex Systems Perspective. *Educ. Sci.* **2021**, *11*, 115. <https://doi.org/10.3390/educsci11030115>

Academic Editor: Palitha Edirisingha

Received: 28 January 2021

Accepted: 5 March 2021

Published: 10 March 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

The global spread of COVID-19 raised the need for adaptive processes at different societal levels and organizations. The World Health Organization defined the outbreak as a pandemic in March 2020, and by late April of the same year, 166 countries had introduced national school closures, affecting 84.5% of all enrolled learners worldwide [1]. As of 2 March 2021, twenty-six countries still face nation-wide school closures, and many others have partial closures limiting access to educational settings to about 8.3% of all learners. Even in countries where physical access to schools has been reinstated, educational settings face the challenge of providing quality educational services while following public health measures aimed at containing the spread of the virus [2–5]. The adoption of remote teaching and learning practices in various countries highlighted at least two major challenges for schools: an internal misalignment between previous experiences and available resources, and the need for new online education practices. Externally, the pandemic highlighted inequalities and the lack of access to technological resources for many socially marginalized groups.

Most of the debate about responses to the COVID-19 pandemic seems to focus on the policy level and the outcome of public health measures aiming to bring the pandemic under control. However, from a complex systems perspective, it is equally important to understand learning and the emergence of new patterns of behavior in different social and organizational settings. Moreover, there is a need to investigate complex adaptive processes in school settings in the context of the pandemic.



The goal of this study is to present a scoping review of the literature about adaptation processes in school settings in the initial stage of the pandemic. The selected articles are analyzed from a selectionist perspective [6] and consider the pandemic as a major environmental perturbation that affects the evolutionary history of schools. This raises questions about the exploration of new possibilities and the possible retention of new practices in a post-pandemic scenario. Therefore, we address two main research questions:

- RQ1: How has selection of organizational behavior taken place in the context of adaptation processes to the COVID-19 pandemic in schools?
- RQ2: How have such processes affected the exploration/exploitation balance in school settings?

We review the literature on organizational change and present a conceptual framework that articulates concepts from complexity theory and the selection of organizational behavior and practices in responses to environmental changes. Next, we detail the research methods, including our selection criteria, and the data analysis of the present scoping review. The presentation of findings follows the same structure according to which the research questions were presented and includes elements of a bibliometric analysis: this traces a network analysis of co-occurrence of key words before and after the literature search and selection. After presenting the findings of this work, we provide the opportunity to discuss adaptive processes at the school level in different national contexts, the emergence of learning and new practices, and lessons for school management and policymaking in education.

## 2. Organizational Change

Organizational changes may occur as responses to societal or technical environmental changes, or sometimes they are rooted within the socio-systematic structures of organizations themselves [7,8]. However, there is an increasing recognition of the evolutionary, rather than planned, nature of most organizational change processes [9]. This requires an understanding of emergent changes, which usually characterize changes in complex adaptive systems [10]. Organizational change is not a straightforward and linear process, but a continuous, open-ended, cumulative, and unpredictable process of experimentation, investigation, and adaptation; it is intended to match an organization's resources and abilities to the opportunities, constraints, and demands of a dynamic and changeable environment [8]. Weick and Sutcliffe [11] stated that any emergent change that is unplanned involves ongoing accommodations, adaptation, and alteration that generate basic change (see also [7,12]). Organizational change may be analyzed at different levels: change as content (what it is that changes), as process (how it changes), as context (why change is needed), and as an interaction; in the last sense, change variables may be mutually defined in a series of interrelated elements (actions, reactions, and interactions) [13]. There is no common method or recipe for bringing about organizational change [13]. Organizations can be analyzed as complex systems, and behavioral change also needs to be understood in relation to the exchange of resources with its surrounding environment [9]. Individual and system behavior change in an organization is not easy to achieve, as it is often driven by an interplay of internal and external factors [14].

Rosenblatt [15] stated that schools undergo several organizational changes. These include changes in curriculum, management, educational structures, programs, and as a result of influx of students and teachers. Schools need to adjust to these changes effectively for the smooth running of the school as an organization [15]. Furthermore, schools are continuously under the pressure of both their internal and external environment. The major forces pushing schools to initiate change are social and demographic developments, new patterns of employment, developments in technology, and globalization. The constant pressure from the various forces of changes are related to the two types of change: namely, top-down planned interventions and bottom-up unplanned change [13]. Unplanned change is emergent change, which is a continuous, dynamic, and contested process that



appears in an unpredictable and unplanned way; thus, these processes should be constantly refined and developed to maintain their relevance [8].

The COVID-19 pandemic is conceptualized as a major environmental change requiring organizational adaptation at different levels. Adaptation processes as such are always important events in the evolutionary history of organizations. Therefore, a selectionist perspective that is able to apply central concepts of complex science and evolution is suitable for investigating organizational change.

### 2.1. Complex Systems

Complexity theory is a scientific framework that analyzes change, renewal, and adaptation. According to this perspective, organizations are regarded as complex adaptive systems. This means that organizational change needs to be understood in terms of its adaptations through interaction and interconnectedness to its environment [16]. Complex systems are constituted of interacting parts at the micro level. Changes at the macro level are often nonlinear outcomes of small perturbations at the micro level [10,16]. According to Axelrod and Cohen, in a complex system, the actions of some agents are tied very closely to the actions of other agents in the system [10]. Morrison stated that the environment in which the schools operate is an ever-changing one, inasmuch as they interact dynamically with the environment that they influence, while also being influenced by the same environment [17]. Waldrop asserted that complex adaptive systems are composed of many independent agents who interact and adapt one another and constantly modify and rearrange their building blocks in light of prediction, experience, and learning [18]. Systems emerge over time; it is often difficult to determine with any certainty in advance the result of that emergence [17].

Although a single, unified theory of complexity is hardly available, Preiser [19] identified six common underlying features that characterize and can help understanding complex adaptive systems. From a complex systems perspective, organizational responses to the COVID-19 pandemic can be conceptualized under these same six principal features of a complex adaptive system:

1. *Constituted relationally*: complex behaviors and structures emerge as a result of recursive and aggregate patterns or emergent networks structures. Observing the emergent webs of interaction among teachers, students, administrators, and parents, the interactions are seen as parts of an emergent network structure that is relationally constituted.
2. *Adaptive*: self-generating, self-organized, and decentralized control. Herein, structures and functions change over time as a consequence of internal dynamics and environmental changes. National and international policies aim to reduce the risk of pandemic in schools, but the emergent character can never be fully predicted and controlled. Schools could develop complex structures from unstructured foundations and without the intervention of external policies.
3. *Dynamic*: non-linear interaction and cross-scale interaction which suggest that the “behavior” of the system is maintained or restricted due to negative or positive feedback loops. The formal and informal responses to COVID-19, which are not uniform, are the result of recursive feedback loops. These are uncertain, unpredictable, and make the system difficult to control. The systems interact dynamically with the environment, influencing and being influenced by its environment.
4. *Context dependent*: changes in function occur as the system changes; these include being sensitive to initial and environmental conditions. Interaction between various factors at different levels matters in the school setting and so does adopting the various changes.
5. *Radically open*: flexible boundaries and constantly exchanging information with the environment. The system and the environment that schools comprise are open. Schools may not be able to identify the boundary line between their comprising or encompassing system and environment.

6. *Complex causality*: the outcome of inter-relational, non-linear, and dynamic interaction.

Schools present many characteristics of complex adaptive systems [20]. Schools are usually nested in overall educational systems, meaning that they interact with rather complex social and political environments. There are regulations and demands from the state and struggle for public and/or private resources. Furthermore, the interaction with local communities and parents characterizes an environment of varied and, at times, conflicting demands. Organizational adaptation in schools is often emergent from the outcomes of interactions among agents: these include the responses of teachers, administrators, and parents [20].

Complex systems may have the capacity to adapt and respond to the environment. As described by de Domenico et al., adaptation happens at multiple scales, ranging from the micro to the macro levels [21]. The properties of resilience and adaptivity possessed by complex systems, enabling them to change their internal structures and generate new patterns of behavior, calls for a selectionist perspective. In the case of organizational settings like schools, this requires an understanding of emergent patterns and interventions that can either focus on standardizing processes and products or matching the complexity of the environment.

## 2.2. A Selectionist Perspective

According to Sandaker [6], variation in behavioral repertoires regarding environmental interaction is a prerequisite for the selection of behavior. Specifically, behaviors must occur within the range of possible behavioral variation to be selected. If the environment in which organizations interact is held constant, organizations can survive at a low level of complexity; furthermore, the selection process in itself is nonintentional or blind, because selection depends on the present conditions, while future selection depends on future conditions [6]. Organizations often try to limit the amount of variation [6] by establishing formal hierarchical structures or setting standard sets of procedures and regulations. However, variation, interaction, and selection are hallmarks of a complex adaptive system and they are created while designing new strategies and organizations [10]. Sandaker [6] describes changes in society and working life that evoked alterations in principles that permeated the organizational consolidation in industrial societies. Such changes are described in the following terms: “moving along a continuum from restricting variation to evoking variability of responses, the range of control may shift from correction of any response deviation to shaping of variation to acquire solutions that are in demand in an unpredictable and continuously changing environment/market” (p. 277). Environmental changes in societies such as the challenges presented by a major pandemic such as the novel coronavirus can be described as alterations in the conditions for the acquisition, change and extinction of behavioral patterns. It is important to observe how such changes happen in school settings in the context of the pandemic. Complex systems adapt as functions of their interactions with their surrounding environments.

We expand further on variation, interaction, and selection below:

### (A) Variation

Variation is a component in which possible strategies for adaptation are presented. It allows organizations to choose a specific action among several available. If organizations are not innovative and creative, they fail to adapt. Complex adaptive systems depict organizations as being capable of producing infinite variety. Axelrod and Cohen assert that variations that are taken as the raw materials of adaptation are the crucial factors in the development of complex systems [10]. Organizations require variation with the potential to present solutions demanded in an ever-changing environment and a “web of influence”; in turn, this may facilitate variation in interaction independently of divisions, departments, or levels of administration across units and hierarchical levels [6].

### (B) Interaction

Analyzing organizations through the lens of complexity means that we look at them as networks of interactions among interdependent agents who are bound together in one social structure [22]. This emergent and informal structure is called a network, and it interacts with its encompassing environment. It is often implied that adaptation to external changes demands matching the complexity of the surrounding environment [22]. Interaction within organizational boundaries includes the entanglement of behavior and its products, which in turn affect the behavior and products of other members of the organization. These comprise a dynamic interaction between the internal components and their relations in the organization [23]. The emergent network structure can either facilitate or restrain the spread of new ideas and behaviors.

### (C) Selection

Selection is the process end that underpins the ambition for continuous improvement. Axelrod and Cohen (2001) viewed selection as the result of mechanisms such as learning by trial and error. They highlighted that when selection leads to success, this is called *adaptation* [10].

Table 1 includes a description of the dynamics of variation, interaction, and selection in relation to a continuum that moves from restricting processes and products to evoking variability (similar to the new leadership paradigm explained by Sims and Lorenzi [24]).

**Table 1.** Selection of organizational behavior.

	<b>Objective: Standardized Process and Products</b>	<b>Objective: Match the Complexity and Competence of the Environment</b>
Variation	Constrain variation in behavioral repertoire for maximum standardization of production	Allow high degree of variation to achieve solutions that are in demand in an unpredictable and continuously changing environment /market
Interaction	Interaction limited to “chain of command” that is, influence within the framework of a low number of relatively conformed individuals	Allows a “Web of influence” (i.e., the facilitating variation in interaction independent of divisions, departments or levels of administration)
Selection	Selection of a limited assortment of behavior patterns governed by the objective of standardizing work processes and products; controlling and correcting for deviations whenever behavior shows too much variation	Sufficient basis for selection of useful behavior under ever-changing conditions; focus on shaping and improving performance

Reproduced from Sandaker [6], p. 277.

In sum, matching the complexity of the environment involves a movement in management principles from control to variation facilitation in terms of organizational behavior. Variation is a condition for the exploration of new possibilities and knowledge, rather than simply the exploitation of already-existing ones.

### 2.3. Exploration and Exploitation in Complex Systems

The balance between the exploration of new possibilities and the exploitation of already-existing ones in complex systems is a topic of interest in various fields, including genetics and decision-making in organizational settings [10]. The emergence of patterns and novelty from processes of interaction is a central concern in the study of complex systems [25]. The two processes were defined by March [26] in the following terms: “Exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, execution ( . . . ) Exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation” (p. 71). Usually, managerial actions enable exploration to involve the facilitation of variation in behavior and interaction across different levels. Exploitation usually involves fewer risks and less uncertainty. However, there is a trade-off between the two processes. Complex systems that engage exclusively in exploitative practices at the expense of exploration may restrict repertoires of knowledge and behavior; this makes it more difficult for them to

adapt to environmental changes. Conversely, complex systems that explore at the cost of exploiting may be subject to the costs of experimentation without gaining the benefits of the acquisition of new practices and knowledge. It is important to bear in mind that in most organizational settings, there is an organic relation between the two processes, rather than them being spatially or temporally separated [27]. Major environmental perturbations, such as the COVID-19 pandemic, raises questions surrounding the exploration of new possibilities in complex systems. Therefore, we aim to identify changes in the balance between exploration and exploitation in the context of adaptive changes in schools.

### 3. Methods

#### 3.1. Design

To empirically map out any organizational change processes in schools in the context of the COVID-19 pandemic, we conducted a scoping review. In accordance with the PRISMA statement [28], this is a broader approach to evidence synthesis that is particularly indicated for providing a broader approach to a given research topic and when the formulation of discrete research questions is premature. The research team was small, but highly international, and included nationals of Nepal, Brazil/Portugal, and Italy; however, this study was performed in Norway.

#### 3.2. Eligibility Criteria

Eligible studies that were included in the literature review needed to possess the following characteristics:

- Participants: schools or schooling systems, but also teachers, pupils and other members of the schooling organization, as long as organizational change was concerned;
- Intervention: studies that describe, report, or synthesizing the implementation of any type of organization-wide change following the COVID-19 outbreak;
- Outcomes: empirical measures of variation, interaction, and selection were the primary outcomes of the studies included. Possible secondary outcomes were any other relevant measures or information related to the level and efficacy of school-wide interventions;
- Study design: no limiter was applied. Any study type and design were included, and empirical measures of organizational change featured both qualitative descriptions and quantitative syntheses of interventions;
- Other criteria: no geographical restriction was applied. The timeframe for the literature search included the years 2020 and 2021.

Although COVID-19 was first identified in December 2019 [29], it is the outbreak of the virus and its characterization as a pandemic in 2020 that raised concern, prompting both public health measures worldwide and changes at the organizational level in different sectors. During the initial screening of the literature, we observed that many studies had an epidemiological rather than organizational character: they were therefore excluded. Moreover, we looked for articles that presented empirical analysis of adaptive processes. Thus, articles that consisted of conceptual discussions without presenting empirical findings were excluded.

#### 3.3. Information Sources and Search Strategy

The research question that guided this work was “How did schools respond to the COVID-19 pandemic with regard to organizational change and system-wide interventions?” Specifically, we were interested in adopting a framework drawn from complex systems that undergo principles of selection. The procedure of this scoping review adhered to the guidelines of a PRISMA protocol. The literature search was performed on one collection of databases and three English databases; these were, respectively, Academic Search Ultimate, Business Source Elite, Education Source, and Scopus. However, the search results on Scopus (n = 251) were only dated up until 31 August 2020 due to the revocation of institutional access to this database; after that date, search results were only returned from Business

Source Elite, Education Source and Academic Search Ultimate. The principal search terms included two blocks: ("School\*") AND ("COVID-19" OR "Coronavirus" OR "2019-Ncov"). The search was performed on 12 February 2021 in the abstract field. We limited the results to (i) peer-reviewed studies featured (ii) in scientific journals (iii) that were written in English. Additionally, search terms were manually checked on Google Scholar and ResearchGate for any unindexed relevant hit.

### 3.4. Study Selection

The studies resulting from the database search were exported from the databases interfaces (e.g., Ebsco) and imported to an online platform for beginning the appraisal phase. The name of this online tool is Rayyan [30] and was developed to assist the conduction of systematic reviews. However, it can be flexibly adapted to scoping reviews for retaining the same strict methodology, such as blinding the classification of articles from one reviewer to another. After all results were imported, all duplicate studies were excluded. Next, the first two authors served as principal reviewers and independently screened each study with the blind on, checking title, abstract and keywords. After the blind was removed, any conflict between the first and the second reviewer was resolved by consensus. Any remaining conflict was resolved by a third independent reviewer (i.e., the third author of this study). The second phase of appraisal consisted of reading full-text versions.

### 3.5. Data Extraction and Analysis

Our analysis of articles was initiated with the extraction of descriptive data such as authors, year of publication, country, number of participants, and educational level approached. The analysis of the content of the article followed an interpretive and theory-driven process [31]. This means that the coding process of the selected articles was guided by the framework for the selection of organizational behavior as suggested by Sandaker [6]. The two overall objectives of producing standardized processes and matching the complexity of the environment provided overall categories and the concepts within there (interaction, variation and selection) were used to code findings. The conceptual presentation of exploration and exploration in organizational settings by March [26] was also used to code articles. Due to the heterogeneity of findings, our presentation and discussion of findings follows a qualitative narrative synthesis [32,33], aiming at identifying similarities and differences in the description of adaptive process in the selected articles. For instance, descriptions of the bottom-up emergence of new practices were labeled as "exploration". Descriptions of variety in terms of practices and behaviors were coded as "variation". Likewise, descriptions of increasing interaction processes beyond formal structures in the context of the pandemic were described as "allowing a web of influence".

None of the articles explicitly applied selectionist principles, and therefore the coding process involved an interpretive dimension in which the authors initially conducted individual analysis of the adaptive process described in the selected literature. However, further discussions among the authors provided the opportunity to compare individual analyses and further refine the coding process.

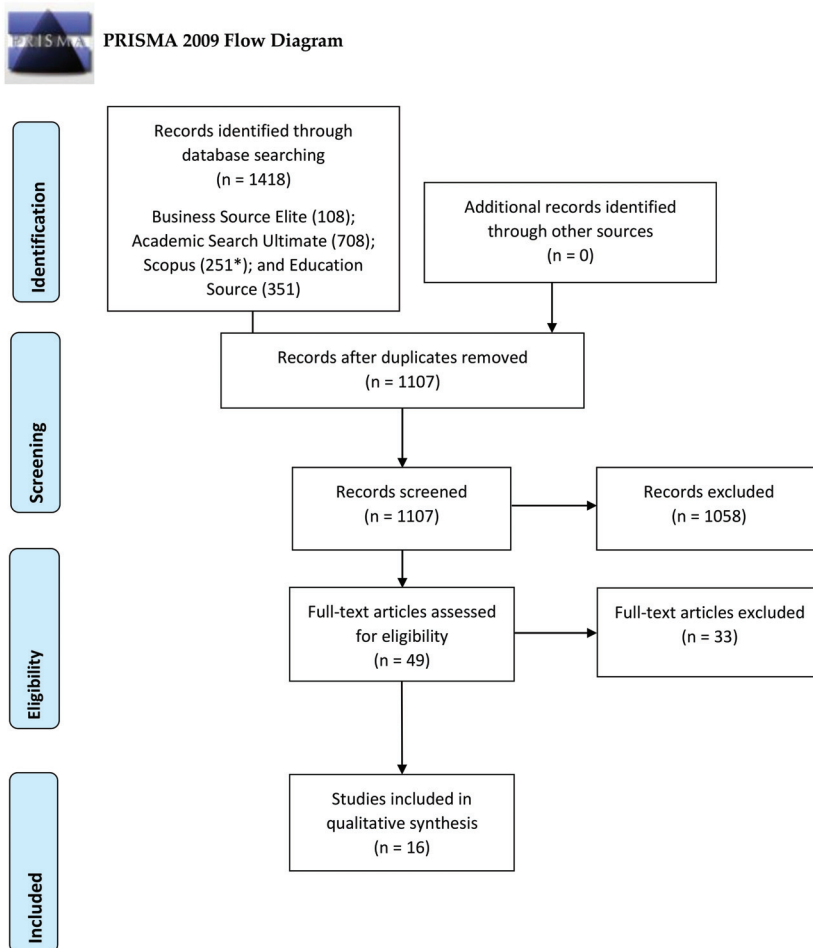
## 4. Results

### 4.1. Literature Search

Our search strategy retrieved 1418 results from all interrogated databases. After duplicates were removed, 1107 studies were independently screened by the first two reviewers. Of these, 36 studies were unanimously included, 1023 were unanimously excluded from further consideration, and 48 studies were characterized by a conflict between the reviewers. By consensus, there were 49 studies that were advanced to the following phase of appraising full-text versions. Of these, 33 studies were excluded for the following reasons: focus on online learning or teaching ( $n = 10$ ), not including any description of organizational change following the pandemic ( $n = 9$ ), reporting limited to

law or policy initiatives ( $n = 4$ ), full-text missing ( $n = 4$ ), not including schools or school-related personnel ( $n = 3$ ), non-peer reviewed interview ( $n = 2$ ), and missing analysis of data ( $n = 1$ ).

In sum, 16 studies were included in the present scoping review. The full appraisal strategy is reported in Figure 1, which illustrates how the Prisma [28] guidelines were followed.



**Figure 1.** Prisma 2009 flow diagram. *Note.* \* Results from Scopus are limited to 31 August 2020 due to loss of institutional access.

#### 4.2. Studies Characteristics

Table 2 provides a summary of the main characteristics of the articles included in the present scoping review. First, descriptive information of each study is presented: this includes country, number of participants, and education level. Of the 16 included studies, the majority of them were performed in the USA ( $n = 9$ ), followed by Canada ( $n = 2$ ) and the UK ( $n = 2$ ). The remaining three studies were performed in Greece [34], Chile [35], and Sweden [36].

**Table 2.** Overview of included articles with descriptive information and classification of school responses based on a complex systems perspective.

Author(s) (Year)	Country	Number of Participants	Education Level	Variation	Interaction	Selection	Exploration/ Exploitation	Methodological Approach	Summary of Findings	Source Title	Citations *
Ahlström, Leo, Norqvist, & Ising (2020)	Sweden	680 principals	All forms of education in the formal school system, from preschool to adult education programs	Increasing variation	Allows a “web of influence”	Sufficient basis for selection	Exploration	Qualitative approach revealing school leaders’ accounts of issues of trust, stability, and equity	Investigation of school leadership in the exceptional context of Sweden, in which it was decided that schools would remain open during the early stages of the pandemic	International Studies in Educational Administration (Commonwealth Council for Educational Administration & Management (CCEAM))	4
Anderson & Hira (2020)	USA	6 elementary school educators	Elementary school	Increasing variation	Allows a “web of influence”	Sufficient basis for selection	Exploration	Qualitative interviews	Discussion of how teachers that usually apply hands-on teaching have coped with challenges presented by the COVID-19 pandemic. Their qualitative study highlights the exploration of new communication tools and practices	Information and Learning Sciences	3
Agyropoulou, Syka & Papaioannou (2021)	Greece	38 school leaders	Primary and secondary level	Increasing variation	Allows the web of influence to facilitate variation	Sufficient basis for selection of the best ways of adaptation	Not available	Qualitative interviews	New aspects of school leadership based on human interaction, less control, use of emotional intelligence and the necessity to tackle ethical dimensions of education.	International Studies in Educational Administration (Commonwealth Council for Educational Administration & Management (CCEAM))	0
Beauchamp, Hulme, Clark, & Hamilton & Harvey (2021)	UK	12 headteachers	primary, secondary and special schools	Selected variety of schools and a range of backgrounds and experience which increase variation	Allows “web of influence” to facilitate variation	Sufficient basis for selection of organizational behavior	Exploration	Qualitative interviews	The pandemic brought the need to produce and maintain new teaching methods. For headteachers, this required further developing relationships of trust and fairness with staff, pupils and parents	Educational Management Administration & Leadership	0



Table 2. Cont.

Author(s) (Year)	Country	Number of Participants	Education Level	Variation	Interaction	Selection	Exploration/ Exploitation	Methodological Approach	Summary of Findings	Source Title	Citations *
Brelsford et al. (2020)	USA	38 primary and secondary school leaders	Elementary and secondary level	Increasing variation	Allows a “web of influence”	Sufficient basis for selection	Exploration	Qualitative analysis of written memories	Exploration of teachers’ personal reflections on how school leaders responded to the pandemic. The authors argue that a pre-existing sense of community helped leaders’ efforts to reach out for students and parents. However, some accounts describe situations in which leaders were not sensitive to teachers’ inputs by presenting unrealistic expectations and not showing support	International Studies in Educational Administration (Commonwealth Council for Educational Administration & Management (CCEAM))	3
Fornaro, Strueloef, Stern & Flowers III	USA	4 administrators (STEAM program having 100 students, 20 instructors and 10 admin- istrators)	Secondary level	Increasing variation	Allows the web of influence to select the ways to adapt in an unprece- dented situation	Sufficient basis for the selection of the appropriate behavior	Exploration	Qualitative interviews, document analysis and participant observations.	The study identifies best practices learned from transitioning from an in-person to a virtual setting: empathy for all, variation in decision-making styles, dedicating time for meaningful engagement, flexibility and ensuring access to technological resources.	International Studies in Educational Administration (Commonwealth Council for Educational Administration & Management (CCEAM))	0
Hall, Roman, Jovel-Arias & Young (2020)	USA	61 pre-service teachers	K-12 classrooms	Increasing variation	Allows a “web of influence	Limited selection of behavior	Not available	Thematic analysis of text-based board responses	A group of pre-service teachers explored experiences with the digital divide. This process led to increasing awareness of the digital inequality and attention to the social environment surrounding school settings	Journal of Technology & Teacher Education	6

Table 2. Cont.

Author(s) (Year)	Country	Number of Participants	Education Level	Variation	Interaction	Selection	Exploration/Exploitation	Methodological Approach	Summary of Findings	Source Title	Citations †
Hash (2021)	USA	462 directors	Primary and secondary school level	Increasing variation	Not available	Sufficient basis for selection	Exploration	Survey	The pandemic presented challenges especially in schools with higher poverty but also the opportunity for instrumental teachers to innovate in curricula.	Journal of Research in Music Education	1
Hauseman, Daraszi, & Kent (2020)	Canada	Not available	K-12 school level	Increasing variation	Allows a “web of influence”	Sufficient basis for selection	Exploration	Not available	Description of increasing challenges presented by the pandemic to school leaders in Canada, in terms of new demands. Their study assumes a prescriptive character by recommending flexibility and spreading positivity to school leaders during rather turbulent times	International Studies in Educational Administration (Commonwealth Council for Educational Administration & Management (CCEAM))	1
Kaden (2020)	USA	1 teacher (single case study)	K-12 school level	Not available	Limited interaction	Limited selection of behavior	Exploration	Qualitative interviews, participant observations, and quantitative data sources.	Descriptive case study of the impact of the pandemic on teaching practices and workload in rural Alaska. This study describes exploratory processes in the context of increasing inequalities and variation in practices.	Education Sciences	29
Kim & Asbury (2020)	UK	24 teachers	Primary and secondary school level	Not available	Limited interaction	Limited selection of the behavior	Exploration	Qualitative, narrative analysis	Six main themes emerged: uncertainty, finding a way, worry for the vulnerable, importance of relationships, teacher identity and reflections.	British Journal of Educational Psychology	20
Martinez & Broennel (2021)	USA	26 graduate students	K-12 school level	Not available	Limited interaction	Limited selection of the behavior	Not available	Qualitative interviews	Although participants declared satisfied with level of support and self-efficacy, they raised concerns about equity in student access to resources.	International Studies in Educational Administration (Commonwealth Council for Educational Administration & Management (CCEAM))	0

Table 2. Cont.

Author(s) (Year)	Country	Number of Participants	Education Level	Variation	Interaction	Selection	Exploration/ Exploitation	Methodological Approach	Summary of Findings	Source Title	Citations *
Schuck & Lambert (2020)	USA	3 teachers	Elementary special schools	Increasing variation	Allows the "web of influence" to facilitate variation	Sufficient basis for the selection of the behavior	Exploration	Qualitative interviews	Teachers identified three main challenges: inequity inherent to emergency remote teaching, providing adequate support to families and changes in the teaching experience.	Education Sciences	0
Sepulveda-Escobar & Morrison (2020)	Chile	27 English as a Foreign Language (EFL) teachers	Not specified	Increasing variation	Allows the "web of influence" to facilitate variation	Sufficient basis for the selection of the behavior	Exploration	Case Study	Lack of previous experience with virtual education made the pandemic more challenging for participants. Teaching degrees need to incorporate ICT literacy.	European Journal of Teacher Education	9
Sider (2020)	Canada	Principal's council representing 5000 principals	Special education needs at school level	Increasing variation	Allows a "web of influence"	Sufficient basis for selection	Exploration	Not specified	Investigation of how principals manage the delivery of services to students with special needs while working remotely. The author highlighted three lessons emerging from the analysis of qualitative accounts: strong beliefs about inclusion, work intensification, and leadership numbness. This last factor means that school leaders have incorporated tasks beyond their formal job description, which required the ability to recognise and respond to various emerging situations even without adequate participation from other organizational members.	International Studies in Educational Administration (Commonwealth Council for Educational Administration & Management) (CCEAM)	0
Trinidad (2021)	USA	1929 (990 teachers and 939 school leaders)	K-12 school level	Not available	Allows a "web of influence"	Sufficient basis for selection	Not available	Survey	Three main issues were highlighted by participants as highest priorities: gaps in student achievement, student engagement and physical and mental health.	Journal of Educational Administration & History	0

Note. \* Citations were taken from Google Scholar and were last updated on 26 February 2021.

With regard to the number of participants, it is important to differentiate between studies whose unit of analysis were individuals or a collective representative organ. In the former case, almost all studies targeted school personnel, with only one exception that targeted graduate students [37]; number of participants ranged from a single case [38] to almost 2000 teachers and school leaders [39]. In the latter case, Sider focused on a council of principals [40].

Descriptions and reports on school responses to the COVID-19 pandemic encompass various educational levels and were performed at different school levels. Five studies described the responses at the K-12 school level to the outbreak, whereas the second-largest cluster featured responses at the primary and secondary school level ( $n = 3$ ), with one study ranging from primary to secondary and special schools [41]. Other educational levels addressed include one study reporting from elementary schools [42], one performed at the elementary and secondary level [43], one study from an elementary special school [5], and another from special needs education at the school level [40]. One study presented a report from only secondary level schools [44], and one study targeted preschool to adult education programs [36]. The remaining study [35] did not specify any school level when presenting the responses of the school to the COVID-19 pandemic.

#### 4.2.1. Results Regarding the Selection of Organizational Behavior (RQ1)

In this section, the dynamics of variation, interaction, and selection are analyzed according to binary categories. The majority of studies ( $n = 12$ ) included in the present scoping review allow a high degree of variation for the adaptation of responding to the COVID-19 for achieving educational success in this unpredictable situation. These studies focus on strategic variation rather than behavioral variation. However, four studies do not seem to create variation or to increase variation in the strategies in response to the COVID-19 pandemic.

In all the included studies, interaction is limited to the principals, teachers, students, parents, school leaders and the administrations of the schools. The pattern of interaction is increased by the need to adapt in the unforeseen circumstances raised by the pandemic. Most studies ( $n = 12$ ) allow a web of influence in the interaction to select the ways to adapt in an unprecedented situation and facilitate variation. Moreover, these studies have a high level of interaction patterns among the individuals. Conversely, three studies seem to have limited interaction. However, the one remaining study does not seem to report interaction between individuals.

We observe that most of the selected studies are focused on the online teaching and learning as a new strategy to continue both teaching and learning processes during the COVID-19 pandemic. They explain empirical findings of the methods of online teaching and other ways of continuing teaching learning, the challenges faced by the teachers and the school and the strategies to overcome the challenges. Several studies ( $n = 12$ ) describe an increasing basis for the selection of appropriate behavior at both the level of the agents and the strategies in response to the COVID-19 pandemic. However, the remaining studies ( $n = 4$ ) feature a limited selection of behavior, as well as a limited selection of agents and strategies.

#### 4.2.2. Exploration and Exploitation (RQ2)

Lastly, we rate the studies on the dimension of exploration or exploitation. The empirical studies show that the schools are in search of new practices, technologies, and strategies to adapt their teaching and learning processes while facing the pandemic. There seems to be high variation concerning the search of the best alternative suited in the current emergency situation. The studies focusing on exploration comprise the largest group ( $n = 12$ ). Conversely, four studies did not feature any explicit description of either of these processes and was hence classified as “not available”.

To a large extent, the included articles examined online teaching learning as a part of social distancing measures, and they discussed the various actions implemented to keep

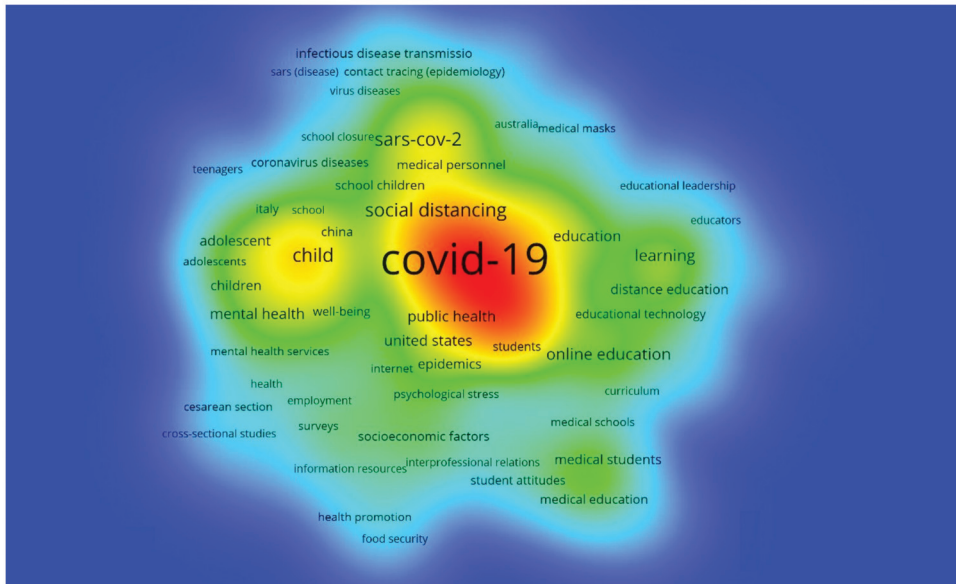
schools in operation. There was variation when selecting agents and strategies in response to the pandemic and to overcome some of the challenges to face. Variations in the selection of strategies and methods arose through the introduction of online and remote teaching, as well as blended learning. These were three ways of addressing the educational needs of the students during the lockdown period. On the basis of some of the findings from these studies, it was noticeable that schools introduced several technological tools for enhancing socially distanced teaching and learning. We can have variation where the selection of technologies and online platforms are concerned. Schools made use of online technologies such as video conferencing, home learning packets, text messaging, and phone calls. They resorted to online platforms such as Google Classroom, Google Form, WhatsApp, Zoom, Google Meets, virtual meetings, and other things.

#### 4.3. Summary of Bibliographic Analysis

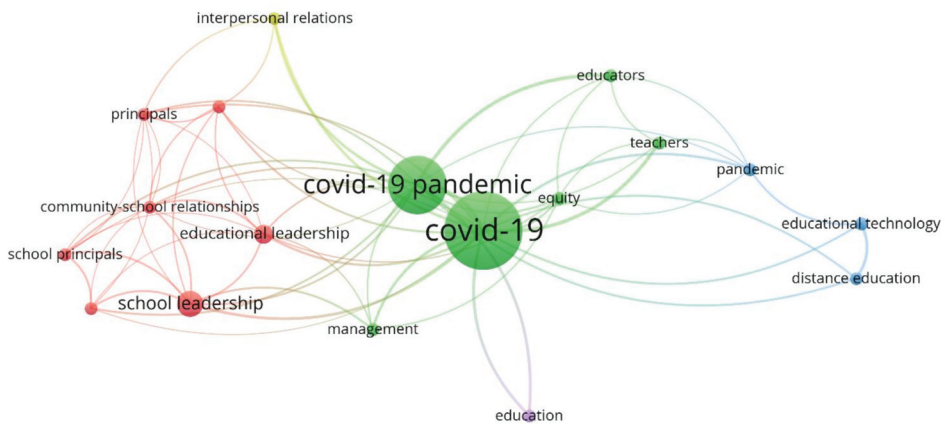
The two right-hand-side columns of Table 2 include further information on the journal in which each study was published, and the total number of citations received at the time of writing. It is noteworthy that almost half of the studies included were featured in the same special issue of “International Studies in Educational Administration” (n = 7), followed by education and learning sciences (n = 3); the rest of the studies were mostly featured in journals concerned with teacher education (n = 2), administration (n = 2), field-specific education (e.g., music [45]), and educational psychology [46]. The study that received the most citations among those included in this work was Kaden [38], followed by Kim and Asbury [46], with 29 and 20 citations, respectively. On the other side of the spectrum, several studies had zero citations (n = 7), although it needs to be stated that some were published only a few weeks before this study was completed (see studies published in 2021 [34,37,39,41,44,45]).

Figure 2 provides a visualization of the heterogeneity of studies screened in this phase based on clustering of keywords included in the 1107 articles that were screened and resulted in the retention of only 49 of them. The analysis was performed using VOSviewer v.1.6.16 (Copyright © 2009–2020 Nees Jan Eck and Ludo Waltman) [47], which is a software package for visualizing the connection between terms and creating and exploring maps based on network data. We analyzed the co-occurrence of 10 or more keywords using a full counting method. It returned 110 items, divided into five clusters, and with 2255 links; the total link strength was 7459. In addition to the terms containing “COVID-19”, which were the most densely connected, other important hubs included terms such as “child”, “learning”, “social distancing”, and “(medical) students. However, such terms were spread across different clusters meaning that although many studies approached education, they have very diverse foci and research areas. For instance, the lower left area of the heatmap shows researched focused on “medical education” and “medical students”, which would be beyond the scope of this study. The upper central part of the heatmap shows keywords such “infectious disease transmission” and “contact tracing”, which indicates research of epidemiological character.

Figure 3 displays a network visualization of the co-occurrence of two or more keywords by fractional counting of the 16 studies included in the present scoping review. Eighteen items were divided into five clusters, corresponding to as many colors, with 56 links, and returning a total link strength of 27.5. The clustering analysis shows the structure interconnectedness across different keywords. As expected, the green cluster including the keywords “COVID-19” and “COVID-19 pandemic” has a central position in the network and plays the structural position of a hub connecting all other clusters. It is interesting to note that the term “equity” is also located in the green cluster, indicating centrality of this term. The red cluster shows interconnectiveness across keywords “school leadership” and “school community”. The blue cluster demonstrates interconnectiveness across the terms “distance learning” and “educational technology”.



**Figure 2.** Heatmap of total link strength of items and clusters of the search results after duplicates were excluded (n = 1107) using VOSviewer v.1.6.16 [47].



**Figure 3.** Co-occurrence of keywords in the included studies using VOSviewer v.1.6.16 [47].

## 5. Discussion

The COVID-19 pandemic is a major health, environmental, political, and economic perturbation that presented several systemic challenges to schools and education around the world. The analysis of selected articles provides the opportunity to discuss complexity in educational settings according to the principles of complex systems suggested by Preiser [19]. In all articles, the complex principles of adaptation and open boundaries to an overall complex environment were present. There were changes in information flow and a need to address the new demands presented by the pandemic. In many ways, the pandemic accentuated the previous environmental context of social inequality. None of the articles provided descriptions of adaptation in terms of relation of linear causality. This

further illustrates the principles of dynamic, relational and complex causality as conceptualized by Preiser [19]. The emergence of different responses across the studies might also be an indicator of another characteristic of complex systems: context dependence. The next subsection provides a discussion of the findings in relation to the overall research questions.

### 5.1. Organizational of Selection Behavior: Variation, Interaction, and Selection (RQ1)

School leadership was the central topic of eight selected articles [34,36,39–41,43–45]. In the light of our conceptual framework, the actions taken by individuals in formal leadership positions can either facilitate or restrain the exploration of new paths [23], and thereby match the complexity of the environment [6].

With four exceptions in which this information was not available [37–39,46], most of the studies included in this review described increasing variation in terms of practices as school leaders and teachers responded to challenges presented by the pandemic. However, this was not the result of organizational interventions explicitly aiming at facilitating variation, but rather emergent outcomes of perceptions of challenges and uncertainty presented by the pandemic. The selected studies describe how schools adopted various strategies during the pandemic, such as social distancing, online learning, etc. Moreover, most of the responses were described in terms of emergent practices in which different agents explored new possibilities in an unexpected and uncertain environmental context.

According to the studies included in this scoping review, there seems to be a broad variation with regard to the strategies that school leaders selected in order to handle the uncertainties caused by the COVID-19 pandemic. Specifically, schools selected various strategies in different stages of the pandemic. For example, as soon as schools were closed, in-person instruction was suspended and shifted to online teaching in the first stage. However, in the second stage, schools reopened partially and in-person learning was gradually reinstated; this included condensed classes, emphasizing small group classes and one-to-one instruction [48]. Anderson and Hira [42] mentioned that teachers created and modified traditional activities to be able to use technology and materials that were accessible to students. This denotes variation not only whenever selecting the strategies for coping with typically developed and educated children, but also whenever selecting the strategies to help disadvantaged children who may have disabilities or are in special educational needs. In fact, although they did not meet the criteria for being included in the present work, we found two studies that targeted this very important and current topic. One of them inquired as to the effects of school change on marginal groups, focusing on the case of equality in Nigeria [49]; the other one provided a conceptual analysis of the equality of pupils and best practices during the implementation of remote learning throughout the pandemic [50].

The selected articles feature a flexible interaction among individuals. The findings suggest that the complex situation has become more adaptive by developing interactions among their members. This interaction seems to be developed as the aim to find ways for adapting to the complex environment. One form that it might take is encouraging the teachers to use remote or distance teaching while in lockdown. In turn, this may raise the level of variation among interacting agents. Schools interacted between and within their encompassing systems by engaging with principals, teachers, students, communities, and various professional associations. For example, in the article of Ahlstrom et al. [36], there could be a high variation in selecting the interacting agents, insofar as the experiences and opinions of 680 principals were presented. Most of the articles focused on the high variation in interaction when presenting and discussing how to overcome the challenges and how to meet the complexity of the environment.

Lastly, schools were regarded as organizations that were actively selecting various methods to adopt in the complexity of the environment. The studies illustrated several mechanisms to make teaching and learning accessible and cost effective for both the schools and the pupils' parents. School principals seemed to actively participate in the decision-



making process; they assisted the teachers in their problem-solving efforts and developed plans for supporting any children with special needs. For example, the teacher would reach the home of students with special needs to provide them with the devices needed for accessing the Internet or any assistive technology [40]. Based on our findings, one of the most important factors to deal with is selecting the technologies required to meet the complexity of the environment.

### *5.2. Exploration in Adaptive Processes*

However, organizational adaptation and exploratory processes went beyond the choice of online lecturing technologies. Two articles [38,51] described lecturers' encounters with contexts of social inequality. It seems fair to assume that approaching such contexts does not only involve choosing the right communication tools, but also understanding the students' socio-economic background and taking this into account when developing teaching/learning practices.

This may lead to questions about school management and policymaking. For instance, in several studies (n = 6), it was possible to identify descriptions or references to situations in which different actors encountered situations in which old practices were not able to cope with a new and unexpected context. Therefore, these articles described the emergent process of exploring new practices rather than only exploitation of existing ones. Variation and exploration were described in five studies. This observation resonates with the conceptualization of exploration presented by March [26]. The main lesson to be gained from the analysis of the selected articles is related to the emergence of variation in educational settings. As observed earlier, variation had an emergent character, as different actors explored new possibilities when encountering the new situations presented by the pandemic.

### *5.3. Implications for Management and Policy (RQ2)*

There is a need to develop management practices that recognize variation, and to facilitate it where appropriate and necessary. Furthermore, it is important to develop channels for open communication about exploratory processes during the pandemic among teachers and across organizational levels. From a selectionist perspective, we expect that variation and exploration of new possibilities increase the basis for behavior selection. Further research may benefit from focusing on school management practices that harness variation and interaction beyond formal hierarchical structures. School managers could facilitate formal and informal communication about adaptation processes during the pandemic, and thereby create positive feedback loops for the emergence of innovative practices at the school level.

This same principle can be applied to policymaking at a broader level. Centrally designed policies are interventions into the evolutionary history of schools that can either facilitate or restrain the emergence of innovative practices. Moreover, as variation increases the base for selection, policymaking could benefit from observing what is emerging at the local level. It may be the case that successful practices at the local level could embed changes at the macro-level. Therefore, it would be important to understand local processes of adaptation, opening up communication across school settings and identifying successful practices emerging during the pandemic.

### *5.4. Limitations and Further Research Avenues*

The present scoping review was conducted in the early stages of the pandemic, and therefore, its results need to be understood as exploratory ones rather than pretending to give a complete overview of how schools around the world have responded to the pandemic. As observed by March [23], one of the challenges related to exploration is that its outcomes are often distant in space and time. Thus, it will certainly take time before it will be possible to understand the outcomes of adaptive processes in schools, namely

in a post-pandemic scenario. However, this scoping review identifies some lessons and highlights some paths for further research.

Most studies ( $n = 12$ ) adopted a qualitative approach, mostly using qualitative interviews to grasp participants' experiences with adaptation process. Two studies [39,45] followed a quantitative methodology, applying surveys to examine participants' practices and perspectives across different schools. Both methods enabled exploring different aspects related to the time perspective of change processes and/or the exploration of different factors that may explain or facilitate adaptation. However, the field may benefit from applying other methods in the future. For instance, social network analysis can help uncover patterns of communication and emergent structural elements can either facilitate or restrain the spread of innovative practices [52]. Likewise, it would be interesting to communicate with the study of community resilience in the context of the COVID-19 pandemic [53] and the emergence of innovation and learning in a broader social perspective.

Nevertheless, this review features some limitations that should be emphasized. First, the number of studies included in this work was small and provides only a partial account of organizational interventions in school following the outburst of the pandemic. While writing this article, it is likely that more studies have been published in peer-reviewed academic journals, and any forthcoming studies should capitalize on the most recent literature and developments. For example, at the time of writing, vaccination programs in several countries have just been started and their effects are expected to have important effects on developing school responses throughout 2021. Another limitation of this work that does not invalidate its effectiveness as a scoping review is the lack of an appraisal of the quality of the studies included, as long as all inclusion criteria were met. In fact, four of the sixteen included studies were featured in the same issue of the *International Studies in Educational Administration*, which creates an imbalance in studies sources. It is also important to notice that the final selection featured 11 studies from North America, 4 studies from Europe and one study from South America [35]. Further research may enrich our understanding of adaptations processes by investigating processes in other geographical and cultural contexts.

As a way to extend the validity and meaningfulness of this work and emphasize their applied implications for decision makers and practitioners within schooling and education, future research should examine how the strategies and practices used by the schools are effective for the learners with special needs education. For example, the fast-paced evaluation and implementation phases of a "new normal" schooling experience may be exposed to several fragilities and risks associated with safeguarding inclusion and attendance to students with disabilities or special needs, who may be exposed to new risk factors and left behind after transitioning to new educational practices (see also the cluster mental health in the heatmap displayed in Figure 2). Schools can benefit from facilitating the exploration of new inclusive strategies. Thus, the challenges of the pandemic to special needs education could be a track for further research from the perspective of complex systems. While this area of inquiry reaches beyond the aims of the present work, we hypothesize that there may be implications in terms of the effectiveness and the efficiency of pupils' learning performance and of teachers' teaching performance (see also [54,55]). In fact, given the prolonged duration of new types of student learning, we claim that it may not suffice to aim at preventing the disruption of education but also avoid compromising on its quality (e.g., from coping with the "new normal" to proactively seeking for continuous performance improvement). This claim also seems to remain valid when considering the relation between teachers and their leaders, such as possible cases of lack of support and expectations misalignments highlighted by Brelsford et al. [43].

## 6. Conclusions

Taken together, the results of this scoping review provide an insight into schools' responses and adaptations to an emergency in the early phases of the COVID-19 pandemic. At the time of writing, the world is still affected by the presence and further spread of

the virus, which has exceeded 100 million cases globally and led to over 2 million deaths worldwide [56]. Although the main challenge for public health seems to have shifted towards the availability of pharmacological vaccines, and more recently their delivery to the general population based on prioritization criteria, schools are still facing several of the issues that first emerged during the first round of lockdowns in the first trimester of 2020.

The role played by schools in the current pandemic is crucial to fostering behavioral and organizational protective practices among society at large, and so is the role of other agents, such as government, media, and scientific and non-profit organizations, whose interdependent and coordinated efforts comprise the necessary steps for implementing a system-wide behavioral vaccine [57]. As paradoxical as it may look, the pandemic may have provided an opportunity for educators to learn more about the social context of their pupils. The question now is to understand the possibilities for the emergence and evolutionary selection of new practices.

We submit that a selectionist perspective can and should be resorted to for accessing and informing the capability of schools and educational systems at large to cope and respond with organizational change resulting from the disruption of the status quo. Variation represents a condition for selection to occur, which is mutually informed by the interaction of organizational practices with their encompassing and contextual environments. Exploration was the mechanism on which twelve studies out of sixteen reported, especially of new tools and practices for communicating and interacting, whereas exploitation Please confirm. was underrepresented in the studies included; this may be due to several reasons, including the high level of risk and uncertainty involved during the outbreak of the COVID-19 pandemic. Management practices that facilitate variation and open communication about learning processes can contribute to the process of organizational adaptation.

**Author Contributions:** Conceptualization, P.K., M.T. and F.B.; Formal analysis, P.K., M.T. and F.B.; Funding acquisition, F.B.; Investigation, P.K., M.T. and F.B.; Methodology, P.K., M.T. and F.B.; Software, M.T. and F.B.; Writing—original draft, P.K., M.T. and F.B.; Writing—review & editing, P.K., M.T. and F.B. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding. The APC was funded by OsloMet—Oslo Metropolitan University (project number 415016).

**Institutional Review Board Statement:** Not applicable.

**Informed Consent Statement:** Not applicable.

**Data Availability Statement:** No new data were created or analyzed in this study. Data sharing is not applicable to this article.

**Acknowledgments:** We thank academic librarian Lilja Johannessen for her support in the initial stage of our literature search.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. UNESCO. Education: From Disruption to Recovery. Available online: <https://en.unesco.org/covid19/educationresponse> (accessed on 27 December 2020).
2. Gupta, M.M.; Jankie, S.; Pancholi, S.S.; Talukdar, D.; Sahu, P.K.; Sa, B. Asynchronous Environment Assessment: A Pertinent Option for Medical and Allied Health Profession Education During the COVID-19 Pandemic. *Educ. Sci.* **2020**, *10*, 352. [[CrossRef](#)]
3. Ferraro, F.V.; Ambra, F.L.; Aruta, L.; Iavarone, M.L. Distance Learning in the COVID-19 Era: Perceptions in Southern Italy. *Educ. Sci.* **2020**, *10*, 355. [[CrossRef](#)]
4. Utunen, H.; George, R.; Ndiaye, N.; Attias, M.; Piroux, C.; Gamhewage, G. Responding to Global Learning Needs during a Pandemic: An Analysis of the Trends in Platform Use and Incidence of COVID-19. *Educ. Sci.* **2020**, *10*, 345. [[CrossRef](#)]
5. Schuck, R.K.; Lambert, R. "Am I Doing Enough?" Special Educators' Experiences with Emergency Remote Teaching in Spring 2020. *Educ. Sci.* **2020**, *10*, 320. [[CrossRef](#)]
6. Sandaker, I. A selectionist perspective on systemic and behavioral change in organizations. *J. Organ. Behav. Manag.* **2009**, *29*, 276–293. [[CrossRef](#)]
7. Burnes, B. Complexity theories and organizational change. *Int. J. Manag. Rev.* **2005**, *7*, 73–90. [[CrossRef](#)]

8. Burnes, B. Understanding the emergent approach to change. In *The Routledge Companion to Organizational Change*; Boje, D.M., Burnes, B., Hassard, J., Eds.; Routledge: Abingdon, UK, 2011; pp. 133–145. [CrossRef]
9. Warner Burke, W. *Organization Change: Theory and Practice*; SAGE: London, UK, 2014; Volume 4.
10. Axelrod, R.M.; Cohen, M.D. *Harnessing Complexity: Organizational Implications of a Scientific Frontier*; Free Press: New York, NY, USA, 2000.
11. Weick, K.E.; Sutcliffe, K.M. *Managing the Unexpected*; Jossey-Bass: San Francisco, CA, USA, 2001; Volume 9.
12. Soparnot, R. The concept of organizational change capacity. *J. Organ. Chang. Manag.* **2011**, *24*, 640–661. [CrossRef]
13. Beycioglu, K.; Kondakci, Y. Organizational change in schools. *ECNU Rev. Educ.* **2020**. [CrossRef]
14. Robertson, P.J.; Roberts, D.R.; Porras, J.I. Dynamics of planned organizational change: Assessing empirical support for a theoretical model. *Acad. Manag. J.* **1993**, *36*, 619–634. [CrossRef]
15. Rosenblatt, Z. Skill flexibility and school change: A multi-national study. *J. Educ. Chang.* **2004**, *5*, 1–30. [CrossRef]
16. Hillel Lavian, R. Masters of weaving: The complex role of special education teachers. *Teach. Teach.* **2015**, *21*, 103–126. [CrossRef]
17. Morrison, K. *School Leadership and Complexity Theory*; Routledge: Abingdon, UK, 2012.
18. Waldrop, M.M. *Complexity: The Emerging Science at the Edge of Order and Chaos*; Simon and Schuster: New York, NY, USA, 1993.
19. Preiser, R. Identifying general trends and patterns in complex systems research: An overview of theoretical and practical implications. *Syst. Res. Behav. Sci.* **2019**, *36*, 706–714. [CrossRef]
20. Aouad, J.; Bento, F. A Complexity Perspective on Parent–Teacher Collaboration in Special Education: Narratives from the Field in Lebanon. *J. Open Innov. Technol. Mark. Complex.* **2019**, *6*, 4. [CrossRef]
21. De Domenico, M.; Brockmann, D.; Camargo, C.Q.; Gershenson, C.; Goldsmith, D.; Jeschonnek, S.; Lorren, K.; Nichele, S.; Nicolás, J.R.; Schmickl, T.; et al. *Complexity Explained*. 2019. Available online: <https://osf.io/r3fas/> (accessed on 28 January 2021). [CrossRef]
22. Hatch, M.; Cunliffe, A. *Organization Theory: Modern, Symbolic and Postmodern Perspectives*; Oxford University Press: Oxford, UK, 2006.
23. Glenn, S.S.; Malott, M.E. Complexity and selection: Implications for organizational change. *Behav. Soc. Issues* **2004**, *13*, 89–106. [CrossRef]
24. Sims, H.P.; Lorenzi, P. *The New Leadership Paradigm: Social Learning and Cognition in Organizations*; Sage Publications: Thousand Oaks, CA, USA, 1992.
25. Padgett, J.F.; Powell, W.W. *The Emergence of Organizations and Markets*; Princeton University Press: Princeton, NJ, USA, 2012.
26. March, J.G. Exploration and exploitation in organizational learning. *Organ. Sci.* **1991**, *2*, 1–147. [CrossRef]
27. Bento, F. Complexity in the oil and gas industry: A study into exploration and exploitation in integrated operations. *J. Open Innov. Technol. Mark. Complex.* **2018**, *4*, 11. [CrossRef]
28. Liberati, A.; Altman, D.G.; Tetzlaff, J.; Mulrow, C.; Gotzsche, P.C.; Ioannidis, J.P.; Clarke, M.; Devereaux, P.J.; Kleijnen, J.; Moher, D. The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: Explanation and elaboration. *PLoS Med.* **2009**, *6*, e1000100. [CrossRef] [PubMed]
29. Chen, L.; Liu, W.; Zhang, Q.; Xu, K.; Ye, G.; Wu, W.; Sun, Z.; Liu, F.; Wu, K.; Zhong, B.; et al. RNA based mNGS approach identifies a novel human coronavirus from two individual pneumonia cases in 2019 Wuhan outbreak. *Emerg. Microbes Infect.* **2020**, *9*, 313–319. [CrossRef]
30. Ouzzani, M.; Hammady, H.; Fedorowicz, Z.; Elmagarmid, A. Rayyan—A web and mobile app for systematic reviews. *Syst. Rev.* **2016**, *5*, 210. [CrossRef] [PubMed]
31. Gibbs, G.R. *Qualitative Data Analysis: Explorations with NVivo*; Open University: Buckingham, UK, 2002.
32. Heinecke Thulstrup, S.; Eklund Karlsson, L. Children of imprisoned parents and their coping strategies: A systematic review. *Societies* **2017**, *7*, 15. [CrossRef]
33. Kitchenham, B.; Charters, S. *Guidelines for Performing Systematic Literature Reviews in Software Engineering*; Keele University: Keele, UK; Durham University: Durham, UK, 2007.
34. Argyropoulou, E.; Syka, C.-H.; Papaioannou, M. School leadership in dire straits: Fighting the virus or challenging the consequences? *Int. Stud. Educ. Adm. (Commonw. Counc. Educ. Adm. Manag. (CCEAM))* **2021**, *49*, 18–27.
35. Sepulveda-Escobar, P.; Morrison, A. Online teaching placement during the COVID-19 pandemic in Chile: Challenges and opportunities. *Eur. J. Teach. Educ.* **2020**, *43*, 587–607. [CrossRef]
36. Ahlström, B.; Leo, U.; Norqvist, L.; Poromaa Isling, P. School leadership as (un)usual: Insights from principals in Sweden during a pandemic. *Int. Stud. Educ. Adm.* **2020**, *48*, 35–41.
37. Martinez, J.A.; Broemmell, A.D. Pencils down: Educators respond to the uncertainty amidst COVID-19 school closures. *Int. Stud. Educ. Adm. (Commonw. Counc. Educ. Adm. Manag. (CCEAM))* **2021**, *49*, 109–132.
38. Kaden, U. COVID-19 school closure-related changes to the professional life of a K–12 teacher. *Educ. Sci.* **2020**, *10*, 165. [CrossRef]
39. Trinidad, J.E. Equity, engagement, and health: School organisational issues and priorities during COVID-19. *J. Educ. Adm. Hist.* **2021**, *53*, 67–80.
40. Sider, S.R. School principals and students with special education needs in a pandemic: Emerging insights from Ontario, Canada. *Int. Stud. Educ. Adm.* **2020**, *48*, 78–84.

41. Beauchamp, G.; Hulme, M.; Clarke, L.; Hamilton, L.; Harvey, J.A. 'People miss people': A study of school leadership and management in the four nations of the United Kingdom in the early stage of the COVID-19 pandemic. *Educ. Manag. Adm. Leadersh.* **2021**, *1*. [[CrossRef](#)]
42. Anderson, E.; Hira, A. Loss of brick-and-mortar schooling: How elementary educators respond. *Inf. Learn. Sci.* **2020**, *121*, 411–418. [[CrossRef](#)]
43. Brelsford, S.N.; Camarillo, E.E.; Garcia, A.S.; Garcia, G.; Lopez, V.R.; Montoya, C.P.; Mora III, R.; Olvera, Z.; Ramirez, A.; Wicker, F.; et al. Keeping the bus moving while maintaining social distance in a COVID-19 world. *Int. Stud. Educ. Adm.* **2020**, *48*, 12–20.
44. Fornaro, C.J.; Struloeff, K.; Sterin, K.; Flowers III, A.M. Uncharted territory: Educational leaders managing out-of-school programs during a global pandemic. *Int. Stud. Educ. Adm. (Commonw. Coun. Educ. Adm. Manag. (CCEAM))* **2021**, *49*, 101–108.
45. Hash, P.M. Remote learning in school bands during the COVID-19 shutdown. *J. Res. Music Educ.* **2021**, *68*, 381–397. [[CrossRef](#)]
46. Kim, L.E.; Asbury, K. 'Like a rug had been pulled from under you': The impact of COVID-19 on teachers in England during the first six weeks of the UK lockdown. *Brit. J. Educ. Psychol.* **2020**, *90*, 1062–1083. [[CrossRef](#)] [[PubMed](#)]
47. Van Eck, N.J.; Waltman, L. Software Survey: VOSviewer, a Computer Program for Bibliometric Mapping. *Scientometrics* **2010**, *84*, 523–538. [[CrossRef](#)] [[PubMed](#)]
48. Hauseman, C.; Darazsi, S.; Kent, S. Collaboration, communication and wellness: Response to the COVID-19 pandemic in Manitoba schools. *Int. Stud. Educ. Adm.* **2020**, *48*, 70–77.
49. Mogaji, I.M. Understanding educational responses to school closure during the COVID-19 pandemic: A case for equity in Nigeria. *Int. Stud. Educ. Adm.* **2020**, *48*, 59–65.
50. Morgan, H. Best practices for implementing remote learning during a pandemic. *Clear. House A J. Educ. Strateg. Issues Ideas* **2020**, *93*, 135–141. [[CrossRef](#)]
51. Hall, J.; Roman, C.; Jovel-Arias, C.; Young, C. Pre-service teachers examine digital equity amidst schools' COVID-19 responses. *J. Technol. Teach. Educ.* **2020**, *28*, 435–442.
52. Borgatti, S.P.; Mehra, A.; Brass, D.J.; Labianca, G. Network analysis in the social sciences. *Science* **2009**, *323*, 892–895. [[CrossRef](#)] [[PubMed](#)]
53. Bento, F.; Couto, K.C. A behavioral perspective on community resilience during the COVID-19 pandemic: The case of Paraisópolis in São Paulo, Brazil. *Sustainability* **2021**, *13*, 1447. [[CrossRef](#)]
54. Gonzalez, T.; de la Rubia, M.A.; Hincz, K.P.; Comas-Lopez, M.; Subirats, L.; Fort, S.; Sacha, G.M. Influence of COVID-19 confinement on students' performance in higher education. *PLoS ONE* **2020**, *15*, e0239490. [[CrossRef](#)] [[PubMed](#)]
55. Arora, K.A.; Srinivasan, R. Impact of Pandemic COVID-19 on the Teaching—Learning Process: A Study of Higher Education Teachers. *Prabandhan Indian J. Manag.* **2020**, *13*, 43–56. [[CrossRef](#)] [[PubMed](#)]
56. Center for Systems Science and Engineering—CSSE, at Johns Hopkins University—JHU. Available online: <https://coronavirus.jhu.edu/map.html> (accessed on 28 January 2021).
57. Couto, K.C.; Lorenzo, F.M.; Tagliabue, M.; Borges Henriques, M.; Freitas Lemos, R. Underlying principles of a Covid-19 behavioral vaccine for a sustainable cultural change. *Int. J. Environ. Res. Public Health* **2020**, *17*, 9066. [[CrossRef](#)] [[PubMed](#)]



Article

# Technology as Thirdspace: Teachers in Scottish Schools Engaging with and Being Challenged by Digital Technology in First COVID-19 Lockdown

Jonathan Brown, Carrie McLennan, Daniela Mercieca, Duncan P. Mercieca \*, Derek P. Robertson and Eddie Valentine

School of Education and Social Work, University of Dundee, Nethergate, Dundee DD1 4HN, Scotland, UK; j.v.brown@dundee.ac.uk (J.B.); C.McLennan@dundee.ac.uk (C.M.); dmercieca001@dundee.ac.uk (D.M.); d.p.robertson@dundee.ac.uk (D.P.R.); e.valentine@dundee.ac.uk (E.V.)

\* Correspondence: dmercieca002@dundee.ac.uk

**Abstract:** This paper looks at the impact of digital technology on teaching and learning in primary schools in Scotland during the first COVID-19 lockdown from March to June 2020. The pandemic has challenged our understanding of schooling as, for the first time in many years, schools as we know them were shut and the school building was removed as the site of teaching and learning. This paper uses the concept of Thirdspace as developed by Edward Soja (1996), where Thirdspace is understood as an in-between space between binaries that enables the possibility to think and act otherwise. Drawing from qualitative data from interviews with primary school teachers, this paper explores how the lockdown in general, and digital technology in particular, facilitated a Thirdspace in the first COVID-19 lockdown. Findings from the study indicate that engaging with digital technology offers the teacher more possibilities than they have come to expect in the physical space of traditional schooling.

**Keywords:** digital technology; home-learning; Thirdspace; primary teachers; Scotland; COVID-19 lockdown

**Citation:** Brown, J.; McLennan, C.; Mercieca, D.; Mercieca, D.P.; Robertson, D.P.; Valentine, E. Technology as Thirdspace: Teachers in Scottish Schools Engaging with and Being Challenged by Digital Technology in First COVID-19 Lockdown. *Educ. Sci.* **2021**, *11*, 136. <https://doi.org/10.3390/educsci11030136>

Academic Editor: Palitha Edirisingha

Received: 26 February 2021

Accepted: 16 March 2021

Published: 21 March 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

Schooling is a fundamental part of society's fabric. The interruption to established forms of learning in schools presented challenges to education systems across the globe. These challenges highlighted levels of unpreparedness of teachers in terms of their digital technical competence and digital pedagogy. The previous experience of viral epidemics, as experienced in countries such as Hong Kong, led to the systematic training of teachers in the use of digital technologies [1]. However, while the real experience of such an event caused this pre-emptive approach to be taken, in other countries such as Germany, France and Italy [2], there has been what may be described as a lag in the expected impact of their investment in the digital on the transformation process of their education systems. In Australia [3], it was reported that students, parents and teachers found that communication in lockdown to be a real challenge with the effective strategies for the use of digital technologies in lockdown remaining unclear. It is interesting to note that, in Darling-Hammond et al.'s [4] examination of teaching systems around the world, no mention is made of improving digital connectivity or of digital tools for learning. Indeed, when discussing how to prepare learners for the 21st century (pre-COVID-19) world, what are flagged as important are factors such as teacher professionalism, dynamic curricula, critical thinking skills and student-centred pedagogies. It is as if there is an assumption that the physical school space is the locus of learning in perpetuity. There does not seem to be any mention of digital skills as having value.

It is against this wider backdrop of disruption, challenge and uncertainty that we turn our eyes to the Scottish context for the purposes of our study. In Scotland, education



has long been perceived and valued as key to social mobility and a means of promoting democracy [5]. This key role of schooling has been challenged by the COVID-19 pandemic as schools as we know them were closed in many countries. According to the United Nations Policy Brief [6] in April 2020, 188 countries imposed countrywide school closures, affecting more than 1.5 billion children and youth (p. 2). This unique phenomenon has, over the period of COVID-19 restrictions, led to a renewed acknowledgement and appreciation of the role of schools within society, and of those who work in schools. However, in the initial period of lockdown in March 2020, educators had to wrestle with how to teach adaptively to meet the needs of all learners, having been plunged into a completely novel situation. According to Darling-Hammond [7], adaptive teaching requires, “deep and sophisticated knowledge about learning, learners, and content” (p. 77); lockdown meant that an additional factor came into stark relief which was namely how to reach and interact with the learners when the physical school space was no longer available in the traditional way. Therefore, lockdown meant that the spotlight was focussed on the purpose of digital tools and spaces for teaching and learning. This lockdown-induced interruption to school-based learning in familiar physical spaces required, and expected, Scottish teachers to begin to use a range of digital communication and presentation tools so that teaching could be transferred online. For some teachers this was their first time engaging with digital technology for more than basic needs. The requirement to transfer teaching to this media was such that not only did Scottish teachers have to familiarise themselves with the technical functionality of tools such as Microsoft Teams or Google Classroom, but they also had to rise to the challenge of thinking about effective learning design and pedagogy in the digital space.

This paper focuses on the role that technology played during this time, but this needs to be seen within a discourse of teacher identity working in a context outside of a school building. We refer to the concept of Thirdspace as argued by Edward Soja [8] to help us think about in-between spaces in binaries. The guiding question of this paper is: how did digital technology manifest as a facilitator of Thirdspace in COVID-19 lockdown?

## 2. Methodology

### 2.1. Aims and Subject of the Research

This paper draws from a qualitative study that was conducted during the first COVID-19 lockdown in Scotland. We authors are part of a larger group of researchers from the School of Education and Social Work at the University of Dundee, all of whom were keen to capture the impact of this unprecedented event on the lives of children, their families and educators. We were ‘curious’ about what they made of their current experiences of work and the contribution of this to their thinking about what is valued in their work as a teacher or Head Teacher as they supported children’s and families’ learning during the lockdown. The wider project was led by the following research question: *What are primary school educators’ experiences of teaching from home/in hub during the COVID-19 lockdown in Scotland?*

### 2.2. Research Procedure

A decision was taken to carry out qualitative research with teachers and Head Teachers working in Scottish primary schools. Such a choice was based on the knowledge of the kind of data that we wanted to gather, which gave detailed insights into the lived experiences of those agreeing to be interviewed. Starting from the second week of lockdown in March until June 2020, teachers and Head Teachers in primary schools in Scotland were invited through different social media platforms to participate in an in-depth interview to capture their lived experiences in real time. These online interviews were carried out through MS Teams.

The process of analysis of the interviews for the purpose of this paper can be visualised in the form of two spirals which seem to weave closer and closer together as they progress. These are constituted by our reading of Edward Soja [8] and our growing awareness of

the prominence of the theme of digital technology in the interviews we were listening to and transcribing. The authors of this paper embarked on reading about Thirdspace, while at the same time becoming more and more immersed in the data. As Hollway and Jefferson [9] stress, “after a whole day working on the transcripts . . . (a process we often referred to as ‘immersion’) we would be inhabited by that person in the sense that our imagination was full of him or her” (p. 69). The authors met online several times to discuss their thoughts about the literature read and the interviews, and started to explore themes that emerged, following Hollway’s idea that the significance of the interviews is not only “a property of the extract, but of the work it is put to do” [10] (p. 36). This was thus a theory-led thematic analysis [11] based on the works of Soja [8], where both theory and interviews were ‘speaking’ to each other while at the same time challenging each other.

### 2.3. Building a Research Tool

The nature of the research question did not lend itself to an organised survey leading to statistical analysis. Since we sought the perceptions and meanings created of the events that were unfolding and their impact on participants, an in-depth interview was the preferred method of collecting this information. Following discussions with the wider research team, ten questions were chosen to guide the interviews, and all interviewers worked with the understanding that this was to be a conversation. Indeed, interviewers reported that most participants needed little prompting as they were very articulate and fluent. Some participants reported that they welcomed such conversations and thought that it gave them space to pause and reflect on what they were engaging with in unique times, a chance to take stock on all that they had accomplished in a short span of time and under intense pressure.

### 2.4. Characteristics of the Research Group

More than sixty primary school teachers and Head Teachers volunteered to participate in the project and were interviewed. The respondents volunteered themselves as participants and all those who did, and who fit the parameters of working in primary schools in Scotland, were accepted. The research group did not seek a representative sample of educators which was distributed according to certain criteria. This was because, although cognizant of the large variety of contexts in which Scottish schools in different geographical and socio-economic areas function, we were not seeking a sociological understanding of their experiences, as much as we sought the educators’ personal thoughts about these experiences. We do not claim to be able to generalise our findings to represent the experience of all primary school educators. As Wendy Hollway [10] suggests, “generalizability... [in this kind of research] . . . has to be established according to theoretical rather than statistical principles” (p. 16). In the Rogerian sense of what is most personal is most general [12], we believe that the issues emerging from our process of analysis are generalisable conceptually and theoretically. We have had several reports in our online seminars about this project that viewers have resonated with the participants’ expressed thoughts and feelings.

We feel the need to clarify that the interviews were reflecting the experiences of participants who were willing to share their story. It should be noted that there are others whose stories may not tally. Yet, there have been many who have ‘recognised’ our interpretations and analyses, “that is, the sense that we made out of them can be shared through the subjectivity of others” [9] (p. 80) “Our work, as well as being theoretically led, is solidly empirical in the sense that supporting and challenging evidence is available” [9] (p. 80).

### 2.5. Research Ethics

Ethical clearance was sought and given by the School of Education and Social Work at the University of Dundee. High in our consideration was the awareness that this was rather a stressful time and that our research should not in any way add to pressures on interviewees. Voluntary participation was key, and when educators expressed interest in

participating, the interviewers took pains to ensure that the time of the interview suited the many claims on the participants. The interview questions were also placed on an online survey tool for those who were keen to participate but felt that they could not find an hour to be interviewed. A few educators opted for this online survey. Besides this, confidentiality and anonymity were naturally very important, as we made sure not only that identifying information was not divulged, but also disguised information of third party persons, places or events which were mentioned.

## 2.6. Limitations of the Study

The urgency of starting the research project as soon as the lockdown in Scotland commenced meant that the teachers were invited to participate through social media. We are aware of the possibility of these respondents presenting as models of hard work and enthusiastic professionalism. We have mentioned elsewhere that these need to be seen as experiences of people willing to share their story and that there are others whose stories may not tally. The voices of these teachers are not captured in our research. A longitudinal study on the impact of the pandemic restrictions on teachers and teaching may capture the narratives of those whose life journeys have been affected significantly.

## 2.7. Theoretical Framework

The data was analysed through a theory-led thematic analysis [11]. This paper understands teachers' identities as multi-layered, complex and continually becoming(s). Yet, in this unprecedented event, which happened with very little warning, teachers were forced to make numerous changes over a short time. Elsewhere, we outline the toll such changes had on teachers and others [13,14]. In this paper, we focus on "the change process [itself], and in particular when a person is in between two identity constructions: when they are neither one thing nor the other" [15] (p. 286). This 'change process' often is uncertain and dilemmatic in nature. Change processes allow for "in between spaces" [15] (p. 2) to reside in the "overlap and displacement of domains of difference" (p. 2). Difference is often produced through thinking that occurs in binary opposites, with our teachers trying to come to terms with the change from teaching pre-COVID-19 and teaching during COVID-19.

Thinking in binaries does not allow "both/and also", what Soja [8] (p. 5) refers to as Thirdspace. He seeks to acknowledge Thirdspace and invites us to follow suit, as Thirdspace allows for creative combinations and restructuring of ideas that can provide new alternatives to binary thinking [2] which is often oppositional. In particular, when structure and agency are seen as 'both/and also', this allows "our understanding of self-identity/social-identity mutual construction" [16] (p. 286) to be viewed in a new light. The acknowledgement allows possibilities of thought which are otherwise stunted—thus the act of acknowledgement is powerful and can even be liberating. It disturbs the established to and fro of the binary. Soja draws upon Foucault's term 'heterotopia' [8] (p. 145) to describe the Thirdspace as 'other', as a space that is disturbing, intense, incompatible, contradictory or transforming. Heterotopia is a "thirding-as-Other" [8] (p. 5), 'a more space', 'an added space' 'a different space' than what we 'normally' understand and live by. Soja's words capture this: "set aside the demands to make an either/or choice and contemplate instead the possibility of both/and logic" [8] (p. 5). We can think of Thirdspace as a space that allows us to "draw selectively and strategically from the two opposing categories to open new alternatives" [8] (p. 5). The application of Thirdspace theory to the digital realm was proposed by Potter and McDougall [17], who posited that websites and online spaces could act as "a negotiated and contested area in which meanings are made and shared, some of which may relate to encountering new knowledge, learning or developing new skills and dispositions," (p. 7). This study is situated within this definition, where contradictory and opposing categories (First and Second space) can work together to generate new knowledges [18] (p. 42) and extend beyond these spaces.

The school lockdown brought to the forefront several binaries which have structured teachers' lives, for example personal and professional, school-time and home-time, teaching and learning. We argue that the lockdown allowed for a third space to emerge, a space where 'everything comes together' [8] (p. 56). Technology has been hailed as a saviour in this scenario, as enabling processes which would otherwise have abruptly stopped. This paper problematises this view of technology within a number of binaries. Through the concept of Thirdspace we think about the possibility of re-imagining (and inhabiting) an alternative space for primary teachers working with technology during COVID-19 school lockdown.

### 2.8. Context

Digital technologies in education have long since played a part in the discourse surrounding the transformation of Scotland's education system. Scotland was one of the first countries to develop a national intranet (Glow) for all teachers and learners. This national intranet, started in 2006, has long since been at the vanguard of digital technology's efforts to become embedded in the "habits of the mind, habits of the heart, and habits of the hand" of Scottish teachers [19] (p. 59). Even though this initiative has cost upwards of £69 million [20] and was also the recipient of the internationally coveted George Lucas Award in 2008 [21,22], it is a platform that has, until very recently, struggled to play its hoped-for part in the digital transformation of teaching and learning in Scotland. Recent years have seen the range of services offered to teachers and learners by Glow improve. Yet, questions remain about how their effective use have become central to the practice of teaching and learning in our schools. Indeed, the recent Enhancing Learning and Teaching through the use of Digital Technology Strategy noted that "despite the pervasive nature of digital technology, its benefits are not always fully felt within our education establishments" [20] (p. 3).

It is interesting to note that although it has been four years since this strategy paper, these concerns are still being raised. In the recent report by the Scottish Government's International Council of Education Advisers, it was stated that it was felt that there were still "students and teachers with insufficiently developed digital skills" [23] (p. 8). The report acknowledged that there had been recent national developments to begin to positively address this ongoing issue and stated that, "there is now a need to exploit the potential contribution of interactive digital pedagogies for the various purposes of the curriculum" [23] (p. 10).

On 20 March 2020, schools in Scotland were closed to students unless they were classed as vulnerable or children of key workers, in which case they would be allowed into "hubs" to be supervised, although their class-based learning would be carried out at home. The Education Minister announced on 19 March that children's education would continue via distance and online learning with as much continuity as possible [23]. It was another month before Scottish Government gave further information [24] in relation to the school term from April to June. This statement indicated that there would be ongoing guidance in relation to working digitally, support for teachers, and equity of support for home learning and children with Additional Support Needs. It was clarified that parents would not be expected to engage with their children's learning formally nor to act as teachers. The nature of the educational infrastructure in Scotland meant that this could be interpreted and enacted differently at local authority and school level.

## 3. Results

Three themes are developed in this section.

### 3.1. Theme One: Knowing—Not Knowing; Valuable—Not of Value

As mentioned earlier, the use of technology has been growing steadily in education. The data points to a pre-COVID-19 state where groups of teachers had various attitudes towards the inclusion of technology in their teaching. Respondents referred to these

attitudes in themselves and their colleagues in terms which were rather polarised. Their responses also indicated a linear progression within their own thinking about technology, referring to tensions about not knowing and not valuing technology enough.

One teacher, a technology champion in her school, had, prior to lockdown, been offering weekly support to her colleagues with their technology issues. She reported that over three years she had only had a handful of people going to her for support. She felt that her colleagues did not value technology and did not put in enough effort to know more:

This is my third year in this current school, and I spent those three years up until the last week before school closure having those colleagues tell me that they are not interested in digital literacy, they hate it. I provided a drop-in session every week and in three years, I had three people come, so every Wednesday after school I spent time in ICT suite offering to help them train them because they all said that they were being deskilled. I was demotivated by that whole kind of scene in my in my setting. So that's completely changed with the schools' closure. And, uh, my days I can hear my phone and my iPad, my school laptop, my own laptop, and it literally starts about 7:30 in the morning. Ding Ding, Ding, Ding and I can be sorting out problems until 11:00 o'clock at night, and I mean my steps have gone from thousands to less than 1000 . . . I've been so busy in this lockdown.

During lockdown, technology use increased dramatically. It became the sole medium through which teaching took place. The interviews show that many teachers were experiencing a rather steep learning curve with this medium and that many were struggling. It became a new source of stress that technology became the new interface through which teachers were deemed as 'good' or otherwise. The interviews reflected how teachers were constructing themselves and their colleagues in a discourse of competence.

Several teachers felt under pressure because their work now was directly accessible to the parents, where previously this used to be mediated through students. Now that everything was online, and young children needed parental support to access work, teachers felt their work was 'scrutinized' by parents:

you just do so much of teaching just off the cuff and, you know, my activities and learning experience are all planned but you don't plan everything you say until it comes out your mouth, whereas I'm very aware that parents are just seeing it online, like everything that I'm doing and putting out as being utterly scrutinized by some quite demanding parents. So, I am very aware of what I'm sending out, that it's got to be good.

This has influenced parental perceptions and constructions about teachers. Some Head Teacher respondents reported becoming aware that their teachers were now being gauged by parents differently:

What's been interesting to me as the headteacher and what I've learnt is the members of the staff team who are very good practitioners on the ground aren't necessarily coming across like that in the digital world. So I've had lots of wonderful messages from parents saying, 'Mr X is amazing, or Miss X is like this, she's brilliant', and I'm actually like, do you know what, in the classroom, their practise isn't matching the level of praise that they're receiving now publicly. Whereas I have some really good classroom practitioners who are very experienced, who know the curriculum inside out, and who will do their very, very best by their children, but in terms of their ability to be able to cope and operate with Teams and upload work, isn't matched, and so I have parents emailing in saying, 'I'm not getting this from that teacher, I'm not getting that'.

Such comparative thinking was also reflected in the teachers' interviews as they constantly compared face-to-face to online teaching, thus pointing out another binary. One teacher described that she no longer benefits from the instant reaction of her students and feels that she engages in more explanatory teaching because of this lack. We need to point

out that, in the first lockdown, many schools in Scotland were following regulations which did not allow live online interaction to take place.

I think it made me realize how much I assume that the children know without it being explained, I think you get to know your class so well that they know what you mean in a way that parents don't. So, I think, OK, well, that explanation would have totally sufficed in the classroom, and it's not at all, you know, I've had to really think about how I explain things and how I word things. I realize how much I rely on instant feedback from the children. Because you get feedback, you know, a hundred times a minute in the classroom and by their faces and you don't have that at all when you're saying 'work this out on MS Teams' and then you're just left...

Several issues can be raised here, but certainly there is a need to question how technology was being used. Some teachers reported that after using technology for a while, it seemed to become

really stagnant, so I'm finding online teaching very repetitive, and that's not how I am day to day in a classroom. I'm usually always thinking of new things, new ideas, so I've sort of challenged myself . . . Trying to do teaching videos as well. Nothing live".

There was also a reported difference between schools who had been engaging with technology prior to the lockdown and those who had not. Some teachers reported that their teaching had embedded technology across the whole school. Students were given tablets, and these were taken daily to schools and are used as part of their learning. The following quotation taken from an interview carried out only a few days into lockdown captures the almost natural flow to online teaching and learning: "I've already put my students into groups and I've assigned them books so that I can lead on my comprehension, I can set them task comprehension related to their books. Not all teachers are going to be doing that [in other schools], they don't know how to". The following quotation reports a very different perspective to the last:

I've heard a lot of people say that it is a waste of time teaching P1 [children aged 5 years] how to login and how to use a computer. I've had really good friends that have taught P1 and have removed all digital technologies from the classroom because that's not what P1s should be doing . . .

### 3.2. Theme Two: Teachers as Parents–Parents as Teachers

Teachers and Head Teachers were asked about how they were experiencing the lockdown, and how they balanced working from home and caring for their families. The binary between the professional and personal/familial was challenged by restrictions imposed because of the COVID-19 pandemic and these boundaries were sometimes completely permeable. This was one of the factors which contributed to our growing appreciation of the impact of the school building on the running of the school, and the impact of the lack of it during lockdown. Teachers reported that not being in schools had an impact on them, even changing what had prior claims to their attention: 'when I am in a classroom, I do not answer a text message from my son, when I am in my kitchen, I do'. Geographical spaces imply distances and proximity, and this was a crucial factor in schools' closure. Students were not directly in front of teachers in classrooms but were at a distance (in their respective homes) online. Changing territorial lines produces new territory and what was once familiar is made strange. This second section concerns how teachers re-negotiated their lives and especially the demands made by technology on their time and/or attention [25].

It was evident that many teachers' personal lives and stories were being juxtaposed with their online presence. Many teachers reported that they felt very stressed:

It was, I have to say it was extremely stressful, the first Monday, Tuesday, Wednesday the adrenaline kicked in but, of course I have a daughter who's immune-suppressant so, you know, it's been a big worry about what my role has been to

not take anything home to her. My husband and my son are, and my daughter, because they are in their 20s my children, they have all been furloughed. It's like they're coming to terms with being at home but I'm still working, you know. My son is a typical 21 year old and you know, wanting fed and attention and he gets bored so, you're trying to work down here and they are rambling about and interrupting, you're stressed enough with what's going on and the general situation and then they are interrupting every 5 min and you are trying to get your head around how can I help vulnerable children . . . it's, it's not great. It's not a great situation.

Many teachers spoke of moving their family lives and timetable to fit around their working hours; this was evident with teachers who were parents and carers of young children. "I keep my kids up later so that I can do work in the morning". Teachers recognise that they are getting to spend more time with their families and enjoying the moment:

in some ways it's lovely because I'm at home and I never get to be at home as well as teaching, I teach and I also tutor four different kids a week and I coached gymnastics two nights a week, so normally I'm really busy and I'm never in my house. I mostly I leave for school at 7:00 in the morning and because of either tutoring or gymnastics or children's activities. I'm generally not home for my tea till after 9, so it's actually been really nice to have more time in the house. Working-wise, it's challenging because it's a small house and my husband's also working from home and he's very noisy. Skype calls pretty much all the time and I've got two children who are also needing time and attention.

Some Head Teachers had to intervene and support teachers directly to help them reduce stress since they felt the need to be constantly online:

I had one member of staff say, she went online just to check one piece of work that she knew was coming in and then suddenly she said, you know, 'It was six o'clock I went on and it was half nine before I came off'. You have to keep reminding, you know, 'You don't need to be on all the time. You know your time to be online is this time'.

Given that the data are from teachers' lived experience, the following idea emerging from the data intrigued us. Teachers who were parents reported that home-schooling their own children was very challenging. They seemed to differentiate their teacher role from their parental role, thus separating the home-space strictly from the school-space, another binary with strict boundaries. However, the ease of access brought about by technology during the lockdown tested and blurred the divisions that both teachers/parents and children were accustomed to. Some teachers reported they had never acted as teachers to their own children:

as a parent myself, I never forced my children to do homework because I thought that they did enough at school, at home they were learning life skills... they were learning other things. And if they wanted to do it then I would support them, but I would never pressure them. But now. That's come back to bite me right in the behind. Because my kids are like... no, I'm not doing it... I'm not at school . . . The worst part is trying to get them to do work, especially the older ones because they don't understand the gravity of what's going on.

In most of the interviews, teachers and Head Teachers were very quick to empathise with parents of the students they teach. "You can't force parents to do that. I know myself being a parent that it's really tricky. Trying to manage four kids! It would be tricky trying to manage even one kid especially if you're not au fait with technology and using these types of things. It's really, really hard".

Very often we speak of teachers and parents as opposing binaries. Yet from the data, we could see an in-between emerging: teachers as parents and parents as teachers. The



very distinct identities were blurred through online engagement. Many teachers who were also parents reported being exasperated with some interactions between their own children and their children's teachers. Some also reported learning from these parental frustrations and trying to modify their own teaching practices accordingly: "I think because I've got my own children at home as well, some things that their teachers are doing are really annoying me. For example, I'm trying really hard to answer emails quickly—my daughter wrote an email to her teacher eleven days ago and didn't get an answer until today that was annoying. So, I'm trying to not do the things which are annoying me as a parent".

Some of the teachers were aware that particular teaching materials uploaded online created complex situations for parents as they had to mediate learning. One teacher called parents "surrogate teachers" saying that "what's harder has definitely been parents . . . They're quite clearly struggling". On the one hand teachers were aware that parents were needed to mediate teaching and learning, but on the other hand they were reluctant to put pressure on parents and impact on their parental relationship with the children: "Honestly, they need to be parents, that's all. We are not expecting them to be teachers. We're not. We don't want to. I don't want to. I don't want parents feeling pressure or stressed or getting upset . . . they've got enough to contend with". Some teachers were actually asking: "As a school, what's our role as a school? To prepare children for life and work and learning' but you know, do we really prepare, prepare them for life?" Some teachers were arguing that maybe during the lockdown children should be learning basic skills, "taking this time to learn to cook and learn to budget and you know, so, you are actually looking at literacy and numeracy which of course will always be important, but suddenly the other subjects that are maybe, you don't have time for in the curriculum are coming to the forefront and you are actually seeing a greater value in them". Many teachers offered support to parents. Some teachers decided to do family learning tasks, where all the family were involved on a learning project, for example exploring animal habitats. Other developed online materials specifically for parents:

I've got a channel just for parents, which is just all about inspiration and hopefully I am answering questions about teaching and how I do things in the class, but well. In the hope that parents will absorb that and copy you, yeah? I've recorded myself, you know, even just reading stories, even recorded reading stories and. And hopefully you know that is helping parents to teach their children about reading and books . . .

### 3.3. Theme Three: Learning New Concepts—Consolidating Concepts

One of the tensions emerging from the data centres on teachers' understanding of teaching and learning during lockdown, what they perceive to be achievable using digital tools, and what is achievable within the restrictions imposed on use of digital tools by the educational hierarchy. This manifests as a tension between introducing new learning concepts or consolidating concepts that children had learnt prior to COVID-19, with one teacher reporting "we've been told to just be going over learning that they've already done this year rather than learning new concepts because they are not really able to do that on their own. So we've just kind of been doing learning that they've already done but trying to challenge them at the same time".

Some teachers were not certain that their use of technology could be conducive to new learning:

It's a mix, really. I think we haven't quite got the pedagogy right at all, and I don't even think that I do, so I would say right now that is definitely more challenging, how to do this in Technology. But I think everybody still trying to get their heads around how to teach this remotely. Because you can't really... we can't record a lesson and then send out to the pupils. You can do a video and then post it, but then it's not interactive for the kids. They can't really ask questions. so I don't think we've got the pedagogy right for remote teaching. In my assignments, I'm trying to make it very simple. Pointing them in directions of an online game, or,

you know, unplug and go and play. But when you are depending on the parent in order to interpret what you've written it's difficult.

This previous comment alludes to the issue of learning new concepts being exacerbated in the first lockdown due to restrictions imposed by the educational hierarchy. Due to General Data Protection Restrictions (GDPR), to concerns about teacher workload, and about what was achievable beyond the physical school space, constraints were imposed; synchronous online sessions were not widely permitted and, where they were allowed, children's cameras were to be switched off. This meant that teachers were limited in their use of digital tools:

When we first got set up, I had assumed, 'Great, I can start doing group work and maybe have 4...6 kids at a time and do a discussion... have a proper lesson because they need that collaborative learning—oh it's such a loss. But Council rules are that there's absolutely completely no way, we are not allowed to video contact children, and presumably it's from a child protection point.

Other teachers reported being concerned about the loss of immediacy and connection because of these restrictions. The importance of responsive feedback and mediation were highlighted, and fear expressed about the impact of their lack on children's motivation and mastery of learning. The following comment reflects these concerns in a teacher who tried to mitigate them by tracking pupil's engagement:

You think of all the the assistance we provide for them in school. It's all gone. They don't have an adult near them. They don't have a wee friend to ask. They don't have any collaborative learning, which is just the pits, and they're just.... the [attainment] gap is just going to become a chasm... I don't think I've really changed much in terms of the learning and teaching aspect, only because I'm just going to do the same lesson, but we will record it. And then, you know, pretend there's chat even though there's not chat, kind of thing. But then maybe don't know which of these children are actually tuning in. Yes, I do know my views are high because on YouTube it does tell you the numbers, but I don't know... it could be one kid watching the film 65 times.

Given the restrictions placed upon the application of the digital tools, some respondents felt it was particularly restrictive for teachers who felt they needed to engage more directly with their children due to the skill/knowledge being developed or the age of the children. This comment applies to the youngest school-aged children (age 5):

The most challenging thing is writing. There's always this kind of... I don't know whether it's perceived pressure or stress to get children writing, and that's a really, really hard thing to kind of balance with play-based learning in the class anyway, because traditionally we would be setting the kids down to write every day, or at least every week, or would be practising handwriting. And I can't see children's pencil grips. I can't see them, you know, to encourage them to start at the edge of the paper, or if their letter formation is the correct way. Those are things I kind of worry about at the back of my head because they're so difficult to unlearn . . . And you know, I'm trying to kind of calm myself down about that whole writing. And can they, can they hold a pencil properly, can they form the letters properly? Can they spell properly? Can they write a sentence? Can they write on the line? Don't know.

Some teachers attempted to carve out spaces for new learning as a response to calls for differentiated teaching. They reported trying to find ways of working round restrictions and indeed sometimes paid lip service to these guidelines. The following comment reflects a teacher's thinking about how she could respond to children's saturation with learning consolidation. She thinks it possible to work around restrictions and use what she can within the digital space to teach new concepts, almost Foucauldian in her transgression:

I am getting to the stage with some of my maths groups where they need to learn new stuff, and the unions have been really quite adamant that we shouldn't be teaching new ideas and that this time should be for consolidation. But I mean I've got a group who are sick to death of consolidation and word problems and problem solving and they just need to learn how to do taking away with crossing out. I've got a MS Teams chat with them tomorrow, just that maths group . . . and I'm going to try and teach them it over video with no video – like audio chat.

Attention to the emotional and psychological demands of entering a national lockdown was a common theme within the interviews and it is possible that the choice to consolidate prior learning rather than deliver new learning was an expression of pastoral care rather than assumptions as to the utility of technologies. Indeed, comparing perceptions and practices relating to the acquisition of new learning between the first and second lockdown would provide valuable information as to developing attitudes and assumptions about learning in this new digital Thirdspace.

#### 4. Discussion

This section addresses the results section and takes the data further into analysis. We have decided to address the themes as a whole which is based on the foundation of Soja's Thirdspace. We believe this is in line with our ontological and epistemological stance as outlined in the methodology section, as we agree with Hollway and Jefferson [9] that were we to address each theme in isolation such fragmentation of thought would diminish the argument we make. In fact, we start this discussion by referring to the impact of the school building and also the impact of its loss during lockdown on the binaries mentioned above. Elsewhere we have highlighted an increased awareness of the importance of the school building [14] as a site which allows for structures and processes to bring about equity and social justice [26]. The closure of the school building caused the necessity for innovative ways of ensuring the continued enactment of these two values, so that teachers and Head Teachers reported numerous creative initiatives in their attempts to reach out to all children, particularly those who were deemed vulnerable [26]. The three themes above similarly emerge due to the loss of the physical school building and the prominence of digital technology to connect people in its absence and are thus intertwined.

Prior to the lockdown, teachers were positioned in different places along the binary representing their views on technology: do they value technology in their teaching, and how comfortable are they using it. Our analysis pushed the school building to the forefront of this debate, as we realised that the binary effectively vanished once the schools closed. Whether teachers valued or were familiar with technology became a thing of the past, as technology became the medium through which all mainstream processes took place. In this way, we acknowledge that technology provides an in-between space, a Thirdspace that gives us more possibilities than we are accustomed to. As a Thirdspace, technology can escape being pinned down to particular ways of doing even if there are always attempts to pin it down. It seems to be in the nature of technology to constantly challenge teachers and students, as it eludes capture—hence guaranteeing a constant place in Thirdspace. It has an impact on the teachers who try to reach it, as it challenges their identities and their engagement with teaching and learning, as seen in the above themes. In Theme Three, the restrictions and constraints accompanying online teaching which were issued by governing bodies and unions effectively limited attempts of teachers to engage with it, to discover new ways of being with children. Thus, it is not only the technology itself, but also the politics that come with it, that have an impact.

We agree that technology is not neutral; it changes people and spaces (schools and homes) in their attempts to engage with it. Jones and Kessler [27] argue that teachers' agency and consequently their realisation of their identities were severely impacted by COVID-19 and our data suggests that engagement with technology contributed significantly to this impact. They quote a teacher describing "the need to separate her work from her personal life, something that in the COVID-19 era teachers have been increasingly un-

able to do” (p. 3). One of the teachers in our study, in fact, remarked “that’s tricky—being at home with my family and working at the same time . . . It’s hard to switch off”, while others reported purposefully reaching out to children and families by showing snippets of themselves in their personal lives. This ranged from one teacher who developed her numeracy lessons on her croft with her two-year old being very much present in her videos, to teachers attempting hand stands as part of a school challenge to encourage pupils’ well-being.

. . . teachers are . . . reacting according to their narrative understandings of selves, schools, and students . . . teachers are now dealing with a complete disruption of their storied professional landscape and, therefore, their sense of how they know themselves and their students. Formerly, “changes ripple[d] through the school and influence the whole web of stories” (Clandinin and Connelly, 1996, p. 160), now the changes have come as something akin to a forest fire, requiring a full remaking of the landscape and teachers’ stories of self [27].

Many teachers in the above themes mentioned the wide range of digital tools and spaces that work on different digital platforms. This choice may place teachers under some pressure as they need to keep up with this ever-changing digital scenario, where no sooner are teachers familiar with digital platforms than they are presented with new ones to use as media for their teaching, risking appearing dated if they do not keep up. This pressure is felt by technology users and sits alongside Camilleri’s [28] argument that the perceived utility of a technology is related to an individual user’s familiarity with that technology within the context it is to be employed within. Castells [29] describes users as the ‘key producers’ of technology, moulding the technology to reflect their values and meet current needs. In this regard the technology itself is transformed by the user’s beliefs, values and assumptions. Orlikowski [30] captures this dynamic by describing technologies as embodied structures, built to be appropriated by users. Locating these ideas within the context of education, Mays [31] suggests that, for technologies to be used for purposes beyond replicating and scaling traditional learning and teaching approaches, teachers must approach technologies open to new possibilities. Indeed, Mays [31] argues that assumptions about pedagogy, engagement and what is ‘possible’ are nested within the very design of the digital learning pathways and opportunities created by educators. Yet, although our research did yield data which showed technology as malleable and flexible for those who claimed familiarity with it, other accounts reflected a view of technology as a stronger force, indeed one which pulled them out of their comfort zone. In fact, this may also be the case once teachers are familiar with a digital platform, as they may unexpectedly be asked to engage with an upgrade or even a completely different platform. Baumans’ [32] theory of liquid modernity argues that, as society moves forward, the pace of change also quickens in many aspects of that society. As this pace of change quickens, what was previously seen as new now has an increasingly reduced lifespan to be replaced by the new. The recently new is now seen to be old-fashioned. If we apply this theory to education and digital technologies, how does this impact on the teacher? Is there still the space and time for that shared grammar of developing practice to take seed, to grow and to flourish?

This liquidity of change is one that is very much linked to the promise of transformation of teaching and learning made to schools by the major educational technology companies. This promise is one that can be seen in the literature and at events such as educational trade shows [33,34]. Indeed, Buckingham [33] (p. 26) in his critique of how digital technology is sold to education argues that, “technology seems to move beyond being a mere consumer product and to assume an almost metaphysical dimension; and in the process, it is endowed with a magical ability to stimulate and transform learning and teaching”. We feel this is suggestive of Soja’s ephemeral and elusive nature of what inhabits Thirdspace as it “introduces a critical ‘other-than’ choice that speaks and critiques through its otherness... It does not derive simply from an additive combination of its binary antecedents but rather from a disordering, deconstruction, and tentative reconstitution of their presumed totalization producing an open alternative that is both similar and strik-

ingly different" [8] (p. 61). In this Thirdspace, "contradictory and seemingly incompatible ideas [are allowed] to coexist and be creatively restructured in new ways to produce new meaning" [35] (p. 57).

Despite some reticence about technology use in schools [36,37] and the nature of engagement with it as dictated by the educational hierarchy, many teachers in Scotland had little option but to try to engage with it at various levels. It was evident from our data that there are different attitudes among teachers' use of technology in their practice, and this is supported by international literature [38–42]. The promise of transformation is a seductive one for education and one that could be argued, from a Scottish perspective, is still a promise that many see as unfulfilled. Indeed, commentators such as Selwyn [43] (p. 9) argue that much of the rhetoric of transformation is very difficult to substantiate. Mays' [31] analysis points out that new media and technology can easily be used simply to replicate the traditional teaching and learning approaches rather than offering new approaches. Selwyn [43] further argues that we should treat descriptions of digital revolution, transformation and improvement as evocative and aspirational stories, rather than sober, objective and accurate descriptions of actual ongoing changes in education. As Higgins et al. [44] (p. 16) argue, "overall the key implication is that the technology is solely a catalyst for change. What is it that teachers or learners actually do which brings about any improvement in learning? Focusing on the change (and the process of change) in terms of learning is essential in supporting effective use." The lockdown has highlighted that, when it comes to effective teaching and learning with digital tools and spaces, we still "don't have a shared picture of what effective practice with digital technologies look like" [45] (p. 3). As Mays [31] argues, new tools should not replicate what has always been done but are ideally used to rethink what is both desirable and possible in an online environment.

It was against this backdrop of an apparent deficit understanding of digital pedagogy in the traditional school-based space of teaching and learning that teachers found themselves wrestling with online teaching. Ewing and Cooper used the term 'instructional MacGyvers' to describe how teachers were feeling during the pandemic, having to improvise solutions in less than ideal circumstances [3]. Arguably, it is the case that what has become the default discourse around digital technologies is the need first and foremost to develop confidence and competence in tools against the already discussed backdrop of rapid change. This rapid change brings into question whether there was the time, and even an appreciation of the importance of going beyond a functional competence and to explore the underlying pedagogies of digital teaching and learning irrespective of the tool, space or device used. Lockdown presented the teaching profession with a new challenge and a new space in which it had to make sense of what it means to be an educator in the challenging context of a lockdown caused by a pandemic.

## 5. Conclusions

This paper looked at the impact of digital technology on teaching and learning in primary schools in Scotland during the first COVID-19 lockdown, based on a study on the lived experiences of primary teachers working in Scotland during this time. As Jones and Kessler [27] remarked, "during the pandemic, the entire landscape of teachers' realities has shifted. Initially, this took place overnight, while public discourse continued to demand their accountability. While attempting to adapt her practices and materials for virtual teaching in March of 2020, a teacher's identity may have undergone one round of renegotiation, reconceptualizing her teaching values or commitments for a new modality" (p. 6). This was also reflected in Kim and Asbury's [46] research.

This paper discusses that Scotland was similar to many other countries internationally in that lockdown revealed a lack of preparedness to switch to online learning and understanding of how to engage with digital technologies and pedagogies. Against this backdrop, Soja's concept of Thirdspace helped us read the data through several binaries, where technology was viewed as providing a space, and itself also being an in-between space, a Thirdspace that gives us more possibilities than we are accustomed to. These pos-

sibilities, in the data analysed from the Scottish digital context, reveal that the teachers in this study were able to realise more meaningful engagement in the digital Thirdspace than had been possible, or perceived as desirable, prior to lockdown. However, the different levels of engagement and consequent competence of teachers with digital technology mean that some teachers, who had previously been very successful in their class teaching, were perceived differently and those with digital expertise were finally able to demonstrate the value of their prior engagement with digital technology. The introduction of the virtual arena of teaching and learning meant that previously well-defined binaries of teachers in school and parents at home meant that roles became blurred; teachers who were also parents found it challenging to manage both roles and had to find an *other* way of being in their home while students' parents became intermediaries for their children and teachers to support the digital channel of communication. The Scottish Government guidance for parents not to act formally as teachers was challenging to enact in their lived reality.

A final tension concerned what was possible in terms of introducing new learning versus consolidation of learning. This was due to teachers' own uncertainty about what was achievable using digital tools exacerbated by well-meaning restrictions imposed upon how they and their students were permitted to engage with the technology. Technology, as a Thirdspace, can support teaching and learning to escape being pinned down to particular ways of doing and contradictory ideas can co-exist. It is in this light that technology is seen as hopeful for teachers and students, yet as well always being a receding horizon that always needs to be aimed at. The COVID-19 lockdown brought this complexity into sharp focus. Moving forward, it is fundamental that educational policies reconceptualise how digital technology can support learning. This would enable teachers and learners to build on what lockdown has shown us to be possible and may support educational structures that transcend our embedded understanding of teaching and learning being always centred around and restricted to the local, physical environs of the school. It is hoped that, as COVID-19 becomes managed, we retain the value of what we have learned as we return to schools and the physical locus of learning and with the reinstating of previous binaries.

**Author Contributions:** All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Institutional Review Board (or Ethics Committee) of University of Dundee (protocol code E2019-83 and date of approval 3 April 2020).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The datasets presented in this article are not readily available because the dataset is only available to the research team. Requests to access the datasets should be directed to corresponding author.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. The World Bank Education Global Practice Guidance Note: Remote Learning & COVID-19. Available online: <https://openknowledge.worldbank.org/handle/10986/33585> (accessed on 15 January 2021).
2. König, J.; Jäger-Biela, D.J.; Glutsch, N. Adapting to online teaching during COVID-19 school closure: Teacher education and teacher competence effects among early career teachers in Germany. *Eur. J. Teach. Educ.* **2020**, *43*, 608–622. [CrossRef]
3. Ewing, L.; Cooper, H. Technology-enabled remote learning during COVID-19: Perspectives of Australian teachers, students and parents. *Technol. Pedagog. Educ.* **2021**. [CrossRef]
4. Darling-Hammond, L.; Burns, D.; Campbell, C.; Goodwin, A.L.; Hammerness, K.; Low, E.L.; Sat, M.; Zeichner, K. *Empowered Educators: How High-Performing Systems Shape Teaching Quality around the World*; Jossey-Bass: San Francisco, CA, USA, 2017.
5. Humes, W.; Bryce, T. *The Distinctiveness of Scottish Education*; Bryce, T.K.G., Humes, W., Gillies, D., Kennedy, A., Eds.; Edinburgh University Press: Edinburgh, UK, 2018; pp. 118–128.



6. United Nations Policy Brief. Policy Brief: The Impact of COVID-19 on Children. 2020. Available online: [https://unsdg.un.org/sites/default/files/2020-04/160420\\_Covid\\_Children\\_Policy\\_Brief.pdf](https://unsdg.un.org/sites/default/files/2020-04/160420_Covid_Children_Policy_Brief.pdf) (accessed on 3 February 2021).
7. Darling-Hammond, L. *Powerful Teacher Education: Lessons from Exemplary Programs*; Wiley and Sons: San Francisco, CA, USA, 2006.
8. Soja, E.W. *Thirdspace: Journeys to Los Angeles and Other Real-and-Imagined Places*; Blackwell: Cambridge, UK, 1996.
9. Hollway, W.; Jefferson, T. *Doing Qualitative Research Differently*; Sage Publications: London, UK, 2000.
10. Hollway, W. *Subjectivity and Method in Psychology: Gender, Meaning and Science*; Sage Publications: London, UK, 1989.
11. Hayes, N. (Ed.) Theory-led thematic analysis: Social identification in small companies. In *Doing Qualitative Analysis in Psychology*; Psychology Press/Erlbaum Taylor & Francis: London, UK, 1997; pp. 93–114.
12. Rogers, C. *A Therapist's View of Psychotherapy—On Becoming a Person*; Constable: London, UK, 2001.
13. Scottish Education Research Association. Teaching and Learning in lockdown in Scotland. November 2020. Available online: <https://sites.dundee.ac.uk/teachers-covid-19-lockdown/> (accessed on 18 March 2021).
14. McLennan, C.; Mercieca, D.; Mercieca, D.P. What can I do? Caring relationships among teachers, students and families during COVID-19 lockdown in Scotland. *Malta Rev. Educ. Res.* **2020**, *14*, 163–181.
15. Bhabha, H.K. *The Location of Culture*; Routledge: New York, NY, USA; London, UK, 1994.
16. Beech, N. Liminality and practices of identity construction. *Hum. Relat.* **2011**, *64*, 285–302.
17. Potter, J.; McDougall, J. *Digital Media, Culture and Education Theorising Third Space Literacies*; Palgrave Macmillan: London, UK, 2017.
18. Moje, E.B.; Ciechanowski, K.M.; Kramer, K.; Ellis, L.; Carrillo, R.; Collazo, T. Working toward third space in content area literacy: An examination of everyday funds of knowledge and Discourse. *Read. Res. Q.* **2004**, *39*, 38–70. [\[CrossRef\]](#)
19. Shulman, L.S. Signature pedagogies in the professions. *Daedalus* **2005**, *134*, 52–59. [\[CrossRef\]](#)
20. Scottish Government. Enhancing Learning and Teaching through the Use of Digital Technology: A Digital Learning and Teaching Strategy for Scotland. 2016. Available online: <http://www.gov.scot/Publications/2016/09/9494/0> (accessed on 5 December 2020).
21. The Scotsman. The Force Is with Glow as Virtual Help Links up Schools. 2008. Available online: <https://www.scotsman.com/news/force-glow-virtual-help-links-schools-2463328> (accessed on 5 December 2020).
22. Scottish Government. International Council of Education Advisers Report 2018–2020. 2020. Available online: <https://www.gov.scot/publications/international-council-education-advisers-report-2018-2020/> (accessed on 5 December 2020).
23. Scottish Government. Coronavirus (COVID 19)—Impact on Education: Deputy First Minister Speech. 2020. Available online: <https://www.gov.scot/publications/statement-covid19-managing-impacts-scottish-education/> (accessed on 19 March 2020).
24. Scottish Government. Coronavirus (COVID 19)—Supporting Pupils, Parents and Teachers—Learning during Term 4. 2020. Available online: <https://www.gov.scot/publications/supporting-pupils-parents-teachers-learning-during-term-4/> (accessed on 20 March 2020).
25. Stiegler, B. *Taking Care of Youth and the Generations*; Stephen Barker (tr.); Stanford University Press: Stanford, CA, USA, 2010.
26. Ferguson, P.; McKenzie, M.; Mercieca, D.; Mercieca, D.P.; Sutherland, L. Primary Head Teachers' Construction and Re-negotiation of Care in COVID-19 Lockdown in Scotland. *Front. Educ.* **2021**, *6*, 617869. [\[CrossRef\]](#)
27. Jones, A.L.; Kessler, M.A. Teachers' Emotion and Identity Work During a Pandemic. *Front. Educ.* **2020**, *5*, 583775. [\[CrossRef\]](#)
28. Camilleri, P. The Ghost in the Machine. A Structural Interpretation of Maltese Policies on ICT and Education. *Malt. Rev. Educ. Res.* **2017**, *11*, 127–147.
29. Castells, M. *The Internet Galaxy. Reflections on the Internet, Business, and Society*; Oxford University Press: Oxford, UK, 2002.
30. Orlikowski, W.J. Using Technology and Constituting Structures: A Practice Lens for Studying Technology in Organizations. *Organ. Sci.* **2000**, *11*, 404–428. [\[CrossRef\]](#)
31. Burgos, D.; Tilil, A.; Tabacco, A. *Radical Solutions for Education in a Crisis Context—COVID-19 as an Opportunity for Global Learning*; Springer: London, UK, 2021.
32. Bauman, Z. *Liquid Modernity*; Blackwell: Oxford, UK, 2000.
33. Buckingham, D. *Beyond Technology: Children's Learning in the Age of Digital Culture*, (Illustrated ed.); Polity Press: Cambridge, UK, 2007.
34. Player-Koro, C.; Rensfeldt, A.B.; Selwyn, N. Selling tech to teachers: Education trade shows as policy events. *J. Educ. Policy* **2018**, *33*, 682–703. [\[CrossRef\]](#)
35. Lauer, C. Constructing the Self in/as Thirdspace: New Potentials for Identity Exploration in the Composition Classroom. *Compos. Stud.* **2009**, *37*, 53–74.
36. Kist, W.; Pytash, K.E. "I love to flip the pages": Preservice teachers and new literacies within a field experience. *Engl. J.* **2015**, *104*, 131–167.
37. Laughter, J. ELA teacher preparation 2.0: Critical media literacy, action research, and mashups. *Contemp. Issues Technol. Teach. Educ.* **2015**, *15*, 265–282.
38. Kim, C.; Keller, J. Towards technology integration: The impact of motivational and volitional email messages. *Educ. Technol. Res. Dev.* **2011**, *59*, 91–111. [\[CrossRef\]](#)
39. Lemon, N.; Garvis, S. Pre-service teacher self-efficacy in digital technology. *Teach. Teach.* **2016**, *22*, 387–408. [\[CrossRef\]](#)



40. Wake, D.; Whittingham, J. Teacher candidates' perceptions of technology supported literacy practices. *Contemp. Issues Technol. Teach. Educ.* **2013**, *13*, 175–206.
41. Wastiau, P.; Blamire, R.; Kearney, C.; Quittre, V.; Van de Gaer, E.; Monseur, C. The use of ICT in education: A survey of schools in Europe. *Eur. J. Educ.* **2013**, *48*, 11–27. [[CrossRef](#)]
42. Spiteri, M.; Chang Rundgren, S. Literature Review on the Factors Affecting Primary Teachers' Use of Digital Technology. *Technol. Knowl. Learn.* **2020**, *25*, 115–128. [[CrossRef](#)]
43. Selwyn, N. *Is Technology Good for Education?* Polity Press: Cambridge, UK, 2016.
44. Higgins, S.; Xiao, Z.; Katispataki, M. The Impact of Digital Technology on Learning. 2012. Available online: <https://educationendowmentfoundation.org.uk/evidence-summaries/evidence-reviews/digital-technology/#> (accessed on 3 November 2020).
45. McFarlane, A. Growing up Digital: What Do We Really Need to Know about Educating Her Digital Generation? 2019. Available online: <https://www.nuffieldfoundation.org/sites/default/files/files/Growing%20Up%20Digital%20-%20final.pdf> (accessed on 5 November 2019).
46. Kim, L.E.; Asbury, A. 'Like a rug had been pulled from under you': The impact of COVID-19 on teachers in England during the first six weeks of the UK lockdown. *Br. J. Educ. Psychol.* **2020**, *90*, 1062–1083. [[CrossRef](#)] [[PubMed](#)]

Article

# COVID-19 Lockdown Education: The Importance of Structure in a Suddenly Changed Learning Environment

Dirk Lauret and Durdane Bayram-Jacobs \*

Eindhoven School of Education, Eindhoven University of Technology, 5600 MB Eindhoven, The Netherlands; d.lauret@student.tue.nl

\* Correspondence: d.bayram.jacobs@tue.nl

**Abstract:** In early 2020, the COVID-19 pandemic emerged, which resulted in global lockdowns. As a result, education could no longer be provided in its current form and was therefore provided online. This study discusses the consequences of online instruction in secondary education and how students perceived this new way of learning. Specifically, this research focuses on how online education was facilitated, how this differs from regular education and how students and teachers experienced these practices. In this study, qualitative and quantitative data were collected from teachers and students. Our findings revealed that the students were missing a proper structure in the lessons. There was a decline in the understanding and enjoyment by students in all courses. This study also shows that the variety of instructional strategies that the teachers used increased during the lockdown period. However, teachers were lacking in other aspects that define good instruction. Moreover, teacher data demonstrate that the teachers needed guidance from the schoolboard. It is remarkable that the schoolboard plays a key role in improving this situation. This research suggests that if the schoolboard provides guidelines on planning education, teachers could focus more on other aspects of a good instruction.

**Keywords:** COVID-19 lockdown education; structure in education; online education; secondary education; teacher knowledge

**Citation:** Lauret, D.; Bayram-Jacobs, D. COVID-19 Lockdown Education: The Importance of Structure in a Suddenly Changed Learning Environment. *Educ. Sci.* **2021**, *11*, 221. <https://doi.org/10.3390/educsci11050221>

Academic Editor: James Albright

Received: 31 March 2021

Accepted: 27 April 2021

Published: 6 May 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

The evolution towards distance education practice started 170 years ago when distance education was an individual pursuit defined by geographical disadvantages between student and teacher [1–3]. Since the last half of the twentieth century, the developments were accelerated by the emergence of three additional generations, supported by: (a) the mass media of television and radio, (b) the synchronous tools of audio and video conferencing, and (c) computer conferencing [1]. In the past two decades specifically, online learning has become an increasingly important component of secondary education [4].

Even though, full online instruction has not been a common practice in secondary schools until recently, many higher education institutions already have been practising online education [3,5,6]. Reference [6] (p. 682) stated that “*online learning offers some significant advantages over learning through traditional, classroom-based courses.*” Students look more objectively at collaborative dialogue and their participation in it. This participation results in more equalized roles, where written exchange of messages leads to more effective communication [7]. Reference [8] distinguished two incentives for universities to engage in online learning: to provide learning to new audiences and to transform learning delivery in a competitive landscape. Reference [3] used these incentives to define four categories for universities to embrace online education [9]:

1. “*Expanding access*” to accommodate for the mismatch in programme calendars, work, and family responsibilities.
2. “*Alleviating capacity constraints*” to provide education to more students than the physical housing of universities allows.

3. “Capitalising on emerging market opportunities” to meet the market’s demand for higher education outside the traditional 18–24 age range.
4. “Serving as a catalyst for institutional transformation” to adapt to the increasingly competitive environment due to a decrease in public funding.

Although online education has been implemented and promoted at higher education before early 2020, it was not common for secondary schools to facilitate education online. The standard setting was in-class education, where all students were physically present. However, when COVID-19 emerged in early 2020, which was declared as a pandemic by WHO, measures such as lockdown and social distancing were introduced in many countries all around the world [10]. Consequently, students were forced to follow their education from home. All countries in the European Union required their secondary schools to provide online instructions to all of the students [11]. This sudden and unexpected change in society required teachers to adapt their teaching practice (i.e., adopting instruction and assessment strategies) for this new way of teaching without any preparation.

Despite the fact that several researchers have studied the impact of the COVID-19 virus on education [12–15], most of these studies focus on medical education or university education. To our knowledge, there are limited studies that examine practices of teachers and perceptions of students about online education during the COVID-19 pandemic in the secondary school education context. The present study aims to explore the perceptions and experiences of both students and teachers with respect to educational practices in the context of the COVID-19 pandemic. More specifically, this research focuses on how online education was facilitated, how this differs from regular education, and how students and teachers experienced these practices. The findings of this study have the potential for improving education outside the context of a pandemic.

### 1.1. Context of Research

In Europe, COVID-19 emerged in late February 2020. As a result, schools were fully closed in March for several months due to contemporary COVID-19 countermeasures in various European countries [11]. In this period, referred to as the *lockdown period*, all students had to follow education from home. This implied that not only higher education, but also primary and secondary schools, were obliged to facilitate online education to their students.

The present study was conducted at a public secondary school in the Netherlands, which has approximately 1200 students, aged between 10 and 19 years old. This school is renowned for its excellence in education and prepares the students for university education. Furthermore, the school encourages students to become responsible for their own learning process rather than being engaged in a cooperative learning process with other students.

The school obtained a licence of an online learning environment and video-conferencing software a few weeks after the beginning of the lockdown period. Furthermore, the school had been using an online administration platform that was already in place for administration of grades, attendance of students and class schedule. The administrative platform was mainly used for registering homework, while the online learning environment was used for deliverables and lecturing. During the lockdown period, no summative assessment took place; only formative assessment was allowed by the schoolboard. This implied that no additional grades could be given to the students.

### 1.2. The Study

Due to the sudden changes in society, the teaching practices had to be adapted quickly to new situations. Specifically, this meant that teachers had to provide their students with education while the students were absent in the classroom. In most cases, online education was provided by the teachers. This new way of teaching should, like teaching in regular scenarios, be of proper quality. Therefore, it is interesting to investigate the teaching practices used during the lockdown and investigate the experiences of the students. The hypothesis of this research is that when teachers were able to apply all their knowledge

during online lessons, in the same way as they did in in-class teaching, the lessons would be of the highest quality.

This study aims to explore perceptions of students and knowledge domains that teachers used regarding education in the context of COVID-19. More specifically, we are interested in exploring needs and positive experiences regarding non-physical education during the pandemic and how these insights could be useful for improving education.

In order to gain better insight into how regular education can be improved with the newly gained insights from COVID-19-related scenarios, the following question needs to be answered: How did teachers' use of knowledge domains during lockdowns influence the students' perception of the courses? In order to answer this question, one first needs to answer the following sub-questions:

- *What are the differences regarding the characteristics of good teaching in regular in-class learning compared to lockdown learning?*
- *How does the use of teachers' knowledge domains influence the students' perception on the subject matter?*

Answering these questions helps in establishing a relationship between teacher knowledge domains, related pedagogical approaches, and the quality of instructions. Ultimately, the answers to these questions enable the establishment of grounded recommendations for pedagogical approaches in regular situations.

## 2. Theoretical Background

### 2.1. Aspects of a Good Instruction

Summarizing the work of [16], there are eight main aspects of good instruction to be distinguished:

- The *goals* of the instruction should be properly formulated [17,18]. The main achievements are typically provided by a curriculum that defines what students should know at the end of every year.
- There should be a "*safe learning environment*" [16]. This environment is built out of both motivational and pedagogical aspects [17,19–22].
- *The instruction should be given in a constructive manner* [18,23]. The instructions could, for instance, be supported by a whiteboard on which the teacher can write notes for the class. This point is about the materials available to support instructions.
- The teacher should be able to *provide proper guidance and coaching* to support a safe learning environment [17,18].
- *The instruction should contain meaningful contexts* [18].
- The student should be *encouraged towards individual learning* [16,24].
- Students should be *encouraged to work together* on exercises [18,25].
- Finally, the learning needs to be *assessed in both a formative and summative manner* [16,26].

All of these aspects are embedded in the Dutch teacher education, i.e., all Dutch teachers should be able to provide the above-mentioned aspects in their lessons [16].

The characteristics of good instruction, as given above, also apply in online education, as enforced by the COVID-19 pandemic. However, the implementation of these characteristics can be different in online education compared to regular education. Reference [27] makes suggestions on how to modify the regular course set-up to meet the requirements set by online education. Reference [27] stated that dividing content into smaller pieces and emphasizing the teacher's voice is beneficial for providing online education. Additionally, Reference [28] stated that teachers should be flexible towards students and their delivery of materials due to possible unstable internet connections. All of these suggestions are aimed at properly adapting to the new, online learning environments rather than redefining *good* instruction.

The International Association of Universities (IAU) launched a global survey on the impact of COVID-19 on higher education around the world. The results show that although almost all Higher Education Institutions (HEIs) reported having infrastructure

to communicate with students and staff, they also reported that it is a challenge to ensure clear communication. Teaching and learning are affected by COVID-19 at almost all HEIs. They reported challenges such as technical infrastructure, competences, and pedagogy for distance education and specific requirements of a particular field of study. On the other hand, it was also reported that online education offers remarkable opportunities for more flexible learning, exploring blended or hybrid learning and combining synchronous and asynchronous learning [10].

## 2.2. Teacher Knowledge

Besides the aspects of good instruction, described above, teacher knowledge domains influence the quality of instructions as well [29]. Reference [30] described five general domains of teacher knowledge:

- Knowledge about the general educational context.
- Knowledge about the specific educational context.
- General pedagogical knowledge.
- Subject matter knowledge.
- Pedagogical content knowledge (PCK).

These domains are subsets of each other, i.e., general pedagogical knowledge and subject matter knowledge are subsets of PCK, which are all subsets of specific educational context, which in turn is a subset of the general educational context [30].

Each teacher knowledge domain is characterized by a set of aspects. First of all, general pedagogical knowledge consists of knowledge about the learners and learning, classroom management, and knowledge about the general curriculum and instruction [30–34]. Secondly, subject matter knowledge is defined by the knowledge of syntactic structures of the discipline and substantive structures of the discipline [30–32]. PCK is defined by blending general pedagogical knowledge and subject matter knowledge. Aspects defining PCK include knowledge about common misconceptions, topic-specific instructional strategies, and purposes for teaching the topic [30]. All of the three above mentioned domains are included in the domain about the specific educational context. Knowledge about specific contexts includes knowledge about the classroom (e.g., the layout of the physical classroom) and knowledge about the students. Lastly, the domain of the general educational context extends the domain about the specific educational context by including knowledge about the state and nation, the community, the school, and former students [30]. Due to the generality of these domains, we argue that these knowledge domains are also applicable for online teaching [29].

According to Shulman's conceptualization of PCK, it includes using appropriate technology to represent concepts to students [32]. However, the authors of [35] argue that it is necessary to add domain of technology knowledge (TK) considering important role of technology in society and in education. TK is defined by [36] (p. 63) as "*knowledge of how to use emerging technologies*". According to this definition, emerging technologies refer to technologies that are not yet often used in a particular context such as education. In addition, TK is also described as procedural knowledge regarding using technology and technological tools, which includes abilities to tackle with problems while using technologies [37]. Furthermore, TK involves knowledge of understanding technologies, being aware of opportunities that technology and technological tools offer for education for a particular concept and level, recognizing how and when various technology and technological tools can support or hinder students' learning, and pursuing learning and using new technologies [38].

## 2.3. Theoretical Framework: Characteristics of Good Teaching

The theoretical framework considered throughout this research is based on the theory presented in Sections 2.1 and 2.2. Both characterizations of a good instruction and teacher knowledge are acknowledged by this research, and therefore both concepts are being

considered. This framework for characteristics of good teaching is divided into seven different categories.

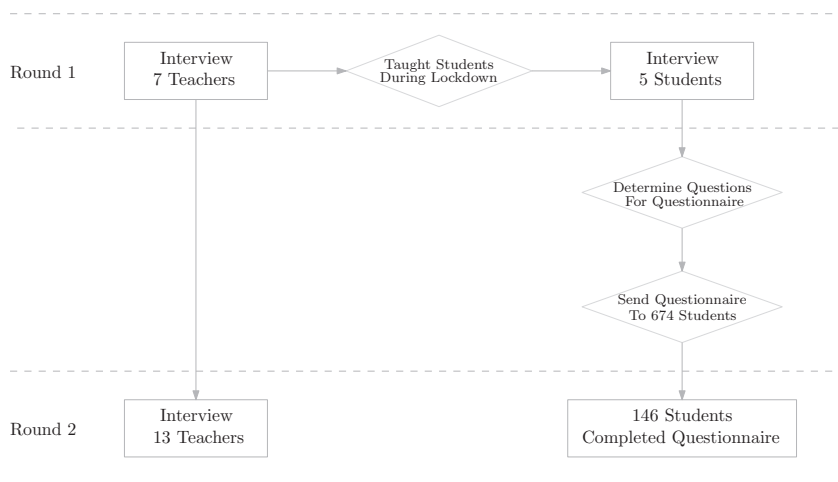
The first category is *assessment (AS)*, which allows a teacher to gain an overview of how well the subject matter is understood by the students. Assessment includes both summative and formative assessment, in which the teacher will be able to closely monitor the progress of the students throughout the learning process. The second category is *goals (GO)*. This category includes all aspects that teachers use to establish learning goals. Goals are defined for the current topic considering the previously acquired goals. The next category, *context (CO)*, considers how well a teacher can provide meaningful context to students. The fourth category is *cooperation (CP)*, which indicates how well students are encouraged to work together. The fifth category is called *individual learning responsibility (IV)*. This category gives insight into how well teachers can guide students towards taking their own responsibility on their learning process. The sixth category is *instructional strategies (IS)* which includes strategies and tools that teachers use throughout their lessons (e.g., topic-specific instructional strategies). The seventh category is *pedagogical guidance (PE)*, which monitors how well teachers guide their students. Aspects include knowledge about the students and the ability to create a safe learning environment. The final category is *technological knowledge (TK)*, which describes how skilled teachers are in handling technological tools for instruction purposes.

The eight categories described above cover all aspects of a good instruction and different domains of teacher knowledge. Therefore, these categories provide a well-suited framework for investigating experiences with respect to educational practices in the context of the COVID-19 pandemic.

### 3. Materials and Methods

#### 3.1. Research Design

In this mixed-methods study, qualitative and quantitative data were collected from teachers and their students in two rounds as illustrated in Figure 1. The first round of the research was designed for a small group of students and teachers. In this round, the data collection method was optimised such that in round 2, this method could be applied to a larger set of participants.



**Figure 1.** Schematic overview of the research design, including the number of participants.

For teachers, the first round of data collection consisted of semi-structured interviews where the teachers could add comments outside the provided interview protocol. The design was such that there was a possibility for adjustment for the second round. Fortunately,

no adaptations had to be performed, and therefore the same interview protocol was used in the second round of the interviews with the teachers.

For students, the first round of data collection consisted of structured interviews. Therefore, students were not able to add comments. The structured interviews were chosen to ensure that students would not deviate from the guidelines provided by the interview protocol. The students' answers led to the design of the questionnaire for the second round. This questionnaire was sent to 674 students, 288 responded to it, and 146 of those 288 students fully completed it.

### 3.2. Participant Teachers and Students Recruitment

The teachers and students were recruited in two rounds. In the first round, seven teachers were selected that were willing to participate in the research. Secondly, five students were selected who were taught by the selected teachers during the lockdown period and were known to be critical and able to provide very elaborate opinions. In this way the most reliable results could be achieved, and links between the answers of the students and teachers could easily be identified.

For the second round, an additional 13 teachers from different departments were selected, indirectly, by the schoolboard. All 13 teachers participated in a group responsible for the development of the pedagogical strategies used by their respective department. Therefore, these teachers were well aware of all developments that were taking place inside their department. This made these teachers appropriate participants. A summary of all participating teachers, their courses and the round in which they interviewed is given in Table 1. References [39–41] state that a group of fifteen participants is the smallest acceptable sample size for qualitative research. Therefore, the number of participants included in this study is sufficient to reach reliable outcomes.

**Table 1.** Overview of the interviewed teachers.

Teacher	Course	Round	Teacher	Course	Round
Teacher-1	Geography	1	Teacher-11	Physics	2
Teacher-2	German	1	Teacher-12	Physics	2
Teacher-3	Latin and Greek	1	Teacher-13	Information theory	2
Teacher-4	Physics	1	Teacher-14	Economics	2
Teacher-5	Dutch	1	Teacher-15	English	2
Teacher-6	Arts	1	Teacher-16	Mathematics	2
Teacher-7	Mathematics	1	Teacher-17	Geography	2
Teacher-8	Dutch	2	Teacher-18	Biology	2
Teacher-9	Chemistry	2	Teacher-19	Music	2
Teacher-10	Arts	2	Teacher-20	Latin and Greek	2

Students in the second round were approached based on the study year. Only students that were in the first three years of secondary education were approached because their schedules were planned according to the study year. In the last three years of secondary education in the Netherlands, all students have personalized schedules, which makes it difficult to design an automated questionnaire and thus makes it difficult to reach a large set of participants simultaneously. Therefore, only the 674 students that were in the first three years of their secondary education during the lockdown period were approached. From the approached 674 students, 288 students responded to the questionnaire, and 146 of them fully completed the questionnaire. Table 2 provides an overview of the participant students. Reference [42] states that, achieving a 90% chance of observing the desired behavior of 3 different themes with the lowest prevalence requires at least 105 participants. Therefore, the number of participants in this research is in line with the guidelines provided by [42].



**Table 2.** Overview of the number of students that responded to the questionnaire.

Year	Age (Range)	Level	Percentile <sup>1</sup>	Participants
1	11–13	N/A	65th and up	106
2	12–14	Havo	65th and up	36
2	12–14	Vwo	82nd and up	45
3	13–15	Havo	65th and up	42
3	13–15	Vwo	82nd and up	59
Total				288

<sup>1</sup> Reference [43]

### 3.3. Data Collection Process and Sources

#### 3.3.1. Teacher Interviews

The data were collected through semi-structured interviews with the teachers. In both the first and the second rounds, the interviews were designed to collect data about teacher knowledge regarding their teaching pedagogies during the lockdown period. The interview protocol was first discussed with other teachers and researchers to make sure that the interview protocol was complete and the questions were clear for the teachers. The final interview protocol, used in both rounds 1 and 2, consisted of 27 questions.

The first four questions aimed to get a good overview of how the goals of the teachers have been adjusted in the lockdown period. The next five questions were used to gather an overview of the pedagogical approaches that were used in the course. The next four questions were for assessing prior knowledge of the students, i.e., how the teacher was able to monitor the progress of the students' learning so far. The following three questions were specifically designed to see how well the teachers were able to detect which students were having troubles with the material. Additionally, these questions indicate what approaches the teacher used to make sure struggling students could understand the material better. Finally, nine questions about the assessment in class were asked of the teachers. Note that this section is different from assessing the prior knowledge of the students, since these final questions ask specifically about assessment moments. Of this last section, the first four questions were mainly about the summative assessment methods. The last five questions were mainly about the formative assessment methods.

The interviews in the first round took one hour on average, where the interviews in the second round lasted 40 min on average. The interviews were audio-recorded and transcribed verbatim.

#### 3.3.2. Student Interviews in Round 1

The student interviews were mainly focused on how they experienced online education during the lockdown period. The interview protocol consisted of five general questions and nine questions per course. Seven courses were considered during the interviews, bringing the total number of questions to 68.

First, the students were asked to state their general opinion about the education in the lockdown period. The next question was about whether the student lacks at a specific course due to the lockdown period. The next two questions were about what the students did and did not like about the lockdown period in general. The fifth question asked if the student's motivation towards school changed during the lockdown period.

After the general questions, the student was asked to answer eight or nine course-specific questions depending on whether or not the same teacher was still teaching the student. The questions in these course-specific parts were the same for each course. The first four questions were about the change in student motivation and how the students liked the course before and during the lockdown period. The next two questions were about what the students liked the most and least about how the specific course during the lockdown period. The next question was about if the teacher used different approaches in explaining the material. Next, the students were asked about their concentration during

the specific course. Finally, the student was asked to list any differences in the teacher's way of teaching if the student still had the same teacher for the same course.

The student interviews in the first round took 10 to 15 min per student. The interviews were audio-recorded and transcribed verbatim.

### 3.3.3. Student Questionnaire in Round 2

The questions presented in the questionnaire for the students were similar to the questions used in the interview. However, in the questionnaire, the questions were formulated in a closed manner; i.e., the student could choose from a limited set of answers. The options to choose from were generated based on the answers given by the students who were interviewed. Since the answers are now finite, analysis can be performed more efficiently compared to the open questions asked during the interviews, since all questions for each course are exactly the same.

For administration of the questionnaire, the survey tool VOspiegel (<https://onderwijs Spiegel.nl/spiegel/vospiegel/>, accessed on 29 April 2021) was used. This tool was able to distribute the designed questionnaire to all considered students with only the questions applicable to them. Furthermore, VOspiegel was able to provide an elaborate summary of the results from the questionnaire with the basic analysis already performed.

The questionnaire itself was constructed in such a way that students only had to answer questions that were applicable to them. In the Netherlands, it is the case that after the first year of secondary education, students get two new courses: German and physics. After the second year, they get two other courses: chemistry and economics. VOspiegel was able to take into account all of these changes in courses. However, students not only get new courses, but they also drop some in the third year: biology and music. Unfortunately, it was not possible to remove courses if they were not being taught any more. Therefore, it was decided not to ask students questions about these courses to maintain the high efficiency of the questionnaire.

## 3.4. Data Analysis

In this study, two different methods of data collection were used: interviews and a questionnaire, which provided qualitative and quantitative data, respectively. These two data types also require different approaches in analysis. This section will discuss the two methods separately.

### 3.4.1. Qualitative Analysis

For the interviews conducted, the analysis was based on coding principles of qualitative data. The coding was executed in iterative cycles where the code list, new codes, and coding strategies were checked, refined and confirmed [44]. Each interview gave approximately 4 pages of data that needed to be analysed. In order to code the data according to the principles of [45], a concept-driven coding approach was used [46], based on the aspects discussed in Section 2. The categories were defined by the aspects noted in Section 2.3, where the characteristics of good teaching are mentioned. The main categories are assessment (AS), goals (GO), context (CO), cooperation (CP), individual learning responsibility (IV), instructional strategies (IS), pedagogical guidance (PE), and technological knowledge (TK). Besides these categories, there are two categories called *course* (CR) and *time* (TM) that, respectively, indicate the course that the interviewed teacher teaches and the time in which the teaching took place. The CR group enables the analysis to distinguish between the approaches used by different courses such that they can be linked to the outcomes of the students. The obtained data were coded using Atlas.ti (<https://atlasti.com/>, accessed on 29 April 2021) qualitative data analysis software. Before coding all the data, firstly, a coding exercise was performed in which the two researchers coded the transcripts of the same teachers with the same a priori code list. When the disagreements were discussed, the two researchers reached a consensus with an interrater agreement of 81% [47]. After this coding exercise,

the a priori code list was updated with new codes that appeared to be significant and frequently emerged from the data.

After the first round of coding, the code list was revised by merging the codes that indicate the same aspect. In the second round, all teacher data from the 7 teachers (first round) were coded again together with the other 13 teachers (second round) by using the final code list (see Table 3). The focus of coding lay on the teacher's experience rather than the interconnection with the students. This analysis extends the analysis in the first round by means of increasing the sample size to draw more reliable conclusions [41]. The results of the analysis in the second iteration eventually were compared to the results of the questionnaire of the students in order to match the effects of certain decisions that were made by the teachers. The comparison is based on the course that the teacher taught.

**Table 3.** Coding scheme for instruction characteristics.

Category	Codes
Assessment (AS)	Formative assessment: <ul style="list-style-type: none"> <li>• Formative assessment of work</li> <li>• Formative oral examination</li> <li>• Formative, summative written examinations (i.e., exams that were originally made for summative assessment, are now examined, but not graded)</li> <li>• Formative written exercises</li> <li>• Making self-made exam questions</li> </ul> Summative assessment: <ul style="list-style-type: none"> <li>• Presentations</li> <li>• Summative oral examination</li> <li>• Summative practical assignment</li> <li>• Summative written examination</li> </ul>
Context (CO)	Provide another dimension to the study material: <ul style="list-style-type: none"> <li>• Illustrative examples</li> <li>• Practical examples</li> </ul>
Instructional strategies (IS)	Ways of presenting material to students: <ul style="list-style-type: none"> <li>• Notes on whiteboard</li> <li>• Using presentation software</li> <li>• Notes on presentations</li> <li>• Separate document with notes distributed</li> <li>• Notes with tablet</li> <li>• Video instructions</li> <li>• Demonstrations</li> <li>• Personalised explanation</li> </ul> Distributing study materials: <ul style="list-style-type: none"> <li>• Electronic learning environment</li> <li>• E-mail</li> </ul> Other factors that influence the instructions: <ul style="list-style-type: none"> <li>• Practical-specific material</li> <li>• Lack of materials</li> <li>• Less instruction possibilities</li> <li>• Providing a static structure</li> </ul>

Table 3. Cont.

Category	Codes
Cooperation (CP)	Stimulation for students to work together: <ul style="list-style-type: none"> <li>• Work together on exercises</li> </ul>
Goals (GO)	Planning related characteristics: <ul style="list-style-type: none"> <li>• Modifications according to situation</li> <li>• Shortened planning</li> <li>• Unmodified planning</li> <li>• Explicit formulation of goals</li> </ul> Checking prior knowledge: <ul style="list-style-type: none"> <li>• Checking achieved goals</li> </ul> Check if material is understood by students: <ul style="list-style-type: none"> <li>• Check intermediate goals</li> <li>• Goals have been achieved</li> <li>• Goals have not been achieved</li> <li>• Unclear if goals have been achieved</li> </ul>
Pedagogical guidance (PE)	Teacher initiatives to help students: <ul style="list-style-type: none"> <li>• Additional instructions</li> <li>• Personal guidance</li> <li>• Share work online</li> </ul> Observations made in the (physical) absence of the teacher: <ul style="list-style-type: none"> <li>• Difficult to provide the students with proper instructions</li> <li>• Less guidance possible when the students are at home</li> <li>• Less motivations when the students are at home</li> <li>• Unable to reach everybody during online classes</li> <li>• Students are properly motivated to work</li> </ul>
Individual learning responsibility (IV)	Helping students improve their own responsibility: <ul style="list-style-type: none"> <li>• Student logs own progress</li> <li>• Students need to take their responsibility</li> <li>• Making exercises in class</li> <li>• Applying scaffolding techniques</li> <li>• Mandatory participation of students</li> </ul> Observations made in the (physical) absence of the teacher: <ul style="list-style-type: none"> <li>• Students do not take their responsibility</li> <li>• Students do not actively participate in the learning process</li> <li>• Students do not know how to learn properly</li> <li>• Students only learn for their grades</li> </ul>
Technological Knowledge (TK)	Ability to handle technological instruction tools: <ul style="list-style-type: none"> <li>• Inability to use technological tools</li> <li>• Knowledge about technological tools</li> <li>• Ability to use technological tools</li> <li>• Disliking of having to use technological tools</li> </ul>

The student interviews were coded with a code list that consists of answer choices for the questions in a questionnaire. Therefore, in the end, the code list provided useful guidelines for setting up the questionnaire for the students.

### 3.4.2. Quantitative Analysis

The questionnaire mainly comprised closed-ended questions with an extra option to provide comments. The statistical results were summarized by the same tool that

acquired the results in the first place: VOspiegel. This tool is able to summarize the responses/choices of the students and provide relative and absolute results.

The results provided by VOspiegel are accompanied by the raw data on which the provided summary is based. Even though the summary might be sufficient to draw conclusions, some references to the original data are used to link certain questions to their respective course. In this way, it is possible to link the effect of certain strategies implemented by a course to the perception of the students. For other, more elaborate analysis, MATLAB (<https://www.mathworks.com/products/matlab.html>, accessed on 29 April 2021) was used with the provided raw data from the questionnaire. With MATLAB, the significance of certain results could also be computed.

#### 4. Results

In this section, first, the results regarding teacher knowledge domains and teachers' experiences are presented. Then, the results with respect to students' perceptions are provided.

##### 4.1. Teacher Interviews

This section provides the reader with the results provided by the conducted interviews with the teachers. First of all, all domains of teacher knowledge are discussed together, and later these aspects will be discussed one-by-one.

##### 4.1.1. Teacher Knowledge

The analysis of the teachers' knowledge showed that teachers faced a lot of difficulties during the first lockdown period. Most teachers indicated that there was a lack of structure and steering from the school board about what was expected of them. "It was not clear in the first few weeks what needed to be done", indicated Teacher 3 (Latin and Greek), who ultimately was unable to teach due to this confusing environment. This new environment caused teachers to face significant difficulties in their teaching approaches at first. Later, when teachers understood what was expected of them, the teachers indicated that they felt more at ease and were able to teach properly.

Table 4 shows, for each of the domains of teacher knowledge, how many aspects teachers used. These aspects only include those factors that teachers can influence; i.e., all opinion and observation codes are left out. Table 4 reveals that each aspect, except IS, is used less during the lockdown than it was before the lockdown. Furthermore, Table 4 shows that the CP characteristic is used significantly less than all other aspects among the interviewed teachers.

**Table 4.** Teacher-dependent aspects present per teacher knowledge category before and during the lockdown period.

Category	Before the Lockdown	During the Lockdown	Relative Difference [%]
AS	65	37	−43.09
GO	19	9	−52.63
CO	30	19	−36.67
CP	2	0	−100.00
IV	23	10	−56.52
IS	49	65	+32.65
PE	31	20	−35.48

##### 4.1.2. Assessment

Teachers indicated that assessment was the most challenging aspect during the lockdown period. The schoolboard announced early in the lockdown that there would be no examinations anymore for the rest of the year, with an exemption being made for practical and oral examinations. For teachers, this meant that no summative assessment was allowed anymore, even though a significant part of the learning material was to be

discussed. Usually, every course has at least two exams during the last period of the year. Most teachers switched to using formative assessment strategies by providing the students with the exam that was meant for the course, without grading it afterwards. Teacher 4 (physics) indicated that this was not the right way of conducting formative assessment.

#### 4.1.3. Goals

During the lockdown period, teachers had to adapt their teaching to the new environment. Therefore, some teachers adapted their planning and learning goals to better suit the new situation. Half of the teachers indicated having changed their goals according to the situation. Of the other half that indicated not to have modified their planning, again, half indicated to discussing less material; e.g., Teacher 1 (geography) said that the goals "... were not modified, but all material was provided on a lower speed."

Even though in 70% of the cases the goals were not achieved, some of them additionally indicated being satisfied with the result. One of those teachers, Teacher 8 (Dutch), indicated that he was "... unsure if this could have been prevented" "... we got the best results, considering these circumstances", Teacher 14 (economics) added. The remaining teachers stated that they were unable to tell if goals were achieved in the first place "... no summative examination took place...", Teacher 18 (biology) mentioned.

Besides being able to tell the level of understanding after giving a course, this teacher knowledge aspect also tells how well the teacher can estimate the level of prior knowledge of the students. During the lockdown period, there was approximately 58% less checking of the goals by the teachers. Teachers 10 (arts), 12 (physics), 15 (English), 16 (mathematics), and 17 (geography) even indicated not having checked the level of understanding at all during the lockdown. Teachers had the opportunity to grade themselves on their ability to guess the level of prior knowledge of their students. Whereas teachers before the lockdown gave themselves a 7.7 on average for diagnosing the level of understanding, during the lockdown, this was only a 3.9.

#### 4.1.4. Pedagogical Guidance

One of the most obstructing aspects of online instruction is the fact that teachers are faced with a physical barrier. This barrier prevented teachers from providing guidance to the students. All of the teachers indicated that, before the lockdown period, they would walk through the class to see where students were struggling with the material. When teachers found a student struggling with the material, they would give this student one-on-one explanation about the material. Unfortunately, during the lockdown, this was no longer possible; there was no possibility of physical contact with the students. Teachers 12 (physics), 15 (English), and 20 (Latin and Greek) found themselves unable to provide the students with any form of (individual) guidance during the lockdown. Of the remaining 17 teachers, 15 relied on the students for personal guidance; i.e., only if the student asked for help was it provided to them (e.g., planning a video call for additional explanation). Whereas, before the lockdown, the teacher decided who got individual guidance, during the lockdown, students had to decide for themselves.

Other observations about the pedagogical guidance during the lockdown that teachers made was the fact that the guidance at home was lacking. Teachers indicated that students were not properly motivated any more to do anything for school. Teacher 2 (German) said that "students were not interested in the material anymore, because there would be no 'real grade' given in the end." Since only formative assessment was allowed, teachers indicated that the motivation of students was significantly lacking.

#### 4.1.5. Individual Learning Responsibility

Not only the pedagogical guidance suffered from the online barrier but also the individual learning responsibility was subject to it. At the school, the students were encouraged to take their own responsibility for their learning process. Therefore, the teachers decided to give more responsibility to the students during the lockdown period.

Teacher 8 (Dutch) even said that "... we [the teachers] will provide the material, but the students are responsible for asking what they want." Fifty percent of the teachers clearly observed a significant lack in students' ability to take their own responsibility, "... the motivation of the students was missing...", Teacher 9 (chemistry) said.

The teacher interviews revealed that there was a 73% reduction in guidance in the process towards taking responsibility of one's own. Even though there was the possibility for students to participate in individual instruction sessions, this already assumed that students were able to take their own responsibility. In the end, most teachers agreed that most students were not yet able to take their own responsibility in their own learning process.

#### 4.1.6. Instructional Strategies

The only teacher knowledge component that was applied more in the lockdown period than before was the instructional strategies component (see Table 4). Before the lockdown period, teachers were using either a whiteboard or PowerPoints. However, using a whiteboard was no longer possible during the lockdown, and therefore other methods were to be investigated. Teacher 7 (mathematics), who was using a whiteboard before, was forced to "... explore other possibilities of providing notes to the students." Furthermore, Teacher 19 (music) was using pilot versions of online-based teaching methods to see what could be used further on.

However, some classes were highly dependent on materials present in the classroom that were not (always) present at the students' homes, for example, arts classes, which are dependent on practical materials that can be found in class (e.g., special drawing ink). It is interesting to see that even these courses, music and arts, were able to adapt their goals and instructional strategies to meet the available materials at students' homes. Teacher 6 (arts) decided to "... divide bigger assignments in smaller ones, doable at home", where she considered the materials that all students have available at home.

One obvious shift in the instructional strategies is the shift in the distribution of study materials. The material originally handed out in class, was to be distributed in another way. Most of the teachers decided to distribute their materials via some sort of electronic learning environment. A few other teachers used emails to communicate material with their students.

#### 4.1.7. Context

Providing context to the students is divided into two aspects: practical and illustrative examples. Practical examples refer to demonstrations of how to directly implement knowledge into a context. Think for instance of some drawing technique being demonstrated by the arts teacher. Illustrative examples show how the theory would be applied in practice but do not directly link theory to the application. For instance, economic examples in mathematics exercises do not always present students how to handle those situations in real life, and therefore, these are only illustrative.

Before the lockdown period, 15 of the 20 teachers used practical examples. However, during the lockdown, only Teachers 5 (Dutch), 13 (Information Theory), and 15 (English) were able to still implement practical examples in their lessons. Teachers 5 and 15 used videos to show how language was to be used in a practical way. Teacher 5 used writing examples and exercises, and Teacher 15 made videos with pronunciations explained. Teacher 13 was an information theory teacher who did not suffer that much from moving to online education: "... information theory was in that sense a privileged course." The students were supposed to work on their computers during regular classes as well, and Teacher 13 thinks that this made online education "... relatively easy ..." compared to other courses.

Illustrative examples, however, did not suffer that much. Whereas before, 15 teachers used illustrative examples, only Teacher 17 (geography), was unable to present illustrative examples during the lockdown. This is due to the fact that Teacher 17 switched fully to the usage of the book and pointed out the students' own responsibility; no additional



instruction was provided any more. Teachers 6 (Arts) and 10 (Arts), however, had to switch from using only practical examples to using only illustrative examples.

#### 4.1.8. Technological Knowledge

In contrast to all other aspects discussed before, technological knowledge was not measured before and after the lockdown period; this aspect was analyzed over both periods at once. Some courses never needed to use any technological tools in their classes, such as mathematics, but that does not mean that the teacher had no knowledge about technology. In the lockdown period, however, all teachers had to use their technological knowledge. In this period it became clear which teachers had TK and was able to use it in their teaching.

From all 20 interviewed teachers, 15 were perfectly capable of adapting to the new online environment. These teachers were directly able to provide their students with some form of online education. Secondly, 3 teachers were able to implement the technological tools, but did not use them to the full potential. This includes, e.g., Teacher 19 being unable to properly show their notes to the students online while being able to start video conferences. Lastly, only two teachers were completely unable to use any form of technology during the lockdown period.

#### 4.1.9. School Organisation

Most teachers made additional comments on the lack of steering from the schoolboard. Mail traffic shows that the board sent teachers an email about education strategies, two weeks after the lockdown started. Before that, teachers had to figure out themselves how to teach in this unusual situation. Teacher 3 (Latin and Greek) found this very inconvenient: *“I am not a hero in technology . . . and now we had to figure out ourselves how to teach online.”* It should be noted that this does not mean that teachers are unaware of the procedures in their school; the board failed to (properly) communicate policies to their employees on time.

#### 4.2. Student Questionnaire

For the students, it is important to get an insight into their understanding and liking of the courses they participated in during the lockdown. Unfortunately, due to privacy issues, it was not possible to ask for the students' grades. However, since there was no examination any more after the start of the lockdown period, there would have been no added value to that information. Therefore, the students were asked about their perception of their understanding and liking of all their courses; these results are summarised in Tables 5 and 6, respectively. Tables 5 and 6 show that for every course, the students' understanding and liking decayed during the lockdown period, and the results have proven to be significant with Pearson's correlation coefficient being up to  $10^{-7}$ . Note that the number of responses in Tables 5 and 6 varies because not all students took all courses in the Dutch education system.

Students also expressed their opinion about the best and the worst aspects for each course. Tables 7 and 8 show the best and worst aspects for each course according to students, respectively. It is interesting to see that for every course, except English and mathematics, the worst aspect was the missing structure during the instructions. English and Mathematics had as the worst aspect, respectively, the inability to talk to fellow students and that too much homework was assigned. It should be noted that for almost every course, the second worst aspect was the fact that students were unable to talk to each other. This shows that students need to communicate with each other.

For the best aspects, it is interesting to see that the most common aspect is a good structure in the classes. Where English and mathematics were the only courses that did not have as worst aspect a lacking structure, their best aspect according to the students is that they had proper structure during the online classes. Note that for Geography, the worst part was a lack of structure, and the best aspect was a proper structure. This contradiction is explained by the fact that only 20% of the students voted for a lacking structure as worst

aspect, apparently from the remaining 80%, some students voted for a proper structure as being the best aspect, resulting in 14% of the all students.

**Table 5.** Average of students' opinion of the understanding of their courses in regular situations and during the lockdown on a scale from 1 to 5.

Course	Regular	Lockdown	$\Delta$ [%]	Total Responses
Chemistry	3.6	2.7	-25	96
Economics	3.6	3.1	-14	62
German	3.9	3.3	-15	125
Physics	3.1	2.6	-16	95
Mathematics	3.8	3.1	-18	203
Dutch	3.7	3.3	-10	172
English	3.9	3.6	-8	157
Art	4.0	3.5	-13	151
Geography	3.8	3.4	-11	149
Latin and Greek	3.4	2.8	-18	51

**Table 6.** Average of students' opinion of the liking of their courses in regular situations and during the lockdown on a scale from 1 to 5.

Course	Regular	Lockdown	$\Delta$ [%]	Total Responses
Chemistry	3.3	2.8	-15	96
Economics	3.2	2.8	-13	62
German	3.3	2.9	-12	125
Physics	2.7	2.5	-7	95
Mathematics	3.2	2.8	-13	203
Dutch	3.0	2.8	-7	172
English	3.6	3.2	-11	157
Art	3.5	2.8	-20	151
Geography	3.3	3.1	-6	149
Latin and Greek	3.5	3.0	-14	51

**Table 7.** Worst aspect of a course during the lockdown period according to students.

Course	Worst Aspect	Percentage [%]
Chemistry	Lack of structure	26
Economics	Lack of structure	23
German	Lack of structure	21
Physics	Lack of structure	19
Mathematics	Too much homework	23
Dutch	Lack of structure	23
English	Unable to talk to your classmates	17
Art	Lack of structure	29
Geography	Lack of structure	20
Latin and Greek	Lack of structure	39

**Table 8.** Best aspect of a course during the lockdown period according to students.

Course	Best Aspect	Percentage [%]
Chemistry	Teacher shared notes	23
Economics	Usage and sharing of presentation slides	28
German	Usage of online learning environments	15
Physics	Teacher shared notes	17
Mathematics	Good structure	13
Dutch	A similar approach was used as before the lockdown	15
English	Good structure	15
Art	Usage of online learning environments	17
Geography	Good structure	14
Latin and Greek	A similar approach was used as before the lockdown	19

### Qualitative Analysis of Student Questionnaire

Besides the given, closed questions, the students were also able to provide additional comments on the courses. Below, the most important findings of these comments are provided.

The most important finding from the students' comments is the fact that they value structure. This became clear already from the results given in Tables 7 and 8; however a *clear structure* does not exclusively mean that the teacher is able to give clear instructions to the students. From the comments of the students, it became clear that even though a teacher was able to provide clear instructions to the students, the overall structure was still lacking. For German courses, for instance, students indicated that there were "proper instructions" and that "...it was clear what was expected of..." the students. However, the German teacher was sometimes unable to turn on the camera, "...making it inconvenient to ask questions." Furthermore, for economics, students indicated that there were "...clear instructions, however it was still difficult to follow online." Therefore, these courses still had as the worst aspect that the structure was missing.

One course that had proper structure was mathematics. Students indicated that it was very clear what had to be done and where to find all the material such as instruction videos: "almost everything was properly arranged." For mathematics, the whole electronic environment was used in an orderly fashion, making it clear to students where everything could be found. Even though there was "...no opportunity to ask questions during instructions...", students still valued the structure present in the mathematics department.

In addition to structure, the students also indicated that it is important for a teacher to be familiar with the digital environments and tools. One of the main complaints towards teachers was the fact that they were unable to properly work with the provided video conferencing software. A geography teacher, for instance, was able to start video conferences, but was unable to properly share their notes with the class. The teacher "...wrote everything on the whiteboard behind them..." which was "...not readable." Students indicated that the quality was "...really bad." The inability to properly sharing notes was, unfortunately, not the only thing that teachers failed to accomplish: some teachers failed to attend the online classes at all. Students indicated that one of the Dutch teachers "...did not know how to work with computers..." which resulted in absence during online classes. An English teacher also "...was sometimes not present..." during online classes. Students also indicated that the teacher of Latin and Greek "...failed to attend the online classes." However, during the teacher interviews, it became clear that the teacher Latin and Greek (Teacher 3) was absent on a personal note and failed to communicate this with their students.

The third aspect that was mentioned by students were practical examples. Some courses, such as chemistry and physics, rely on their practical examples to demonstrate students the real-world implications of certain theories. Students indicated that for chemistry, "...the material might have been more clear if there were any practical examples. Maybe something that could be done with things you have at home." Of course, there are

limitations on practical examples with chemistry due to the lack of materials that students have at home. However, physics teachers managed to provide the students with practical examples executable at home. According to students, "... these practical examples made sure ..." the students "... understood the material better." Even the videos of experiments shared by the physics teachers were considered to be "... very helpful."

The last aspect that students noted became present in the comments given on the Dutch courses. Here it was appreciated by students that "... the teacher started with asking the class how they were doing ... before discussion of the material ..." Students indicated that this personal aspect was something that "... was missing in other courses." Students valued the opportunity of sharing their experiences of the lockdown with the class.

## 5. Discussion

Prior work has documented the effects that competent teachers have on students' understanding of subject matter [48]. One of the main characteristics of a good teacher is a profound knowledge of tasks and instructional strategies that aid students' understanding [49,50]. Both the teacher knowledge domains and the aspects of good instruction are based on what is possible inside the physical classroom [16,30]. Unfortunately, due to the COVID-19 pandemic, teachers for secondary education were forced to move towards online education quickly [51]. Even though there are some studies on teacher competences in online education [27,52], these studies are focused on higher education, i.e., tertiary education. In particular, there is little known about what happens if education shifts from in-class to online at secondary school education [53].

The main aim of this study was to explore how the pedagogical strategies used during the lockdown period influence students' perception of the courses. The aspects of good instruction and domains of teacher knowledge before and during the lockdown have been investigated. Knowing about the perceptions of teachers and their students, together with the aspects of the lessons that are appreciated or not appreciated by the students, provide insights into the improvement of online and in-class education practices.

All student comments pointed out the aspects of the online lessons that deviated from the lessons before the lockdown period. These comments suggest that students relate structure to in-class lesson structure. If the teacher used different teaching practices in online lessons, students perceived this as a structural change. Therefore, it could be argued that students value a smooth transition from in-class to online education.

These findings are in line with previous research focused on the influences on a student when enrolment is changed [54]. Reference [54] showed that when pedagogical approaches change, this has a negative influence on the students' academic achievements. Even though the social ties are intact during a lockdown situation, the pedagogical approaches that teachers use are different, similar to when a student gets a new teacher. This suggests that any disruptive change in pedagogical approaches has a negative effect on the students' motivation, understanding, and hence achievement.

Additionally, this study shows that the number and variety of instructional strategies that teachers used increased during the lockdown period. This indicates that the teachers were trying to adapt to the sudden change to an online teaching environment. Our findings revealed that the teachers spent most of their time adapting to online teaching environment, while all other aspects of good instruction were lacking in this process. However, previous research suggests that teachers should not only focus on how to present their material but also on how to properly guide students in the learning process [55–57]. It is argued that teachers should also think of how to pedagogically guide their students when a sudden change in environment occurs.

This finding is in line with the comments that students gave on specific courses. Students valued the fact that a teacher was asking them personally how they were doing, for example, as it was done during the Dutch language course. Furthermore, students indicated that they disliked the fact that there was no possibility for interaction with the

teacher during mathematics courses. This suggests that students value the pedagogical guidance capabilities of their teachers.

On the other hand, students also made clear that they appreciated the quality of the instructions during the lessons. When something was not properly arranged, such as the readability of the presented material or the ability of the teacher to be online, this was found to be disturbing. This shows that students value the quality of the lesson's content as well. Therefore, it is beneficial for students when teachers are able to balance all aspects of good instruction properly.

One of the most important comments teachers made during the interviews was the reoccurring need for steering from the schoolboard. This indicates that not only do students require proper structure, but teachers also want to have some degree of structure and guidance for teaching. In the first days of the lockdown period, teachers were told to teach without any structure provided by the schoolboard. This most likely caused the increase in instructional strategies; teachers were searching for different ways of teaching.

This finding is in line with previous research indicating that the schoolboard influences the quality of education [58–60]. Therefore, this study suggests that teachers require proper guidance from the board on the basic guidelines about how to teach. When some degree of guidance is provided, teachers could spend less time in finding proper instructional strategies and more time on providing proper guidance to the students.

Especially with sudden transitions in education, it is important that guidelines are provided such that the teachers can focus on other aspects of good instruction such as pedagogical guidance. These guidelines include the available material and how to use them, e.g., the usage of a smartboard with specific software. This enhances the general educational context domain of teacher knowledge, which, due to the subset structure, enhances all other domains of teacher knowledge. In turn, this would result in better understanding on the students' side and, consequently, would provide a proper foundation for good achievement.

Most notably, this is the first study to our knowledge that investigates the effects of the sudden transition from in-class to only online education from teachers' and students' perceptions. The presented results provide compelling evidence indicating the importance of structure throughout all levels of the education system.

It is interesting to note that, even though there is no direct interaction between the board of a school and the students, the decisions of the board influence the students' perception on their level of understanding. It would be interesting to further investigate on the influences of board decisions.

This study also has some limitations that should be noted. First of all, this study was performed in only one school. Other secondary schools might have used other practices or strategies than the ones presented here. It would be interesting to investigate, in future research, how schools with different directions influence the perceptions of students.

Another limitation of this study is the fact that the individual approaches of teachers for their courses are not being considered. At every school, there are policies about how to teach specific courses, but the teachers mainly determine how this policy is translated into instruction. This means that almost every teacher uses their preferred style of teaching, which could also affect the liking of a course by students. Even though our study is only interested in the deviation of the score before and during the lockdown, it might still be interesting to link the individual teaching style of a teacher to the level of liking and understanding of the students.

Another limitation is that this research has been executed in only one country; similar to the previous limitation, it might have been that other countries applied different strategies in their secondary education. It is known that different countries have different educational systems. It would be interesting to see if guidelines provided by a nation's government also influence the perceptions of the students. This would extend this research by means of broadening the scope from school-wide to nation-wide.

## 6. Conclusions

The research hypothesis that teachers should apply all knowledge domains in online lessons for the best quality is supported by the reported findings. This research showed the relationship between the distribution of applied teacher knowledge domains and the perceived understanding from students and the importance of finding a balance between all of these domains. This research suggests that during online teaching, teachers should aim for implementation of all aspects of good instruction.

Furthermore, our findings demonstrated that students value structure when learning. This includes not only that the teacher provides proper instructions and makes clear what is expected from the students, but also provides stability to the students, e.g., using similar instructional tools throughout different courses. Students' difficulty in following what the teacher is doing contributes to the students' perception of a lacking structure in the particular course.

This research demonstrated the importance of a proper structure throughout the educational hierarchy, in particular during an unexpected, sudden change in learning environment. The board should provide their teachers with sufficient guidelines in using available materials. In this way, teachers can focus on implementing all aspects of good instruction and thus provide the students, in turn, with a properly structured instruction.

This research is not only applicable for instantaneous disruptions of the teaching environment such as the contemporary COVID-19 lockdown considered here, but also for education in general. We conclude that it is important to provide proper structure at all times. It is always important to establish structure throughout the whole school system, from the board to the teachers and from the teachers to the students.

**Author Contributions:** Conceptualization, D.L. and D.B.-J.; methodology, D.L. and D.B.-J.; software, D.L.; validation, D.L. and D.B.-J.; formal analysis, D.L.; investigation, D.L.; resources, D.L. and D.B.-J.; data curation, D.L.; writing—original draft preparation, D.L.; writing—review and editing, D.L. and D.B.-J.; visualization, D.L.; supervision, D.B.-J.; project administration, D.L. Both authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethics Committee of the Eindhoven University of Technology (protocol code ERB2020ESEO2; 21 February 2020).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** All data used in this research are anonymized and, with consent, made publicly available at <https://github.com/LAD96/COVID19-Education>, accessed on 29 April 2021.

**Acknowledgments:** The authors would like to thank the school for their support throughout the research, allowing this work to reach a very diverse set of participants. Furthermore, thanks to all participants for their time and effort in filling out the questionnaire and participating in interviews.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. Anderson, T. *The Theory and Practice of Online Learning*; Athabasca University Press: Athabasca, AB, Canada, 2008.
2. Taylor, J. The future of learning-learning for the future: Shaping the transition. In *Open Praxis: The Bulletin Of The International Council For Distance Education*; International Council for Open and Distance Education: Oslo, Norway, 2001; pp. 20–24.
3. Volery, T.; Lord, D. Critical success factors in online education. *Int. J. Educ. Manag.* **2000**. [CrossRef]
4. Watson, J. Blended Learning: The Convergence of Online and Face-to-Face Education. In *Promising Practices in Online Learning*; North American Council For Online Learning: Vienna, VA, USA, 2008.
5. Oomen-Early, J.; Murphy, L. Self-actualization and e-learning: A qualitative investigation of university faculty's perceived barriers to effective online instruction. *Int. J. Learn.* **2009**, *8*, 223–240.
6. Posey, L.; Pintz, C. Online teaching strategies to improve collaboration among nursing students. *Nurse Educ. Today* **2006**, *26*, 680–687. [CrossRef] [PubMed]

7. Uribe, D.; Klein, J.; Sullivan, H. The effect of computer-mediated collaborative learning on solving III-defined problems. *Educ. Technol. Res. Dev.* **2003**, *51*, 5–19. [CrossRef]
8. Poehlein, G. Universities and information technologies for instructional programmew issues and potential impacts. *Technol. Anal. Strateg. Manag.* **1996**, *8*, 283–290. [CrossRef]
9. Whitty, G.; Power, S.; Halpin, D. *Devolution and Choice in Education: The School, the State and the Market*. Australian Education Review No. 41; Australian Council for Educational Research: Melbourne, Australia, 1998.
10. Marinoni, G.H.; Jensen, T. The impact of COVID-19 on higher education around the world. In *IAU Global Survey Report*; International Association of Universities: Paris, France, 2020.
11. European Centre for the Development of Vocational Training. EU Countries Respond to the Effect of Coronavirus on Their Education Systems. 2020. Available online: <https://www.cedefop.europa.eu/en/news-and-press/news/eu-countries-respond-effect-coronavirus-their-education-systems> (accessed on 22 March 2021).
12. Ferrel, M.; Ryan, J. The impact of COVID-19 on medical education. *Cureus* **2020**, *12*, e7492. [CrossRef]
13. Franchi, T. The impact of the COVID-19 pandemic on current anatomy education and future careers: A student's perspective. *Anat. Sci. Educ.* **2020**, *13*, 312–315. [CrossRef]
14. Schleicher, A. The Impact of COVID-19 on Education Insights from Education at a Glance. 2020. Available online: <https://www.oecd.org/education/the-impact-of-covid-19-on-education-insights-education-at-a-glance-2020.pdf> (accessed on 5 April 2021).
15. Torda, A.; Velan, G.; Perkovic, V. The impact of the COVID-19 pandemic on medical education. *Med. J. Aust.* **2020**, *14*. [CrossRef]
16. Sol, Y. *Pedagogisch-Didactisch Handelen van Docenten in Het Voortgezet Onderwijs*. Ph.D. Thesis, Utrecht University, Utrecht, The Netherlands, 2012.
17. Bransford, J.; Derry, S.; Berliner, D.; Hammerness, K.; Beckett, K. Theories of learning and their roles in teaching. In *Preparing Teachers for a Changing World: What Teachers Should Learn and Be Able To Do*; Jossey-Bass: San Francisco, CA, USA, 2005; pp. 40–87.
18. Windschitl, M. Framing constructivism in practice as the negotiation of dilemmas: An analysis of the conceptual, pedagogical, cultural, and political challenges facing teachers. *Rev. Educ. Res.* **2002**, *72*, 131–175. [CrossRef]
19. Blumenfeld, P.; Soloway, E.; Marx, R.; Krajcik, J.; Guzdial, M.; Palincsar, A. Motivating project-based learning: Sustaining the doing, supporting the learning. *Educ. Psychol.* **1991**, *26*, 369–398. [CrossRef]
20. Doyle, W. Classroom organization and management. In *Handbook on Research on Teaching*; Wittrock, M.C., Ed.; Macmillan: New York, NY, USA, 1986; pp. 392–431.
21. Houtveen, A. *Succesvol Adaptief Onderwijs: Handreikingen Voor de Praktijk*; Kluwer: Alphen aan den Rijn, The Netherlands, 2000.
22. Ryan, R.; Deci, E. Intrinsic and extrinsic motivations: Classic definitions and new directions. *Contemp. Educ. Psychol.* **2000**, *25*, 54–67. [CrossRef]
23. Elshout-Mohr, M.; Vanhout-Wolters, B.; Broekkamp, H. Mapping situations in classroom and research: Eight types of instructional-learning episodes. *Learn. Instr.* **1998**, *9*, 57–75. [CrossRef]
24. Oostdam, R.; Peetsma, T.; Derricks, M.; Vangelder, A. *Leren Van Het Nieuwe Leren: Casestudies in Het Voortgezet Onderwijs*; Sco-Kohnstamm Instituut: Amsterdam, The Netherlands, 2006.
25. Webb, N. The teacher's role in promoting collaborative dialogue in the classroom. *Br. J. Educ. Psychol.* **2009**, *79*, 1–28. [CrossRef]
26. Crooks, T. The impact of classroom evaluation practices on students. *Rev. Educ. Res.* **1988**, *58*, 438–481. [CrossRef]
27. Bao, W. COVID-19 and online teaching in higher education: A case study of Peking University. *Hum. Behav. Emerg. Technol.* **2020**, *2*, 113–115. [CrossRef]
28. Mahmood, S. Instructional strategies for online teaching in COVID-19 pandemic. *Hum. Behav. Emerg. Technol.* **2021**, *3*, 199–203. [CrossRef]
29. Gess-Newsome, J. *Pedagogical Content Knowledge: An Introduction and Orientation*; Springer: Berlin/Heidelberg, Germany, 1999.
30. Carlsen, W. *Domains of Teacher Knowledge*; Springer: Berlin/Heidelberg, Germany, 1999.
31. Grossman, P. *The Making of a Teacher: Teacher Knowledge and Teacher Education*; Columbia University Teachers College Press: New York, NY, USA, 1990.
32. Shulman, L. Those who understand: Knowledge growth in teaching. *Educ. Res.* **1986**, *15*, 4–14. [CrossRef]
33. Shulman, L. Knowledge and teaching: Foundations of the new reform. *Harv. Educ. Rev.* **1987**, *57*, 1–23. [CrossRef]
34. Shulman, L.; Sykes, G. A national board for teaching? In *Search of a Bold Standard*; Carnegie Forum on Education and the Economy: New York, NY, USA, 1986.
35. Koehler, M.; Mishra, P. *Introducing TPCK*; Routledge: New York, NY, USA, 2008.
36. Cox, S.; Graham, C. Using an elaborated model of the TPACK framework to analyze and depict teacher knowledge. *Techtrends* **2009**, *53*, 60–69.
37. Anderson, L.; Krathwohl, D.; Bloom, B. *A Taxonomy for Learning, Teaching, and Assessing: A Revision of Bloom's Taxonomy of Educational Objectives*; Allyn & Bacon: Boston, MA, USA, 2001.
38. Kurt, S. TPACK: Technological Pedagogical Content Knowledge Framework. 2018. Available online: <https://educationaltechnology.net/technological-pedagogical-content-knowledge-tpack-framework/> (accessed on 16 April 2021).
39. Bertaux, D. From the life-history approach to the transformation of sociological practice. In *Biography Furthermore, Society: The Life History Approach In The Social Sciences*; SAGE Publications: Newbury Park, CA, USA, 1988; pp. 29–45.
40. Guest, G.; Bunce, A.; Johnson, L. How many interviews are enough? An experiment with data saturation and variability. *Field Methods* **2006**, *18*, 59–82. [CrossRef]



41. Mason, M. Sample size and saturation in PhD studies using qualitative interviews. *Forum Qual. Soc. Res.* **2010**. [[CrossRef](#)]
42. Fugard, A.; Potts, H. Supporting thinking on sample sizes for thematic analyses: A quantitative tool. *Int. J. Soc. Res. Methodol.* **2015**, *18*, 669–684. [[CrossRef](#)]
43. Nederlands Jeugdinstituut, Opleidingsniveau Jongeren. 2020. Available online: <https://www.nji.nl/nl/Databank/Cijfers-over-Jeugd-en-Opvoeding/Cijfers-per-onderwerp/Onderwijsprestaties#ch313832> (accessed on 3 March 2021).
44. Bayram-Jacobs, D.; Henze, I.; Evagorou, M.; Schwartz, Y.; Aschim, E.; Alcaraz-Dominguez, S.; Barajas, M.; Dagan, E. Science teachers' pedagogical content knowledge development during enactment of socioscientific curriculum materials. *J. Res. Sci. Teach.* **2019**, *56*, 1207–1233. [[CrossRef](#)]
45. Cohen, L.; Manion, L.; Morrison, K. *Research Methods in Education*; Routledge: New York, NY, USA, 2017.
46. Gibbs, G. Thematic coding and categorizing. *Anal. Qual. Data* **2007**, *703*, 38–56.
47. Miles, M.; Huberman, A. *Qualitative Data Analysis*; Sage: London, UK, 1994.
48. Rivkin, S.; Hanushek, E.; Kain, J. Teachers, schools, and academic achievement. *Econometrica* **2005**, *73*, 417–458. [[CrossRef](#)]
49. Sadler, P.; Sonnert, G.; Coyle, H.; Cook-Smith, N.; Miller, J. The influence of teachers' knowledge on student learning in middle school physical science classrooms. *Am. Educ. Res. J.* **2013**, *50*, 1020–1049. [[CrossRef](#)]
50. Fauth, B.; Decristan, J.; Decker, A.; Buettner, G.; Hardy, I.; Klieme, E.; Kunter, M. The effects of teacher competence on student outcomes in elementary science education: The mediating role of teaching quality. *Teach. Teach. Educ.* **2019**, *86*, 102882. [[CrossRef](#)]
51. UNESCO. Education: From Disruption to Recovery. 2021. Available online: <https://en.unesco.org/covid19/educationresponse> (accessed on 5 April 2021).
52. Goodyear, P.; Salmon, G.; Spector, J.; Steeples, C.; Tickner, S. Competences for online teaching: A special report. *Educ. Technol. Res. Dev.* **2001**, *49*, 65–72. [[CrossRef](#)]
53. Murphy, E.; Rodríguez-Manzanares, M.; Barbour, M. Asynchronous and synchronous online teaching: Perspectives of Canadian high school distance education teachers. *Br. J. Educ. Technol.* **2011**, *42*, 583–591. [[CrossRef](#)]
54. Grigg, J. School enrollment changes and student achievement growth: A case study in educational disruption and continuity. *Sociol. Educ.* **2012**, *85*, 388–404. [[CrossRef](#)]
55. Hubber, P.; Tytler, R.; Haslam, F. Teaching and learning about force with a representational focus: Pedagogy and teacher change. *Res. Sci. Educ.* **2010**, *40*, 5–28. [[CrossRef](#)]
56. Yuen, M. Exploring Hong Kong Chinese guidance teachers' positive beliefs: A focus group study. *Int. J. Adv. Couns.* **2002**, *24*, 169–182. [[CrossRef](#)]
57. Gysbers, N.; Henderson, P. *Developing and Managing Your School Guidance and Counseling Program*; John Wiley & Sons: Hoboken, NJ, USA, 1988.
58. Smylie, M.; Hart, A. School leadership for teacher learning and change: A human and social capital development perspective. *Handb. Res. Educ. Adm.* **1999**, *2*, 421–441.
59. Useem, E.; Christman, J.; Gold, E.; Simon, E. Reforming alone: Barriers to organizational learning in urban school change initiatives. *J. Educ. Stud. Placed Risk* **1997**, *2*, 55–78. [[CrossRef](#)]
60. Youngs, P.; King, M. Principal leadership for professional development to build school capacity. *Educ. Adm. Q.* **2002**, *38*, 643–670. [[CrossRef](#)]



Article

# What Can We Learn about Science Teachers' Technology Use during the COVID-19 Pandemic?

Liina Adov and Mario Mäeots \*

Institute of Education, University of Tartu, 50090 Tartu, Estonia; liina.adov@ut.ee

\* Correspondence: mario.maeots@ut.ee

**Abstract:** The purpose of this qualitative research was to describe teachers' experiences in a technology-mediated teaching context during the COVID-19 pandemic. We mainly focused on teachers' experiences with technology use (change and variety of the use) and their willingness to use technology in teaching. We designed an interview-based study. The participants were Estonian science teachers who voluntarily agreed to share their experiences about teaching in new and—for most of them—unexpected, distanced learning conditions. Based on teachers' reflections on technology use we could distinguish between three groups in which teachers described different levels of willingness to use technology, change in technology use from pre-COVID to distanced learning, and variety in the use of technology. Our results revealed that the higher teachers' perceived willingness to use technology, the easier it was for them to overcome potential obstacles and cope with the unexpected distanced learning. The main obstacles there were grouped as external (e.g., issues with internet connection, lack of students' digital skills) and internal (e.g., teachers' beliefs about technology use for teaching). It was observed that some obstacles were shared by all teachers (such as limitations on students' digital skills) whereas others were more prevalent in separate groups. This highlights the importance of understanding and considering the variability in the possible obstacles that emerge in using technology in education for teachers with different levels of experience.

**Citation:** Adov, L.; Mäeots, M. What Can We Learn about Science Teachers' Technology Use during the COVID-19 Pandemic? *Educ. Sci.* **2021**, *11*, 255. <https://doi.org/10.3390/educsci11060255>

Academic Editor: Peter Williams

Received: 31 March 2021

Accepted: 18 May 2021

Published: 24 May 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

**Keywords:** distanced learning; COVID-19; technology-mediated learning; technology-mediated teaching

## 1. Introduction

The pandemic of spring 2020 required teachers to instantly revise their daily teaching practices by endeavouring to apply technological novelty to achieve pedagogical aims. This unexpected pedagogical transformation was smoother for some teachers than others. The COVID-19 pandemic pushed educational systems to jump into the conditions of technology-mediated teaching and learning. This substantial change provided us with an extraordinary opportunity to learn about the role of technology use in teaching in a situation where teachers did not have any other option. Over several decades, researchers have shown that teachers' attitudes predict their willingness to use technology, which in turn predicts how likely they are to engage in the activity [1,2]. Due to this, it has been suggested that the rejection of technology use usually results from low willingness and a negative attitude to using technology. Little is known about what happens when teachers with different levels of willingness are expected to teach using mostly technology. Spoel and colleagues [3] showed that teachers who used technology in their teaching moderately before COVID-19 had a more positive experience in the first month of distanced teaching. This suggests that technology-mediated teaching experiences (e.g., perceived obstacles) may vary based on teachers' previous experiences and willingness to engage with technology. Understanding these experiences gives us the opportunity to acquire a deeper knowledge of which aspects of attitudes and experience should be addressed if we aim to support teachers' purposeful technology use at different levels of willingness and experience after the pandemic as well.

### 1.1. Willingness to Use Technology

Since the inception of the Theory of Planned Behaviour [4] in the 1980s, behavioural intention has been viewed as the “gate” between attitudes and behaviour, where attitudes can only influence behaviour through changing intention. Behavioural intention has been conceptualized as the willingness to engage in a certain behaviour, or, in Ajzen’s words: “A person’s readiness to perform a behaviour. This readiness to act can be operationalized by asking whether people intend to engage in the behaviour, expect to engage in the behaviour, are planning to engage in the behaviour, will try to engage in the behaviour, and indeed, whether they are willing to engage in the behaviour” ([5] p. 1122). Therefore, teachers’ attitudes towards technology in teaching shape how willing they are to utilize it, which in turn predicts the use itself. Based on the previous theoretical model, numerous studies have looked at willingness as a dependent variable (or BI; e.g., [6–8]), with the presumption that without willingness, there will be no behaviour. However, later studies have suggested that the relationship between attitudes, willingness, and behaviour is more dynamic than proposed by the theories borne out of the Theory of Planned Behaviour (TPB). Scherer et al. [9] found similar results on a meta-analysis showing that technology acceptance attitudes predict technology use directly, but not through willingness. Adov, Pedaste, Leijen and Rannikmäe (submitted) [10] found similar results showing that attitudes may predict behaviour above and beyond the willingness-mediated effect. While Scherer et al. [9] used general technology acceptance attitude to aggregate more specific attitude factors, Adov et al. of current manuscript [10] showed that when looking into more specific attitude factors, we can see different relationships with willingness and behaviour. Whereas some attitudes seem to predict others (social influence and facilitating conditions [2]) or relate directly with reported behaviour (social influence and self-efficacy [10]), the evaluations of the usefulness of technology for teaching seem to interact with willingness in predicting behaviour [10]. Tsybulsky and Levin [11] proposed looking beyond individual attitudes and observing the change in teachers’ technology-related worldview, which they conceptualized as a system of beliefs where it is not only important to understand the content of the beliefs but their interactions and different patterns of coexistence. The authors used Wilber’s (1995) three-dimensional construct to describe an approach to the digital worldview that comprises objective (“how I relate to digital content”), intersubjective (“how I relate to others through digital means”), and subjective dimensions (“how I see myself represented in the digital world”), suggesting that changes in teachers’ digital worldview will have an impact, as will changes in pedagogical practices. In one way or another, previous studies show that attitudes, e.g., willingness to use technology, play a role in understanding the behaviour itself.

### 1.2. Frequency and Variety in the Use of Technology

The majority of studies aiming to evaluate the experience of technology usage measure the frequency of the behaviour through surveys, e.g., [12]. Evaluating frequency offers us an insight into the usage of technology; however, it leaves us short on information on how the technology is being used. Studies have also aimed to evaluate the frequency of different activities (e.g., content creation, communication, or information search) for students and teachers that relate to digital literacy or related literacies [13,14]. However, this has still given very limited insights into the complexity and scope of technology use by teachers. Puentedura [15] proposed an SAMR (substitution, augmentation, modification, and redefinition) framework to evaluate the educational use of technology focusing on how technology is integrated into the teaching-learning process. Cromton and Burke [16] used the SAMR framework in a systematic review to evaluate the level of technology implementation based on the level to which it enhances learning experiences. Based on this study, the authors empirically extended the framework and provided an overview of the usage cases for every level of the framework. The first two levels (substitution and augmentation) are collectively named enhancement; on these levels the focus is on substituting usual tasks with similar ones using technology or adding some minimal function,

such as slides with embedded videos to illustrate the topic [17]. When in substitution, technology acts as a direct substitute for the tool with no functional change, whereas on the second level, augmentation, the direct substitution is enhanced with some functional improvement [16]. The next two levels (modification and redefinition) are named transformative, as the technology used enables one to redefine learning activities up to the point where technology is necessary, as the activity would not be possible in any other way: e.g., collaboratively solving problems or writing text. In the case of modification, technology enables significant task redesign (such as finding stars in the sky using augmented reality), whereas with redefinition technology enables the creation of a new task which would not be possible without technological solutions (such as students recording experiments and editing them to illustrate the learning process) [15]. Cromton and Burke [15] concluded that 54% of the studies (out of 186) reached the transformational level, while in 46% of the studies technology was used on the enhancement level. It could be argued that in the case of distanced learning, many technology-mediated activities move towards the transformational level, as it would not be possible to be in contact with students without the mediation of technology. However, the SAMR framework encourages researchers to look one step further and focus on the learning processes and ask if these would be possible without the help of technology.

### 1.3. What Makes Technology Difficult to Use?

Based on research into technology acceptance, teachers' evaluation of how difficult (effort expectancy or perceived ease of use) or useful technology is for teaching is predictive of willingness and ultimately of usage, e.g., [18]. While attempting to better understand the possible obstacles in using technology, researchers have aimed to measure effort expectancy or perceived ease of use, which has been defined as the "degree of ease associated with the use of the system" (p. 450 [18]); in the context of teaching, this can be viewed as the teachers' perceptions of how easy or difficult it would be to use technology for teaching or how inhibiting the foreseen obstacles might be. Bowman et al. [19] divide obstacles to technology use into external barriers which are outside of the teachers' control (e.g., institutional level decisions and infrastructural possibilities) and internal barriers which are under teachers' control (e.g., skills and knowledge, attitudes, and beliefs in technology use). Several studies have suggested that attitudes towards usefulness and effort might overlap to an extent to which their differentiation may not be reasonable [6]. Scherer and colleagues [7] even proposed that obstacles should be viewed as part of usefulness—encountering or anticipating problems with technology use also affects the perceived usefulness of this technology. However, these attitudes have been measured more often than not via questionnaires where teachers can express agreement or disagreement to statements asking them to evaluate whether using technology would be difficult [11]. Yet, this does not give us any information on how teachers see the obstacles that technology poses in teaching and how these might differ for teachers with different willingness and experience in technology use for teaching.

Furthermore, it has been proposed that usefulness might mean different things to teachers based on their goal orientation [20]. For example, a teacher whose goal is to train students for exams will evaluate the usefulness of a technology in teaching differently to a teacher who is aiming to motivate students. Therefore, the perceived difficulties of using technology might depend on the specifics of perceptions—aiming to train students for exams is very likely to create a different set of obstacles in technology use compared with the goal of motivating them. Tondeur and colleagues [21] showed in their meta-synthesis that teachers' beliefs can act as a barrier in technology adoption. Tondeur and colleagues [20] identified three recurrent themes in relation to obstacles in technology use for teachers: lack of time, perceived lack of control (not having an overview of how students are progressing), and traditionalist beliefs (where teachers see no need for technology as traditional practices continue to work). While the first two obstacles may be addressed in technology development by reducing the time it takes to use technological solutions or offering training courses to show teachers that technological solutions take less time than expected, the latter

requires addressing and changing teachers' beliefs and attitudes. In addition to specific attitudes and beliefs, Tsybulsky and Levin [11] differentiated three groups of teachers based on their digital worldview, reflecting different levels of engagement with the digital world. Even though this was not the main focus of the study, teachers' worldview seemed to be connected to their openness to navigate and explore digital options in teaching. As the authors described, a group of teachers named "outside observers", who reported the lowest level of engagement with all three dimensions of the digital worldview, also expressed in their professional life a lack of interaction, interest, or trust towards the digital solutions. The "circumspect participants" and "conscientious participants", however, reflected more positive attitudes towards the digital world and showed more openness to engage with it. In conclusion, looking into the difficulties expressed by teachers with different levels of willingness and experience with regard to technology use can provide stakeholders with opportunities to address these obstacles.

#### 1.4. The Present Study

Due to the COVID-19 pandemic, teachers found themselves in a new relationship with technology and teaching. Interviews give us an opportunity to obtain richer data on the behaviour of the teachers and the possible connections to different aspects of teacher attitudes and experiences.

The aim of the present study is to describe teachers' experiences, e.g., obstacles they encounter, in a technology-mediated teaching context during COVID-19 while taking into account their experiences with technology use (change and variety of the use) and willingness to use technology in teaching.

Therefore, we formulated the following research questions:

1. Which groups of teachers can be distinguished based on the teachers' descriptions of their technology use before and during the COVID-19 pandemic based on three aspects: willingness to use technology  
change in technology use from pre-COVID to distanced learning, and  
variety in the use of technology?
2. How do the perceived obstacles of technology use differ between groups of teachers?

## 2. Methods

### 2.1. Context and Participants

Our study was conducted in spring 2020 during the COVID-19 pandemic lockdown (as a remark: The Republic of Estonia announced lockdown on the 12 March and the period was officially over on the 17 May). The participants were Estonian science, geography, physics, chemistry, and biology teachers who voluntarily agreed to share their experiences about teaching in new and for most of them unexpected (i.e., unfamiliar teaching practice) distanced learning/teaching conditions. The call to participate was sent to all Estonian basic school STM teachers. In total, there were 13 teachers (see Table 1) from different parts of Estonia who accepted our call to participate in a one-on-one online interview on very short notice during the pandemic.

### 2.2. Procedure

We employed a qualitative study with an interview approach. First, we designed an interview scheme, then tested it with one of the STEM teachers and adjusted the interview questions as needed. The teachers were reached through their school emails inviting them to participate in a study focusing on teacher experience and technology use during the COVID-19 pandemic. One-hour interviews were scheduled and conducted within the lockdown period (April to May 2020); the aim was to collect teachers' experiences in the form of recent and authentic present tense. Participants were informed in advance that the interview would take about an hour. All interviews were conducted via video conferencing systems Zoom or Microsoft Teams and were recorded at least in audio format (except for

one video in which the recording failed) and as a preventive activity written notes were made during the interview. Oral consent to record the interview was obtained from every participant as the first question with the explanation that the recordings would be used only for achieving the aims of the study and stored on a physical hard drive with access only given to the authors of the current study.

**Table 1.** Descriptions of participants.

Participant (Pseudonym)	Working Experience as a Teacher	Subjects
Anna (female)	3 years	Science and Geography
Kati (female)	2 years	Science and Physics
Kristi (female)	7 years	Science and Chemistry
Mati * (male)	30 years	Physics
Karolin (female)	10 years	Biology and Science
Maria (female)	20 years	Biology
Timo (male)	4 years	Science
Kristjan (male)	64 years	Physics and Science
Triinu (female)	16 years	Biology, Geography, Science
Veiko (male)	20 years	Biology
Paul (male)	17 years	Physics and Chemistry
Anne (female)	34 years	Biology
Piret (female)	35 years	Biology

\* Note: For this teacher, the interview took place via Microsoft Teams and was not recorded.

### 2.3. Instrument

We collected data with semi-structured interviews (see Appendix A), which provided us with flexibility and possibilities to widen the scope of questions in accordance with the teachers' answers. The main questions of the interview were about how the teachers perceived teaching in distanced learning conditions (e.g., "What are you doing differently in your teaching compared to the period before the distanced learning?") and how they described their use of technology and its variation compared to prior experiences (e.g., "Please describe what role technology plays in your current lessons").

### 2.4. Data Analysis

We used cross-case analysis to describe the similarities and differences between the cases. This enabled us to position these cases relative to each other on three target aspects: willingness to use technology, change in technology use from pre-COVID to distanced learning, and variety in the use of technology. The relevant paragraphs of the interviews were transcribed and analysed using inductive content analysis based on the research questions.

We believe that the replication of the study by others is feasible, as we followed trustworthy principles as described by Williams & Morrow (2009) [22]:

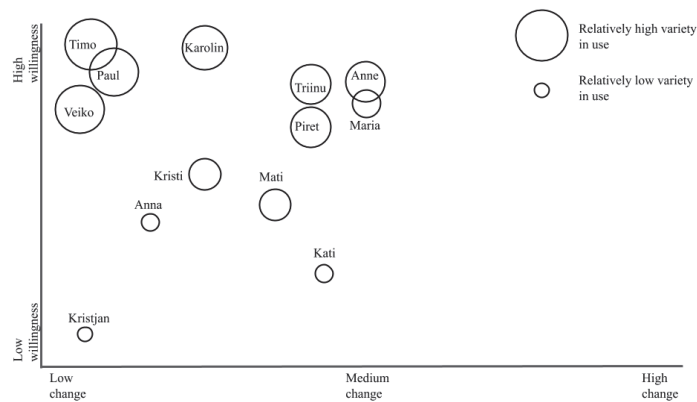
- Regarding the integrity of the data: interviews were prepared and conducted by the authors of the current paper; authors had a consensual agreement in interpreting data; all interpretations are exemplified with direct quotes from teachers' answers; 4 out of 12 interviews were co-analysed by the authors of the study; any differences in coding were discussed and a common agreement was reached; these interviews were used as referents for the other cases, if needed, to find the relative positioning of the remaining cases; as the interview was in Estonian, all quotes were subsequently translated into English;
- in terms of the balance between reflexivity and subjectivity—in order to check the meaning of the answers given we asked reflective questions during the interview;
- pertaining to the clear communication of findings: all analyses are interpreted and compared with findings from other studies.



### 3. Results

#### 3.1. Teachers' Willingness, Change, and Level of Technology Use

First, we aimed to describe which groups of teachers could be distinguished from one another on the basis of teachers' descriptions of technology use before and during the COVID-19 pandemic based on three aspects: willingness to use technology for teaching, change in technology use (compared to pre-COVID-19), and variety of technology use. In order to give an overview of the participants' relative position on these three aspects, we illustrated the relative positioning of every teacher in our study in Figure 1. Below, we will describe each aspect separately with examples illustrating teachers' relative positioning, which leads us to define the groups of teachers.



**Figure 1.** Teachers' relative position on three aspects: willingness to use technology for teaching, change in technology use (compared to pre-COVID-19), and variety of technology use.

##### 3.1.1. Teachers with High Willingness (Timo, Paul, Karolin, Triinu, Maria, Anne, and Piret)

We detected a group of teachers who described clearly their willingness to use and try out technological solutions prior to the COVID-19 lockdown who were open to testing different solutions in distanced learning situations.

For example, a teacher with 35 years of experience claimed that she was a frequent technology user and was willing to learn and had already widened her knowledge and skills of using software for conducting video lessons. It is worth noting that she even made comparisons between different kinds of software (e.g., Google Meets, Zoom, Microsoft Teams).

"I was a frequent user already before the crisis and I can say that this has increased during the current situation." (Piret)

They expressed some hesitations on some occasions; however, they saw that these were not something holding them back.

"It was quite a challenge, but not very scary." (Maria)

In many cases, these teachers mentioned that using technology was not an aim in itself and that it would also be important to do things in real life (experiments, etc.), so they did not aim to increase the amount of their technology use. However, they mentioned often their interest in and desire to try out new solutions, as well as their enjoyment at finding a technological solution to their needs and those of their students.

"I am very much pro-technology; I enjoy it when a solution works very well. But we also want to do things in real life." (Karolin)

"I'm aware that it takes more time to prepare lessons, but I'm making efforts to keep pushing at my own pace ... technology is motivational and brings excitement to the students." (Anne)

### 3.1.2. Teachers with Low Willingness (Kristjan and Kati)

From the interviews, we could see that one group of teachers described a rather low willingness to use technological solutions in teaching before the COVID-19 lockdown, a tendency which also continued during the pandemic under the distanced learning conditions. These teachers reflected being content with the low levels of technology use in their practice and/or an uneasiness in adopting technology in teaching.

“Right now, this digital and distanced learning is still unknown/unusual.” (Kristjan)

“I still lean towards the principle that in science subjects (students) should get to do more real experiments and that videos are supportive material.” (Kati)

### 3.1.3. Teachers with Medium Willingness (Anna, Kristi, and Mati)

In this group, teachers expressed neutrality or different opinions about technology for teaching. They reported, for example, that they had not been against its use but had not found it very easy to implement.

“I have never been hostile (towards technology), but now it was a bit more difficult . . . ” (Anna)

“I know there are so many interesting things, but I haven’t had the time to make them work for me and haven’t had that now either.” (Kristi)

In this group, teachers pointed out that they would not change their teaching much once the distanced learning period is over. This had nothing to do with their principles, however, but rather with a hesitation as to how well or how smoothly the implementation would go for them.

“I did not get any braver and will not do things differently than I used to (after the distance teaching).” (Anna)

“I look with envy at how already, only a few days later, younger ones (colleagues) are already working in Classroom (authors’ note: program Classroom) and have made their videos with smartphones.” (Mati)

## 3.2. Technology Use: Change in Behaviour and the Level of Technology Adoption

In order to describe teachers’ behaviour in the changing situation, we addressed two aspects. The first related to changes in technology use in teaching before and during the COVID-19 pandemic. Secondly, we aimed to describe the variety in teachers’ technology use, where we focused on the teachers’ descriptions of their main aims of technology use and whether these fall into the categories of enhancement or transformational within the SAMR framework, as described above.

### Change in Technology Use

None of the teachers reported an extreme leap in their technology use; however, all teachers pointed out that their amount of technology use had risen. For example, one teacher said the following:

“The use of technology (in the classroom) was rising (before the lockdown); however, now it is absolute.” (Timo)

- Low change (Timo, Paul, Karolin, Kristjan, Anna, and Kristi)

From the interviews emerged a group of teachers who described the change in their technology use as minimal. As one teacher said:

“A teacher in a state of emergency is still a teacher.” (Timo)

Overall, the teachers in this group did not report much change in the environments they used. For some, this was connected to the fact that they had already used a variety of technological solutions prior to the COVID-19 pandemic.

“There is not much difference when it comes to the environments that I use.” (Anna)

“I haven’t had the need to work in anything new (referring to the environments used for teaching), besides Zoom.” (Kristi)

“I use about 18 different technological solutions.” (Karolin)

In this group, the teachers described change with a focus on their own behaviour with the role of technology in the background, and so even though they clearly described a change, technology use was not central. For example, methods that had previously been used in the classroom were altered to produce technology-mediated versions, e.g., answering or talking to students.

“I give more individual feedback on independent work. Before, I didn’t give feedback on every step.” (Kristi)

“With some sentences in the e-school, I give instructions on which pages to go through, to which questions to pay extra attention. . . . Otherwise in the classroom there was oral answering, reporting/answering in front of the class.” (Kristjan)

For some teachers, the subtle change was within the focus of how and why they used technology.

“Now, the focus is more on which tools we can use to work together or what they can use for that . . . ” (Timo)

“Before, I checked (Messenger or emails) once a day . . . and I did not . . . answer right away . . . now, when I read it, I answer right away.” (Anna)

One teacher emphasized his previous experiences in conducting e-learning, which placed him in good stead. Indeed, previous experience provides an opportunity for a smoother transformation in teaching, but on the other hand, the success of the transformation depends on how flexible the prior material is for modification to new teaching and learning conditions.

“For me, it was nothing new. I have experience of online teaching, I have prepared e-learning materials and conducted video lessons.” (Veiko)

- Medium change (Kati, Mati, Piret, Triinu, Anne, and Maria)

Teachers whose stories reflected a medium change described a more substantial change in which the focus was on technology. As one teacher said,

“Everything had to be redone/adapted to a digital version.” (Maria)

In some cases, they added that they had used some technological solutions before as well; however, they had preferred not to. During the COVID-19 pandemic, technology became more prevalent than it would have otherwise. As one teacher described,

“For me it has changed substantially. . . . Some things we watched before, simulations, videos which connected to physics. But the thought that we have some real things to deal with (authors’ note: in the classroom, referring to experiments and discussions in the classroom).” (Kati)

The teachers also noted that the distanced learning period gave them an opportunity to try out things that they had thought about before, or to work on new materials for this occasion:

“(The distanced learning situation) forced me to work on things, to work on things that I was thinking of using, but . . . ” (Maria)

The teachers also said that even though they had some things “worked in” at the time of the interviews some weeks into the distanced learning period, it takes time.

“Now we have agreed upon which environments we use. Learning new things takes time.” (Mati)

Additionally, teacher's described the maintaining of students' motivation as a reason behind their decision use more technology than before the COVID-19 pandemic.

"For me, technology carries the motivational aim . . . students do not like to just fill in worksheets." (Anne)

### 3.3. *The Level of Technology Adoption during the COVID-19 Pandemic (How Teachers Described the Aims of Using Technology)*

#### 3.3.1. Enhancement-Focused Adoption (Substitution and Augmentation) (Anna, Kati, Maria, Kristjan, and Kristi)

For one group of teachers, we saw relatively low levels of variety in technology use. They mentioned several environments that they used; we could identify three main categories of aims emerging from the descriptions.

- Instructing

All teachers in this group reported using technology for giving instructions, checking if and how assignments were being done, and giving feedback. They described different environments that helped to fulfil this goal, from pictures of workbooks to files shared via email. Change in this aspect varied among teachers. For some, the tasks were the same, only the sharing was different, for others, the format for the tests changed as well. Two teachers described their somewhat different experiences:

"They send it (referring to a photo of a textbook page) to my email . . . and I send it back with my evaluation or comment." (Kristjan)

"I started using Socrative . . . now instead of the (open-ended questions) test we do with a multiple-choice test. . . . Most of the time goes to giving feedback." (Maria)

In some cases, teachers described how technological solutions set some limitations on giving instructions and controlling processes, indicating that during their usual teaching practice they would have performed their task differently. As one teacher indicated,

"Testing is done more in the multiple-choice test format. . . . We have less of these longer exams where they had to verbalize (their answers)." (Kristi)

- Communicating

Another aim was communication with students. One teacher explained that previously, they had almost never used emails to communicate with students. Some teachers mentioned the growing role of social media in communication, as it enables seamless, fast communication, and that students would not use other technological solutions as often. As one teacher described,

"Children do not read emails or pick up their phones. . . . Now I am accessible all the time. . . . I need to be on social media all the time." (Maria)

- Sharing materials

Teachers also expressed the need to share materials. The level of and ways in which technology was used for this goal varied between the teachers in these groups as well. For example, one teacher explained how he asked students to use physical materials and share the photos:

"They take a photo of page 14 (referring to the textbook) for which they have read the theory from the book." (Kristjan)

Others described using electronic materials which were either in a written format, such as articles and textbooks, or in a video format. The teachers also shared either existing video materials, videos made by themselves, or used Zoom classes. For example, one teacher reported using,

"e-õpik (collection of electronic textbooks and workbooks), where I ask students to read the textbook and fill in the workbook" (Anna)

whereas another noted that,

“To explain the topic further, there are some video clips or a link to an e-textbook.” (Kati)

### 3.3.2. Transformation-Focused Adoption

The teachers indicated by a bigger circle in Figure 1 referred to using regularly technological solutions in their teaching, moreover, they referred to this use as an opportunity to change the process of learning. In their descriptions, teachers described using solutions which brought about new possibilities which would not have been accessible for learning with the help of books or workbooks. As one teacher described in the context of giving feedback or checking students’ work,

“With the worksheets in Wisser, they can check themselves if they are correct. With the workbooks this doesn’t happen, maybe they wait until the teacher collects (the workbooks) . . . and then get to know (the right answers), but now they get (them) right away.” (Karolin)

Another example of this comes in the form technological co-creation, which became especially valuable during the COVID-19 pandemic.

“Google slides where you can work on something together, rearrange pictures.” (Timo)

Interpreting the outcomes described above (willingness to use technology, change in technology use from pre-COVID to distanced learning, and the level of technology adoption) allowed us to distinguish between these three groups of teachers, which helped us to address the second research question. We formed the following groups:

Group A: high willingness, low change, and relatively high variety in use (Timo, Karolin, Paul, and Veiko)

Group B: high willingness, medium change, and average variety (Triinu, Anne, Maria, and Piret)

Group C: low willingness, low to medium change, and low variety (Kristjan, Kati, Anna, Mati, and Kristi).

### 3.4. Perceived Obstacles to Technology Use for the Three Groups of Teachers

After extracting the three groups of teachers based on their experiences, we aimed to describe the differences in their perceived obstacles to technology use (see Table 2). A set of obstacles emerged from each group of teachers, with each group expressing some aspects of the obstacles that were distinct from the others. First, we will cover the overlaps that emerged from the teacher descriptions from the three groups. From there, we will move to the distinctive obstacles for each group.

Table 2. Perceived obstacles by group.

Groups	Shared Obstacles	Distinctive Obstacles
Group A: Timo, Karolin, Paul, and Veiko	Problems with infrastructure Problems with giving immediate feedback	Limitations of technological solutions Too many solutions in use in parallel
Group B: Triinu, Anne, Maria, and Piret		Difficulties with external learning materials
Group C: Kristjan, Kati, Anna, Mati, and Kristi		Difficulties with technological solutions Teachers’ attitudes and beliefs

### 3.4.1. Overlaps Common for all Three Groups

- Infrastructure

Teachers pointed out students' lack of access to technology as a possible obstacle. Here, the teachers' environment began to play a role, as according to some teachers, all students had the required technological tools (provided by the school), whereas others reported that regardless of the expectation that everyone has access to tools, they might not.

"All students do not have the means. It is assumed that they would, but they still do not." (Karolin)

Other teachers added that a lack of computers or internet connection can be a problem. However, it was mentioned several times that a solution was usually found; for example, the school administered computers to those students who needed them. Some examples of teachers' experiences include:

"Some have poor internet. . . . Some have only one computer for the whole family . . . there are still a few with these problems." (Maria)

"We heard about some (families) that were lent a computer." (Anna)

- Feedback

Teachers pointed out the lack of immediate feedback as difficulty in teaching solely via technological solutions. This leaves the teacher in the dark as to how much the student understands or if they require any additional support. As one teacher described,

"It is more of a mystical and dark territory (how the student reacts and if they are listening), which makes it also more difficult to adapt the tasks to the specific needs of the student in that situation." (Timo)

Another teacher added:

"I see that everything is filled out (referring to students' work); however, I don't see the state (of the student) behind." (Karolin)

- Students' digital skills

Teachers in all three groups mentioned students' digital skills as one obstacle. Teachers in group A (high willingness, low change, and relatively high variety in use) reflected more resources to overcome these obstacles (previous experience). Here, teachers said that it was important to consider students' skills and choose an environment based on this. One teacher explained:

"I have chosen environments where I know that they have acquired (the skills) already." (Timo)

Another teacher added:

"There are (students) who will never start wanting (to try to figure out environments) and those who can't." (Karolin)

In the other groups, teachers reported that hinderances to do with the lack of student skills also bring with them more general concerns as regards to predicting which environments the students would be able to use on their own. In the teachers' own words:

"Give them a file and they can't use the speller. They know certain things, things that you wouldn't even think of." (Maria)

"There are so many environments, to consider when thinking about which one the student can manage (on her own) at home."

(Anna)

For students' digital skills, we did see a small division between group A and the others, where group A described their previous experience of using digital solutions to help students overcome obstacle, but not for all students. In the other groups, the

lower previous experience of teachers brought about some inhibiting surprises and more experimenting with different solutions, which added to the workload (new for both the teachers and students).

#### 3.4.2. Overlap between Group B and Group C

There were a few obstacles that were not mentioned in group A but that were described as important obstacles within the two other groups.

- Time-consuming for the teacher

The teachers viewed learning how to use different solutions as being rather time-consuming, especially in relation to videos, which can be a useful material for the students but take a lot of time for the teacher, thus setting some limits on how accessible this solution is.

“It takes time to learn how to use (different solutions), after that it’s useful.” (Mati)

“Making videos is extremely time-consuming, I cannot make a video for them for every class.” (Maria)

Teachers also described how doing some tasks via technological solutions became more laborious than in the real-life setting—compared to browsing over the student assignments in the classroom, it takes more time digitally as the teacher feels the need to go over every individual assignment.

“Revising is time-consuming, there are no easy, simple solutions for revising (referring to the lack of technological solutions).” (Mati)

Time was also an obstacle in cases where the teacher saw that in the usual teaching situation reliance on a colleague made the preparation time was less costly.

“I’m ready for the technology, but it takes more time for me to prepare materials . . . at home, I don’t have colleagues who can help . . . before it was easier.” (Anne)

- Students’ study skills

Teachers in this group referred to obstacles beyond technological difficulties, pointing out that for students, working independently was difficult and took more time. Therefore, teachers proposed fewer materials or directed them in a more focused way. Based on the variability within the teachers’ use of technology, this obstacle was described on different levels. It was the only obstacle for the following teachers:

“The biggest difficulty is that (students) lack the skills to work on their own with the textbook.” (Kristjan)

“More self-discipline is needed, how do I focus on this, how long it takes . . . ” (Maria)

For other teachers, this was reflected more in the choice of materials shared and the number of assignments given. As one teacher illustrated,

“I have to give things in smaller chunks. In the classroom, I would go through everything in one lesson, now it takes two lessons. . . . Plus, we don’t leave homework, as they do everything at home.” (Kati)

#### 3.4.3. Distinctive Obstacles for the Three Groups

##### **Group A (Timo, Karolin, Paul, and Veiko)**

In this group, teachers mentioned more distinctly that most of the obstacles they faced were as a result of the distanced learning and were not so clearly connected to technology use for teaching. As one teacher explained,

“The problem is not technology but distance. We do not know and can’t evaluate what the situation is (for the student), if they have a place to focus . . . ” (Timo)



- Limitations of technological solutions

Teachers in this group are described as having higher expectations for technology, which in turn overlaps with some obstacles, one of which being that finding environments to fit the needs of their students requires resources which the teacher might lack. One important aspect here was that the teachers perceived the solutions not as too complex (as described by others), but rather not complex enough. This showed that the teachers in this group had very specific pedagogical goals in mind which were not met by the options available to them at the time. This was described by one teacher as follows:

“If I don’t have the energy to look that much to pay to find the best solutions for my needs. . . . There are not many environments or I don’t know how to find them. I want more complex environments.” (Karolin)

- Too many solutions in use in parallel

One teacher was teaching in three schools and explicitly stressed that in some cases it was challenging for him to keep track of which technological tool he had to use with the students, as different schools were using different options, e.g., for learning management systems.

“Now all schools are mixed up for me. Earlier I was quite precise with school days (e.g., on Wednesday I’m at one school and on Friday I’m at another school) and I had a clear system. This made it easy to keep track, but now I’m not moving physically from one school to another. Now students contact me at a random time, so I always have to first understand which school, which platform.” (Veiko)

#### **Group B (Triinu, Anne, Maria, and Piret)**

Teachers in this group described obstacles through situations where they used additional materials provided by national institutions (e.g., quizzes provided by environmental institutions). They mentioned that in many cases it was not easy to get an overview of the students’ results or that the registration process was time-consuming.

“I asked students to take part in a forest quiz . . . basically, it meant that I had to manually insert students name by name . . . at some point, I thought I would stop, but as I had already added the task description in the e-school, I did finish adding the names of more than 100 students . . . it took time.” (Triinu)

#### **Group C (Kristjan, Kati, Anna, Mati, and Kristi)**

In this group, the distinctive difficulties were described with a focus on the teachers’ perspectives, revealing several topics; teachers noted their own experience as an obstacle alongside student experience.

- Difficulties with technological solutions

Teachers described technological difficulties which limited their options in using the necessary solutions. One teacher described a problem with internet speed/capacity:

“I live in an apartment building, and the internet can just stop working at one point during the day . . . there are five class sets of students on the call.” (Kati)

Next to student skills, teachers in this group also mentioned their own learning curve alongside obstacles that emerged from the students’ low levels of digital skills.

“They (referring to students) cannot use it very well. First of all, you need to teach how, where and then you learn yourself alongside it.” (Kati)

Several teachers mentioned that parents had also suggested that students should not spend too much at the computer. On the other hand, teachers highlighted the downsides related to the time spent at the screen by the teachers. One teacher described this from both angles:

“One parent was even upset that so much work is on the computer. . . . The students may sit there for 30 min, but when checking (student work), the teacher is there longer . . . this is tiring for the eyes.” (Kati)

- Teachers' attitudes and beliefs

One of the more elusive obstacles we observed in this group was the teachers' attitudes towards the potential value of digital solutions. Even though the teachers themselves did not mention these explicitly as an obstacle, based on their descriptions of their experiences and principles guiding them in making choices and finding solutions, we observed a clear theme emerging. Attitudes emerged including that non-digital solutions were viewed as preferable or as there was some harm perceived in using more digital solutions.

"I have thought (about using Zoom) but the system that I use . . . I am happy and students are happy . . . they are used to sending me the worksheets (authors' comment: pictures of worksheets on paper) on time." (Kristjan)

We saw different reasons for this group not engaging with technology use for teaching. In one case, teachers described fundamental principles that led them to limit technology use in teaching. As one teacher describes,

"I took the position (before COVID-19) that as technology is used in many subjects anyway, then in science classes we do 'real things'." (Kati)

#### 4. Discussion

The COVID-19 pandemic pushed many educational systems to jump almost entirely into conditions of technology-mediated teaching and learning. This substantial change gave us an extraordinary opportunity to learn about the role of technology use in teaching when teachers did not have any other option. The present study aimed to describe teachers' experiences, e.g., obstacles they encounter, in a technology-mediated teaching context during the COVID-19 pandemic, while taking into account teachers' experiences with technology use (change and variety of the use) and their willingness to use technology in teaching. We addressed this aim in two steps. First, we aimed to group teachers based on their descriptions of technology use before and during the COVID-19 pandemic, considering three aspects: willingness to use technology, change in technology use from pre-COVID to distanced learning, and variety in the use of technology. Secondly, we set out to compare the perceived obstacles of technology use between groups of teachers.

Research question 1: Which groups of teachers can be distinguished based on their descriptions of technology use before and during the COVID-19 pandemic?

The level of willingness distinctly characterized teachers' openness and curiosity to use technology in their teaching before and during the COVID-19 pandemic. Based on these descriptions we saw three levels emerging: teachers with high willingness described their willingness to learn, and their descriptions were more driven by the possibilities that technology provides; in contrast to teachers with medium willingness, who expressed more hesitation; and teachers with low willingness, who expressed some reluctance to using technology in teaching. It can be said that the qualitative descriptions of teachers' willingness reflected the previously suggested dynamic relationship between willingness and other attitudes [7,8]. Like Scherer and colleagues [9], we observed a close connection or overlap of several attitudinal aspects, as teachers described the potential usefulness and difficulties of technology use for teaching, to name a few.

From here we looked at the change in technology use, where teachers described a relatively low or medium change in technology use from pre-COVID-19 to teaching during the COVID-19 pandemic. Interestingly, none of the teachers reported an extreme leap in their technology use. Whereas past research has found that the pressure to use technology (as teachers experienced during the COVID-19 pandemic) has a positive impact on its use [23], the present study confirmed this result with some exceptions. Most teachers indeed described some rise in their technology use and described taking relatively comfortable next steps in adopting technology for teaching. However, for some teachers this change was minimal, or, according to their own description, almost non-existent. For example, among teachers with high willingness two trends emerged in reference to their change of their technology use during the COVID-19 situation: we detected teachers with high willingness

who described a low change in their technology use and those who reflected a medium change. It is important to note here that some teachers in the high willingness group reported that their technology use did not change much as they had used technological solutions prior to the COVID-19 situation. On the other hand, teachers with relatively low or medium willingness described, in some cases, technology use that stayed on the low frequency side, while some described a bigger leap in their use of technology. In the latter cases, teachers mentioned that they had had the intent to use more technological solutions in their teaching before the pandemic and that the COVID-19 situation had given them the nudge to do so. This group's experience follows quite closely what Shin, Han, and Kim proposed in [23].

Acknowledging that the frequency of technology use in teaching might not provide us with information regarding how it is being used, we delved deeper into teachers' descriptions of their technology use before and during the COVID-19 pandemic. Relying on the SAMR model [15], we observed the emergence of different levels of technology use. Looking at these alongside willingness and change in technology use, we could see that descriptions of technology use for teachers with lower willingness expressed enhancement levels. Similar to the findings of Cromton and Burke [16], teachers described using technological solutions (such as taking pictures of homework) as a substitute for their usual teaching practices (checking students' workbooks in the classroom). Descriptions of teachers with relatively higher willingness, on the other hand, more often reflected the transformational level of this framework. As in the Crompton and Burke [16] study, teachers described solutions where technology enables the creation of a new task which would not be possible without technological solutions: for example, asking students to fill in worksheets where they can check themselves if their answer was correct.

Based on the teachers' descriptions we saw the emergence of three groups: (1) teachers with high willingness, low change, and relatively high variety in their technology use (group A); (2) teachers with high willingness, medium change, and average variety (group B); and (3) teachers with low willingness, low to medium change, and low variety (group C, illustrated in Figure 1).

We would also like to highlight a few higher-level observations:

1. Similar to previous studies on willingness and technology use [6–8], we observed based on teachers' descriptions a rather clear connection between willingness and technology use and integration level. Teachers who reflected higher willingness to use technology also described more technology integration within their teaching (before and after the COVID-19 pandemic) and were more likely to be working on the transformational level with this integration. However, when it came to willingness and change in technology use, this relationship was not as straightforward.
2. It is essential to consider that the lack of change in the usage behaviour from pre-COVID-19 to the COVID-19 pandemic might not reflect the extent to which teachers use technology in their work. Teachers with relatively high willingness described frequent technology use already before the COVID-19 pandemic; therefore, the change in their technology use was rather low. On the other hand, several teachers whose willingness was relatively low gave a similar description of their technology use during the COVID-19 pandemic. However, we observed that within the medium willingness group the change in technology use from classroom teaching to teaching during the COVID-19 pandemic was quite diverse. Based on this, it could be argued that the impact the distanced teaching situation on the use of technology [23] may vary across the levels of willingness to use technology. To gain more insight into what may inhibit different groups of teachers from adopting technology in their teaching practices, we focused on the kinds of obstacles emerging from the descriptions given by the teachers in these three groups.

Research question 2: How do the perceived obstacles of technology use differ between groups of teachers?

It is important to note that several obstacles expressed by teachers were shared by either all three groups or two. In the interest of providing insights into how to support teachers in using technology for teaching, we will provide an overview of the shared obstacles and go into more detail about the obstacles shared only by separate groups.

The label “shared obstacles” included three categories: (a) infrastructure (problems with internet connection), (b) feedback (difficulties in providing immediate feedback), and (c) students’ digital skills (and lack of students’ digital skills). Poor infrastructure is an external obstacle difficult for the teacher to overcome alone and that is usually solved at school level [18]. Thus, it is crucial for schools and local governments to support teachers and students by providing access to the technology necessary for learning, e.g., laptops for home use, as was mentioned by our teachers. As for the second obstacle (difficulties with providing feedback) this overlapped with one recurrent theme in the study by Tondeur and colleagues’ [20] on perceived lack of control. The last obstacle highlighted the issue of students’ lack of digital skills. This may be viewed as a surprising outcome, as digital competence (including skills) is embedded in the Estonian national curriculum (since 2014) and therefore students’ digital skills should not have been an issue.

Group-based obstacles covered areas that included both external and internal issues that teachers experienced during the COVID-19 pandemic. For example, group A reflected on issues relating to the limitations of the technological solutions; some members of the group pointed out that too many solutions in use were not the best way to manage the learning process. The limitation of technology implies that teachers who are at a transformational level set higher expectations for the technology, and when a teacher cannot realize his or her pedagogical goal, he or she perceives it as an obstacle.

Unlike groups B and C, group A did not consider time as an obstacle, or more interestingly, did not mention students’ poor learning skills. This finding may be explained by the idea that the teachers in group A had a more extensive collection of learning resources and prior experience of using them. Preparing new or modifying existing learning resources takes time, which is an inhibiting factor for teachers when it comes to integrating technology into the classroom [24]. In addition, we can see that this group of teachers resembles the “conscientious participants” in the research by Tsybulsky and Levin [11], where teachers described seeing more opportunities and less difficulties in using new technologies. The adoption of this worldview may have meant that some of the obstacles described by the other groups of teachers, such as groups B and C in our case, were not perceived as obstacles by teachers with a digital worldview.

Obstacles within group B related to the continuing process of seeking new ways and technologies to support pedagogical goals. However, this was a complicated process for this group, as they claimed that they missed support from colleagues and thus, it took more effort. This was confirmed by their average variety in technology use. Tsybulsky and Levin [11] described similar experiences of teachers who indicated their desire to be more able to use technological solutions to be there for their students, but saw some difficulties engaging with the technology themselves.

The last group of teachers, group C, indicated difficulties that related to technological solutions (external barriers) and teachers’ own attitudes or beliefs (internal barriers) about integrating technology. The latter is consistent with the work of Liu et al. [25], which looks into teacher confidence and comfort using technology in teaching. Although we could expect a change in technology use [23], interestingly, the pressurized situation of the pandemic did not reinforce the teacher disposition to use technology and did not increase their confidence in using technology. As Tsybulsky and Levin [11] noted, changing a set of beliefs or worldview which may help a person’s relationship with technology in the distanced learning environment is a long and gradual process which requiring a comprehensive approach. As seen from the descriptions of group C, having situational pressure is not enough as hesitations about technology and the digital world outweighs any external pressure.

## 5. Conclusions

Through teachers' reflections on teaching during the COVID-19 pandemic, the current study presented several observations and potential bottlenecks in the field of technology adoption by teachers. In addition, through these reflections we were able to take a deeper look at the reasons behind frequency of technology use. We saw that teachers with higher willingness, situated on a more transformative level of technology use, described external obstacles, while teachers with a lower willingness and working at the enhancement level of technology use reported both internal and external obstacles. These internal obstacles included beliefs towards technology, which may go undetected when asking teachers to report their attitudes via a questionnaire. The identification of these obstacles might help us better understand the hesitation in adopting technology for teaching and exploring the possibilities of transforming the learning experiences through technology. However, it is important to note the understanding that teachers with high willingness have different needs for support and training in technology use compared to teachers with relatively low willingness.

### *Limitations and Implications for Further Research*

One limitation of this qualitative study is that the sample used was not representative of the whole population of Estonian science teachers; thus, generalizations are not possible. Another, possibly the most important, limitation (this could also be viewed as a strength) is that similar COVID-19 pandemic conditions will be difficult to repeat as the situation will have lost its novelty for teachers. During our study, teachers did not know what to expect, and, moreover, they did not have any time to prepare for changes in their teaching.

As participation in the study was voluntary, it could be argued that teachers with certain openness towards the topic of the study were more prone to participate. Even though we saw that there was variety in the experiences teachers described in their teaching with technology, it is relevant to be mindful of possible participation bias. Future studies could take this into account, aiming to recruit teachers based on random sampling.

In this study, we did not pay extra attention to the characteristics of the schools in which our participants worked. As mentioned by a few teachers, these characteristics might be connected to possible obstacles and possibilities for the teachers to overcome these (e.g., is the school able to help students with computers).

In terms of future research, it would be useful to extend the current findings by examining schools to identify internal obstacles and their role in teaching during distanced learning. Another interesting future perspective would be to have follow-up interviews with the same teachers in order to explore longitudinal views on their teaching experiences throughout the pandemic.

**Author Contributions:** Conceptualization, L.A. and M.M.; methodology, L.A. and M.M.; validation, L.A. and M.M.; formal analysis, L.A. and M.M.; investigation, L.A. and M.M.; data curation, L.A. and M.M.; writing—original draft preparation, L.A. and M.M.; writing—review and editing, L.A. and M.M.; visualization, L.A. All authors have read and agreed to the published version of the manuscript.

**Funding:** This work was sponsored by the Estonian Research Council (ERC) through the institutional research funding project "Smart technologies and digital literacy in promoting a change of learning" (Grant Agreement No. IUT34-6).

**Institutional Review Board Statement:** The study was conducted according to the guidelines of the Declaration of Helsinki.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** Not applicable.

**Conflicts of Interest:** The authors declare no conflict of interest.

## Appendix A

Semi-structured interview questions applied in the study:

### A. Descriptive questions

1. What does it mean to be a teacher working under distanced learning conditions?
2. What are you doing differently in your teaching compared to the period before the distanced learning?
3. What has been the biggest change in preparing the lessons; in conducting the lessons; and in giving feedback to the students.

### B. Technology use in teaching

1. What role does technology play in your current lessons? How does it differ from before?
2. What kind of technology do you usually apply to your lessons?
3. What are the main goals of using technology in your lessons during distanced learning? Give some examples.
  - a. What are the main obstacles to using technology under distanced learning conditions?
  - b. What is positive about using technology under the conditions of distanced learning?
  - c. Does distanced learning change your attitude to technology?
4. What were the main goals of using technology in your lessons before distanced learning?

### Background

1. Age
2. Years taught
3. Subject(s) taught

## References

1. Scherer, R.; Teo, T. Editorial to the special section—Technology acceptance models: What we know and what we (still) do not know. *Br. J. Educ. Technol.* **2019**, *50*, 2387–2393. [CrossRef]
2. Adov, L.; Pedaste, M.; Leijen, Ä.; Rannikmäe, M. Does it have to be easy, useful, or do we need something else? STEM teachers' attitudes towards mobile device use in teaching. *Technol. Pedagog. Educ.* **2020**, *29*, 511–526. [CrossRef]
3. Van der Spoel, I.; Noroozi, O.; Schuurink, E.; van Ginkel, S. Teachers' online teaching expectations and experiences during the Covid19-pandemic in the Netherlands. *Eur. J. Teach. Educ.* **2020**, *43*, 623–638. [CrossRef]
4. Ajzen, I. From Intentions to Actions: A Theory of Planned Behavior. In *Action Control: From Cognition to Behavior*; Kuhl, J., Beckmann, J., Eds.; Springer: Berlin/Heidelberg, Germany, 1985; pp. 11–39. [CrossRef]
5. Ajzen, I. The theory of planned behaviour: Reactions and reflections. *Psychol. Health* **2011**, *26*, 1113–1127. [CrossRef]
6. Kabakçi-Yurdakul, I.; Ursavas, Ö.F.; Becit-İsçitürk, G. An Integrated Approach for Preservice Teachers' Acceptance and Use of Technology: UTAUT-PST Scale. *J. Educ. Res.* **2014**, 21–36. [CrossRef]
7. Scherer, R.; Siddiq, F.; Teo, T. Becoming more specific: Measuring and modeling teachers' perceived usefulness of ICT in the context of teaching and learning. *Comput. Educ.* **2015**, *88*, 202–214. [CrossRef]
8. Scherer, R.; Siddiq, F.; Tondeur, J. The technology acceptance model (TAM): A meta-analytic structural equation modeling approach to explaining teachers' adoption of digital technology in education. *Comput. Educ.* **2019**, *128*, 13–35. [CrossRef]
9. Scherer, R.; Siddiq, F.; Tondeur, J. All the same or different? Revisiting measures of teachers' technology acceptance. *Comput. Educ.* **2020**, *143*, 103656. [CrossRef]
10. Adov, L.; Pedaste, M.; Leijen, Ä.; Rannikmäe, M. Moving from intention to behaviour: Predicting teachers' mobile device use for teaching. (submitted).
11. Tsybulsky, D.; Levin, I. Science teachers' worldviews in the age of the digital revolution: Structural and content analysis. *Teach. Teach. Educ.* **2019**, *86*, 102921. [CrossRef]
12. Al-Emran, M.; Mezhuyev, V.; Kamaludin, A. Technology Acceptance Model in M-learning context: A systematic review. *Comput. Educ.* **2018**, *125*, 389–412. [CrossRef]
13. Kippers, W.B.; Poortman, C.L.; Schildkamp, K.; Visscher, A.J. Data literacy: What do educators learn and struggle with during a data use intervention? *Stud. Educ. Eval.* **2018**, *56*, 21–31. [CrossRef]
14. Hatlevik, O.E.; Ottestad, G.; Throndsen, I. Predictors of digital competence in 7th grade: A multilevel analysis. *J. Comput. Assist. Learn.* **2014**, *31*, 220–231. [CrossRef]
15. Transformation, Technology, and Education. Available online: <http://hippasus.com/resources/tte/> (accessed on 30 March 2021).
16. Crompton, H.; Burke, D. Mobile learning and pedagogical opportunities: A configurative systematic review of PreK-12 research using the SAMR framework. *Comput. Educ.* **2020**, *156*, 103945. [CrossRef]

17. Wahyuni, S.; Mujiyanto, J.; Dwi, R.; Fitriati, S. Teachers' Technology Integration into English Instructions: SAMR Model. In Proceedings of the International Conference on Science, Education and Technology (ISET 2019), Semarang, Central Java, Indonesia, 29 June 2019. [[CrossRef](#)]
18. Venkatesh, V.; Morris, M.G.; Davis, G.B.; Davis, F.D. User acceptance of information technology: Toward a unified view. *MIS Q.* **2003**, *27*, 425–478. [[CrossRef](#)]
19. Bowman, M.A.; Vongkulluksn, V.W.; Jiang, Z.; Xie, K. Teachers' exposure to professional development and the quality of their instructional technology use: The mediating role of teachers' value and ability beliefs. *J. Res. Technol. Educ.* **2020**, 1–17. [[CrossRef](#)]
20. Karaseva, A.; Pruulmann-Vengerfeldt, P.; Siibak, A. Relationships between in-service teacher achievement motivation and use of educational technology: Case study with Latvian and Estonian teachers. *Technol. Pedagog. Inf.* **2018**, *27*, 33–47. [[CrossRef](#)]
21. Tondeur, J.; Roblin, N.P.; van Braak, J.; Voogt, J.; Prestridge, S. Preparing beginning teachers for technology integration in education: Ready for take-off? *Technol. Pedagog. Educ.* **2017**, *26*, 157–177. [[CrossRef](#)]
22. Williams, E.N.; Morrow, S.L. Achieving trustworthiness in qualitative research: A pan-paradigmatic perspective. *Psychother. Res.* **2009**, *19*, 576–582. [[CrossRef](#)] [[PubMed](#)]
23. Shin, W.S.; Han, I.; Kim, I. Teachers' Technology Use and the Change of Their Pedagogical Beliefs in Korean Educational Context. *Int. Educ. Stud.* **2014**, *7*, 11–22. [[CrossRef](#)]
24. Harrell, S.; Bynum, Y. Factors Affecting Technology Integration in the Classroom. *Educ. Manag. Adm. Leadersh.* **2018**, *5*, 12–18.
25. Liu, F.; Ritzhaupt, A.D.; Dawson, K.; Barron, A.E. Explaining technology integration in K-12 classrooms: A multilevel path analysis model. *Educ. Technol. Res. Dev.* **2017**, *65*, 795–813. [[CrossRef](#)]





Article

# Parental Involvement during Pandemic Times: Challenges and Opportunities

Luísa Mota Ribeiro <sup>1,\*</sup>, Rosário Serrão Cunha <sup>1</sup>, Maria Conceição Andrade e Silva <sup>2</sup>, Marisa Carvalho <sup>1</sup> and Maria Luísa Vital <sup>3</sup>

<sup>1</sup> Research Centre for Human Development, Faculty of Education and Psychology, Universidade Católica Portuguesa, 4169-005 Porto, Portugal; rscunha@porto.ucp.pt (R.S.C.); mscarvalho@porto.ucp.pt (M.C.)

<sup>2</sup> CEGE—Católica Porto Business School, Universidade Católica Portuguesa, 4169-005 Porto, Portugal; csilva@porto.ucp.pt

<sup>3</sup> LeYa Educação, 4410-083 Vila Nova de Gaia, Portugal; mvital@leya.com

\* Correspondence: lmribeiro@ucp.pt

**Abstract:** Due to COVID-19, many countries implemented emergency plans, such as lockdown and school closures. This new situation has significantly affected families, namely, the involvement required to support children's learning at home. The current study aimed to analyze Portuguese parents' perceptions of their home-based parental involvement in their children's learning during the lockdown and school closures in 2020 due to COVID-19. An online survey, using a closed-ended questionnaire, was employed. Variables included parents' sociodemographic and COVID-19 related characteristics; students' sociodemographic characteristics; distance learning context; parental involvement; and students' autonomy. Data were collected from a sample of 21,333 parents with children from elementary school to secondary education, and statistical data analysis was performed using IBM SPSS Statistics 26. Findings revealed that Portuguese parents supported their children during the pandemic mainly through the monitoring of attention in classes and task realization. However, several variables appear to significantly determine parental involvement time, which is higher when students attend public schools, when they are less autonomous and younger, when parents' level of education is lower, when the child is a boy (except in secondary education where gender is not relevant), and when the online school time is higher. Findings highlight the need for a significant investment of time from parents, particularly of primary school children, making it difficult to cohere work or telework with school activities. Implications for policies, schools, families are discussed in order to promote children's learning and success.

**Keywords:** parental involvement; children's learning; COVID-19; online learning

**Citation:** Ribeiro, L.M.; Cunha, R.S.; Silva, M.C.A.e.; Carvalho, M.; Vital, M.L. Parental Involvement during Pandemic Times: Challenges and Opportunities. *Educ. Sci.* **2021**, *11*, 302. <https://doi.org/10.3390/educsci11060302>

Academic Editors: Garry Hornby and Palitha Edirisingha

Received: 31 March 2021

Accepted: 25 May 2021

Published: 18 June 2021

**Publisher's Note:** MDPI stays neutral with regard to jurisdictional claims in published maps and institutional affiliations.



**Copyright:** © 2021 by the authors. Licensee MDPI, Basel, Switzerland. This article is an open access article distributed under the terms and conditions of the Creative Commons Attribution (CC BY) license (<https://creativecommons.org/licenses/by/4.0/>).

## 1. Introduction

With the spread of COVID-19, countries implemented emergency plans to slow down and limit the virus's transmission such as the closure of schools, either nationwide, regionally, or in a targeted way [1,2]. Some schools and universities were temporarily closed for face-to-face educational activities [3]. In Portugal, all schools were closed at a national level during the pandemic's first wave between March and May 2020. In May 2020, some schools provided face-to-face educational activities for secondary students (the last two years of secondary school with final national exams). In September 2020, after the summer holidays, all schools and educational levels re-opened in the country. The interruption of school activities may have affected students, both academically and psychologically. The psychological effects of home schooling and social isolation on the mental health and wellbeing of students, teachers, and families in this pandemic phase are an issue to consider [3,4]. School learning interruption may have contributed to students' significant academic losses, mostly for those students already at a previous disadvantage [4].

Specific educational measures were implemented to mitigate these learning losses, and different forms of online education and educational resources were mobilized to assure teaching and learning continuity. Consequently, during the pandemic, requirements for digital technology intensified significantly, despite the challenges that this intensification meant for teachers, families, and students to ensure the continuity of learning from home. As most schools and teachers were not used to online teaching, an immediate change was challenging [1,3,5]. Even with the availability of technological resources, both teachers' qualifications and school practices for using digital devices effectively needed to improve [2]. Other difficulties were identified, such as students' lack of access to technology and the internet, alternate modes for academic activity supplies such as additional tasks and excessive homework, and limited opportunities for more in-depth explanations from teachers when required [3,5]. Online schooling, therefore, resulted in higher levels of stress for students and families [3].

When schools were closed, companies and institutions had to introduce remote work, which led families into new routines and interaction patterns [6]. This new situation has significantly affected families' work-family balance, parental support, and school-family modes of collaboration. Necessarily, this imposed changes that affected the entire community of Portuguese parents, students, and schools; and shaped parents' role in their children's education and learning during this time, in a form never previously experienced.

#### *Study Objectives and Research Questions*

Acknowledging the relevance of parental involvement and simultaneously considering the specific challenges for parents supporting their children at home during the lockdown, this moment in time may have created new challenges for home-based parental involvement, or intensified existing ones. Following Lu [7], the COVID-19 pandemic can open the way for improvements in education, such as the support and promotion of parental involvement. Hence, understanding parents' perspectives is key during these unprecedented times.

The purpose of this paper is to report Portuguese parents' perceptions of their home-based parental involvement in their children's learning and school life during the lockdown and school closures (March to July 2020). The results reported in this paper are part of a broader study where other objectives were also considered (e.g., understanding the perception of parents regarding teachers or the school mission and understanding the main tools that were being used in home-based learning).

Our research questions, focused on the lockdown period, were:

RQ1: How did parents support student's learning during the pandemic at each level of education? Is this involvement similar for private and public schools?

RQ2: How are parents' involvement and students' autonomy related per level of education?

RQ3: Are the determinants of parent's involvement the same at each level of education?

## **2. Literature Review**

### *2.1. Parental Involvement*

Existing research has called attention to parental involvement's relevant role in children's schooling and success [8–11]. Parental involvement is a complex construct that has been defined in several ways (e.g., [9,10,12,13]). Recently, Antipkina and Ludlow [10] proposed a holistic concept of parental involvement: a "continuum of parenting behaviours ranging from those representing lower levels of involvement to those representing higher levels of involvement" (p. 856). In his meta-synthesis, Wilder [14] found the following parental involvement definitions used in different articles: parent-child communication about school; home-supervision; checking homework; homework assistance; education expectations and aspirations; attendance and participation in school activities; reading with children; communication with schools; parenting style; and parental attitudes toward education. Parental homework involvement, for instance, is a commonly found opera-

tionalization of parental involvement, which can be seen as a form of quantitative help (e.g., doing homework, helping with questions) or qualitative help (e.g., organizing the tasks, helping with the creation of a no-distraction environment, supporting the search for answers) [8].

Often in the literature, studies of parental involvement are focused on involvement at home (home-based involvement, meaning parents' behavior towards school life and practicing activities related to school learning with their children at home, such as parents helping their children with homework, parents discussing schooling with their children, parental monitoring of school tasks and rule-setting), involvement with the school (school-based involvement related to parents' various forms of participation in the schools' activities), or acknowledge both places for the analysis of involvement behaviors and activities (home-school communication, such as parents interacting with teachers) [15,16]. Some studies also establish a difference between *school-initiated parental involvement* and *parent-initiated involvement* [17].

For several years now, the literature has emphasized the relevance of different variables in mediating the level of parental involvement, from parental/family characteristics to student variables, and school characteristics. Some examples of parental/family variables that are associated with parental involvement include [18]: sociodemographic factors (e.g., more education seems to relate to higher levels of involvement at school; being a father or mother has mixed results in the literature—some studies show non-significant influence of students' level of education [19], others mention that mothers show higher levels of involvement [20]); parents' perceptions of their child's academic competency and need for their support (perception of lower learning autonomy usually increases the frequency of parents' involvement); and parents' time to support (having more work demands or family responsibilities, such as more children, is negatively associated with involvement). As for students' characteristics, their age is one variable which influences parental involvement [21], mostly because it tends to decrease from primary to middle school and even more during secondary school, mostly related to parents' perceptions that their involvement is less necessary/less welcomed by their adolescents and lower parental self-efficacy on the learning topics during high school; parental perceptions of their child's needs/efficacy in different subjects mediates their involvement [18]. Schools' actions to promote parental involvement are considered one of the main predictors of parental involvement: when parents consider that schools are promoting their involvement, parental involvement is generally higher [18] and there appears to be higher parental involvement in private schools than in public schools [22].

## 2.2. Parental Home-Based Involvement during the Pandemic

Considering the COVID-19 pandemic and the changes it brought to students' learning, parental home-based involvement was particularly crucial. Parents' role in supervising their children's learning was reinforced, mostly through accompanying their children's study and developing self-regulation strategies related to online learning [23].

Several barriers to distance and home-learning have been identified from parents' perspectives [24–27], such as personal barriers, technical barriers, logistical barriers, and financial barriers. Personal barriers included low technical expertise to support their children in accessing online learning and the materials/tools used in this environment. Technical barriers were mainly related to the lack of adequate internet access or technology to follow learning activities properly. Logistical barriers were related to the perception that online learning did not meet pupils' individual needs/learning rhythm, and parents also found that it was not an effective substitute for face-to-face learning process. As for financial barriers, these are highly related to the logistical ones (not being able to afford better technological tools and internet access).

Spinelli and colleagues [28] showed that more *stressed* parents were less involved in their children's learning activities during the pandemic. Dong and colleagues [25] reported

that the majority of parents felt the need to be present with their children during online learning activities at least once per day.

Even though hurdles did exist, parental involvement in children's learning may also have increased during lockdown home learning [29]. The literature highlighted how parents of children of all ages, from primary to secondary pupils, felt closer to their children's learning by acknowledging a more in-depth insight into their learning and that created opportunity to contribute more to their learning [30]. Additionally, most parents, mainly of younger pupils, found that the home-learning situation improved parent-teacher relationships, augmenting parents' appreciation for teachers and this perception was shared by the teachers [30].

### 3. Materials and Methods

#### 3.1. Instruments and Measures

The current study employed an online survey using a closed-ended questionnaire developed by the researchers and administrated through Google Forms from the 1st of June 2020 to the 13th of July 2020, sent to a national sample of parents. Variables included in this study were organized into several groups: parents' sociodemographic and COVID-19 related characteristics; students' sociodemographic characteristics; distance learning context; parental involvement; and students' autonomy. Variables are described in Table 1.

**Table 1.** Description of the main variables of the study.

Variables	Measures
Parents' sociodemographic and COVID-19 related characteristics	Age
	Gender
	Educational level (from without studies to having PhD)
	Number of children
	Contact with COVID-19 in the family
	Having technologies that allow all members of the household to work simultaneously <i>What have been your major difficulties when accompanying the school tasks of your child?</i> (closed answers)
Students' sociodemographic characteristics	Age
	Gender
	School year (from 1st to 12th) Type of school (public or private)
Distance learning context	Having online classes Average number of hours in online classes per day Having online classes for all subjects
	<i>Select the predominant form through which you have been supporting the study of your child:</i> Supporting task realization Monitoring child attention in the classes and school tasks realization Ensuring that deadlines are accomplished Autonomous child I cannot help Other
Parental involvement	<i>On average how much time per day have you supported your child in school activities?</i> No time Less than 30 min 30 min 1 h 2 h More than 2 h
	<i>Do you consider your child autonomous in the realization of school tasks?</i> Not autonomous at all Little autonomy Moderate autonomy Very autonomous Totally autonomous
	<i>How does your child usually perform school tasks?</i> Frequently needs the presence of an adult Takes the initiative and does the tasks alone, but expects the final supervision of an adult Performs tasks alone Other

COVID-19 related characteristics were selected from the broader study referred to in the purpose of the study, and were aimed at describing some dimensions related to

the pandemic situation: contact with COVID-19 in the family; adequate technologies; difficulties in accompanying the school tasks in the context of online learning.

It is important to mention that there are different instruments in the literature to collect data on parental involvement, including home-based parental involvement, school-based parental involvement, and home-school communication [14]. However, the circumstances of the data collection for this study demanded a more focused questionnaire, adjusted to the specific behaviors and activities of parental involvement during the COVID-19 lockdown of schools. For instance, activities relevant to “regular” parental involvement such as parents attending school meetings or going to museums with children were not possible during this time. For this reason, these specific items were excluded. Other items were included to explore home-based parental involvement, such as parents supporting children’s study behaviors or time spent on supporting children’s school activities. Monitoring child attention in the classes and school task realization is an example of an item that was prepared specifically for this pandemic time, since this kind of monitoring is usually done by teachers in the classroom. Ensuring that deadlines are accomplished turned out to be a relevant item in a time characterized by a significant number of assignments and school tasks with different and challenging deadlines to accomplish. Thus, the items developed for this study are derived from the literature review and also from the previous work of the authors in the field of educational intervention, with intense interaction between school contexts, teachers, students and parents (before COVID-19 and during pandemic). Since there was a lack of adequate instruments to measure parental engagement in pandemic times, we have chosen to use different forms of measuring the same variable so that we could have a more complete picture of the phenomenon and could inter-relate the variables.

Parental involvement was also operationalized through the amount of time dedicated by parents to supporting children’s school activities, as seen in the literature in this domain.

Student’s autonomy was operationalized through the perceived degree of children’s autonomy, on a 5-point Likert scale. However, we have chosen to measure the involvement of parents in task realization as an additional indicator of autonomy, since this variable relates to parents’ reported behavior and the other relates to a more abstract perception of autonomy.

### 3.2. Participants and Sample Sociodemographic Characteristics

Data were collected from a sample of 21,333 parents (89% mothers and 11% fathers), with children in various stages of schooling, from the 1st level of basic education (primary school) to secondary education. The first level of education includes children from 6 to 10 years old, the second level of education from 10 to 12 years old, the third level of education from 12 to 15 years old, and the secondary from 15 to 18 years old.

The distribution of responses through each level of schooling, the respective average age of students, and the % of girls is shown in Table 2.

This distribution implies that the 1st level of education is the best represented in our sample, with 50.4% of the parents having children in this level of education. 22.2% of parents had children in the 2nd level of education, 20% in the 3rd level of education, and 7.4% in the secondary. In total, 48.8% of the students were girls, 92.6% of the students were enrolled in public schools and 7.4% in private schools. The percentage of students in private education in our sample is lower than the actual percentage in the population (according to Pordata ([www.pordata.pt](http://www.pordata.pt), (accessed on 15 June 2021)), in 2019 the % of students attending private schools in Portugal was 12.5% in the 1st, 2nd and 3rd levels of education, and 21.2% in the secondary).

**Table 2.** Distribution of students per level of education, average age, and gender.

Level	Year	N	%	Avg. Age Students	% Girls
1st level	1 <sup>o</sup> year	2413	11.3%	6.55	47.9%
	2 <sup>o</sup> year	2705	12.7%	7.58	51.3%
	3 <sup>o</sup> year	2906	13.6%	8.60	55.1%
	4 <sup>o</sup> year	2726	12.8%	9.55	52.2%
2nd level	5 <sup>o</sup> year	2576	12.1%	10.56	48.0%
	6 <sup>o</sup> year	2145	10.1%	11.58	48.6%
	7 <sup>o</sup> year	1748	8.2%	12.59	49.5%
3rd level	8 <sup>o</sup> year	1453	6.8%	13.57	47.7%
	9 <sup>o</sup> year	1075	5.0%	14.60	48.2%
	10 <sup>o</sup> year	708	3.3%	15.56	48.8%
secondary	11 <sup>o</sup> year	494	2.3%	16.62	47.2%
	12 <sup>o</sup> year	384	1.8%	17.56	52.0%
	Total	21,333	100.0%		

In total, 32.7% of the sampled parents reported they have a bachelor's degree and 13.2% reported having a level of education higher than a bachelor's degree. This implies that our sample is constituted of highly educated parents. According to Pordata ([www.pordata.pt](http://www.pordata.pt), accessed on 15 June 2021), the proportion of people between 15 and 64 years of age that have a bachelor's or higher education level is 27% of the Portuguese population. In our case, in spite of the different range of ages, that percentage was 47.1%, clearly above population values. This implies that our sample, despite its size, is not completely representative of the education level of parents in Portugal (however, for other variables the sampled percentages are similar to population percentages).

In total, 89.6% of the parents were between 31 and 50 years old and they were distributed throughout the country in a representative way (e.g., 30% of parents were from the central region, 25% from the north, 10% from the Lisbon metropolitan area, 5% were from Madeira, and 5% were from Azores). A total of 43.5% of parents have one child, 47.5% have two children, and 9% have three or more children. Most of the confined parents did not have any contact with COVID-19 in their families (99.1% reported 0 cases). This is explained by the fact that the first wave in Portugal was quickly contained, and the pandemic was clearly under control, contrary to what happened in the second wave that started around October 2020.

A total of 67.6% of parents reported having technologies that allow all members of the household to work simultaneously. When we cross this variable with the parents' educational level, we realize that this percentage was higher in families where the parents have a higher level of education. This implies that the national reality regarding the existence of technologies may be over-estimated in this sample.

### 3.3. Procedures

Responses from parents were collected from the 1st of June 2020 to the 13th of July 2020 through a Google Forms questionnaire. In cases with multiple children, parents were asked to focus on one child only.

Questionnaires were administered through contact with diverse schools across the country and parents' associations. Respondents were recruited through an email list of Leya Education (a group of the editorial company Leya that has very close contacts with school stakeholders, in particular CONFAP—the National Confederation of Parents' Associations—had an important role in helping spreading the questionnaire via email through registered parents all over the country). Respondents had no incentive for their participation.

The current study followed the recommendations from the ethics committee of the Universidade Católica Portuguesa. All parents participated voluntarily and gave informed



consent to participate in the research, in accordance with the Declaration of Helsinki. Participants were informed about the aims of the research, and confidentiality and anonymity were assured.

#### 3.4. Data Analysis

The analysis of the data was performed using IBM SPSS Statistics 26. We employed various statistical techniques from descriptive analysis to inferential statistics. Various tests were performed on the data and their selection related to the types of data at hand. For the overall analysis of the full list of determinants of parental involvement, an ordinal regression analysis was chosen. The need for an ordinal regression was related to the nature of the dependent variable—time of involvement—that is a categorical variable, since we have categories for involvement time but not the exact amount of time spent by parents in supporting their children. Note that for ease of analysis and presentation of results, in some parts of this paper we compute averages for this variable; therefore, treating it as continuous. We will signal throughout the paper where and how this practice was undertaken.

### 4. Results

#### 4.1. Descriptive Data

Some descriptive data for the full sample of participants are shown next.

##### 4.1.1. Parental Involvement

Regarding the predominant form of parental involvement, the possible answers and the respective percentages in each category are shown in Table 3, where 3.4% of parents indicated that they are unable to support their children, 36.5% monitored child attention in the classes and school task realization and 23.8% provided support in the realization of school tasks.

**Table 3.** Descriptive data for predominant form of parental involvement.

	N	%
Monitoring child attention in the classes and school tasks realization	7780	36.5
Supporting task realization	5077	23.8
Ensuring that deadlines are accomplished	4804	22.5
Autonomous child	2661	12.5
I cannot help	730	3.4
No answer	281	1.3
Total	21,333	100.0

Concerning parental involvement time, 66.9% of parents spent 1 or more hours per day supporting their student's learning (Table 4).

**Table 4.** Descriptive data for parental involvement time.

	N	%
No time	1780	8.3
Less than 30 min.	2673	12.5
30 min	2615	12.3
1 h	4626	21.7
2 h	3781	17.7
More than 2 h	5858	27.5
Total	21,333	100.0

If we convert this variable to continuous (considering the value 0.25 for less than 30 min and the value 3 for more than 2 h) we can observe that on average parents spent 1.5 h per day supporting their child's school activities. The scale used asks for the actual

time in some alternatives (“1 h”, “2 h”, etc.) but also asks for time intervals in others (“Less than 30 min”, “More than 2 h”). In one case or the other, parents’ answers were just an approximation of the exact time that is generally unknown, and therefore the approximation to a continuous variable provides an alternative way of analysis.

It is interesting to verify that the time of involvement seems to be directly related to the form of involvement (Table 5). In fact, the forms of parental involvement that represent more temporal intensity are the support in task realization, and the monitoring of child attention in the classes and school tasks realization. When the child is seen as autonomous or the parent cannot help, the average time of involvement is less than one hour.

**Table 5.** Relationship between parental involvement form and parental involvement time.

Forms of Parental Involvement	N	Average Parental Involvement Time
Supporting task realization	5077	1.95
Monitoring child attention in the classes and school tasks realization	7780	1.75
Ensuring that deadlines are accomplished	4804	1.36
Autonomous child	2661	0.36
I cannot help	730	0.46

A qui-square test between the two variables (forms of parental involvement and the time of involvement, considered as categorical) results in a statistically significant relationship between the two variables (Pearson qui-square of 9084.95 and *p*-value of 0.000) and a phi value of 0.635.

Regarding parental involvement difficulties during the pandemic (Table 6), the predominant difficulty was conciliation between supporting the student’s school activities and telework (24.4%). Tiredness and mental disposition was the second most chosen option, with 20.3% of parents providing this answer.

**Table 6.** Descriptive data for parental involvement difficulties.

	N	%
Conciliating with telework	5204	24.4%
Tiredness and mental disposition	4327	20.3%
Time to conciliate with all tasks	3434	16.1%
Lack of knowledge about the contents	2776	13.0%
My child is autonomous	2326	10.9%
Conciliating the needs of various children	1843	8.6%
Little appetite for technology	239	1.1%
Missing/other	1184	5.6%
Total	21,333	

#### 4.1.2. Distance Learning Context

A total of 89.1% of parents reported that their children took online classes, and in the majority of cases these classes were for all subjects (only in 15% of the cases was some absence of classes reported, mainly in subjects related to arts or physical activity). This percentage was around 88% in the 1st level of education, but it was 91% in secondary. So, in general, distance learning was a reality for a great percentage of Portuguese students in this sample. Regarding the time that children spent on online classes (see Table 7), most students spent between 2 and 6 h per day in online classes.

**Table 7.** Time of online classes and parental involvement time.

Online Classes Time	N	%	% Public Schools
Less than 0.5 h	173	0.8%	93.1%
Between 0.5 and 2 h	1445	6.8%	97.6%
Between 2 and 4 h	11,154	52.3%	94.2%
Between 4 and 6 h	6385	29.9%	89.8%
More than 6 h	2073	9.7%	89.0%
Missing	103	0.5%	

Note that the proportion of public schools in each interval of online classes' time decreased, meaning that in general students from private schools tended to have a higher number of online classes.

#### 4.1.3. Student's Autonomy

Regarding the perception of the child's autonomy, 36.9% of the parents reported that their children were very autonomous or totally autonomous (Table 8).

**Table 8.** Descriptive data for the perception of the child's autonomy.

	N	%
Not autonomous at all	1013	4.7
Little autonomy	4032	18.9
Moderate autonomy	8417	39.5
Very autonomous	5088	23.9
Totally autonomous	2783	13.0
Total	21,333	100.0

Concerning school tasks and how the student usually performed them, in 41.4% of the cases the student frequently needed the presence of an adult (Table 9).

**Table 9.** Descriptive data for how the child performs school tasks.

	N	%
Frequently needs the presence of an adult	8834	41.4%
Takes the initiative and does the tasks alone, but expects the final supervision of an adult	6874	32.2%
Performs tasks alone	5431	25.5%
Other/missing	194	0.91%
Total	21,333	

#### 4.2. Inferential analysis

RQ1: How did parents support student's learning during the pandemic in each level of education? Is this involvement similar for private and public schools?

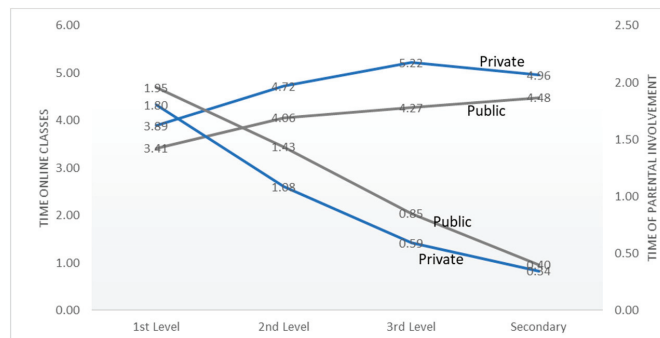
As seen in the previous section, the most prevalent form of parents' involvement in the full sample was monitoring the child's attention in the classes and school tasks realization, followed by supporting task realization. The involvement of the parents is, however, largely dependent on the age of the children and on the level of education. Dividing the involvement variable per level of education, we have the following data (Table 10).

**Table 10.** Level of education of studies and involvement form.

	Support in Task Realization	Monitoring Attention in Classes and Tasks Realization	Ensuring That Deadlines Are Accomplished	Autonomous Child	Cannot Help	N	Avg Parental Involvement Time	Avg Online Classes Time
1st level	33.2%	43.2%	19.1%	1.7%	2.7%	10,626	1.94	3.45
2nd level	20.5%	36.5%	30.8%	8.6%	3.6%	4664	1.41	4.10
3rd level	12.5%	29.1%	27.2%	26.5%	4.7%	4206	0.84	4.32
Secondary	4.2%	17.0%	12.3%	61.7%	4.8%	1556	0.39	4.53

In the first level of education the prevalent form is the monitoring of attention in classes and tasks realization, but the support in the actual realization of tasks was also very prevalent. In the second and third levels of education the prevalent forms were the monitoring of attention in classes and tasks realization, and ensuring deadlines were accomplished, and in secondary education students were mostly autonomous.

The average time of parental involvement decreased and the average time of online classes increased from the first level of education to the secondary, as can be seen in the last two columns of Table 10. In these columns, we used continuous scales for parental involvement time, as explained before, and also for the time of online classes (obtained by using the value of the center of the intervals in Table 7 as an estimate of the online class time to convert it into a continuous scale). In Figure 1 we show the values in the last two columns of Table 10 disaggregated per school type.



**Figure 1.** Time of online classes and parental involvement time per level and type of school.

The involvement of the parents and the online classes’ time is also related to the type of school attended, with public schools’ parents spending more time supporting their children than private schools’ parents, and with private schools providing more online classes time in all levels of education. The higher time spent in online classes in private schools may be an explanatory factor for the lower parental involvement in this type of school. The differences observed in the graph (for the two time variables) are statistically significant as concluded from an ANOVA test for two factors.

In conclusion, we can say that Portuguese parents supported their children during the pandemic mainly through the monitoring of attention in classes and task realization, except for the secondary schools where students are predominantly autonomous. In the first level of education, parents’ involvement frequently implied their support in the actual realization of the school tasks; whereas in the second and third levels, parents tended to pay more attention to the accomplishment of deadlines. The parents’ involvement time is higher when students attend public schools and in public schools the time of online classes is on average lower than in private schools.

RQ2: How are parents’ involvement and students’ autonomy related per level of education? Are involvement and autonomy similar for private and public schools?

This research question is the first step towards deciding which of the two variables that capture the autonomy of the students is better for the analysis.

First, it is important to note that there is a certain mismatch between the two questions on autonomy (the perception of student’s autonomy and how students perform tasks). Figure 2 shows the percentage of students in each category.

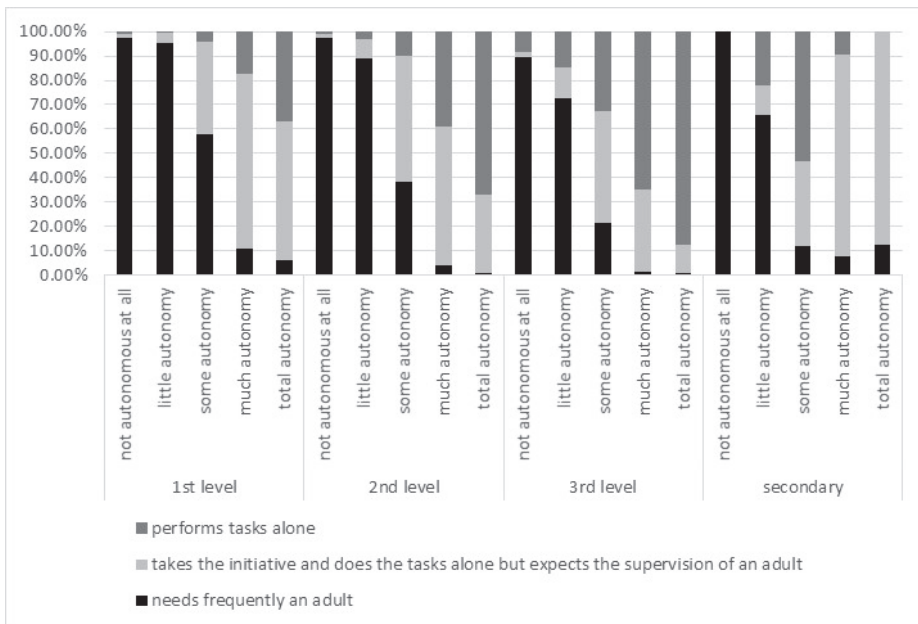


Figure 2. Percentage of students in each category when cross comparing the two autonomy variables.

If the variables ‘student autonomy’ and ‘how students perform tasks’ were in full agreement, one would expect, within each level of education, a reduction in the black columns’ (frequently needs an adult) percentages when the perception of autonomy increases. On the other hand, one would expect the dark grey column (performs tasks alone) to be the maximum for the level of perception of ‘total autonomy’. While the former indeed happens, the latter does not happen for all levels of education. Indeed, secondary education students perceived as totally autonomous by their parents are also perceived as still needing the supervision of an adult. Only in the third level of education does the dark grey column dominate the total autonomy category.

There is therefore some misconception between the perception of autonomy and the way tasks are performed. Given this misconception we have chosen to use the involvement of parents in the task realization as an indicator of autonomy, since this variable relates to parents’ actual behavior and the other relates to a more subjective perception of autonomy.

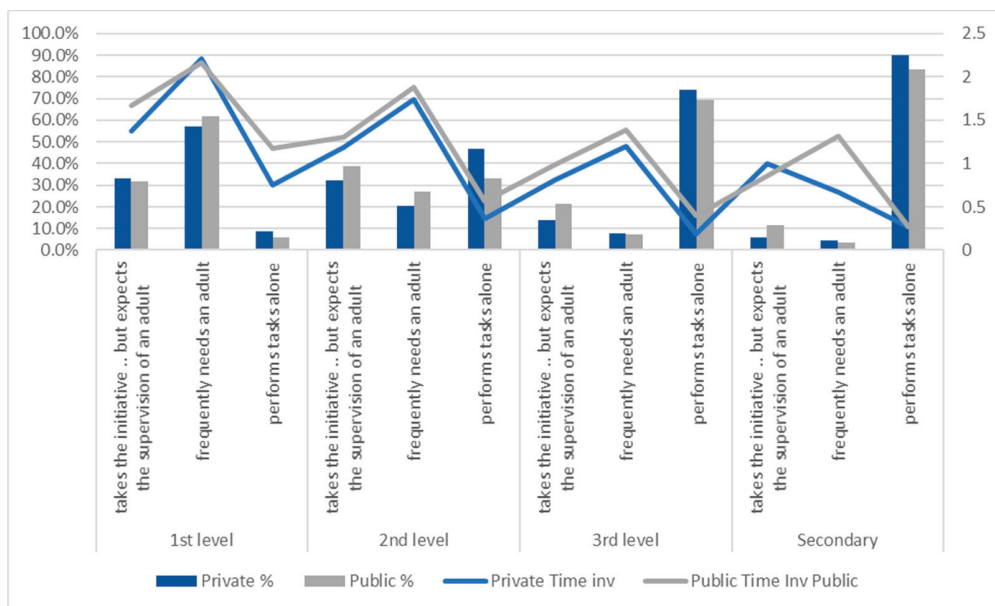
Using the variable of how school tasks are performed as a surrogate for the autonomy of the children, and crossing this variable with the parents’ involvement time, we have the following (Table 11).

**Table 11.** Autonomy versus parents’ involvement time.

		N	Involvement Time
1st level	Frequently needs an adult	6601	2.17
	Takes the initiative but expects the supervision of an adult	3439	1.65
	Performs tasks alone	647	1.15
2nd level	Frequently needs an adult	1610	1.95
	Takes the initiative but expects the supervision of an adult	2009	1.37
	Performs tasks alone	1060	0.68
3rd level	Frequently needs an adult	564	1.63
	Takes the initiative but expects the supervision of an adult	1253	1.16
	Performs tasks alone	2390	0.49
Secondary	Frequently needs an adult	59	1.26
	Takes the initiative but expects the supervision of an adult	173	0.89
	Performs tasks alone	1334	0.29

In the first level of education, parents spend more than 2.17 h on average supporting their children when they are less autonomous. In the secondary, less autonomous students require on average 1.22 h per day of parents’ time, while more autonomous students require just 0.29 h.

Figure 3 shows the above values taking into account the type of school.



**Figure 3.** Autonomy and involvement time per level of education and per type of school.

In the columns, we see the percentage of students in each of the groups of autonomy, in each level of education, and each school type. Interestingly, more autonomous students dominate in private schools in all levels of education. In terms of parental involvement time, it is always larger in public than in private schools and decreasing with the degree of autonomy of the student, as expected. Only in secondary education does it appear that more autonomous students from private schools require a larger involvement time from their parents, but this finding should not be highlighted since the sample size for private

schools in secondary education is small. Note that the level of education, the type of school and the student autonomy are all considered statistically significant in explaining parental involvement (a generalized linear model showed the significance of all factors).

In conclusion, we can say that the autonomy of the student is related to parents' involvement, with more autonomous students requiring a lower amount of parental involvement time—at each level of education we found that more autonomous students required at least one hour less of parental involvement, on average. From the first level of education to secondary, the expected reduction in parental involvement time in all classes of autonomy is less than 1 h, meaning that although significantly different, the time of parental involvement is not, in absolute terms, much reduced over all the levels of education.

Regarding public and private schools, it appears clear that parents of students from private schools report a higher autonomy for their children, and therefore the time of involvement is generally higher for public school students in all classes of autonomy (with the exception of the secondary schools). This may be related to the amount of online schooling, which tended to be higher in private schools.

RQ3: Are the determinants of parent's involvement the same in each level of education?

Taking the variable of parents' involvement time as the proxy variable for parents' involvement, we ran a regression model to explain involvement time through the set of variables discussed above, including the socio-demographic characteristics of students and their parents. An ordinal regression was performed for each level of education given the previous findings that the level of education of studies is a determinant in explaining the time of parental involvement, and therefore the determinants of this involvement may differ per level.

The results from Table 12 indicate that many variables are consistently relevant in explaining parents' involvement, in all levels of education. The main conclusions that can be inferred from the analysis of Table 12 are as follows.

Parents involvement time tended to increase when the parent is the mother and all else is constant; it tended to decrease when the level of education of the parent increased (meaning that more educated parents on average have less time of involvement with their children); students attending public schools tended to require more involvement time from their parents than students from private schools; girls tended to require less involvement time than boys; the number of children in the household has a negative effect on the individual involvement time with a specific child; children who are less autonomous (frequently need an adult or can take their own initiative but then wait for supervision) require more involvement time from parents than autonomous children; and the involvement time varies positively with school activities' time. That is, with all else constant, parental involvement time was always lower for students with fewer than 6 h of school activities than for students with more than 6 h of school activities (the base case for the nominal variable school time). This seems to suggest that the more school time, the more involvement is required from parents (probably in helping their children with homework and online classes follow up). Note that this happens within each level of education, although as seen previously, as the level of education increased the mean school time increased and mean parental involvement time decreased.

Regarding factors that are only relevant to some level of education, it is interesting to note that the number of children is a relevant factor only for parents whose children are in the first level of education, since after that level of education this variable loses its statistical significance. The gender of the parent is only relevant in the first and second levels, suggesting that in these levels of education respondent women tended to report more involvement time than men, but afterwards the difference between genders is not statistically significant (note however, that the small number of male respondents may bias our results). In secondary education, probably due to a reduced sample size, many variables lose their statistically significant status. The type of school is not a factor in determining parents' involvement in secondary education, nor the gender of the student.



In addition, there is no difference in parents' involvement when school online time lies between 4 and 6 h or more than 6 h.

**Table 12.** Coefficients for the Ordinal Regression per level of education (non-significant values in bold).

		Estimate	Sd.Error	Wald	Sig.
1° level Pseudo R <sup>2</sup> 0.264	Sex of parent (1 women)	0.280	0.059	22.180	0.000
	Parents' education (years)	−0.071	0.007	116.950	0.000
	Type of school (1 public)	0.495	0.068	53.520	0.000
	Sex of student (1 girls)	−0.141	0.037	14.620	0.000
	Student age (years)	−0.284	0.015	338.422	0.000
	N of children	−0.093	0.027	12.238	0.000
	Needs adult	2.043	0.078	685.080	0.000
	Own initiative + supervision	1.052	0.079	179.361	0.000
	SchoolTime ≤ 0.5 h	−4.892	0.231	447.000	0.000
	0.5 h ≤ SchoolTime ≤ 2 h	−3.432	0.129	710.067	0.000
	2 h ≤ SchoolTime ≤ 4 h	−1.802	0.114	251.202	0.000
	4 h ≤ SchoolTime ≤ 6 h	−0.660	0.118	31.255	0.000
	Sex of parent (1 women)	0.265	0.083	10.118	0.001
	Parents' education (years)	−0.069	0.009	57.575	0.000
2° level Pseudo R <sup>2</sup> 0.293	Type of school (1 public)	0.549	0.109	25.378	0.000
	Sex of student (1 girls)	−0.197	0.054	13.076	0.000
	Student age (years)	−0.070	0.032	4.762	0.029
	N of children	−0.002	0.038	0.003	0.955
	Needs adult	2.731	0.082	1100.910	0.000
	Own initiative + supervision	1.663	0.073	513.688	0.000
	SchoolTime ≤ 0.5 h	−2.822	0.348	65.691	0.000
	0.5 h ≤ SchoolTime ≤ 2 h	−2.052	0.145	200.747	0.000
	2 h ≤ SchoolTime ≤ 4 h	−1.219	0.094	169.877	0.000
	4 h ≤ SchoolTime ≤ 6 h	−0.697	0.093	55.795	0.000
	Sex of parent (1 women)	0.031	0.086	0.127	0.722
	Parents' education (years)	−0.049	0.009	27.774	0.000
	Type of school (1 public)	0.563	0.126	20.007	0.000
	Sex of student (1 girls)	−0.259	0.057	20.735	0.000
3° level Pseudo R <sup>2</sup> 0.276	Student age (years)	−0.115	0.026	19.176	0.000
	N of children	0.048	0.039	1.464	0.226
	Needs adult	2.529	0.093	732.286	0.000
	Own initiative + supervision	1.681	0.068	612.934	0.000
	SchoolTime ≤ 0.5 h	−1.982	0.343	33.450	0.000
	0.5 h ≤ SchoolTime ≤ 2 h	−1.043	0.154	45.822	0.000
	2 h ≤ SchoolTime ≤ 4 h	−0.675	0.081	68.684	0.000
	4 h ≤ SchoolTime ≤ 6 h	−0.241	0.081	8.800	0.003
	Sex of parent (1 women)	−0.257	0.146	3.099	0.078
	Parents' education (years)	−0.042	0.017	6.451	0.011
	Type of school (1 public)	0.301	0.174	2.974	0.085
	Sex of student (1 girls)	−0.087	0.100	0.766	0.381
	Student age (years)	−0.150	0.041	13.234	0.000
	Secondary Pseudo R <sup>2</sup> 0.168	N of children	0.084	0.066	1.656
Needs adult		2.563	0.253	102.659	0.000
Own initiative + supervision		1.914	0.155	151.995	0.000
SchoolTime ≤ 0.5 h		−1.308	0.546	5.736	0.017
0.5 h ≤ SchoolTime ≤ 2 h		−0.992	0.276	12.923	0.000
2 h ≤ SchoolTime ≤ 4 h		−0.283	0.131	4.679	0.031
4 h ≤ SchoolTime ≤ 6 h		0.000	0.128	0.000	0.997

## 5. Discussion

As mentioned, this study focused on parental involvement during the first Portuguese confinement related to the pandemic which enforced schools' closure. Considering the changes that this situation brought to students' learning, parental home-based involvement

was particularly significant, with parents' supervision of schoolwork being reinforced [23] and requested by online teaching.

In general, for the sample analyzed, we can say that online classes were a reality for most students since more than 92% of the students attended more than 2 h of online classes daily. Likewise, parental involvement was also generalized (and unavoidable) since in about 80% of the cases, parents reported being involved in supporting their children's study for at least 30 min per day. Although it may be true that parents devoted daily time to support children, they also reported specific difficulties, the most prevalent of which was the conciliation of school support with telework, and the second of which was the tiredness and mental disposition that affected all in quarantine. Despite the significant number of variables that can be related to parental involvement (e.g., students, family, and school variables) [18–20], it is of note that in this sample, parental/family variables related to parents' time and parent's health gained relevance, which may be due to the specific nature of the pandemic and the imposed changes.

The research questions posed in this paper allowed us to understand the prevalent form of support that Portuguese parents used, which is the monitoring of attention in classes and task realization in all levels of education except for secondary, where students are predominantly autonomous. When analyzing the parents' involvement time, we found that it is, as expected, decreasing with the level of education, but we also found significant differences between public and private schools, with parents of students from public schools spending more time on supporting the learning of their children. It is important to realize that, in Portugal, private schools have had more synchronous activities during schools' closure than public schools, for all levels of education, which may contribute to a reduction in the need of attention from parents of children in private schools. Even at a distance, teachers at private schools have supported and guided children's study more. As expected, we also found that the autonomy of children clearly reduced the involvement time of parents [18], but differences in involvement time between the first level of education and the secondary are generally lower than 1 h (for all classes of autonomy).

Finally, we attempted to analyze the determinants of parents' involvement time in a model with all the variables and performed this per level of education. Interestingly some determinants varied per level of education. For example, the number of other children at home determines the time parents spend with their children only when they attend the first level of education, which is the level where there is less autonomy. As in other studies, e.g., [18], children's age is one variable which influences parental involvement, as it tends to decrease from primary to middle school and even more during secondary school, mostly related to parents' perceptions that their involvement is less necessary. The gender of the parent that answered the questionnaire also loses significance when the level of education increases, as also reported in other studies [19,20]. Female parents show a higher time of parental involvement than male parents in the first and second levels, but then that factor is no longer significant. Most importantly, several variables appear to significantly determine parental involvement time, which is higher when students attend public schools, when they are less autonomous and younger, when parents level of education is lower, when the child is a boy (except during secondary education where gender is not relevant), and when the online school time was higher. In part, this is surprising, considering previous research where parental involvement was higher when students attend private schools and parents' level of education is higher [18,22]. Different results may be explained by the specific situation of schools' closure during pandemic, the diversity of educational measures defined by different schools, and the related consequences on parents' behaviors.

These findings are useful for supporting governmental decisions owing to the pandemic prevalence, which required many government measures in 2020 that are still required in the current 2021 year. In case of a new period of online classes, it is important to know that this implies a significant investment of time for parents, particularly for parents with lower levels of education, for whom it is difficult to conciliate work or telework with school activities. This is particularly relevant for families with many children (where the lower involvement

of parents may put learning at risk) and/or students attending public schools who require more time from their parents. Governmental measures should pay special attention to large families with young children where learning may indeed become compromised.

As we have seen, COVID-19 brought significant challenges to families, to students, and to teachers, including school-stress; difficulties in managing time and personal resources; and lack of technical, logistical, and financial conditions.

Opportunities could also be identified, such as the greater presence and involvement of parents in their children's school life. New forms of parental involvement have emerged during the pandemic that can be addressed as useful methods of involvement even after pandemic, particularly referring to home-based parental involvement and home-school communication. So, we can ask: what can be harnessed for the post-pandemic era? What new forms of parental involvement may remain after the pandemic? We suggest moments of sharing and deep reflection about this question in schools with all stakeholders, identifying critical aspects that should be maintained and lessons learned, both during and after the pandemic: How to improve students' learning and autonomy? How to involve parents and promote their development? How to involve teachers in attitudes and behaviors that promote a true partnership between school and family?

Interventions to promote parental involvement should be designed considering multiple factors, as we could see in this study. Therefore, multilevel interventions are welcome, involving school leaders, teachers, parents, and students in the promotion of students' learning and success; in the analysis of the needs of parents, teachers and students; and thus the development of action plans. Another relevant question refers to the direction of the relationship between parental involvement and students' autonomy. Do more involved parents make their children less autonomous? Do less autonomous children require more involved parents? These are questions that could be analyzed in the family and school contexts, trying to figure out the best options for students' learning and development.

Some limitations of the study should be acknowledged. Data were collected through an on-line questionnaire, which may have contributed to the difficulty of access for parents with lower educational qualifications or lack of information technology resources. Additionally, self-reported measures of parents' perceptions were used. We also point out the lack of comparison with similar studies during the lockdown. Future studies might analyze the adaptations of other types of parental involvement in times of a pandemic, namely, school-initiated parental involvement or home-school communication. Taking into account the context of online and distance learning, it would be useful to have a specific question measuring parents' digital and information literacy skills, since it could influence parental support of their children.

**Author Contributions:** Conceptualization and methodology, all authors; formal analysis, M.C.A.e.S.; investigation, M.L.V.; writing—original draft, M.C.A.e.S., R.S.C., M.C. and L.M.R.; writing—review & editing, L.M.R. and M.C.A.e.S.; project administration, M.C.A.e.S.; funding acquisition, L.M.R. and M.C.A.e.S. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research received no external funding.

**Institutional Review Board Statement:** The study was conducted according to the guidelines of the Declaration of Helsinki, and according to the Catholic University Ethical Code.

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** The data presented in this study are available on request from the corresponding author.

**Conflicts of Interest:** The authors declare no conflict of interest.

## References

1. OECD. *Education Responses to Covid-19: Embracing Digital Learning and Online Collaboration*; OECD: Paris, France, 2020.
2. UNESCO. Distance learning strategies in response to COVID-19 school closures. *UNESCO COVID-19 Educ. Response* 2020, 2, 1–8.

3. Wajdi, M.B.N.; Kuswandi, I.; Faruq, U.; Zuhijra, Z.; Khairudin, K.; Khoiriyah, K. Education Policy Overcome Coronavirus, A Study of Indonesians. *EDUTECH J. Educ. Technol.* **2020**, *3*, 96–106. [\[CrossRef\]](#)
4. Reimers, F.; Schleicher, A. *A Framework to Guide an Education Response to the COVID-19 Pandemic of 2020*; OECD: Paris, France, 2020.
5. Carvalho, M.; Azevedo, H.; Cruz, J.; Fonseca, H. Inclusive education on pandemic times: From challenges to changes according to teachers' perceptions. In Proceedings of the ICERI2020: 13th Annual International Conference of Education, Research and Innovation, Seville, Spain, 9–11 November 2020.
6. Markowska-Manista, U.; Zakrzewska-Oleđzka, D. Family with children in times of pandemic—what, where, how? Dilemmas of adult-imposed prohibitions and orders. *Soc. Regist.* **2020**, *4*, 89–110. [\[CrossRef\]](#)
7. Lu, S. School + Family Community Learning Model of PE Course under COVID-19 Epidemic Situation. *Int. J. Emerg. Technol. Learn.* **2020**, *15*, 218–233. [\[CrossRef\]](#)
8. Dettemers, S.; Yotyodying, S.; Jonkmann, K. Antecedents and Outcomes of Parental Homework Involvement: How Do Family-School Partnerships Affect Parental Homework Involvement and Student Outcomes? *Front. Psychol.* **2019**, *10*, 1–13. [\[CrossRef\]](#) [\[PubMed\]](#)
9. Gugiu, P.C.; Gugiu, M.R.; Barnes, M.; Gimbert, B.; Sanders, M. The Development and Validation of the Parental Involvement Survey in their Children's Elementary Studies (PISCES). *J. Child Fam. Stud.* **2019**, *28*, 627–641. [\[CrossRef\]](#)
10. Antipkina, I.; Ludlow, L.H. Parental Involvement as a Holistic Concept Using Rasch/Guttman Scenario Scales. *J. Psychoeduc. Assess.* **2020**, *38*, 846–865. [\[CrossRef\]](#)
11. Punter, R.A.; Glas, C.A.W.; Meelissen, M.R.M. *Psychometric Framework for Modeling Parental Involvement and Reading Literacy*, 1st ed.; Springer One: Heidelberg, Germany, 2016; pp. 5–31. [\[CrossRef\]](#)
12. Hoover-Dempsey, K.V.; Walker, J.M.T.; Sandler, H.M.; Whetsel, D.; Green, C.L.; Wilkins, A.S.; Closson, K. Why Do Parents Become Involved? Research Findings and Implications. *Elem. Sch. J.* **2005**, *106*, 105–130. [\[CrossRef\]](#)
13. Hoover-Dempsey, K.V.; Sandler, H.M. Why do parents become involved in their children's education? *Rev. Educ. Res.* **1997**, *67*, 3–42. [\[CrossRef\]](#)
14. Epstein, J.L. *School and Family Partnerships. Report No. 6*; Center on Families, Communities, Schools & Childrens' Learning: Baltimore, MD, USA, 1992; pp. 3–25. Available online: <https://eric.ed.gov/?id=ED343715> (accessed on 15 June 2021).
15. Wilder, S. Effects of parental involvement on academic achievement: A meta-synthesis. *Educ. Rev.* **2014**, *66*, 377–397. [\[CrossRef\]](#)
16. Bakker, J.; Denessen, J.; Brus-Laeven, M. Socio-economic background, parental involvement and teacher perceptions of these in relation to pupil achievement. *Educ. Stud.* **2007**, *33*, 177–192. [\[CrossRef\]](#)
17. Driessen, G.; Smit, F.; Slegers, P. Parental Involvement and Educational Achievement. *Br. Educ. Res. J.* **2005**, *31*, 509–532. Available online: <https://www.jstor.org/stable/30032581> (accessed on 15 June 2021). [\[CrossRef\]](#)
18. Eccles, J.S.; Harold, R.D. Family involvement in children's and adolescents' schooling. In *Family-School Links: How Do They Affect Educational Outcomes?* Booth, A., Dunn, J.F., Eds.; Lawrence Erlbaum Associates, Inc.: New York, NY, USA, 1996; pp. 3–34.
19. Kim, S.W.; Hill, N.E. Including fathers in the picture: A meta-analysis of parental involvement and students' academic achievement. *J. Educ. Psychol.* **2015**, *107*, 919–934. [\[CrossRef\]](#)
20. Fleischmann, F.; Haas, A. Explaining parents' school involvement: The role of ethnicity and gender in the Netherlands. *J. Educ. Res.* **2016**, *109*, 554–565. [\[CrossRef\]](#)
21. Hurley, K.D.; Lambert, M.C.; January, S.A.; D'Angelo, J.F. Confirmatory factor analyses comparing parental involvement frameworks with secondary students. *Psychol. Sch.* **2017**, *54*, 947–964. [\[CrossRef\]](#)
22. American Institute for Research. Available online: <https://www.air.org/resource/public-vs-private-parental-involvement-k-12-education> (accessed on 1 March 2021).
23. Kong, Q. Practical Exploration of Home Study Guidance for Students during the COVID-19 Pandemic: A Case Study of Hangzhou Liuxia Elementary School in Zhejiang Province, China. *Sci. Insight Edu. Front.* **2020**, *5*, 557–561. [\[CrossRef\]](#)
24. Abuhammad, S. Barriers to distance learning during the COVID-19 outbreak: A qualitative review from parents' perspective. *Heliyon* **2020**, *6*, 1–5. [\[CrossRef\]](#) [\[PubMed\]](#)
25. Donga, C.; Caob, S.; Lia, H. Young children's online learning during COVID-19 pandemic: Chinese parents' beliefs and attitudes. *Child. Youth Serv. Rev.* **2020**, *118*, 2–9. [\[CrossRef\]](#) [\[PubMed\]](#)
26. Bhamani, S.; Makhdoom, A.Z.; Bharuchi, V.; Ali, N.; Kaleem, S.; Ahmed, D. Home Learning in Times of COVID: Experiences of Parents. *J. Educ. Educ. Dev.* **2020**, *7*, 09–26. [\[CrossRef\]](#)
27. Garbe, A.; Ogurlu, U.; Logan, N.; Cook, P. COVID-19 and Remote Learning: Experiences of Parents with Children during the Pandemic. *Am. J. Qual. Res.* **2020**, *4*, 45–65. [\[CrossRef\]](#)
28. Spinelli, M.; Lionetti, F.; Setti, A.; Fasolo, M. Parenting Stress during the COVID-19 Outbreak: Socioeconomic and Environmental Risk Factors and Implications for Children Emotion Regulation. *Fam. Process* **2020**, 2–15. [\[CrossRef\]](#) [\[PubMed\]](#)
29. Bubb, S.; Jones, M. Learning from the COVID-19 home-schooling experience: Listening to pupils, parents/carers and teachers. *Improv. Sch.* **2020**, *23*, 209–222. [\[CrossRef\]](#)
30. Bozkurt, A.; Jung, I.; Xiao, J.; Vladimirsch, V.; Schuwer, R.; Egorov, G.; Lambert, S.R.; Al-Freih, M.; Pete, J.; Olcott, D., Jr.; et al. A global outlook to the interruption of education due to COVID-19 pandemic: Navigating in a time of uncertainty and crisis. *Asian J. Distance Educ.* **2020**, *15*, 1–126. [\[CrossRef\]](#)



MDPI  
St. Alban-Anlage 66  
4052 Basel  
Switzerland  
Tel. +41 61 683 77 34  
Fax +41 61 302 89 18  
[www.mdpi.com](http://www.mdpi.com)

*Education Sciences* Editorial Office  
E-mail: [education@mdpi.com](mailto:education@mdpi.com)  
[www.mdpi.com/journal/education](http://www.mdpi.com/journal/education)







MDPI  
St. Alban-Anlage 66  
4052 Basel  
Switzerland

Tel: +41 61 683 77 34

[www.mdpi.com](http://www.mdpi.com)



ISBN 978-3-0365-5248-4