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Investigating Special Education Teachers' Views on Mathematics Instruction Process: Suggestions for Sustainable Special Education in Mathematics Instruction

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Abstract: This study aimed to explore the experiences of special education teachers' mathematics instruction process and to present suggestions for sustainable special education in mathematics instruction. Seventeen special education teachers were interviewed in this study. Hence, a qualitative research design and content analysis were used. Three dimensions were considered in the interviews, including: teaching mathematics to students with disabilities in terms of teaching methods, manipulatives, and assessments; the mathematics curriculum; and challenges that special education teachers face throughout the process. According to the results, most teachers still use direct or explicit instruction based on the behaviorist approach. All participants stated that they use mathematics manipulatives to help learners perceive mathematical concepts. They also use Individualized Education Programs to assess their students. Participants stated that every disability group and every child need to be considered uniquely since their disabilities and levels vary. Participants also said that they are only able to teach numbers, addition, and some basic geometric shapes due to time insufficiency and crowded classrooms. Almost every participant stated that insufficient time and teacher shortage are the biggest problems of the system. The study has limitations or weaknesses. In this study, since the interviewing method was used, and the findings are the extent of what the participants have indicated, and the statements of the participants are limited to what she/he explained to the researcher. In the study, it is suggested that mathematics teachers and special education teachers should cooperate. In addition, suggestions are made, such as conducting experimental research studies to see the most efficient way to teach mathematics in homogenous groups. Finally, future researchers are advised to focus on the possible consequences of applying constructivist learning theory.

Keywords: special education; mathematics education; children with disabilities; sustainable special education



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1. Introduction

The requirement for mathematics within the education system in a country and the universality of mathematics language is an inevitable factor of becoming an information (knowledge) society while moving towards the new millennium. Mathematics, in understanding and discovering the world around us, has become more important than ever in today's world, and it is a fact that we will need much more of it in the future [1]. Baykul [2] stated that mathematics is an important instrument used not only for science but also to solve the problems within our daily lives. Being competent in mathematics is important because it helps develop the ability of thinking. Even social sciences, music, literature, and art require mathematical knowledge to understand concepts. The crucial role of mathematics makes it one of the most important disciplines in any level of education. Therefore, teaching mathematics in schools has been important since the Third Millennium BC [3].

The rapid improvement of science and technology in the world has changed the type of knowledge that societies require for individuals to succeed, and education is now expected to teach individuals to adapt themselves to change, to be open to improvement, to

be entrepreneurs, to have problem solving skills, to establish knowledge, and to be able to implement said knowledge in the face of new and real problems. Former studies in mathematics education have focused on developing concepts for years. Austin [4] emphasized that improving comprehension in mathematics is essential, and there are particular activities to maintain it, including teaching vocabulary and problem solving procedures and helping students read mathematical sentences with the purpose of using the skills later. Similarly, Fuentes [5] underlined that learning mathematics depends on how you read it. He said that, "For my students to reach their potential as mathematicians, they must learn to comprehend mathematical texts, that is, texts constructed of numbers, abstract symbols, and yes words". Fuentes [5] also stated that any student can be successful with the help of appropriate and timely corrective feedbacks. Parallel with this understanding, the mathematics education program in Turkey is based on the principle of "any child can learn mathematics" [6]. Mathematics is one of the most important lessons that students need to learn, although it is considered very difficult to learn by most students. Students think that mathematics involves only numbers, abstract symbols, and their interrelationships, and they ignore or are unable to recognize that mathematics also involves natural thought [5]. According to Abbasi, Samadzadeh, and Shahbazzadegan [7], students developing mathematics anxiety is a huge hindrance that put barriers in the way of improving mathematics skills. There are similar findings in the Turkish education system as well problems in our culture ([8,9]). Students being prejudiced against and having negative attitude towards learning mathematics makes it difficult to for them to learn mathematics and therefore prevents learning ([2,10–12]; Ma and Xu, 2004; Yenilmez, 2006; [7]). In addition to the fact that mathematics has a great importance and gravity in school programs, it also takes a great deal of students' study time in every stage of education. However, most students consider mathematics a scary subject which gets difficult eventually; therefore, success in mathematics is very low, and teachers' time is wasted [13]. Olkun and Uçar [14] stated that the student needs to focus on mathematics knowledge, skills, and manners in order to achieve a good math education and success. They also stated that as a condition to achieve mathematics knowledge, operative and cognitive knowledge should integrate as they both have different individual functions. Yıldızlar [15] explained that the reason mathematics is important in every level of education and in every country is because mathematics is an inevitable instrument for scientific studies and the daily lives of individuals. Miller and Mercer [16] remarked that it would be a mistake to expect every child with the same intelligence level in the same class to learn the skills and the operations on the same level because this would mean adapting the child according to the program instead of adapting the program according to the child. Therefore, this approach would be against the main principles of special education. The Special Education Regulation of the Ministry of Education (2006) describes children with disabilities as "individuals showing meaningful differences from expected levels of their peers with regard to their personal features and educational competences for various reasons" [17]. Children with disabilities is a very comprehensive term, including children showing differences in their mental features as well as the children with learning and behavioral difficulties and emotional or physical disabilities.

Children with disabilities, similar to many children showing normal progress, experience difficulties learning basic mathematics concepts and skills, implementing what they learn, and problem solving. It is very important to evaluate and assess mathematics skills in order to obtain the knowledge required for preparing education programs, especially for students with special education needs due to the unsatisfactory progress in their mathematics skills ([18–20]). Enç, Çağlar, and Özsoy, [21] consider the children with special education needs as visually impaired, hearing impaired, speech impaired, orthopedic impaired, children with permanent illnesses, mentally disabled, incompatible (maladaptive) children, children requiring guardianship, and children with learning difficulties.

Mainly, special education is provided for seven different categories and levels, including

- visually impaired,
- hearing impaired,

- mentally disabled,
- permanent illnesses,
- adjustment disorder,
- speech difficulties, and also
- children with special and superior skills in Turkey and Northern Cyprus [22]. The Ministry of National Education (2006) defines special education as education programs and methods developed together with the personnel trained to meet the educational and social requirements of individuals with the special education needs based on the competences of individuals with special education needs and maintained in the circumstances compatible with the progress features.

Recently, students with disabilities have been educated in mathematics in general education classes. As any student, the students with disabilities want to make use of the educational programs in the best manner and live their lives as effective individuals within society. It is necessary to adapt and revise the curriculum, program content, education techniques, and assessment process to meet these students' personal needs and enable them to make the most of their mathematics education in the general education classes [23]. Revising the curriculum is also significant for a sustainable special education system.

There are various factors that influence why students with disabilities fail math classes. Although the type and the degree of disability is important, they fail due to the fact that they are not provided with a suitable education. It is possible to list the reasons they fail, such as receiving ineffective education, verbal communication problems, cognitive factors, weak reading skills, affective factors, insufficiency in visual perception, inattention, and incompetence in motor skills ([24,25]).

Erickson, Hanser, Hatch, and Sanders [26] state that students with disabilities in intermediate and advance levels have limitations in mathematics education since they have poor reading and writing skills. Hence, they stated that the standards and the objectives defined in the curriculum should be revised in order to help students learn lifelong skills. Instead of focusing on the traditional mathematics program, it would be more effective to prepare a program based on the requirements raised by the performances of students with disabilities.

Cawley [27] stated that an effective presentation of math concepts to students with disabilities is helpful for them to understand math skills and concepts. Regarding the skills expected to be acquired by students during mathematics education, it is explained that teaching divided in small steps with the intention of increasing students' success experiences, based on starting the teaching process with objects and progressing in stages with the usage of the flash cards and visual cards, has reached more effective results [28]. Browder, Spooner, Delzell, Harris, and Wakemanxya [29] stated that research is should be done about mathematics education for students with serious cognitive disabilities. It is stated that research on special education teachers is limited [30]. On the other hand, it is claimed that most studies in this field are limited to quantitative studies [31]. The difficulties experienced by teachers who teach mathematics to individuals with special education needs is actually recognized as a subject matter in the special education field. For this reason, it is important to consider the views of teachers to improve sustainable special education in mathematics instruction. Thus, the purpose of this research is to determine the problems faced by teachers of special education classes and to provide data for future researches.

2. Research Model

The model of the study is shown in Figure 1. The model presents three dimensions of teachers' experiences teaching mathematics to students with special education needs. The first dimension is the approaches adopted by the teachers. In the model of the research, these approaches are discussed from three perspectives: strategies and method, manipulatives, and evaluation.

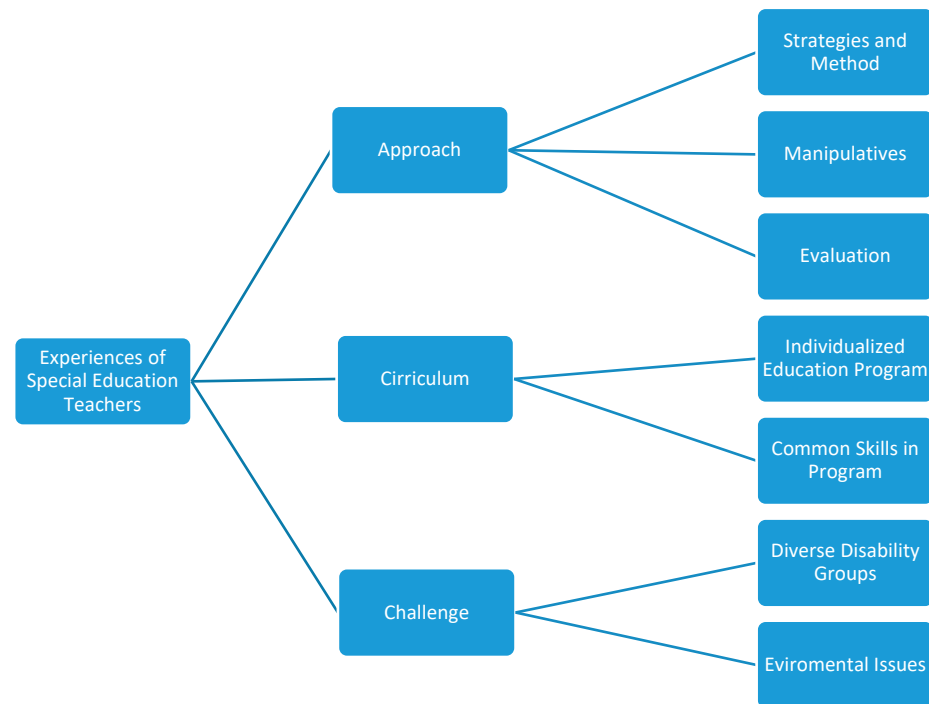


Figure 1. Research model.

Another dimension that the research model evaluates is the applied curriculum. The research model focuses on two issues within the scope of the applied curriculum. The first of these is the individualized education program. The other is common skills in the program.

The last dimension that the research model focuses on is the challenges faced by teachers. The model also touches on two issues in this respect. Firstly, the diversity of students with disabilities is discussed, and secondly, environmental issues are evaluated.

In this context, the research questions are listed as follows:

- Q1. Do mathematics teaching approaches in special education differ from mathematics teaching approaches in general education?
 - Q1a. Are there differences in strategy and methodology?
 - Q1b. Are there differences in manipulatives?
 - Q1c. Are there differences in evaluation strategies?
- Q2. Do mathematics teaching curriculum in special education differ from mathematics teaching curriculum in general education?
 - Q2a. Are individual education programs implemented effectively?
 - Q2b. Are common skills programs included in the curriculum?
- Q3. Are there challenges in teaching special education mathematics?
 - Q3a. Does the diversity of disability groups emerge as a challenge in teaching special education mathematics?
 - Q3b. Do environmental issues emerge as a challenge in special education mathematics teaching?

3. Methodology

3.1. Design

A qualitative methodological approach was used in this study. It was important to explore special education teachers' views on teaching since they face a wide range of challenges while teaching mathematics. Qualitative approaches can dig deeper into the aspects of teaching more effectively compared to traditional questionnaires or surveys.

This article is designed as a case study, and its aim is to explore the experiences of special education teachers regarding particular parameters of the mathematics instruction process, such as teaching mathematics to children with disabilities, the mathematics curriculum, and challenges in the mathematics instruction process. Creswell [32] defines case study as “the study of an issue explored through one or more cases within a bounded system” and “a description and analysis of an individual matter or case.” He also states that basic purposes of the case study are identifying variables, structures, forms, and orders of interaction between the participant in the specific situation. This study selected its case based on the literature ([33]; Born-Miller, 2001; Kroesbergen & Van Luit, 2003; Maccini & Gagnon, 2000). As Hailikari, Nevgi, and Kommulainen [34] stated, selecting a research design based on prior knowledge is crucial to enable a strong theoretical base for the research.

3.2. Data Analysis

An interviewing method was used to collect the data. This method is a common approach to collecting data that requires participants to answer pre-determined, open-ended questions. In this study, the data obtained from three schools and seventeen teachers was analyzed. A series of propositions were derived from the research questions. These propositions also served as a basis to create the codes. The gathered data were rewritten in order to analyze the data easier.

Data analysis continued until saturation was reached for each question [35]. Researchers followed Kleiman’s [36] procedures, and as a first step, the interview transcripts were read thoroughly. Afterwards, they were read again more slowly to divide the data into meaningful units. Similar units were identified, and those sections were subjected to free imaginative variation, which is known as “determining which of them is essential for, and constitutive of, a fixed identity for the phenomenon under study.” The findings were elaborated and justified according to the raw data. Subsequently, to demonstrate the accuracy of the findings based on the raw data, critical analyses were completed in steps, including obtaining concrete, detailed descriptions from the participants; reducing the data; discovering essential meanings; articulating a structure; and verifying the results based on the raw data. In order to ensure the internal validity, the results were shared with a special education center manager (who is also a special education teacher) to verify whether the authors were consistent when creating categories. The findings were consistent and eloquent with the existing literature. To provide the notion of trustworthiness, the authors of the study never directed the participants when answering the questions. The participants responded to questions relevant to the subjects and aim of the study.

3.3. Study Group

All participants in this study freely consented to participate. Researchers helped participants get information about the study. The participants were also assured that declining or leaving the study would not affect any services being received and that their identity would be disguised and would not be used for any other reason. Like in many qualitative research studies, purposive sampling is used in this study.

Researchers kept interviewing until nothing new emerged from the data. Seventeen teachers were interviewed for this study due to the saturation standard in a qualitative research study. “Saturation is a tool used for ensuring that adequate and quality data are collected to support the study” [37]. The participants were described in detail in Table 1. Each participant was coded as T (the initial letter of teacher). There are eight public and 11 private special education centers in North Cyprus. One public and two private special education schools were selected from two districts (Nicosia and Famagusta), and seventeen teachers from these schools participated in this study. It should also be noted that there are only a few people who specialize in special education teaching in North Cyprus. In contrast, psychologists, music teachers, English teachers, and psychological guides are commonly hired in these schools and centers. However, following the declaration of the

Cyprus Turkish Teacher's Trade Union [38], the Ministry of National Education employed 10 special education teachers in 2021 [39].

Table 1. Study Group.

Participants	Gender	Bachelor	Experience (Years)	Institute
T.1	Female	Teaching Students with Mental Disabilities	2	Public
T.2	Male	Teaching Students with Mental Disabilities	2	Private
T.3	Female	Elementary School Teacher	9	Private
T.4	Female	Elementary School Teacher	16	Public
T.5	Female	Teaching Students with Mental Disabilities	2	Private
T.6	Male	Teaching Students with Mental Disabilities	21	Public
T.7	Female	Teaching Students with Mental Disabilities	3	Private
T.8	Female	Special Education Teacher	5	Private
T.9	Female	Teaching Students with Mental Disabilities	1	Private
T.10	Male	Special Education Teacher	12	Public
T.11	Male	Teaching Students with Mental Disabilities	10	Public
T.12	Male	Psychological Guidance and Counselling	25	Public
T.13	Female	Special Education Teacher	2	Public
T.14	Female	Special Education Teacher	3	Private
T.15	Female	Teaching Students with Mental Disabilities	2	Public
T.16	Male	Teaching Students with Mental Disabilities	11	Public
T.17	Female	Special Education Teacher	1	Private

Participants included six male and 11 female teachers. Eight teachers worked at a public school and nine teachers worked at a private special education center. Ten of the teachers have 1–5 years of experience, while four of them have 9–12 years of experience, and three of them have 16–25 years of experience in teaching. Every participant except three graduated from special education or Teaching Children with Disabilities Departments. Data were collected from three different schools. Raw data are summarized below in Table 2.

Table 2. The Distribution of Categorical Variables Based on the Study Group.

	Participants	Number	Percentage (%)	Average Experience (Years)
Gender	Female	11	64.71	4.18
	Male	6	35.29	13.5
	Total	17	100.00	7.47
Bachelor	Mentally Disabled Teaching	9	52.94	6
	Elementary School Teacher	2	11.76	12.5
	Special Education Teacher	5	29.41	4.6
	Psychological Guidance and Counselling	1	5.88	25
	Total	17	100.00	7.47
Institute	Public	9	52.94	11.22
	Private	8	47.06	3.25
	Total	17	100.00	7.47

Table 3 shows the participants' school characteristics and a brief description of its student population.

3.4. Data Collection Tool

The survey questionnaire was prepared according to the existing literature. Eight questions were asked regarding the participants' experiences and opinions on teaching mathematics to students with disabilities, the current mathematics curriculum, and challenges about teaching mathematics in a special education class. To assure the validity of the interview questions, three special education specialists/teachers and an academician

were asked to review and evaluate the questions. Afterwards, within the framework of the research model presented in Section 2, a pilot study was conducted with three special education teachers as informants to also check the validity. Eight questions were reviewed and arranged due to the pilot study. Sample questions from the survey are listed below, and the related questions in Section 2 are shown in the parentheses.

- Which method, approach or strategies do you prefer to use while teaching mathematics? (Q1, Q1a, Q1b, Q1c)
- What kind of challenges do you experience when teaching mathematics to students with disabilities? (Q3, Q3a, Q3b)
- Is there any particular subject that you have difficulties or problems during the process? (Q3, Q3a, Q3b)
- How do you evaluate mathematics curriculum in terms of convenience, adaptability, and/or flexibility? (Q2, Q2a, Q2b)

Table 3. The Participants' School Characteristics.

School Name	
A	School A is a public special education school. There are 72 students with different disabilities. There are 10 children who have learning difficulties, two who have Down Syndrome, seven who have Autism Spectrum Disorder, and one of them has a hearing disability. The remainder of students have mental disabilities.
B	School B is a private special education center. There are 35 students. Twenty of them are inclusion students, and the rest of them are full-time students at the center. There are two children who have Down Syndrome, two who have learning difficulties, two who have Autism Spectrum Disorder, one who has a hearing disability, and one who has Attention Deficit-Hyperactivity Disorder. The remainder of students have mental disabilities.
C	School C is a private special center. There are 11 students. Two of them have Down Syndrome, two of them have cerebral palsy, four of them have learning difficulties. The remainder of students have mental disabilities.

3.5. Data Gathering

The interviews were conducted in 10 days. Thirteen teachers participated in an in-depth, semi-structured, face-to-face interview, and the other interviews were conducted by telephone. Interviews were audio recorded for transcription, and they ranged in length from approximately 25 to 30 min. Patton's [40] "standardized open-ended interview" approach was used. Based on the approach, 10 open-ended questions were prepared. Questions were developed based on the existing literature and expert opinions. The researchers used an interview plan in order to use possible probes.

3.6. Trustworthiness

This study included seventeen participants. According to Glick Huber, Miller, and Sutcliffe [18], in a case study, it is important to use multiple participants (informants) for the validity of information so data provided by one informant can be checked against that provided by other informants. Therefore, participants were selected from varying perspectives. Researchers also focused on the key informants who were supposed to be more knowledgeable about the topic. Using tape recorder was also another point that ensures trustworthiness. After collecting the data, the researchers analyzed the data, and codes were shared with a special education center manager (who is a special education teacher as well) to verify whether the authors were consistent about creating categories. The manager delivered an oral speech to the authors emphasizing the same problems mentioned by participants. It is also noteworthy that the manager has a PhD degree in the field of special education. The findings were consistent and eloquent with the existing literature. In short, the trustworthiness of the findings was increased due to the manager's confirmations.

4. Findings

In this section, the results according to the three research questions are analyzed and direct quotations are shared. In order to reveal the opinions of the special education teachers in depth, the researchers proposed themes and sample answers, which are specified under these titles considering to the questions' subtitles. These subtitles are referred as S (the initial letter of subthemes). The findings were summarized in Table 4.

Table 4. Summary of the Findings.

Mathematics Instruction Process	
Strategies and Methods The instructional strategy is the teaching method and even the form of evaluation that a teacher will pick to achieve goals when teaching a lesson or a subject.	Explicit Instruction "Explicit instruction helps children to see how they succeed in mathematics." (T10)
	Direct Instruction "Direct instruction is a well-structured form of instruction which helps both teachers and students to define and understand the skill to achieve it." (T4)
	Demonstration
Manipulatives Any physical object that help students discover a mathematical concept in an active, hands-on approach.	Abacus "When studying with children with disabilities, it is important to make abstract concepts solid like mathematical knowledge. I always use pictures and counting sticks or three-dimensional objects to teach mathematics." (T7)
	Counting Sticks "Teaching mathematics without counting sticks are impossible for me. I have different kinds of objects like colorful pom poms, handmade felt manipulatives, plastic glasses, ping pong balls." (T16)
Evaluation This evaluation is not a process to determine a child's disability. The evaluation is about reaching the objective defined in the IEP	IEP "Each child is evaluated in his/her position, developmental stage. I ask opinions from colleagues and we cooperate while preparing IEP's. Each child is evaluated uniquely according to the chart like a checklist." (T.9)
Mathematics Curriculum	
Benefits of an IEP Benefits of an Individualized Education Program are considered in terms of teaching and learning efficiency, evaluating the child, evaluating the program regarding the skills stages of teaching, using manipulatives, and giving insights about the future.	Meet Students' Needs Helps Teaching Efficiently "I can count many benefits of IEP that helps me and help any other special education teacher. 1- It is a great guide to show the way where to start and what to teach and how long it will take. 2- Helps evaluating students efficiently. 3- When I double check an IEP or apply it, I see different alternatives to teach or evaluate since my students' disabilities vary." (T.3)
Selecting Math Skills Mathematics skills are considered under two titles: process standards and content standards. Process standards are listed as problem solving, reasoning and proof, communication, representing, and connections. Content standards are numbers and operation, algebra, geometry, measurement and evaluation, and data collection.	According to the Students' Level Developmental Stage "I have a student who has both high degree of hearing and seeing disability. In one year, he was only able to count up to 3. So, I have to plan what to teach based on the student's developmental stage."

Table 4. Cont.

Common Math Skills Common math skills refer to the most studied chapters and skills during the instruction process.	Numbers Money Geometrical Shapes “Geometrical shapes like triangle, square, and circle are three shapes that I teach with wooden geometrical shapes. T.2) Time Counting
Challenges	
Diverse Disability Groups Diverse disability groups refer different types of disabilities such as hearing disabilities and learning disabilities, etc.	Heterogenous Groups “Different disability groups and language disorders are two main factors that I struggle most.” (T.5) Poor Reading Skills Different Ages Different Developmental Stages Language Disorders
Environmental Issues Environmental issues refer to physical facilities, such as classrooms and manipulatives.	Poorly Equipped Classrooms “In special education, students need hands-on manipulatives to enjoy learning and understand it conceptually. But we do not have enough manipulatives in schools.” (T.4) “Manipulatives’ multisensory properties help students learn faster and better. Each classroom needs to be equipped with relevant manipulatives, but we are not at the most desired point here.” (T.6)

4.1. Special Education Teachers’ Approach through Mathematics Instructional Process

The questions related to the mathematics instruction process maintain that special education teachers embrace a behaviorist approach. Skinner [41] defines learning as the transmission of information from teacher to learner, which is basically the transmission of the appropriate response to a certain stimulus. Skinner also states that consistent repetition of the material, small, progressive sequences of tasks, and continuous positive reinforcement are fundamental elements since learned responses will quickly become extinct without positive reinforcement. Positive reinforcement helps learners continually shape their behavior in order to receive it [41]. Davis [42] mentions that direct instruction, explicit instruction, rehearsal reinforcement, and skill or task specific or imitation methods point to behavioral teaching approaches. As such, behaviorism focuses on measurable outcomes.

S1: Strategies and Methods

“I use explicit instruction and always give positive reinforcement.” (T.14)

“Direct Instruction is the most common method I use since it is a convenient method to apply in a special education class.” (T.11)

“Demonstration.” (T.8)

Furthermore, special education teachers tend to use traditional manipulatives that do not require much instruction. The direct demonstration approach is a method of instruction especially used when trainees need to repeat steps. Teachers use counting blocks, abacuses, and sticks to teach counting and numbers with the use of manipulatives. As mentioned before, the behaviorist-teaching model requires consistent repeating and behavior reinforcement. Therefore, special education teachers use traditional manipulatives to help their students gain objectives through repetitions.

S2: Manipulatives

“I use abacus and counting sticks with the demonstration method. I especially focus to teach psychomotor and cognitive objectives with these manipulatives.” (T.5)

"Photos, textbooks, and number cards are the instructional materials that I use very often." (T.12)

S3: Evaluation Strategies

Teachers stated that evaluation strategies used in the classes can differ according to the child's developmental stage. Similarly, they stated that since they prepare individualized learning programs (IEPs) for each student, evaluation strategies vary. However, mainly, the participants stated that behavior charts are convenient to evaluate children with disabilities.

"There are charts that we prepare for each student. This chart is prepared according to the student's developmental stage and his/her needs. Teachers cooperate and prepare these charts according to disability and developmental stage sub-groups." (T.1)

"I think evaluation should be planned to identify students' needs, which has to be improved. So, I plan written tests for most of my students considering their disability." (T.2)

4.2. Special Education Teachers' Views on Mathematics Curriculum for Children with Disabilities

Almost every participant in the study answered similarly about the mathematics curriculum. They indicated that IEPs should have been made considering three crucial factors: the hierarchy and sequence of skills, choosing vital skills, and creating a consequential context.

S1: The Benefits of Using IEPs with Mathematics Education

"I think any other plans different than IEPs are not eligible to apply. Ministry of National Education offers some particular criterion-based measurement charts in their websites, but such tools may be lacking to meet students' needs in some cases." (T.5)

"Criterion-based measurement tools are easy to find on websites, but preparing IEPs helps students to learn more efficiently and permanently." (T.6)

S2: Selecting Mathematics Skills

"When preparing IEP for a student, it is very important to be aware of his/her developmental stage. Additionally, disability group is another important factor about selecting and sequencing skills. Students' needs are the key elements here." (T.4)

"As a first step, student's level of performance in mathematics should be evaluated. After specifying student's performance, one should focus on vital skills and sequence skills, from simple through complex, by considering to create a meaningful context." (T.7)

All participants emphasized that numbers and addition are the most common skills that are taught. Furthermore, the participants did not mention any objective related to analyzing data. In other words, none of the participants include objectives about analyzing data in their IEPs.

S3: Most Common Mathematics Skills in Programs

"Numbers, money, addition." (T.1, T.4, T.8)

"Geometrical shapes (triangle, square, and circle), rhythmic counting, and numbers." (T.11)

"Numbers, time reading, addition." (T.2, T.6, T.9, T.12)

4.3. Challenges of Mathematics Instruction Process in Special Education: Teachers' Views

Almost all participants focused on two problems, including student and environment factors. They stated that many problems they face arise from heterogeneous groups,

i.e. age, developmental stage, and disability subgroup. Special education teachers also emphasized that language development is another main problem. They underlined that most children they are dealing with have serious language disorders. Secondly, they indicated that inadequate time and insufficient number learning tools (manipulatives) are also disadvantages in the instruction process.

S1: Diverse Disability Groups

“Number of students is too much, which brings another issue: heterogeneous groups. There are disability subgroups. I have many students who are at different ages and development stages. Many of my students have also language disorders which makes communication and learning difficult.” (T.3)

“Different disability groups and language disorders are two main factors that I struggle most. Number of students in the class is too much for a special education teacher. So insufficient number of teachers is another problem.” (T.5)

“I struggle most with students who have poor reading skills and attention deficit, which makes mathematics instruction more difficult.” (T.17)

S2: Environmental Issues

“Insufficient time makes learning harder. Students need to repeat each step we teach in order to remember. I wish we had enough time for teaching. I believe we should spend more time with students.” (T.4)

“There should be convenient instructional materials for each objective. But we do not have enough manipulatives. Touching, seeing, using is very important for a student with disabilities.” (T.8)

To summarize the data and provide detail for the confirmability of the research, Table 4 is given above. The themes mentioned in Table 4 are also explained briefly.

5. Conclusions

Children with disabilities must have access to quality education, which also helps society in terms of economic growth and social life. As Jacobs and Olisaemeka [43] remarked, each member of society should be cared for and educated to advance human society. Special education is a new field in the Turkish education system. This system has many different parameters, such as teachers' education, curriculum, recognizing children with disabilities, parent education, schools, and many other factors. Although the system has been improving in recent years, we still face challenges and problems educating students with disabilities. Findings of the research are significant for the sustainability of mathematics teaching in special education. Firstly, there is not a sufficient number of special education teachers in most schools. Secondly, inclusion practices have been applied inappropriately due to the insufficient number of special education teachers in the schools. Perhaps the worst point is that many teachers, other than special education teachers, are not adequately skilled in the inclusion and/or education of individuals with disabilities. Therefore, most students in North Cyprus with disabilities cannot receive basic education, or in some cases (physical environment), any education.

In this study, the experiences and difficulties of mathematics instruction are examined through 17 special education teachers' perspective and practices. For sustainable special education in mathematics instruction, three main points are questioned: the elements of mathematics instruction process, the mathematics curriculum for children with disabilities, and the challenges they encounter.

Questions about the mathematics instruction process show that special education teachers use a behaviorist approach. They mainly use a direct and/or explicit instruction approach. Many research studies also utilize the same methods. Direct instruction provides solid support and guidance that helps students organize while teachers teach basic mathematics concepts and skills.

One of the most important elements of mathematics instruction is manipulatives (or learning materials). Bateman and Bateman [44] stated that students with disabilities might achieve mastery in learning with the help of learning materials. These instructional materials help students with disabilities feel more comfortable and ready to learn by making their environment handy, functional, and convenient. ([44,45]).

This research shows that IEPs are used while teaching mathematics and there is no standard curriculum. However, the literature indicates that there are other techniques to evaluate the mathematics skills of special education students, such as peer evaluation, portfolio, self-evaluation, and skill-operation analysis.

The mathematics curriculum is another component in the process. As explained above, content standards are numbers and operations, algebra, geometry, measurement, and data analysis. Yet participants indicated that only numbers, addition, and names of basic geometrical shapes are taught. This result may be due to several unfortunate factors, which are also related to another point in this article.

It has been 46 years since children with disabilities in Cyprus first started being educated in schools. Despite the past 46 years, little improvement is noticed. The Cyprus Turkish Teacher's Trade Union [38] declared that there is an insufficient number of teachers in schools who work hard to study children with disabilities. Although the Ministry of National Education employed 10 additional special education teachers in 2021 [39], in 2022, only one additional teacher was employed [46]. As participants mentioned, there needs to be more employment for special education teachers in North Cyprus. This challenge is very similar in the Turkish education system.

5.1. Discussion

Direct instruction can be used more effectively for students with disabilities compared to other practices ([47,48]; Miller & Kit-hung, 1998; Miller & Swanson, 1999; Kroesberg & Ban Luit, 2003). There has been a vast amount of research on direct instruction. According to the Education Consumers Foundation, meta-analysis results showed that direct instruction has a great impact on learning and is widely used in special education ([49–54]). For instance, Mangundayao, McLaughlin, Williams, & Toone [55] found a clear functional relationship between the Direct Instruction (DI) flashcard system and accurately identifying colors, shapes, and numerals for the three participants. The findings suggest that the participants made progress using a DI flashcard intervention, which supports the effectiveness of this procedure to teach mathematics facts. Aufan Al-Makahleh [56] also found that teaching mathematics with direct instruction improves the mathematics skills and attitudes of children with disabilities. However, a group of researchers think that teaching all students in the same way with the same methods is not very reasonable and effective. Additionally, it is not very compatible with the needs of today's children. Hitchcock, Meyer, Rose, and Jackson [45] stated that using the same methods to teach all students no longer meets the expectations of today's education reform. Effective teaching of diverse students requires different instructional methodology, curriculum materials, and assessment methods ([44,45,57]; Jorun Buli-Holmberg & Jeyaprathaban, 2016). For instance, Hall, Vue, Strangman, and Meyer [58] stated that Universal Design for Learning is a new way to create learning environments and is effective as explicit instruction for all children, including children with disabilities. They defined Universal Design for Learning (UDL) as a "theoretical framework developed by CAST (the Center for Applied Special Technology) to guide the design and development of learning environments that represent materials in flexible ways and offer a variety of options for learners to comprehend information, demonstrate their knowledge and skills, and be motivated to learn."

Jimenez and Stanger [59] emphasized that some research has shown that students with severe intellectual disabilities can learn some basic mathematics, such as numbers, money, or telling time. However, they point out the main factor contributing to the problem, which is the gap in math skills instruction that has focused on money and time with little to no problem-solving skills instruction. Jimenez and Stanger [59] defined two main

problems, including: “the sparseness of research on building the early numeracy skills, beyond number identification, for students with severe intellectual disability” and “an absence of instructional tools to build foundational numeracy skills to allow students access to mathematical problem solving”. This research also shows that manipulatives help students learn to move from solid practices to abstract reasoning [60]. However, as the participants mentioned, there are not enough manipulatives in the classes. The first special education center was founded in 1976. Therefore, it can be concluded that special education is a newly developing field of education. To speed up the equipping process of classes in terms of learning materials, universities and special education centers should cooperate. Moreover, the Ministry of National Education should establish a unit to supply the necessary equipment based on developmental stages, disability subgroups, and objectives. Special education teachers confirmed that they use checklists, rubrics, and individualized evaluation strategies to measure the child’s progress. They did not declare any difficulties about the evaluation of students. Nevertheless, based on other findings, it is obvious that number of teachers should be increased in order to improve and facilitate the evaluation process and monitor student progress more effectively.

Gürsel [61] underlines that special education teachers should use more than one method to monitor students’ mathematics performance in order to determine their needs and create more precise IEPs. Moreover, teachers should undertake regular and ongoing assessments to get continuous feedback about the effectiveness of their instruction and ensure that their students are progressing. Ongoing assessments will also help teachers indicate the points thoroughly while teaching and reshape their instruction [62]. Similarly, Craig-Unkefer and Kaiser [63] suggest that identifying the areas of instructional needs and establishing clear, concrete guidelines for behavioral learning areas should be accomplished. They also mentioned that individualized education program should be prepared by considering written and reasonable expectations. Moreover, any behavior or characteristic that needs to be taught or changed needs to be described in several ways and demonstrated in several settings [63].

Cowan [64] underscored that language disorders are at risk for poorer educational achievement in mathematics just as in other curriculum subjects. “This is not surprising when one considers the general importance of communication in schooling, the role of oral language in classroom mathematical investigations, and more specific connections such as the fundamental contribution made by knowledge of the number-word sequence to developing understanding of symbolic notation”. It is very important to diagnose disabilities in early childhood to help children receive necessary services and reach their true potential [65]. To be able to diagnose disorders early, families should be aware of possible disorders. According to Zucker [66], stimulating interactions between family members and children, primarily through the auditory modality, will enhance their verbal language skills and cognition. Zucker put emphasis on the relationship with parents as parental conversation with children is the most useful way for the child to develop language skills. It should be underscored that the denial process of the parents also takes this process one step back. Healey [67] mentioned that even after parents accept and find ways to ways to cope with the situation in terms of health and social environments, “other complications can cause set-backs in adjustment, such as unanticipated experiences of being socially rebuffed by friends and strangers or being treated inappropriately by poorly informed educators.” These depressing experiences can aggravate the difficult process, and the process can be damaged. Therefore, information services should be active, and the Ministry of Health and the Ministry of National Education must cooperate to provide courses for parents and build a strong and secure connection among society. In fact, these courses may be online and free to ensure efficient and fast access to the courses. Diagnosing disabilities or disorders early may help students move forward. In addition to this, early intervention programs should be applied and coordinated by these ministries in the light of official procedures, plans, and regulations.

As Melekoğlu [68] noticed, both universities and other schools need experts and academics. For instance, in North Cyprus, six universities have special education departments, but only a couple of them have doctoral degrees in special education. The government or universities may provide financial and educational support for its graduates to complete their doctoral degrees. There is another dimension which is also critical. Students in the three schools in this study are mainly inclusion students. Based on the findings of this study, it should be affirmed that cooperation between special education teachers and other teachers is of great importance regarding the development of children with disabilities. As the findings show, the participants agreed that time is insufficient for children to learn effectively. Moreover, they stated that they could only elaborate on numbers, money, and addition because of time and teacher shortages. If both teachers cooperate and organize their instruction processes together, the child can benefit at a maximum level. In order to achieve such cooperation, all teacher candidates in the faculties of education should be educated with a cross-categorical understanding perspective. Namely, special education teachers should become experts in other discipline areas, and other teachers should be well educated to ensure they can design lessons for any student in the classroom. The Ministry of National Education needs to support this cooperation by providing resources, time, and money for teachers. However, in Northern Cyprus, the National Education Law No. 17/1986 is followed, which insufficiently defines the needs and requirements of special education. The Assembly of the Republic, Administrative, Public and Health Affairs Committee discussed the draft Law on Education of Individuals with Disabilities on 2 July 2020. Since the establishment of the Turkish Republic of Northern Cyprus, special education has been carried out according to bylaws and circulars created based on the National Education Law No. 17/1986. As mentioned here, it has been 36 years, but No. 17/1986 has not changed. However, in modern times, special education is an integral part of general education. Almost all other countries in the world are moving forward with the philosophy of “no child is left behind,” underlining the fact that all children must have access to education as every child has the fundamental right to education.

5.2. Recommendations

The Public and Health Affairs Committee has addressed particular issues based on the Universal Declaration of Human Rights, the United Nations Convention on the Rights of the Child, the European Union Criteria, the Constitution of the TRNC, and national and international legislation texts, such as the National Education Law. According to the committee, special education principles must include the following:

- (a) Early diagnosis in light of scientific approaches;
- (b) Having access to qualified education and an appropriate educational environment at the earliest possible age;
- (c) In line with the general objectives and basic principles of the Turkish Cypriot National Education, being able to access general and/or vocational education free of charge;
- (d) To have the maximum benefit from the individualized education programs (IEPs), which will be prepared considering all their developmental characteristics, with all the opportunities of the educational environments in which they are placed;
- (e) Helping children with disabilities to have quality time with peers;
- (f) At every stage of their education life, considering the characteristics specified in the individualized education programs, their evaluation is legally secured;
- (g) To benefit from all kinds of rehabilitation services uninterruptedly in line with their needs;
- (h) To benefit from effective monitoring services that will prepare them for training programs or appropriate higher education institutions in line with their development;
- (i) The active participation of their families in the decision and implementation stages of all services to be provided; and
- (j) Providing lifelong education services and helping them join the community as active members [69].

According to these principles, a new mathematics curriculum should be designed to teach problem solving skills. As previously mentioned, there are numerous types of disabilities, and the type of disability is key regarding the level of learning mathematics. For instance, people with profound mental disabilities who can only develop basic self-care and vital communication skills [70] cannot be taught mathematics. Yet a person with mild to moderate profoundly mentally disabled may learn basic numerical skills, computation skills, and base ten system [71].

As the law is modified, experts who specialize in teaching mathematics to children with disabilities should conduct research studies, collect data, and analyze the current situation. For each type of disability, a teacher handbook should be prepared. This handbook should include process and content standards and mathematics objectives according to the disability. The handbook should also help teachers teach chapters by stages based on everyday life problems. Manipulatives must be designed and prepared by professionals, and different manipulatives must be used for every chapter, if necessary. The National Ministry of Education should provide manipulatives for every school.

We have some noteworthy ideas for future research work. All teachers stated that the lack of manipulatives is a disadvantage. Therefore, a replication of this study should be done after providing the necessary manipulatives. Classifying students based on their disabilities is another teacher concern. Teaching and learning mathematics can be examined in homogenous groups. Relevant to the existing literature and the findings of this study, it is observed that IEPs are very teacher-centered, and the focus is on procedural mathematics knowledge. Butler, Beckingham, and Novak [47] also stated that previous research studies focus on basic skills rather than on conceptual skills. However, the current understanding of the new curricula is based on constructivism that supports people to intrinsically learn for themselves. In other words, it is an approach to help students develop responsibility for their own learning, although instruction in special education uses the “direct approach” [72]. Experimental research studies should also be conducted to determine the most efficient way to teach mathematics in particular groups, such as students with mild mental handicap and hearing disability, etc. Therefore, we need to bring mathematics teaching experts and special education teachers together to collaborate. Co-teaching is another point to be studied in order to see the differences implementing of an IEP. Future researchers should also focus on the possible conclusions of applications of constructivist learning theory, concentrating on conceptual learning rather than procedural knowledge.

Gallagher [73] stated that research studies about disability are concerned not only with differences among people in their behavior, appearance, functioning, sensory acuity, and cognitive processing, but more importantly, they are concerned with the meaning we attach to these differences. She also added that traditional practices might have been keeping disabled students “disabled”. Based on the literature findings, each disability should be elaborated and defined correctly since the term disability comprises a cultural/social phenomenon. Akpan and Beard [74] stated that the constructivist teaching approach is about accepting student autonomy, letting student thinking drive instruction, valuing dialogue, inquiry, and guesswork, and assessing student learning in the context of instruction. This approach helps teachers collect more information about their students and design lessons. Akpan and Beard [74] argue that “social interaction among students as learners is at the core of knowledge construction as individuals”. Therefore, interactive classrooms are the best place for students with disabilities. However, it is also important to define who is disabled. As Gallagher [73] points out, the individual needs of the learner should be clarified before the lesson is designed. For students with neuro-related behaviors, such as learning disabilities, attention deficit hyperactivity disorder, sensory integration disorder, and bipolar disorder, the brain’s ability to process information is impaired, requiring teachers to guide processes and provide clear, reliable, and consistent feedback to students [74].

5.3. Weakness of the Study

Almost all research studies have limitations or weaknesses [75]. Like any research study, particular weaknesses are addressed here. In this study, the interviewing method is used, and the findings reflect what the participants shared. However, their statements are limited to what they have explained to the researcher. The participants may have indicated opinions different from their actual thoughts. Additionally, since they were not observed during their teaching or when preparing an Individual Education Program, the findings rely solely on their statements.

Ten questions were asked to the participants during their working hours, and the teachers all tried to answer the questions shortly with little detail. This might have led the authors to obtain and analyze less data than expected.

The teachers' perspectives on teaching mathematics to children with disabilities may have affected the way they teach mathematics and thus their responses.

In Northern Cyprus, there are only a few schools delivering special education, with few students and teachers. Although generalization is not an aim of qualitative research, the small sample size is still a weakness of this study.

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