digital

MDPI

Article

The Effects of Augmented Reality on Very Young Learners' Motivation and Learning of the Alphabet and Vocabulary

Eleni Korosidou

Department of Primary Education, University of Western Macedonia, 53100 Florina, Greece; ekorosidou@uowm.gr

Abstract: This study aspires to contribute some initial results to the growing area of research regarding technology potential in the field of early foreign language literacy. An experiment was conducted to examine very young learners' alphabet and vocabulary learning and retention in an early foreign language (FL) learning context when implementing augmented reality (AR) applications, while very young learners' motivation was also assessed. A pilot intervention was implemented in a state school in northern Greece. The participants (n = 26) were primary school first-graders (5.5–6 years old) and were assigned into two groups, experimental (13) and control (13). To examine the effects of the intervention, this current study employed two instruments: (a) a pre-test–post-test model to assess young learners' alphabet and vocabulary learning during three phases and (b) a questionnaire to assess their motivation during the learning process. The findings of this study reveal that both groups displayed significant improvements in FL alphabet and vocabulary learning; however, there are statistical differences in favor of the experimental group regarding long-term alphabet and vocabulary learning and retention. Furthermore, qualitative results regarding children's perceptions of the technology used indicate that AR was highly appealing and motivating to participating students.

Keywords: augmented reality; foreign language; alphabet and vocabulary learning; retention; motivation; early childhood

Citation: Korosidou, E. The Effects of Augmented Reality on Very Young Learners' Motivation and Learning of the Alphabet and Vocabulary. *Digital* **2024**, *4*, 195–214. https://doi.org/10.3390/digital4010010

Academic Editor: Manuel Reis

Received: 11 January 2024
Revised: 3 February 2024
Accepted: 8 February 2024
Published: 13 February 2024

1. Introduction

The integration of technology has transformed the learning environment into a more engaging, interactive, authentic, and joyful environment [1,2]. Additionally, increasing children's motivation to learn a new language is an important factor in acquiring language skills [3]. Augmented reality (AR) is defined as "the real-time insertion of computer-generated three-dimensional content into a real scene" [4] (p. 357). AR learning resources are characterized by dynamic interactions and the creation of visualization learning environments that facilitate children's understanding [5]. To Yang [6], AR books are one of the cornerstones that allow for bridging the digital world with the real one, offering interactive experiences that make learning a pleasurable experience for digital native learners. According to Lee [7], 3D-rendered models embedded into books with AR technology allow young children to read books in a more engaging and realistic way. Furthermore, AR-based games, such as board games or map-based games, create links between the real environment and virtual elements and are widely used by teachers since they seem to facilitate learners in forming new relationships or connections between items [8]. AR applications attract attention in language learning settings, as they enable the interface between reality and digital information, therefore allowing learners to use the target language to convey their ideas [9] in a live direct or indirect real-world environment in real time [10].

The impact of AR on early foreign language vocabulary seems to be positive, with AR facilitating vocabulary learning and leading to increased motivation levels with preschoolers [11]. AR technology can also be a favorable tool for the enhancement of older

students' motivation during language learning [12]. Although there is an increase in the number of studies on AR integration in early target language learning, there is still space for additional research since the early childhood period is crucial for language familiarization and development. In the Greek context, research findings have demonstrated that mobile devices offer unique possibilities for learner-centered approaches to teaching and the implementation of innovative language teaching practices, not usually experienced in other learning tools [13]. Researchers incorporated AR into various areas such as physics [14,15], history [16], or mathematics [17], underlining the pedagogical value of AR technology. However, studies about the use of AR educational applications in the field of early foreign language are rather sparse [18,19], mostly placing emphasis on the use of AR games or AR books [20,21] rather than on applications integrated into the learning process to enable familiarization with the target language. In this light, there is a need to further investigate the use of AR applications and the possibilities they can offer in early foreign language (FL) teaching and learning. In this current study, AR applications were used to investigate possible differences in the performance and learning motivation of very young language learners studying an FL. More specifically, this study presents a pilot intervention that was designed and implemented in the context of learning English as an FL, focusing on primary school children's familiarization with the English alphabet and basic vocabulary, associated with the alphabet letters presented.

This study is structured as follows: first, a brief reference is made to the theoretical framework related to the educational use of AR applications in the field of foreign/second language teaching and learning. The design and implementation of the pilot program is then described, followed by its evaluation. This paper concludes with the presentation of the conclusions of the study, their connection with the results of related research, and a number of suggestions for future research.

2. Literature Review

In the field of early literacy, alphabet knowledge refers to children's ability to match the name of a letter with its shape as well as with one or two sounds corresponding to that particular letter in written speech [22]. It is measured by recognition, production, and writing tasks. Knowledge of the alphabet seems to be of primary importance, as it is linked to the acquisition of skills of understanding, the production of written language, and the possibility of predicting the acquisition of these skills [23–25]. Alphabet familiarization is usually conducted through the use of flashcards, songs, and/or videos, as well as related worksheets or the use of educational software, enabling users to interact by means of a mouse and keyboard, which is considered a traditional approach.

Regarding vocabulary learning in early foreign/second language contexts, Wilkins states that "without grammar, very little can be conveyed, without vocabulary nothing can be conveyed" [26] (pp. 111–112), pointing out that vocabulary development is paramount for interaction and successful communication. When words are used in a context, they become more easily absorbed and remembered, and including the written form of a word on a flashcard when introducing it helps learners remember its spelling [27]. Researchers also argue that even hearing a new word only once is sufficient for children to learn it receptively [28], although productive vocabulary knowledge will require more time and exposure. Chela-Flores [29] (pp. 85–101) also recommends the integration of pronunciation into language programs under the perspective that pronunciation has to be given the same attention as grammar and vocabulary for language learning.

As is recorded in the relevant literature, early familiarization with a target language and the creative use of technology is recommended for effective language learning [30]. Animation and multimedia tools attract children's attention and are effective in enhancing motivation [31]. According to Cabero and Barosso [32], the learning experiences created through the use of AR applications seem to (a) facilitate the understanding of complex ideas in various fields of knowledge, (b) encourage students to understand and reinforce new knowledge through visualizing the content and through contact with additional

data in a different form, (c) increase learning motivation through discovery processes, (d) promote authenticity through access to authentic content during language learning, (e) promote engagement in the learning process and interactivity, resulting in better student performance, (f) and promote learning through the use of digital technologies, enhancing the cultivation of 21st century skills.

The term AR actually applies to "any technology that combines real and virtual information in a meaningful way. . . therefore, the AR concept is not limited to any one type of technology" [33] (p. 42). An AR interface allows the user to use physical objects in order to interact with virtual ones in a natural way. Studies examining the use of AR technology in foreign language learning contexts with young learners reveal its definite advantages in alphabet and vocabulary learning, providing learners with ample opportunities to "animate" information and to visualize letters or words, simultaneously offering exposure to their written forms and pronunciation. Researchers observe that, in AR-based alphabet books with preschoolers, where they are provided with presentations of the corresponding letter patterns and animations of letter drawings, 3D models of objects starting with each alphabet character and puzzle games that test children's knowledge create an effective and enjoyable learning environment [34,35]. Moreover, enhancing vocabulary and grammar structure learning with the use of AR applications by incorporating AR activities into an educational book has been shown to facilitate the development of English language skills as well as the learning of vocabulary and grammatical structures [36]. Hung, Chen, and Huang [37] found that, in addition to new opportunities for teaching and learning [38], possibilities are offered through AR applications for better understanding in relation to other teaching materials, therefore facilitating the learning process. Tsai [39] compared a traditional language learning approach focused on lecturing to an AR approach in order to assess English vocabulary learning in a primary education context. The findings demonstrated differences in relation to the motivation and academic performance of young learners taught by employing AR applications and proved to be superior to those taught by employing traditional lecturing approaches. Furthermore, there seems to be a positive correlation between students' motivation and an AR experience-enhanced learning process, as both motivation and student involvement in the learning process are improved [40]. Relevant studies document high levels of participant excitement when engaging in AR learning experiences [41,42], as well as high levels of satisfaction for preschoolers and their willingness to repeat AR activities [40]. The degree of involvement of elementary school students in activities also seems to vary as regards their motivation [43], with AR-supported materials having a positive impact on students' understanding, success, and motivation while acquiring English vocabulary [44,45]. Research [46] also shows that mobile learning and AR applications can be both intrinsically and extrinsically motivating and promote cooperation and collaborative work. Last but not least, Parmaxi et al. [47] attempted a research review, focusing on AR-based projects in an English as a foreign language-learning classroom, underlining the importance of AR in an FL curriculum.

3. Materials and Methods

3.1. Aim and Research Questions

The primary aim of this study was to investigate the effectiveness of using AR-based applications for alphabet and associated vocabulary learning and retention in the first grade of primary school in the context of learning English as an FL. The research questions posed were the following:

1. What is the effect of the use of AR-based applications regarding learning and retention of the alphabet and related vocabulary in the early learning of English as an FL?
2. How does the use of AR applications affect early childhood learners' motivation to learn English as an FL?

3.2. Context of the Study and Participants

The pilot intervention designed was implemented in a state primary school in a suburban area in northern Greece. Participants were 26 first graders (5.5–6 years), 13 boys and 13 girls, who had never before attended English classes in an official context. They were of both native and non-native origin (22 Greeks, 3 Albanians, and 1 Ukrainian), all learning English as an FL. The children attended two classes in the same state primary school and were randomly divided in two groups, an experimental (n = 13) and a control group (n = 13).

3.3. Research Procedure

3.3.1. Design and Implementation of the Syllabus

The primary purpose of the pilot intervention was very young learners' familiarization with the English alphabet as well as associated vocabulary relevant to each letter of the alphabet and suitable for the age and language level of the participants.

In the traditional approach, very young learners of the control group were given tracing and drawing worksheets, as well as letter and word repetition activities, regarding both capital and lower-case letters as well as associated vocabulary. In addition, lecturing with vocabulary cards was employed, videos were shown, and pronunciation familiarization in the target language was sought through songs. On the other hand, AR applications were used with the learners of the experimental group. AR alphabet letters and AR vocabulary presented to the experimental group followed the alphabet sequence of the Alpha and Beta English coursebooks (http://rcel.enl.uoa.gr/peap/en accessed on 4 December 2023.). These coursebooks are approved by the Greek Ministry of Education and Religious Affairs to be taught in Greek state schools in early language learning contexts. There was a provision that the order of the letters, as they appear in the alphabet, should not be followed. According to the relevant literature, for the effective learning of an alphabet, emphasis should be placed on the name of the letters as well as the knowledge of the sound of the letters, while the ability to recall the name of the letters and the ability to recall the sound and the writing of the letters are predictive indicators that link emergent literacy with the later acquisition of reading comprehension and spelling skills [48]. Additionally, alphabet letters were related to vocabulary under the thematic categories "Animals", "Everyday Objects", and "Food". The integration of the AR-based technology into language teaching and learning followed the principles of the Situational Language Teaching approach, viewing speech, structure, and a set of basic vocabulary as fundamental for language learning. Therefore, the mini-syllabus created was designed upon a word list and relevant activities, ensuring that "all learning takes place within a specific context, and the quality of the learning is a result of interactions among the people, places, objects processes and culture within and relative to that given context" [49] (p. 736). The words presented in the material were taken from frequency wordlists. The criteria for the selection of vocabulary was not only the frequency of occurrence but also the connection of the words to the alphabet letters to be learned. The aim was to build word links via presenting vocabulary around specific topics, on the grounds that new vocabulary should be presented in a context familiar to very young learners, with the provision of visual aids to trigger their memory and help them make associations.

To complete the AR activities, the children of the experimental group were asked to draw given pictures that represented the vocabulary. These elements, as well as the related letters, were augmented with the help of tablet devices. They were provided with ample opportunities to interact with virtual representations of the AR alphabet letters and the related AR vocabulary, e.g., "Zz" and "zebra" (Figures 1 and 2). The AR applications included gamification elements (time elements, reward sounds, leaderboards, etc.) as well as audio, giving students opportunities to hear letter sounds as well as associated vocabulary in the target language. In addition, very young learners participated in playful activities in a digital environment (e.g., anagramming the relevant vocabulary, matching

the sound and picture, and dragging and placing letters in the right order to form a given word).

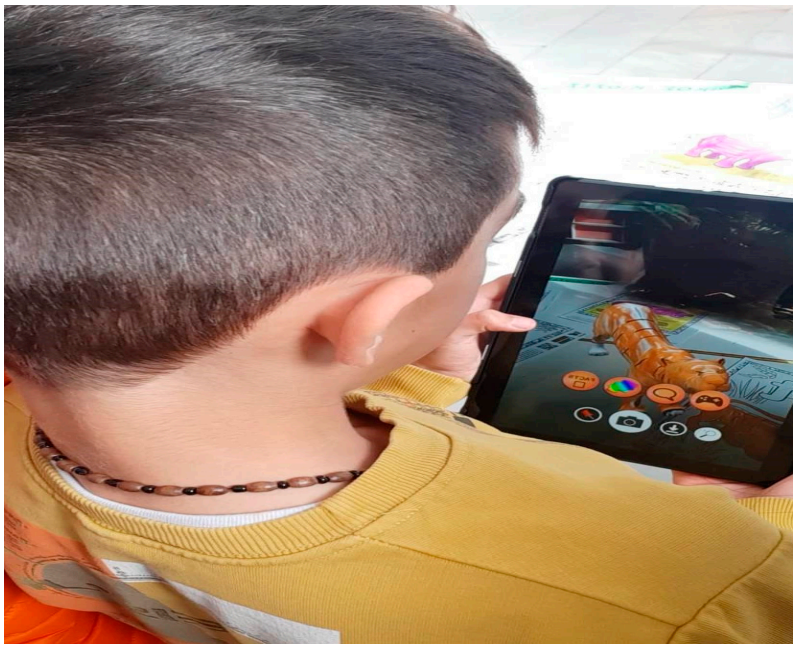


Figure 1. Early childhood learners' interaction with AR-based applications.

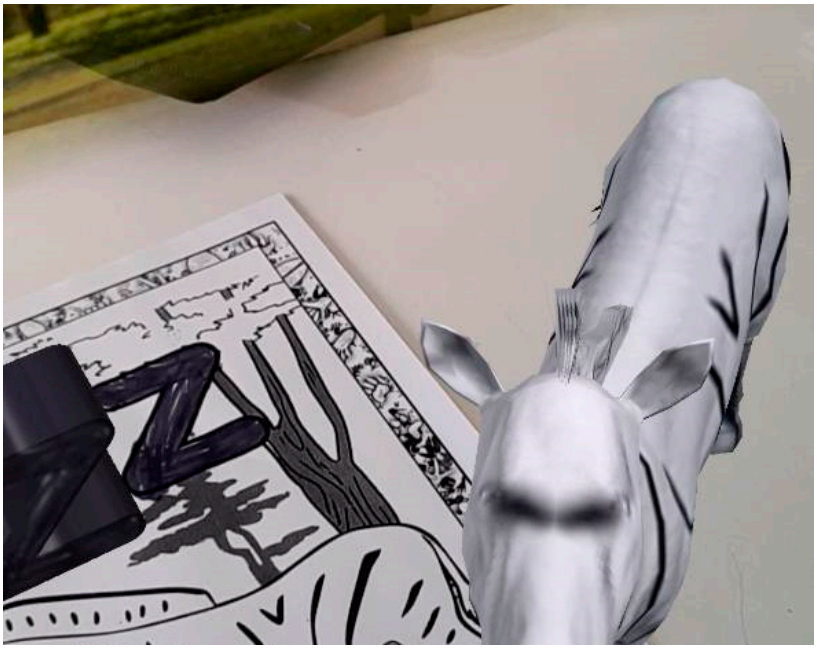


Figure 2. ' Interaction with AR-based applications.

The pilot program was implemented during an 8-week period, where both the control and the experimental group were taught English as an FL for 2 h per week. The teaching covered the same number of letters and vocabulary words per week for both groups. The process was repeated until the alphabet was completed. The weekly design of the program implemented is depicted in Figure 1.

3.3.2. Research Instruments

(a) Pre- and post-test

A pre-test and post-test model was employed with pre- and post-intervention measurements to assess the effect of using AR-based educational applications on children's learning of English alphabet letters and vocabulary and their retention levels. The non-parametric Wilcoxon test was chosen since the data did not follow normal distribution [48].

Firstly, the alphabet letters test was conducted as a pre-test, which consisted of two parts. In the first part (Appendix A), the children were asked to match an alphabet letter to a concept given as a picture. Both capital and lower-case letters were provided for each test item. In the second part (Appendix B), the children were asked to match a word, starting with a specific alphabet letter, to a concept given as a picture. The words in the test were the ones the very young learners had been familiarized with during the implementation stage.

The procedure applied was as follows: all the children were given the pre-test at the beginning of each week. Afterwards, the traditional approach was followed for the control group, and the approach using AR applications was employed with the experimental group. After 1 week of implementation, the same test was applied as a post-test, while a pre-test for the next unit followed (Figure 3).

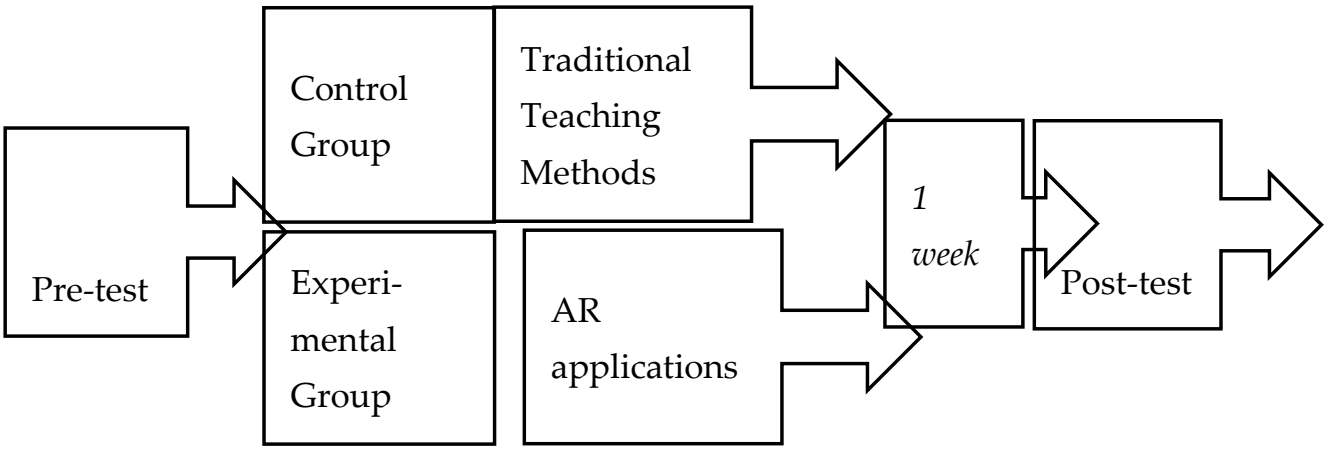


Figure 3. Implementation stages of the pilot program for the experimental and control groups on a weekly basis.

(b) Motivation assessment questionnaire

Regarding learning motivation, an assessment questionnaire was created on the basis of the ARCS motivation model [50], which incorporates motivation-related theories to facilitate learning, enhancing the improvement of students' motivation. In the ARCS motivation model, the main factors of motivation are considered, namely, attention (A), relevance (R), confidence (C), and satisfaction (S).

Questionaries were completed via face-to-face interviews conducted in two phases (A and B) with all the participants of the experimental and the control groups (a) at the mid-period of the intervention (after week 4) (Phase A) and (b) within a week after the final tests (Phase B). The questionnaire (Appendix C) was completed by the researcher, in collaboration with the class teacher, so as to ensure that the children felt comfortable expressing their views. Questions were posed by the class teacher in an oral form in the children's mother tongue (Greek) in order to be easily understood.

4. Results

4.1. Pre- and Post-Test

Data for all variables were processed in the IBM SPSS v.26 program. The initial processing of the pre-test and post-test data revealed statistically significant differences for the experimental group, demonstrating the positive effect of AR applications on early

childhood learners' performance. In more detail, statistically significant differences were recorded in Part B of the test, with learners of the experimental group showing particular improvement in vocabulary retention in Phases 2 and 3, as well in Part A during Phase 3.

More specifically, in Phase 1, statistically significant differences were recorded for both the experimental group and the control group in Parts A and B of the test (Tables 1–4). Although the mean scores were greater for the control group, revealing they performed better in the pre-test, significant differences were observed for both groups in both parts of the post-test. More specifically, a Wilcoxon signed-ranks test indicated that the post-test ranks were statistically significantly higher than the pre-test ranks ($Z = 3.020$, $p < 0.003$) for the experimental group, and the post-test ranks were statistically significantly higher than the pre-test ranks ($Z = 2.410$, $p < 0.016$) for the control group.

Table 1. Wilcoxon test results for independent groups performed for the experimental group's pre-test and post-test scores, Phase 1, Part A.

Experimental Group		Phase 1	Z	*p*
Pre-test, Part A	Mean	1.077	3.020	0.003
	Std. Dev.	1.0377		
Post-test, Part A	Mean	2.538		
	Std. Dev.	1.8536		

Table 2. Wilcoxon test results for independent groups performed for the control group's pre-test and post-test scores, Phase 1, Part A.

Control Group		Phase 1	Z	*p*
Pre-test, Part A	Mean	2.538	2.410	0.016
	Std. Dev.	1.9839		
Post-test, Part A	Mean	3.846		
	Std. Dev.	1.7246		

Table 3. Wilcoxon test results for independent groups performed for the experimental group's pre-test and post-test scores, Phase 1, Part B.

Experimental Group		Phase 1	Z	*p*
Pre-test, Part B	Mean	1.538	2.156	0.031
	Std. Dev.	1.1266		
Post-test, Part B	Mean	2.769		
	Std. Dev.	1.7394		

Table 4. Wilcoxon test results for independent groups performed for the control group's pre-test and post-test scores, Phase 1, Part B.

Control Group		Phase 1	Z	*p*
Pre-test, Part B	Mean	2.692	2.060	0.039
	Std. Dev.	2.3588		
Post-test, Part B	Mean	4.077		
	Std. Dev.	1.7541		

In Phase 1, Part B, the Wilcoxon signed-ranks test indicated that the post-test ranks were statistically significantly higher than the pre-test ranks (Z = 2.156, $p < 0.031$) for the experimental group, and the post-test ranks were statistically significantly higher than the pre-test ranks (Z = 2.060, $p < 0.039$) for the control group.

In Phase 2, statistically significant differences were recorded for both the experimental and the control group in Part A of the test (Tables 5 and 6). Although the mean scores remained greater for the control group, statistically significant differences were observed only for the experimental group in Part B of the post-test (Tables 7 and 8), underlining the positive effect of AR applications regarding vocabulary learning and retention. More specifically, the Wilcoxon signed-ranks test indicated that the post-test ranks were statistically significantly higher than the pre-test ranks (Z = 3.020, $p < 0.003$) for the experimental group, and the post-test ranks were statistically significantly higher than the pre-test ranks (Z = 2.232, $p < 0.026$) for the control group.

Table 5. Wilcoxon test results for independent groups performed for the experimental group's pre-test and post-test scores, Phase 2, Part A.

Experimental Group		Phase 2	Z	*p*
Pre-test, Part A	Mean	1.077	3.020	0.003
	Std. Dev.	1.0377		
Post-test, Part A	Mean	2.538		
	Std. Dev.	1.8536		

Table 6. Wilcoxon test results for independent groups performed for the control group's pre-test and post-test scores, Phase 2, Part A.

Control Group		Phase 2	Z	*p*
Pre-test, Part A	Mean	2.615	2.232	0.026
	Std. Dev.	2.4337		
Post-test, Part A	Mean	3.769		
	Std. Dev.	1.9215		

Table 7. Wilcoxon test results for independent groups performed for the experimental group's pre-test and post-test scores, Phase 2, Part B.

Experimental Group		Phase 2	Z	*p*
Pre-test, Part B	Mean	1.077	2.869	0.004
	Std. Dev.	0.7596		
Post-test, Part B	Mean	2.615		
	Std. Dev.	1.2609		

Table 8. Wilcoxon test results for independent groups performed for the control group's pre-test and post-test scores, Phase 2, Part B.

Control Group		Phase 2	Z	*p*
Pre-test, Part B	Mean	2.846	1.633	0.102
	Std. Dev.	2.2303		
Post-test, Part B	Mean	3.462		
	Std. Dev.	2.1454		

In Phase 2, Part B, the Wilcoxon signed-ranks test indicated that the post-test ranks were statistically significantly higher than the pre-test ranks (Z = 2.869, $p < 0.004$) for the experimental group. The Wilcoxon signed ranks test indicated that the post-test ranks were not higher, with no statistically significant differences for the control group.

In Phase 3 (Tables 9–12), statistically significant differences were recorded for the experimental group in both parts of the test (Tables 9 and 11). No statistically significant differences were observed for the control group (Tables 10 and 12). Mean scores remained greater for the control group; however, the results revealed the long-term positive effect of AR applications regarding both alphabet and vocabulary learning and retention. More specifically, the Wilcoxon signed-ranks test indicated that the post-test ranks were statistically significantly higher than the pre-test ranks (Z = 2.646, $p < 0.008$) for the experimental group, whereas the post-test ranks were not higher, with no statistically significant differences for the control group.

Table 9. Wilcoxon test results for independent groups performed for the experimental group's pre-test and post-test scores, Phase 3, Part A.

Experimental Group		Phase 3	Z	*p*
Pre-test, Part A	Mean	1.077	2.646	0.008
	Std. Dev.	1.2558		
Post-test, Part A	Mean	1.615		
	Std. Dev.	0.9608		

Table 10. Wilcoxon test results for independent groups performed for the control group's pre-test and post-test scores, Phase 3, Part A.

Control Group		Phase 3	t	*p*
Pre-test, Part A	Mean	2.923	1.732	0.083
	Std. Dev.	1.8467		
Post-test, Part A	Mean	3.154		
	Std. Dev.	1.5730		

Table 11. Wilcoxon test results for independent groups performed for the experimental group's pre-test and post-test scores, Phase 3, Part B.

Experimental Group		Phase 3	Z	*p*
Pre-test, Part B	Mean	1.385	2.236	0.025
	Std. Dev.	1.0439		
Post-test, Part B	Mean	1.769		
	Std. Dev.	0.8321		

Table 12. Wilcoxon test results for independent groups performed for the control group's pre-test and post-test scores, Phase 3, Part B.

Control Group		Phase 3	Z	*p*
Pre-test, Part B	Mean	2.615	1.342	0.180
	Std. Dev.	1.7097		
Post-test, Part B	Mean	2.923		
	Std. Dev.	1.3821		

In Phase 3, Part B, the Wilcoxon signed-ranks test indicated that the post-test ranks were statistically significantly higher than the pre-test ranks ($Z = 2.236$, $p < 0.025$) for the experimental group. The Wilcoxon signed-ranks test indicated that the post-test ranks were not higher, with no statistically significant differences for the control group.

4.2. Motivation Assessment Questionnaire

All the participants' perceptions regarding the four motivation factors are recorded in the following tables (Tables 13–20). In the following tables (Tables 13–20), "FL" is used to refer to English as an FL.

First of all, in relation to the attention motivation factor (Tables 13 and 14), it is possible to observe that most of the participants of the experimental group perceived the FL as easy during both Phase A and Phase B, whereas participants of the control group mostly perceived the FL as useful for their life. This observation can be attributed to AR applications being appealing to very young learners.

Table 13. Attention motivation factor for the experimental group in Phase A and Phase B.

Experimental Group	Phase A	Phase B
Participant 1	I think FL learning is easy.	I think FL learning is easy.
Participant 2	I am good at FL learning.	I think FL learning is easy.
Participant 3	I like FL lessons at school.	I think FL learning is easy.
Participant 4	I think FL learning is easy.	I think FL learning is easy.
Participant 5	I really like the materials we have in FL class.	I think FL learning is easy.
Participant 6	I really like the materials we have in FL class.	I am good at FL learning.
Participant 7	I think FL learning is easy.	I think FL learning is easy.
Participant 8	I am good at FL learning.	I think FL learning is easy.
Participant 9	I think FL learning is easy.	I am good at FL learning.
Participant 10	I really like the materials we have in FL class.	I really like the materials we have in FL class.
Participant 11	I think FL learning is easy.	I think FL learning is easy.
Participant 12	I really like the materials we have in FL class.	I think FL learning is easy.
Participant 13	I think FL learning is easy.	I think FL learning is easy.

Table 14. Attention motivation factor for the control group in Phase A and Phase B.

Control Group	Phase A	Phase B
Participant 1	FL learning is a bit difficult.	FL learning is a bit difficult.
Participant 2	FL learning is useful for my life.	FL learning is a bit difficult.
Participant 3	FL learning is useful for my life.	I am good at FL learning.
Participant 4	FL learning is a bit difficult.	FL learning is useful for my life.
Participant 5	FL learning is a bit difficult.	I am good at FL learning.
Participant 6	FL learning is useful for my life.	FL learning is a bit difficult.
Participant 7	I think FL learning is easy.	FL learning is useful for my life.
Participant 8	FL learning is useful for my life.	FL learning is useful for my life.
Participant 9	FL learning is useful for my life.	FL learning is useful for my life.
Participant 10	FL learning is useful for my life.	FL learning is useful for my life.
Participant 11	I really like the materials we have in FL class.	I am good at FL learning.
Participant 12	FL learning is useful for my life.	FL learning is useful for my life.
Participant 13	I really like the materials we have in FL class.	I think FL learning is easy.

Considering the relevance motivation factor (Tables 15 and 16), it is possible to observe that most of the participants of both the experimental and the control groups considered the FL to be important. This observation can be interpreted if we take into account the

perceptions of what "others" in children's lives (parents, teachers, siblings) consider important, with these people usually insisting on the importance of children learning English as an FL, relating it to their future academic success. It is worth noting that participants of the experimental group also stated that they have fun in their FL classes, probably finding the AR-based applications used in the learning process motivating and fun.

Table 15. Relevance motivation factor for the experimental group in Phase A and Phase B.

Experimental Group	Phase A	Phase B
Participant 1	I have fun in my FL class.	I have fun in my FL class.
Participant 2	FL learning is very important for me.	I have fun in my FL class.
Participant 3	I have fun in my FL class.	FL learning is very important for me.
Participant 4	FL learning is very important for me.	FL learning is very important for me.
Participant 5	FL learning is very important for me.	FL learning is very important for me.
Participant 6	FL learning is very important for me.	FL learning is very important for me.
Participant 7	FL learning is very important for me.	FL learning is very important for me.
Participant 8	I think I can learn an FL very well.	I have fun in my FL class.
Participant 9	FL learning is very important for me.	FL learning is very important for me.
Participant 10	FL learning is very important for me.	FL learning is very important for me.
Participant 11	I think I can learn an FL very well.	I have fun in my FL class.
Participant 12	FL learning is very important for me.	I have fun in my FL class.
Participant 13	I have fun in my FL class.	I have fun in my FL class.

Table 16. Relevance motivation factor for the control group in Phase A and Phase B.

Control Group	Phase A	Phase B
Participant 1	FL learning is very important for me.	FL learning is very important for me.
Participant 2	FL learning is very important for me.	FL learning is very important for me.
Participant 3	I have fun in my FL class.	FL learning is very important for me.
Participant 4	I have fun in my FL class.	I think I can learn an FL very well.
Participant 5	FL learning is very important for me.	I think FL learning is boring.
Participant 6	I have fun in my FL class.	FL learning is very important for me.
Participant 7	FL learning is very important for me.	I think I can learn an FL very well.
Participant 8	I have fun in my FL class.	FL learning is very important for me.
Participant 9	I have fun in my FL class.	FL learning is very important for me.
Participant 10	I have fun in my FL class.	I think FL learning is boring.
Participant 11	FL learning is very important for me.	FL learning is very important for me.
Participant 12	I have fun in my FL class.	I have fun in my FL class.
Participant 13	I have fun in my FL class.	I have fun in my FL class.

As far as the confidence motivation factor (Tables 17 and 18) is concerned, most participants of both the experimental and the control groups considered FL lessons as either interesting or appealing, since they liked having FL classes. This observation can be interpreted if we consider the fact that first graders in Greek primary schools are familiarized with English in a relaxed and playful environment with appropriate materials. However, it needs to be mentioned that participants of the control group also stated that they could perform well in FL tests, probably connecting FL learning to a more traditional learning context, where tests are employed to evaluate progress.

Table 17. Confidence motivation factor for the experimental group in Phase A and Phase B.

Experimental Group	Phase A	Phase B
Participant 1	I really like having FL classes.	The FL lessons in the classroom are very interesting.
Participant 2	I really like having FL classes.	The FL lessons in the classroom are very interesting.
Participant 3	I really like having FL classes.	
Participant 4	The FL lessons in the classroom are very interesting.	The FL lessons in the classroom are very interesting.
Participant 5	The FL lessons in the classroom are very interesting.	The FL lessons in the classroom are very interesting.
Participant 6	I really like having FL classes.	I really like having FL classes.
Participant 7	I really like having FL classes.	I really like having FL classes.
Participant 8	I really like having FL classes.	I really like having FL classes.
Participant 9	The FL lessons in the classroom are very interesting.	I really like having FL classes.
Participant 10	I really like having FL classes.	The FL lessons in the classroom are very interesting.
Participant 11	The FL lessons in the classroom are very interesting.	The FL lessons in the classroom are very interesting.
Participant 12	I really like having FL classes.	I really like having FL classes.
Participant 13	The FL lessons in the classroom are very interesting.	The FL lessons in the classroom are very interesting.

Table 18. Confidence motivation factor for the control group in Phase A and Phase B.

Control Group	Phase A	Phase B
Participant 1	I can do very well in FL tests.	I really like having FL classes.
Participant 2	I can do very well in FL tests.	I really like having FL classes.
Participant 3	What my FL teacher tells me makes me think I am doing very well.	I really like having FL classes.
Participant 4	The FL lessons in the classroom are very interesting.	I really like having FL classes.
Participant 5	I really like having FL classes.	I really like having FL classes.
Participant 6	I really like having FL classes.	I really like having FL classes.
Participant 7	I can do very well in FL tests.	I can do very well in FL tests.
Participant 8	I can do very well in FL tests.	I can do very well in FL tests.
Participant 9	I can do very well in FL tests.	What my FL teacher tells me makes me think I am doing very well.
Participant 10	The FL lessons in the classroom are very interesting.	The FL lessons in the classroom are very interesting.
Participant 11	I really like having FL classes.	The FL lessons in the classroom are very interesting.
Participant 12	I really like having FL classes.	I like having FL classes.
Participant 13	The FL lessons in the classroom are very interesting.	The FL lessons in the classroom are very interesting.

As regards the satisfaction motivation factor (Tables 19 and 20), participants of both the experimental and the control groups stated that they were very happy to learn an FL, therefore showing their satisfaction concerning language learning. The majority of the participants of the experimental group also mentioned that they considered the activities they did in the FL class as fun, indicating the motivating nature of the AR-based activities employed.

Table 19. Satisfaction motivation factor for the experimental group in Phase A and Phase B.

Experimental Group	Phase A	Phase B
Participant 1	I am very happy to learn an FL.	I am very happy to learn an FL.
Participant 2	The activities we do in the FL class are fun.	I am very happy to learn an FL.
Participant 3	I am very happy to learn an FL.	I am very happy to learn an FL.
Participant 4	I am very happy to learn an FL.	I am very happy to learn an FL.
Participant 5	The activities we do in the FL class are fun.	The activities we do in the FL class are fun.
Participant 6	The activities we do in the FL class are fun.	I am very happy to learn an FL.
Participant 7	The activities we do in the FL class are fun.	The activities we do in the FL class are fun.
Participant 8	I am very happy to learn an FL.	I am very happy to learn an FL.
Participant 9	The activities we do in the FL class are fun.	The activities we do in the FL class are fun.
Participant 10	The activities we do in the FL class are fun.	The activities we do in the FL class are fun.
Participant 11	I am very happy to learn an FL.	The activities we do in the FL class are fun.
Participant 12	The activities we do in the FL class are fun.	The activities we do in the FL class are fun.
Participant 13	The activities we do in the FL class are fun.	The activities we do in the FL class are fun.

Table 20. Satisfaction motivation factor for the control group in Phase A and Phase B.

Control Group	Phase A	Phase B
Participant 1	I am very happy to learn an FL.	I am very happy to learn an FL.
Participant 2	I am very happy to learn an FL.	I am very happy to learn an FL.
Participant 3	I am very happy to learn an FL.	I am very happy to learn an FL.
Participant 4	The activities we do in the FL class are fun.	The activities we do in the FL class are fun.
Participant 5	The activities we do in the FL class are fun.	The activities we do in the FL class are fun.
Participant 6	The activities we do in the FL class are fun.	I am very happy to learn an FL.
Participant 7	I am very happy to learn an FL.	I am very happy to learn an FL.
Participant 8	I am very happy to learn an FL.	FL classes at school make me feel good.
Participant 9	The activities we do in the FL class are fun.	I am very happy to learn an FL.
Participant 10	FL classes at school make me feel good.	I am very happy to learn an FL.
Participant 11	I am very happy to learn an FL.	I am very happy to learn an FL.
Participant 12	I am very happy to learn an FL.	I am very happy to learn an FL.
Participant 13	I am very happy to learn an FL.	The activities we do in the FL class are fun.

5. Discussion and Conclusions

The findings of this current study show that there is a positive impact of AR applications on early childhood learners' alphabet and vocabulary learning and retention, as well as on their motivation levels in an English as an FL-learning context. The development of immersive, interactive experiences seems to enable language learning in a fun and interesting way, also facilitating very young learners' ability to acquire and recall new vocabulary. In this study, very young learners' interaction with AR applications meant the provision of ample opportunities to interact with (a) digital objects, (b) labels imposed on the digital objects, (c) sounds, offering a connection between graphemes and phonemes, and (d) digital games, which enabled them to better learn and recall the FL alphabet and vocabulary.

Drawing on the processing of quantitative data from the pre- and post-tests, it is possible to observe that the mean scores were greater for the control group in all phases of the program, indicating that the control group probably had some previous experience with the FL in an informal context, as they performed better in all phases in the pre-test. However, statistically significant differences were observed for the experimental group in both parts of the post-test in all phases of the program. This finding reveals the AR approach employed was effective as regards alphabet and vocabulary learning and retention. This fact can also be related to the qualitative findings of this study, showing very young learners' high motivation levels while familiarizing themselves with English as an FL with AR applications. It is, however, worth mentioning that the control group participants also appeared to be satisfied and confident during their FL classes. This finding can be interpreted if we take into account the fact that, in the first grade of Greek primary school, emphasis is placed on having fun with the FL and learning in a creative and playful way, with no focus placed on studying or homework. Therefore, children feel that the nature of English lessons is totally different from any other subject they are taught. As a result, children seem to become accustomed to the playful manner of the FL class, seeking approaches that will keep their interest levels high. This observation explains why the experimental group learners remained motivated and achieved better long-term results, presenting statistically significant differences in their performance in Phases 2 and 3 of the pre- and post-tests. Therefore, it seems that the participants of the experimental group were able to remain motivated and engaged in what they were learning because they found the AR approach "fun", "interesting", and, consequently, "easy", with the activities being appealing and appropriate for their age. It can also be assumed that, as they were having fun during learning, their typical distractions were diminished, which resulted in better long-term performance. Furthermore, specifically regarding the satisfaction motivation factor, it was observed that the majority of the participants of the experimental group mentioned that they considered the activities they took part in in the FL class as "fun", indicating the motivating nature of the AR-based applications employed. This fact can also account for the improved performance results of the experimental group obtained in the post-test, despite the fact that the mean scores of their performance were lower at all phases of the intervention in comparison with these of the control group. This assumption can also be supported through the use of digital games in the classroom to enhance student motivation, which, in turn, boosted the outcomes of their learning. What is more, statistically significant differences observed for the experimental group in alphabet and vocabulary learning and retention can be explained by stating that AR applications enable a better understanding of concepts related to words through instant visual representations, while also attracting children's enthusiasm and focus.

The results of this study are consistent with findings from several researchers in the field. Yangin Ersanli [51] also examined the efficacy of AR in enhancing vocabulary learning and retention among young learners, concluding that the intervention was more lasting in the experimental group compared to the control group regarding the retention results. Previous research also implies that augmented reality-based learning resources facilitate children's understanding in an FL learning context [5]. Korosidou and Bratitsis [20] found

significant differences regarding vocabulary acquisition in activities designed for very young learners with the integration of digital storytelling and AR-based applications. Furthermore, positive effects of animated and interactive multimedia were recorded regarding word recognition and writing skills with preschoolers [52]. The results of this study are in line with Çevik et al. [53], supporting the discovery that AR-supported teaching is more effective in terms of English vocabulary learning success than teaching by using more traditional approaches, like pictures or toys.

Previous research findings also underline the finding that AR technology can enhance language learning by making it more interactive and engaging, therefore contributing to students' motivation and interest in language learning [54]. The unique AR interface acts as a natural attention grabber for children [40,55], and they experience feelings of enjoyment when using the application in learning English as an FL [56]. This current research results also confirms previous findings underlining the discovery that the use of digital games in the classroom enhances student motivation [57] and the conclusion that "the AR approach increases engagement in the learning process" [58] (p. 2868).

All in all, the pilot intervention presented with the suggested AR approach cannot lead to the drawing of generalized conclusions. However, the observations and conclusions drawn give a very positive first impression, as it appears that this novel teaching approach generated enthusiasm and stimulated the interest of the participating early childhood learners, who remained focused and motivated all throughout the implementation of the pilot program and the AR activities in the FL class. The use of the applications, combining virtual and real elements, as well as sound and image in a gamified context, made learning more interesting. They kept the children's interest undiminished but also gave them the opportunity to see, hear, and learn alphabet letters and the associated vocabulary at their own pace, proceeding with vocabulary practice through digital activities that kept their motivation levels high and facilitated retention. Very young learners' high enthusiasm for engaging in AR experiences is highlighted in this study, as the participants' high levels of satisfaction and their eagerness to participate in the AR experiment led to improved language learning. As research shows [59], learners of English as an FL seem to develop a positive attitude when learning lexical items using AR, as AR-based technologies help them create an emotional bond with the materials studied, resulting in a significant improvement in motivation.

The limitations of this study include the small number of participating young learners and the short implementation period of the pilot intervention. AR applications should be included in the weekly schedule of the English as a foreign language subject in order to measure the long-term effect of the intervention, adding an interdisciplinary approach to language learning. By applying the pilot program for a longer period of time, the differences noticed in this current study, demonstrating a positive effect on language performance, can be verified, moving beyond participants' positive reaction towards the AR applications due to their enthusiasm or enjoyment. A possible positive correlation obtained between the level of motivation and vocabulary performance also needs to be studied in order to conclude if the materials that include AR in the syllabus have a positive influence on very young learners who use this tool in the learning of lexical items. However, it needs to be mentioned that previous research findings [60], even with very young learners [61], establish that AR-based applications possess a novel appeal, but this effect alone may not generate or enhance learning. This novelty factor effect can also be catered to learners if the educator effectively adapts digital tools to an educational context, following the principles of specific approaches and designing an appropriate syllabus according to them, as well as according to the specific learners' needs and interests. In this sense, a needs analysis can also be conducted before the implementation of a future pilot study.

AR is an affordable tool due to the accessibility of mobile devices. Therefore, its widespread use needs to be further studied. AR-based applications offer novel experiences, even to learners of more underprivileged environments, like the ones of the suburban area

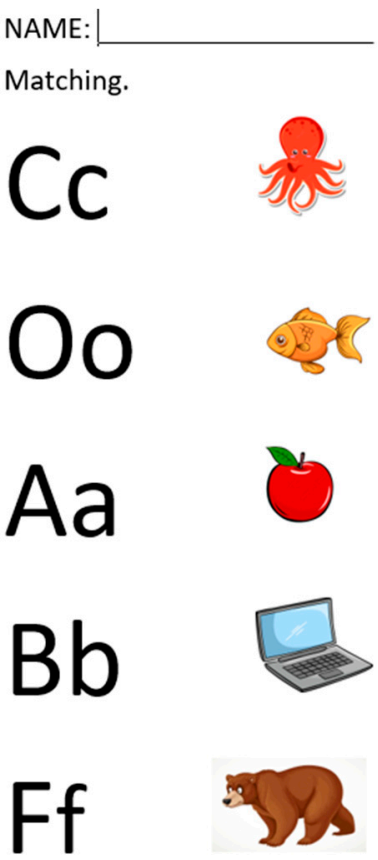
school where this current study was realized. They can take young learners to "worlds" that would not be possible to reach due to a number of uncontrollable circumstances and provide them with opportunities to connect their language learning to prior knowledge or a number of new experiences. In that vein, future research should focus on examining the extent to which individuals' learning processes can benefit from learning in an interactive learning environment that is accessible from anywhere and at any time. What is more, AR technology in the improvement of pronunciation and speaking skills should be studied, as AR applications can provide instant feedback to the user. Effects related to pronunciation accuracy can be recognized and evaluated. What is more, further research should focus on audiovisual material (images, videos, and sound effects) and their effect on all four language skills, as well as on very young learners' collaborative skills. The effect of AR technology on very young learners with weak language learning performance or learners with learning disabilities can also be explored.

Funding: This research received no external funding.

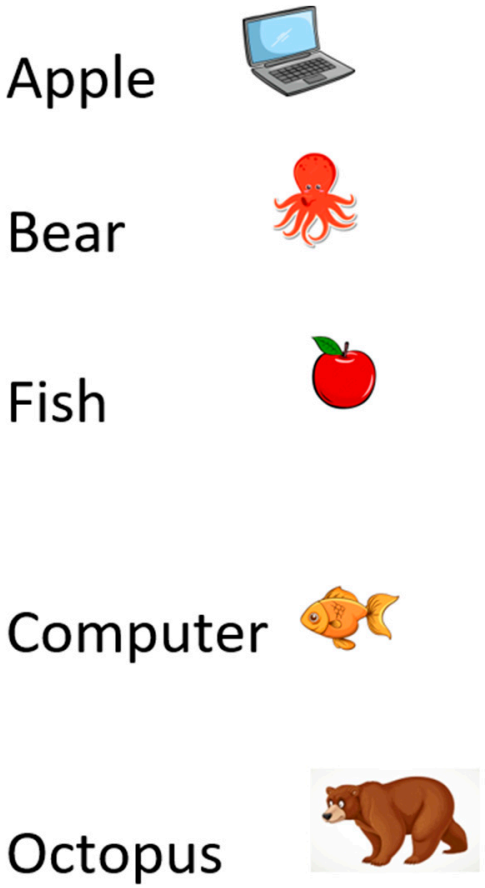
Data Availability Statement: The available data are included in the manuscript.

Conflicts of Interest: The author declares no conflicts of interest.

Appendix A



Appendix B



Appendix C

Attention (A)
A1. I think English is easy.
A2. I think English is a bit difficult.
A3. I know what kind of English I need to learn in my classroom.
A4. I am good at English.
A5. English is useful for my life.
A6. I really like the materials we have in English class.

Relevance (R)
R1. English is very important to me.
R2. I think English is boring.
R3. I think I can learn English very well.
R4. I have fun in my English class.
R5. The materials we use in English class are boring.

Confidence (C)
C1. Learning English well will help me to do more things that I like.
C2. I will use the English words I learned in my daily life.
C3. English tests trouble me.
C4. English in the classroom is very interesting.
C5. I really like having English class.
C6. I can do very well in English tests.
C7. I do not need to learn English in class because I already know a lot.
C8. What my English teacher tells me makes me think that I am doing very well.

Satisfaction (S)
S1. The activities we do in English class are fun.
S2. The activities we do in English class are not fun.
S3. English classes at school make me feel good.
S4. I do not understand what my English teacher is teaching.
S5. English class is very nice; I think I can learn English well.
S6. I am very happy to learn English.

References

1. Gan, C.L.; Balakrishnan, V. Mobile Technology in the Classroom: What Drives Student-Lecturer Interactions? *Int. J. Hum.-Comput. Int.* **2018**, *34*, 666–679. [CrossRef]
2. Wei, C.Y.; Kuah, Y.C.; Ng, C.P.; Lau, W.K. Augmented Reality (AR) as an Enhancement Teaching Tool: Are Educators Ready for It? *Contemp. Educ. Technol.* **2021**, *13*, 303. [CrossRef] [PubMed]
3. Li, S.; Chen, Y.; Vorvoreanu, M. A pilot study exploring augmented reality to increase motivation of Chinese college students learning English. *CoED J.* **2015**, *6*, 23–33.
4. Azuma, R.T. A survey of augmented reality. *Presence* **1997**, *6*, 355–385. [CrossRef]
5. Chen, P.; Liu, X.; Cheng, W.; Huang, R. A review of using augmented reality in education from 2011 to 2016. In *Innovations in Smart Learning*; Chang, M., Yanyan, L., Eds.; Springer: Berlin/Heidelberg, Germany, 2017; pp. 13–18.
6. Yang, T.-H. Recent advances and opportunities of active materials for haptic technologies in virtual and augmented Reality. *Adv. Funct. Mater.* **2021**, *31*, 2008831. [CrossRef]
7. Lee, K. Augmented Reality in Education and Training. *TechTrends* **2012**, *56*, 13–21. [CrossRef]
8. Kerr, J.; Lawson, G. Augmented Reality in design education: Landscape architecture studies as AR experience. *Int. J. Art Des. Educ.* **2020**, *39*, 6–21. [CrossRef]
9. Klopfer, E. *Augmented Learning*; MIT Press: Cambridge, MA, USA, 2008.
10. Kipper, G.; Rampolla, J. *Augmented Reality: An Emerging Technologies Guide to AR*; Syngress: Waltham, MA, USA, 2013.
11. He, J.; Ren, J.; Zhu, G.; Cai, S.; Chen, G. Mobile–based AR application helps to promote EFL children's vocabulary study. In Proceedings of the IEEE 14th International Conference on Advanced Learning Technologies, Athens, Greece, 7–10 July 2014. [CrossRef]
12. Robert, J.D.R. Enhancing Education through Mobile Augmented Reality. *J. Educ. Technol.* **2015**, *11*, 8–14.
13. Ventoulis, E.; Xinogalos, S. "AR The Gods of Olympus": Design and Pilot Evaluation of an Augmented Reality Educational Game for Greek Mythology. *Multimodal Technol. Interact.* **2023**, *7*, 2–19. [CrossRef]
14. Polyzou, S.; Botsoglou, K.; Zygouris, N.C.; Stamoulis, G. Interactive Books for Preschool Children: From Traditional Interactive Paper Books to Augmented Reality Books: Listening to Children's Voices through Mosaic Approach. *Education* **2022**, *51*, 3–13. [CrossRef]
15. Arvanitis, P.; Krystalli, P. Mobile Assisted Language Learning (MALL): Trends from 2010 to 2020 Using Text Analysis Techniques. *Eur. J. Educ.* **2021**, *4*, 13–22. [CrossRef]
16. Volioti, C.; Keramopoulos, E.; Sapounidis, T.; Melisidis, K.; Zafeiropoulou, M.; Sotiriou, C.; Spiridis, V. Using Augmented Reality in K-12 Education: An Indicative Platform for Teaching Physics. *Information* **2022**, *13*, 336. [CrossRef]
17. Zafeiropoulou, M.; Volioti, C.; Keramopoulos, E.; Sapounidis, T. Developing Physics Experiments Using Augmented Reality Game-Based Learning Approach: A Pilot Study in Primary School. *Computers* **2021**, *10*, 126. [CrossRef]
18. Rammos, D.; Bratitsis, T. Inclusive strategies for the History Subject in 6th Grade of Greek Primary School: Gamifying the curriculum with Digital Storytelling and Augmented Reality. In Proceedings of the International Conference on Software Development and Technologies for Enhancing Accessibility and Fighting Info-Exclusion (DSAI'18), Thessaloniki, Greece, 20–22 June 2018; ACM: New York, NY, USA, 2018; pp. 227–233.
19. Volioti, C.; Orovas, C.; Sapounidis, T.; Trachanas, G.; Keramopoulos, E. Augmented Reality in Primary Education: An Active Learning Approach in Mathematics. *Computers* **2023**, *12*, 207. [CrossRef]
20. Korosidou, E.; Bratitsis, T. Gamifying Early Foreign Language Learning Using Digital Storytelling and Augmented Reality to Enhance Vocabulary Learning. In *Internet of Things, Infrastructures and Mobile Applications, Proceedings of the 13th IMCL Conference, Thessaloniki, Greece, 31 October–1 November 2019*; Auer, M.E., Tsiatsos, T., Eds.; Springer: Berlin/Heidelberg, Germany, 2020; pp. 726–737.
21. Konstantakis, M.; Lykiardopoulou, A.; Lykiardopoulou, E.; Tasiouli, G.; Heliades, G. An Exploratory Study of Mobile-Based Scenarios for Foreign Language Teaching in Early Childhood. *Educ. Sci.* **2022**, *12*, 306. [CrossRef]
22. Castles, A.; Coltheart, M.; Wilson, K.; Valpied, J.; Wedgwood, J. The genesis of reading ability: What helps children learn letter–sound correspondences? *J. Exp. Child Psychol.* **2009**, *104*, 68–88. [CrossRef]
23. Justice, L.M.; Pence, K.; Boles, B.; Wiggins, A. An investigation of four hypotheses concerning the order by which 4-year-old children learn the alphabet letters. *Early Child. Res. Q.* **2006**, *21*, 374–389. [CrossRef]
24. Kapelner, A.; Soterwood, J.; Nessaiver, S.; Adlof, S. Predicting contextual informativeness for vocabulary learning. *IEEE Trans. Learn. Technol.* **2018**, *11*, 13–26. [CrossRef]

25. Piasta, S.B.; Wagner, R.K. Learning letter names and sounds: Effects of instruction, letter type and phonological processing skill. *J. Exp. Child Psycol.* **2010**, *105*, 324–344. [CrossRef] [PubMed]
26. Wilkins, D.A. *Linguistics in Language Teaching*; Edward Arnold: London, UK, 1972.
27. Cameron, L. *Teaching Languages to Young Learners*; Cambridge University Press: Cambridge, UK, 2001.
28. Coyle, Y.; Gracia, R.G. Using songs to enhance L2 vocabulary acquisition in preschool children. *ELT J.* **2014**, *68*, 276–285. [CrossRef]
29. Chela-Flores, B. Pronunciation and language learning: An integrative approach. *Int. Rev. Appl. Linguist. Lang. Teach.* **2001**, *39*, 85–101. [CrossRef]
30. Akbulut, Y.; Cardak, C.S. Adaptive educational hyper-media accommodating learning styles: A content analysis of publications from 2000 to 2011. *Comput. Educ.* **2012**, *58*, 835–842. [CrossRef]
31. Gilakjani, A.P. The significant role of multimedia in Motivating EFL Learners' Interest in English Language Learning. *Int. J. Mod. Educ. Comput. Sci.* **2012**, *4*, 57–66. [CrossRef]
32. Cabero-Almenara, J.; Barroso-Osuna, J. The educational possibilities of augmented reality. *J. New Approaches Educ. Res.* **2016**, *5*, 44–50.
33. Wu, H.-K.; Lee, S.W.-Y.; Chang, H.-Y.; Liang, J.-C. Current status, opportunities and challenges of augmented reality in education. *Comput. Educ.* **2013**, *62*, 41–49. [CrossRef]
34. Ablyaev, M.; Abliakimova, A.; Seidametova, Z. Design of mobile augmented reality system for early literacy. In Proceedings of the 15th International Conference on ICT in Education, Research and Industrial Applications, Kherson, Ukraine, 12–15 June 2019; pp. 274–285.
35. Rambli, D.R.A.; Matcha, W.; Sulaiman, S. Fun Learning with AR Alphabet Book for Preschool Children. *Procedia Comput. Sci.* **2013**, *25*, 211–219. [CrossRef]
36. Martínez, A.A.; López, I.A.; Benito, J.R.L.; González, E.A. Leihoa: A window to augmented reality in early childhood education. In Proceedings of the 2016 International Symposium on Computers in Education (SIIE), Salamanca, Spain, 13–15 September 2016.
37. Hung, Y.H.; Chen, C.H.; Huang, S.W. Applying augmented reality to enhance learning: A study of different teaching materials. *J. Comput. Assist. Learn.* **2017**, *33*, 252–266. [CrossRef]
38. Martin, S.; Diaz, G.; Sancristobal, E.; Gil, R.; Castro, M.; Peire, J. New technology trends in education: Seven years of forecasts and convergence. *Comput. Educ.* **2011**, *57*, 1893–1906. [CrossRef]
39. Tsai, C.-C. The effects of augmented reality to motivation and performance in EFL vocabulary learning. *Int. J. Instr.* **2020**, *13*, 987–1000. [CrossRef]
40. Yilmaz, R.M.; Kucuk, S.; Goktas, Y. Are augmented reality picture books magic or real for preschool children aged five to six? *Br. J. Educ. Technol.* **2017**, *48*, 824–841. [CrossRef]
41. Kaufmann, H.; Dünser, A. Summary of usability evaluations of an educational augmented reality application. In *Virtual Reality, Proceedings of the Second International Conference, ICVR 2007, Held as Part of HCI International 2007, Beijing, China, 22–27 July 2007*; Springer: Berlin/Heidelberg, Germany, 2007; pp. 660–669.
42. Liu, Y.; Wang, X.H.; Liu, C.X. Scalable video streaming in wireless mesh networks for education. *Int. J. Distance Educ. Technol.* **2009**, *9*, 1–20. [CrossRef]
43. Dincer, A.; Yeşilyurt, S.; Noels, K.A.; Vargas Lascano, D.I. Self-determination and classroom engagement of EFL learners: A mixed-methods study of the self-system model of motivational development. *Sage Open* **2019**, *9*, 1–15. [CrossRef]
44. Binhomran, K.; Altalhab, S. The impact of implementing augmented reality to enhance the vocabulary of young EFL learners. *JALT CALL J.* **2021**, *17*, 23–44. [CrossRef]
45. Chen, S.-Y.; Liu, S.-Y. Using augmented reality to experiment with elements in a chemistry course. *Comput. Hum. Behav.* **2020**, *111*, 106418. [CrossRef]
46. Töröková, M.; Dupláková, D.; Török, J.; Duplák, J. Application Use of Augmented Reality in the Educational Process. *SAR J.* **2021**, *4*, 14–18. [CrossRef]
47. Parmaxi, A. Augmented Reality in language learning: A state-of-the-art review of 2014–2019. *J. Comput. Assist. Learn.* **2020**, *36*, 861–875. [CrossRef]
48. Howitt, D.; Cramer, D. *Introduction to Research Methods in Psychology*; Pearson/Prentice Hall: Hoboken, NJ, USA, 2011.
49. Dunleavy, M.; Dede, C. Augmented Reality Teaching and Learning. In *Handbook of Research on Educational Communications and Technology*; Spector, J.M., Merrill, M.D., Bishop, M.J., Eds.; Springer: New York, NY, USA, 2014; pp. 735–745. [CrossRef]
50. Keller, J.M. Development and use of the ARCS model of instructional design. *J. Educ. Dev.* **1987**, *10*, 2–10. [CrossRef]
51. Yangin Ersanli, C. The Effect of Using Augmented Reality with Storytelling on Young Learners' Vocabulary Learning and Retention. *Novitas-Royal* **2023**, *17*, 62–73.
52. Vernadakis, N.; Avgerinos, A.; Tsitskari, E.; Zachopoulou, E. The Use of Computer Assisted Instruction in Preschool Education: Making Teaching Meaningful. *Early Child Educ. J.* **2005**, *33*, 99–104. [CrossRef]
53. Çevik, G.; Yılmaz, R.M.; Göktaş, Y.; Gülcü, A. Learning English vocabulary with augmented reality in preschool period. *J. Instruct. Technol. Teach. Educ.* **2017**, *6*, 50–57.
54. Redondo, B.; Cózar-Gutiérrez, R.; González-Calero, J.A.; Sánchez Ruiz, R. Integration of augmented reality in the teaching of English as a foreign language in early childhood education. *Early Child. Educ. J.* **2019**, *48*, 147–155. [CrossRef]
55. Oh, S.; Woo, W. ARGarden: Augmented edutainment system with a learning companion. In *Transactions on Edutainment I*; Lecture Notes in Computer Science; Springer: Berlin/Heidelberg, Germany, 2008; Volume 5080, pp. 40–50.

56. Serio, Á.D.; Ibáñez, M.B.; Kloos, C.D. Impact of an augmented reality system on students' motivation for a visual art course. *Comput. Educ.* **2013**, *68*, 586–596. [CrossRef]
57. Acquah, E.; Katz, H. Digital game-based L2 learning outcomes for primary through high-school students: A systematic literature review. *Comput. Educ.* **2020**, *143*, 2020. [CrossRef]
58. Ibrahim, A.; Huynh, B.; Downey, J.; Höllerer, T.; Chun, D.; O'donovan, J. Arbis pictus: A study of vocabulary learning with augmented reality. *IEEE Trans. Vis Comput. Graph.* **2018**, *24*, 2867–2874. [CrossRef]
59. Solak, E.; Cakir, R. Exploring the effect of materials designed with augmented Reality on language learners' vocabulary learning. *J. Educ. Online* **2015**, *12*, 50–72. [CrossRef]
60. Zamora-Franco, R.X. Realidad aumentada: Rol del docente y modelos pedagógicos en el proceso educativo. *Rev. InGenio* **2018**, *1*, 34–47.
61. Yilmaz, R.M. An examination of vocabulary learning and retention levels of pre-school children using augmented reality technology in English language learning. *Educ. Inf. Technol.* **2022**, *27*, 6989–7017. [CrossRef]