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Research Article

The Effect of Using Augmented Reality with Storytelling on Young Learners' Vocabulary Learning and Retention

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Abstract: The incorporation of technology has revolutionized the education industry, with augmented reality (AR) being one of the emerging technologies that exhibit great potential in educational settings. This study examines the efficacy of AR in enhancing vocabulary learning and retention among young 5th-grade learners. This study was conducted with 56 students, comprising an experimental and a control group. Both groups were taught using the storytelling technique, with the experimental group using AR materials, while the control group utilized flashcards. Pre-test and post-test results showed that both groups displayed significant improvements in vocabulary learning. However, the experimental group, which utilized AR materials, demonstrated a significant enhancement in vocabulary retention compared to the control group three weeks after the post-test. Additionally, the use of AR materials was highly appealing to participating students, and it motivated them to learn. This study provides empirical evidence that supports the effectiveness of AR as an innovative teaching tool in enhancing vocabulary retention among young learners.

Anahtar Sözcükler:

artırılmış gerçeklik (AG)

yabancı dil öğretimi ve öğrenimi

AG ile ile hikaye anlatımı

sözcük öğrenimi

çocuk öğrenenler

Artırılmış Gerçeklik ile Hikâye Anlatımının Çocuk Öğrenenlerin Sözcük Öğrenimi ve Hatırda Kalıcılığına Etkisi

Özet: Eğitimde büyük potansiyel taşıyan ve gelişen teknolojilerden biri olan artırılmış gerçeklik (AR) teknolojisinin eğitim alanına dahil edilmesi devrim yaratmıştır. Bu çalışma, AG kullanımının 5. sınıf öğrencilerinin kelime öğrenimini ve kalıcılığını geliştirip geliştirmediğini belirlemeyi amaçlamaktadır. Deney ve kontrol gruplu bu çalışmaya 56 öğrenci katılmıştır. Her iki grupta da öğretmen hikâye anlatma tekniğini kullanır. Ancak, öğretmen kelime öğretimi için deney grubunda artırılmış gerçeklik materyalleri kullanırken, kontrol grubunda bilgi kartları kullanmıştır. Ön test ve son test sonuçları, her iki grubun da kelime öğreniminde önemli gelişmeler gösterdiğini göstermiştir. Bununla birlikte AG materyallerini kullanan deney grubu, son testten üç hafta sonra kontrol grubuna kıyasla sözcük dağarcığının akılda tutulmasında önemli bir gelişme göstermiştir. Ek olarak, AG materyallerinin kullanımı, katılan öğrenciler için öğrenmeye motive ediciydi. Bu çalışma, AG'in çocuk öğrenciler arasında sözcük dağarcığının kalıcılığını artırmada yenilikçi bir öğretim aracı olarak etkinliğini destekleyen kanıtlar sunmaktadır.

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1. Introduction

The tremendous advancements in science and technology have altered how individuals use technology in the twenty-first century. These rapid technological changes have had an impact on every industry. One of the fields that benefits the most from technology use is education. Education has made extensive use of technology to support teaching and learning. With the use of technology, innovative learning strategies are pursued to inspire students' learning, enhance their comprehension, and encourage teamwork and involvement. New tools and products are being developed and introduced daily for use in technology-supported education programs. The idea of computer-assisted language learning (CALL), which Levy (1997, p. 1) defines as "the research and study of the use of computer applications in language education and teaching," was first introduced in the 1960s and has gone through various stages since then. As groups of practitioners have attempted to promote their own views and philosophies, the field has gone by a number of different names like Computer-enhanced language learning (CELL), Computer-based language learning (CBLT), and Technology-enhanced language learning (TELL). TELL takes into account more than simply computers, and the computer is viewed as a component of a bigger system. It is becoming more and more common as a general term. As a result, due to the advancement of technology, the rise in mobile and smart devices and wireless connection technologies have promoted the idea of mobile-assisted language learning (MALL). MALL differs from computer-assisted language learning in that it emphasizes personal or portable devices that offer new modes of learning.

Innovative technologies for language education, like Augmented Reality (AR) technology, have emerged as a result of the rise in the use of mobile-assisted language learning tools. The most well-known definition of AR is "the real-time insertion of computer-generated three-dimensional content into a real scene" (Azuma, 1997, p. 357). AR does this by fusing real life with virtual objects. The development of AR, one of the most significant innovative technologies in use today, is ongoing. AR is one of the emerging technologies attracting attention in educational settings. It enables users to see computer-generated items overlaid with reality and the real-time integration of digital and virtual information (images and sounds) in a genuine environment. Because of AR's nature, users can interact with both real and virtual things in the same environment, resulting in fresh user learning experiences.

According to research, the use of AR in education has many benefits. First, three-dimensional objects, the most crucial elements of augmented reality, enable people to interact with real-world situations more frequently during their learning processes (Azuma et al., 2001). The interaction between objects used in AR is increased because they engage both the auditory and visual parts of the brain. In particular, using AR to visualize abstract concepts helps people comprehend them better (Shelton & Hedley, 2002). Second, AR technology can make language learning more interactive, fun, and engaging. It contributes to students' motivation and interest in language learning (Redondo et al. 2019). Third, AR improves pronunciation and speaking skills by giving instant feedback. Students' pronunciation accuracy can be recognized and evaluated by AR, which can guide students in getting better (Hu et al., 2022). Another definite advantage of AR is its promotion of cultural context. In order to help pupils better understand the language they are studying, AR can help by supplying them with cultural context. The use of AR, for instance, might overlay historical or cultural details on actual places, assisting students in better comprehending the context of the language they are studying (Chang et al., 2013; Kuru Gönen & Zeybek, 2022; Liu, 2009; Liu & Tsai, 2013). AR also enhances collaboration among students. It can help students

communicate and work together to solve problems and finish assignments by giving them the opportunity to do so. It personalizes learning by adjusting to the specific requirements of each student by delivering focused feedback, timing, and material to aid in improving student learning. Finally, many studies have yielded a positive impact of ARs on vocabulary learning and retention. By developing immersive, interactive experiences that make language learning more memorable, AR can help students acquire new words. Students can interact with digital objects and labels that are imposed on actual objects, which helps them learn and remember vocabulary better.

Additionally, the ease of use of AR due to the accessibility of mobile devices is a significant factor in its widespread use (Reinders & Pegrum, 2017). Mobile device technology can provide students with an interactive learning environment whenever they want because it is accessible from anywhere and at any time. Individuals' learning processes benefit from this type of learning process.

1.1. Vocabulary Learning and AR

Vocabulary learning is fundamental in language learning and teaching. As Wilkins states, "without grammar, very little can be conveyed, without vocabulary nothing can be conveyed" (1972, pp. 111–112). However, learning new words is a very complicated process. Teachers work extremely hard to address the challenge of learning, remembering, and using new vocabulary. It is difficult to think using one theory or method about learning or acquiring vocabulary due to the complexity of vocabulary knowledge, the wide variety of lexical items, and their diversity. Schmitt's claim supports this view: "it is a common observation that there is currently no overall theory of vocabulary acquisition" (2010, p. 97). Thus, several vocabulary teaching strategies have captured the attention of educators. Software applications are one of those tools that have positive effects on target language vocabulary learning. The communicational capabilities of smartphones, computers, and tablets also promote EFL students' vocabulary repertoire. Computer simulations of vocabulary learning appear optimistic and promising, although technology in vocabulary learning is still relatively new (Schmitt, 2010).

Studies on the application of AR technology in vocabulary learning have proliferated in recent years. Eang and Na-Songkhla (2020) proposed a framework for an AR-Quest instructional design model based on situated learning to enhance Thai undergraduate students' vocabulary ability. The findings revealed the definite advantage of using AR on vocabulary ability. Costuchen et al. (2021) examined second-language vocabulary memorization and the use of AR. The main original finding of this study was that a sample of 21st-century university students who were trying to learn a second language showed improved vocabulary recall test performance when immersive AR experiences were incorporated into a comfortable physical environment.

In a similar vein, the number of studies examining the use and effectiveness of AR applications on vocabulary learning and retention of children have been growing in recent years. Amaia et al. (2016) conducted a material development study to enhance vocabulary and grammar structure learning with the use of AR technology in English teaching at a young age. In this study, the authors aimed to support students' own autonomous learning by incorporating AR activities into a section of an educational book. They concluded from the study that using AR technology made it simpler for students to use their English language skills and increased their learning of vocabulary and grammatical structures. Chen et al.

(2020) used an experimental design to examine the impact of AR-supported videos on students' success and motivation while teaching English vocabulary. The study found that AR has a beneficial impact on children's language development and motivation. Binhomran and Altalhab (2021) investigated the effect of implementing AR to enhance the vocabulary of young EFL learners. The study used an experimental research design. The results showed that, although not statistically different, the mean scores were different, favoring the experimental group. Additionally, seventeen students were questioned about how they felt about the technology being used. The results demonstrated that AR increases student motivation and improves understanding. The study, conducted by Yılmaz et al. (2022), used AR technology to examine the vocabulary learning, retention, and perspectives of pre-schoolers learning the English language. The quantitative results showed that there was a statistically significant increase in their vocabulary learning and retention levels after the AR implementation. The qualitative results indicated that children liked AR materials in general and that it had a positive effect on their learning. He et al. (2014) conducted an experimental study contrasting traditional and AR-supported vocabulary teaching and revealed that children who learned vocabulary with an AR-supported application had higher vocabulary success. Tsai (2020a) compared the traditional lecturing approach and the AR method to assess the differences in elementary school students' English vocabulary learning performance and the motivation of the instructional materials. The findings demonstrated that the motivation and academic performance of students taught using AR were superior to those taught using the conventional lecture technique. In another study Tsai (2020b) compared the usage of conventional English flashcards with the vocabulary learning approach of AR to see which was more effective for children in elementary school. The findings of this study demonstrated that, among the various skill levels, the AR learning technique was more effective than studying using English flash cards. Besides, assuming that AR applications could improve students' learning results, Huang (2009) attempted to apply AR to English teaching studies on nouns, verbs, and adjectives and to assist students in acquiring English vocabulary with a computer. When the AR computer was utilized to support teaching, the variations in students' English learning about nouns, verbs, and adjectives were discussed. The outcomes demonstrated that teaching with AR was beneficial in fostering elementary school student's ability to learn English.

However, despite the increase in the number of studies on AR integration in children's target language learning, there is still a need for additional studies since that period is crucial for language development (Çevik et al., 2017). Therefore, the current study aims to investigate the effectiveness of AR technology used in storytelling for young learners on their vocabulary learning and retention compared to more traditional vocabulary teaching techniques such as flashcards. In addition, student opinions about the AR technology accompanying storytelling are investigated.

2. Procedure

The participating young learners take a diagnostic vocabulary test (pre-test) session with 24 items. Once the students in both groups had completed the test, the teacher used the storytelling technique and taught the key vocabulary items in the story using two different methods. In the experimental group, she uses AR materials developed by Unity and QR codes. Unity is a well-known game production tool, and by following certain procedures, AR materials can be produced with Unity. Firstly, the teacher opens it and creates a new 3D project. She makes sure to select the appropriate platform for her target audience (such as Android, IOS, etc.). Then, the selected AR development software is used to develop

materials for the intervention so that the features and capabilities of the AR development tool will be evaluated. Next, the 3D objects needed for the AR experience are made. There may be a need to set up tracking for the AR objects depending on the AR development tool used. Next, the AR experience has started to take shape. This entails incorporating interactive components, producing animations, and establishing the appearance and behaviour of the AR objects. Finally, to ensure that the AR experience operates as expected, the teacher tests it across various platforms and settings before the intervention in the experimental group. The teacher uses vocabulary flashcards in the control group to teach the same vocabulary items. After the treatment, an immediate post-test is administered, followed by a retention test (delayed post-test) three weeks later.

This study seeks to find answers to the following research questions:

1. Is there a significant difference between storytelling with AR materials and flashcards in terms of young learners' vocabulary learning?
2. Is there a significant difference between storytelling with AR materials and flashcards in terms of vocabulary retention of young learners?
3. What are the opinions of young learners about AR materials?

2.1. Research Design

This study uses a mixed-method research design. Creswell (2014) defines mixed-methods research as gathering both quantitative and qualitative data and using various designs that may incorporate theoretical frameworks and philosophical presumptions. This type of research is predicated on the fundamental premise that combining qualitative and quantitative methods yields a better understanding of a research problem than either method by itself. In the current study, the quantitative data is obtained via vocabulary tests, and qualitative data is gathered through focus group interviews, which have been widely used as a scientific qualitative research tool in academic fields for the last two decades. The participants are assigned into two groups, experimental and control. Prior to the intervention, necessary ethical and formal permissions from the school authority are taken. Parents give their written consent allowing their children to participate in the study. The independent variable is the use of AR applications, and the dependent variable is vocabulary learning and retention in the study.

2.2. Participants

Fifty-six 5th-grade young learners make up the sample for this study, which is selected through convenience sampling. The experimental group consists of 28 students, and the control group consists of 28 students. The participants in the study are already familiar with several learning resources such as videos, animations, songs, and educational apps on the smartboard but not with augmented reality technology. According to the CEFR (Common European Framework of Reference for Languages), the children's level is A2. The young learners using AR materials are interviewed in groups to investigate their opinions about the experience.

2.3. Data Collection Tools

2.3.1. Vocabulary Test:

The data collection tools used in the study as pre-, post- and retention tests are developed by the researcher examining a well-known story in children's literature, 'Goldilocks and the

three Bears'. First, the researcher has identified 29 keywords in the story that are believed as necessary for better comprehension. Those vocabulary items are illustrated in the test. Students are asked to match the pictures with the words. This initial version of the test has been piloted to another group of students (60 fifth-grade students with the same language level). The students' responses are analyzed, five words, which most students know, are removed, and the test is finalized.

2.3.2. *Focus Group Interviews:*

According to a growing body of research, focus group interviews are among the most often used techniques for gathering qualitative data (Cheng, 2007; Krueger & Casey, 2000). Semi-structured questions were asked to have an in-depth analysis of the experimental group participants' ideas about the use of AR materials.

2.4. Data Analysis

All statistical analyses are performed in the SPSS 23 data analysis program. The normality assumption is tested using the Shapiro-Wilk test yielding a value of 0.0648, which suggests that the sample is likely to be normally distributed. T-test for independent samples is used for the experiment and control group mean scores in the students' pre-test, post-test, and follow-up (retention) tests. The focus group interviews are recorded and analyzed using by content analysis method. Four individuals are interviewed in a single group session immediately following the intervention. In all, 28 students are interviewed for the study. Each group interview is recorded for ten to fifteen minutes. On a mobile device, each interview is saved as an audio file so that it can be listened to at a later time. The audio files are transcribed after the interviews, and their content is then examined in relation to the transcriptions. The qualitative data from the focus group interviews are examined and coded to reveal the themes and categories that arise in answer to the research topic. The bottom-up inductive coding approach is preferred without any predetermined codes, to begin with. Due to the small sample size, two researchers manually code the data. The two coders, who are both English language instructors, have analyzed the data to increase the inter-coder reliability of the qualitative data analysis. First, the interview data from each focus group is analyzed separately. Each researcher independently looks for repeated, meaningful themes related to the questions. From the data that emerged, they have identified and isolated tentative categories (Shkedi, 2005; Strauss & Corbin, 1990). Then, the tentative categories are compared across participants, and the two researchers agree upon the categories. As a consequence, the categories from all the interviews are re-examined and organized by the researchers together into resulting categories (presented in the Findings section below)

3. Findings

The following tables show the findings related to pre-test scores of both experimental and control groups to find out whether both groups were similar in vocabulary knowledge before the intervention. Later, both groups' pre-test and post-test scores are compared statistically to determine if there is a significant improvement in their vocabulary knowledge. Finally, the retention scores of each group are compared to investigate if participating students have forgotten the target vocabulary items.

Table 1.

T-test Results for Independent Groups Performed for Pre-test Scores

	n.	Mean	SD	df	*t*	p
Experimental	28	14.82	4.68	54	.11	.912
Control	28	14.68	4.93			

In Table 1, no significant difference is found in students' pre-test scores (.912, p>.05). In other words, the level of vocabulary knowledge of the students in the control and experimental group were similar before the storytelling intervention.

Table 2.

T-test Results for Post-test Scores for Experimental and Control Group

	n.	Pre-test	Post-test	df	*t*	p
Experimental	28	14.82	21.57	27	-9.9	.000*
Control	28	14.68	18.53	27	-10	.000*

According to t-test results for dependent groups seen in Table 2, the post-test scores of students in both the experimental and control groups differ significantly after the intervention (.00, p<.05). A closer look shows that the mean scores of the experimental group show a much higher increase compared to the control group (experimental group: 21.57, control group: 18.53). The findings indicate that both groups of students have learned new vocabulary.

Table 3.

T-test Results for Retention Test Scores for Experimental and Control Group

	n.	Post-test	Retention	df	*t*	p
Experimental	28	21.57	21.39	*27*	.464	.647
Control	28	18.53	15.60	*27*	5.585	.000*

According to t-test results for dependent groups seen in Table 3, the retention test scores of the experimental group show no statistical difference, which means the students in the experimental group have not forgotten target vocabulary items, as can be seen in the mean scores of post- and retention tests (post-test: 21.57, retention test: 21.39). As for the control group, however, there is a statistically significant difference between the post-test and retention test scores (.000, p<.05). The decrease in mean scores indicate that the students in the control group have forgotten some vocabulary: post-test: 18.53, retention test: 15.60).

The qualitative findings from Focus group interviews with students studying with AR materials are analyzed below. To respect their privacy, participants are attributed labels as (St1), (St2), etc. Table 4 depicts the emerging themes in relation to the following questions:

1. Do you like the AR materials? If so, what do you like most? If not, why don't you like studying with AR materials?
2. Do you think AR materials helped you learn and remember the vocabulary items in the story better? If yes, how have they helped you?

Table 4.

The Themes, Categories, and Codes Gathered through Focus Group Interviews

Main Themes	Categories	Codes
1. Technology use	Using smartphones and tablets	1.1 sense of accomplishment and authority 1.2 not like a learning material, but more like a game
2. Collaborative learning	Learning together with friends	2.1 working effectively in groups 2.2 peer learning
3. Motivation	Intrinsic desire to learn	3.1. high motivation 3.2. fun learning 3.3. being willing to use the application even during the break time 3.4. high concentration
4. User Friendly	Easy interface	4.1. interactive components and animations 4.2. visually appealing
5. Achievement	High vocabulary retention	5.1. more vocabulary knowledge 5.2. effective recalling 5.3. permanent vocabulary knowledge

The first theme that emerged from the qualitative analysis is technology use. All participants state that they like to study with AR materials. They express that they like mostly using smartphones and tablets as learning materials "*I liked using smartphones and tablets as learning materials the most"* (St5). A great majority of the students indicate that engaging with tablets and smartphones gives them a sense of accomplishment and authority in their own learning "*I felt like having the control over my learning when studying with a tablet by my own*" (St18), "*I liked to study at my own pace*" (St20). All students express that they have found using those AR materials as interactive games, not like learning materials *"I liked using mobile phones in the classroom. It was not forbidden, and it was just like a game. Not a regular lesson"* (St3).

The second main theme that emerged from the analysis is *Collaborative Learning*. Nearly all of them find peer learning enjoyable and state that it contributes to the positive and enjoyable atmosphere in the classroom (one mobile device is given to two students). They help each other in the learning process, which promotes collaborative learning *"We studied with friends and tablets. I liked that"* (St18).

The qualitative findings further reveal that high degrees of motivation are another emerging theme. Students express that they like to be engaged with tablets and smartphones in their free time. Therefore, they state a high motivation and intrinsic desire to use them in classroom activities. They state that they enjoyed using them so much that even in break time, they want to go on using the application, which points to high levels of concentration and motivation *"I didn't want the class to end. It was fun. I enjoyed it a lot"* (St7).

The fourth theme is determined as *User Friendly*. Most students find the AR materials user-friendly because of their easy interface. Nearly all students state that they especially like interactive animations and visually appealing illustrations *"It was very easy to use. The pictures were very interesting. I especially enjoyed 3D images"* (St21).

Finally, the last theme that emerged from the analysis is an achievement. All students believe that such AR materials promote their vocabulary learning *"It was very easy to remember the words. I just imagined the visuals, animations and remembered the words"* (St19). They explain that incorporating 3D content into language learning helps them learn and recall vocabulary items better.

4. Discussion and Conclusion

The findings presented in the given description suggest that the storytelling with AR intervention positively impacts students' vocabulary knowledge and that the intervention's effect is stronger in the experimental group compared to the control group. The study findings are in tune with Lin's (2009) and Tsai's (2020) findings.

The first set of quantitative findings indicates no significant difference between the pre-test scores of the students in the control and experimental groups. This is important because it suggests that the two groups have similar vocabulary knowledge before the intervention, strengthening the experiment's validity. The post-test findings indicate a significant increase in the scores of both groups, suggesting that using AR materials effectively teaches new vocabulary to students in both groups. However, the mean score of the experimental group is higher than that of the control group, indicating that the intervention has had a greater impact on the vocabulary knowledge of the experimental group. The retention test findings suggest that the effect of the intervention is more lasting in the experimental group compared to the control group. While the retention test scores of the experimental group show no significant difference compared to the post-test scores, indicating that the students in the experimental group have retained the vocabulary they learned, the retention test scores of the control group are significantly lower than the post-test scores, indicating that the students in the control group have forgotten some of the vocabulary they have learned.

Overall, the study's findings indicate that learning English vocabulary through AR is more effective than learning it by utilizing English flash cards. In other words, it appears that the effects of teaching with AR outperformed those of using conventional ways to learn target vocabulary. Focus group interviews with children reveal that by studying target vocabulary with AR, which concurrently overlays virtual objects and real-world scenes, the monotony of the English vocabulary instruction can be made more exciting. By using this technology with 3D visuals that are displayed in the real environment, students' interest in learning and motivation may be increased. Consequently, employing vibrant and animated images might grab children's attention. Children can generate interest in learning through AR by subconsciously connecting an object with its English name. By incorporating AR into children's daily lives, it is desirable to enhance their English language learning.

Note on Ethical Issues

The author confirms that ethical approval was obtained from Ondokuz Mayıs University (Approval Date: 24/02/2023).

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