Effectiveness of Augmented Reality Technology in Enhancing Primary School Students' Acquisition of Creative Reading Skills

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Abstract

The current study aimed to investigate the effectiveness of augmented reality (AR)-based learning in enhancing creative reading skills among primary school students in English language learning environments, specifically in Syrian refugee schools in northern Jordan. The study employed an AR-based learning guide and a creative reading skills test, both validated for accuracy and reliability. The study conducted with two groups. One as the experimental group using AR and the other, as the control group following conventional methods. The results indicated that the group that took part in the experiment performed better, than the control group in creative reading skills based on average scores achieved by them compared to the control group's performance. The statistical analysis confirmed that these differences were of significance which implies that Augmented Reality had an impact on enhancing creative reading skills. These results suggest that Augmented Reality can have an improvement on creative reading skills by offering students captivating and interactive materials that aid in improving their understanding and vocabulary. The study proposes the incorporation of Augmented Reality technology in education to enhance the learning process and encourage creativity, among students. However the research had some shortcomings such, as concentrating on schools for refugees in Jordan which could restrict how widely the results apply Also they used only a few evaluation tools and did not look into the lasting effects of AR It would be valuable, for upcoming studies to look into how AR affects various educational settings delve into its enduring impacts and consider what teachers and students think about incorporating AR in teaching The research highlights that even though there are constraints, in the studys findings regarding the potential of Augmented Reality (AR) to boost creative reading skillsand enhance educational achievements.

Keywords: augmented reality, primary school, reading learning, creative thinking, reading skills

1. Introduction

Reading plays a role, in education. Is vital for nurturing the human mind at various life stages. It aids in comprehension of connections, between concepts. Improves critical thinking skills and problem-solving skills(AlAli et al., 2024; AlAli & Al-Barakat, 2024; Alhama et al., 2024). When people read books and articles, they can link ideas and situations together in their minds which helps them think flexibly (Besoni et al., 2024; Bujak et al., 2013). Reading also lets individuals broaden their experiences by letting them see what others think and go through in life. This helps them become better at handling problems in their day, today lives well as, in school or work environments. Furthermore engaging in reading helps, in fostering mental equilibrium by offering a glimpse, into cultures and individuals stories. This process enriches ones understanding of emotional dynamics (Baniomar, 2022; Khasawneh et al., 2023; Mohammadhossein et al., 2024; Wulandar, 2018).

Furthermore engaging in reading is crucial, for the development of life skills like making decisions and enhancing critical thinking and emotional intelligence. When individuals immerse themselves in the narratives and adventures of others they gain insights, from teachings that can be implemented in their lives. These teachings offer them a comprehension of their surroundings enabling them to tackle academic and real-life obstacles more effectively.

Numerous research studies have shown that reading plays a role, in improving performance and influencing both intellectual and emotional development of individuals. It equips them with the skills needed to thrive in an interconnected society (Burguera, 2015; Cao et al., 2024; Castles et al., 2018; Baniomar, 2022; Khasawneh et al., 2023; Mohammadhossein et al., 2024; Wulandar, 2018).

Understanding written material involves more, than recognizing letters and grasping words. It also entails delving into the meaning of the content and using that knowledge in real life scenarios to boost thinking and creativity (Baki, 2020; Hassan, 2018; Baki, 2020). It is widely recognized as a method, for enhancing cognitive skills and abilities in students. It plays a role, in bolstering self assurance and nurturing intricate and analytical thinking skills. Objectives that lie at the core of education (Al Barakat et al., 2023; Al Hassan et al., 2023; AlAli & Al Barakat, 2024).

Numerous academic research works have highlighted the role of reading in fostering creative and critical thinking skills (Bani Irshid et al., 2023; Chang et al., 2023; Chen et al., 2017; Fraihat et al., 2022; Kasem et al., 2020; Khasawneh et al., 2022; Mohammadhossein et al., 2024; Remolar et al., 2021). Studies confirm that reading enhances deep thinking and understanding of concepts, making it an effective tool for deriving facts and solving educational problems. Engaging with reading contributes to the development of thinking skills and the acquisition of knowledge. This process not helps in problem solving but fosters creativity and innovation. Ultimately creating a generation that can think both critically and creatively plays a role in advancement and elevates individual intellectual capacities.

Reading comprehension plays a role, in enhancing and advancing ones reading skillswithin this context. It goes beyond understanding the literal content of a text to encompassing the deeper ideas it conveys (Al-Hassan, 2012; Baki, 2020). The ability to distinguish between main and secondary ideas in texts reflects a high level of reading comprehension, as reading without deep understanding does not achieve the desired goals (Mohammadhossein et al., 2024; Remolar et al., 2021; Tobar-Muñoz et al., 2017; Turkan et al., 2017). Reading comprehension is a sign of the learner's linguistic development, as it grows their ability to critique texts, infer ideas, and provide innovative insights (Al-Barakat et al., 2023; Kasem et al., 2020).

Studies have highlighted the significance of critical reading in education as an element for fostering critical thinking skills and analytical skills (Baki, 2020; Kassim, Ismail, & Elsaid, 2020). Critical reading involves more than understanding the text—it also entails examining and assessing ideas and concepts to improve ones capacity to extract information and offer interpretations (Guegan et al., 2015; Guegan et el., 2017).

Research indicates that engaging in creative reading can boost integrative thinking and enhance students' comprehension of texts, from various viewpoints. However, it faces challenges in educational institutions due to the lack of focus on in-depth text analysis and the application of creative thinking. Research (AlAli & Al-Barakat, 2023; Ayashi, 2018; Baki, 2020; Cheng, 2016; Chien et al., 2019; Childs et al., 2023; Kazakou & Koutromanos, 2023) emphasizes the importance of creative reading in developing metacognitive thinking skills, which play a vital role in enhancing deep cognitive abilities. Despite its benefits, creative reading remains underdeveloped in many educational contexts, as traditional methods fail to encourage the necessary creative engagement to fully explore students' potentials. Henceforth experts suggest incorporating digital techniques to tackle these obstacles and enhance the development of creative reading skills. (Ayashi, 2018; Kazakou & Koutromanos, 2023; Wedyan et al., 2022).

An exciting method, in this field involves employing Augmented Reality (AR) technology. This represents an advancement in education as it combines virtual and real environments through different mediums like pictures, videos and three-dimensional objects (Xu et al., 2023; Xie et al., 2024). AR has demonstrated promising abilities, in enrichening the learning experience in boosting reading comprehension. By integrating digital elements with the real world, AR provides an interactive environment that allows students to engage with texts and educational content in innovative ways, enhancing their understanding of materials and helping them link words to images or illustrative concepts. This dynamic experience enhances both visual and auditory comprehension, making learning to read easier and more engaging. Additionally, AR facilitates the learning process by customizing the educational experience to fit each student's needs, making it more effective in improving reading skills.

AR also contributes to improving memory and recall by transforming dry information into lively educational experiences, making it easier for students to store and retrieve information. For instance, students can interact with characters or elements in texts through AR, helping them associate main ideas with tangible images and enhancing their ability to understand and remember content more quickly. This interaction also boosts students' motivation by allowing them to learn in an enjoyable and engaging way, which increases their interest in educational content and encourages them to continue learning. Moreover, previous studies (AlAli & Al-Barakat, 2024; Al-Hassan et al., 2012; Fabella & Abaoag, 2023; Fan, Antle, & Warren, 2020) revealed that AR provides opportunities for students to stimulate critical and creative thinking by interacting with texts from multiple perspectives. They can analyze content

in innovative ways, expanding their thinking horizons and enhancing their ability to interpret and understand texts in new ways. AR is also an effective tool to support students with special needs, such as those with intellectual disabilities or learning difficulties, as it can integrate illustrative elements that help simplify texts and make them clearer. This support helps students interact with content more easily and increases their confidence in the learning process.

In the same context, several field studies (AlAli & AlBarakat, 2022; Datahan, 2020; Desierto et al., 2020; Ding et al., 2019) have shown that AR is a mobile educational tool that provides a continuous learning environment, where students can learn to read anytime and anywhere, whether inside or outside the classroom. Through AR applications, students can easily access educational content, enhancing opportunities for continuous learning and motivating them to keep developing their reading skills in diverse ways. Therefore, AR is an innovative tool that contributes to improving the reading learning experience, enhancing student interaction with content in a way that captivates their attention and helps them absorb information in innovative and engaging ways (Fabella & Abaoag, 2023; Fan, Antle, & Warren, 2020; McGeown & Smith, 2024; McGeown & Wilkinson, 2021; Miyamoto et al., 2019).

Integrating AR technology into the educational process helps bridge the current research gap by offering a more interactive and effective way to enhance reading comprehension. Although there is growing evidence supporting its effectiveness, further research is needed to explore how AR enhances creative reading and critical thinking skills in different educational contexts. This research seeks to add to the body of knowledge by exploring how augmented reality (AR) can be utilized to boost reading skills and foster creative thinking while assisting students facing learning challenges in education settings. The outcomes of this research are anticipated to offer perspectives into how AR can be implemented in educational settings to empower educators in maximizing the benefits of this technology for more engaging and profound learning encounters. This studys significance is, in its capacity to address the existing shortcomings in educational practices by presenting an innovative approach to enhance students reading comprehension and foster creative thinking.

1.1 Statement of the Study

This study aims to explore how AR technology can improve creative reading skills among elementary school students by providing evidence of its effectiveness in enhancing the learning experience and developing linguistic skills. In addition it seeks to assess the impact of AR on the acquisition of creative reading skills in elementary students, such as originality, fluency, and flexibility. The results of the study highlight the importance of employing AR to improve creative reading skills and demonstrate how this technology can enhance students' ability to interact with and understand texts more deeply, representing a significant step towards improving the quality of education in Saudi Arabia.

In light of the above, the study raises the following question: What is the effect of using Augmented Reality technology on the development of creative reading skills (fluency, originality, flexibility) among elementary school students in Arabic language learning environments?

2. Method

This study employed a quasi-experimental design with a 2×2 factorial framework to examine the impact of Augmented Reality (AR) technology on students' creative reading skills. The study included two groups: an experimental group using AR technology and a control group following the conventional teaching method. Performance in creative reading skills was measured for both groups before and after the intervention to assess improvements.

2.1 Study Design

A purposive sampling method was used to select the participating school, and classes were randomly assigned to either the experimental or control group, ensuring objectivity and reducing potential bias. The study comprised two groups with distinct instructional approaches:

2.1.1 Group Descriptions

- **Experimental Group (G1)**: This group engaged in an educational experience using AR technology, studying an instructional unit designed to develop creative reading skills. Members of this group participated in a pre-test to assess their initial skill level before the intervention and a post-test to evaluate any skill development after using AR technology.
- **Control Group (G2)**: This group received traditional instruction without the use of AR technology. Like the experimental group, members of this group also completed a pre-test and a post-test to measure their natural progression in creative reading skills without technological intervention.

2.1.2 Measurement Framework

- **Pre-Test (O1)**: Conducted to establish a baseline of creative reading skills for both groups before instruction using either method.
- **Intervention (X)**: Represents the application of AR technology, which was exclusive to the experimental group (G1).
- **Post-Test (O1)**: Conducted after the instructional period to measure improvements in creative reading skills for both groups.

Overall Design Structure:

- **G1: O1 × O1** (Experimental Group)
- **G2: O1 – O1** (Control Group)

Where:

- **O1** represents the performance measurements in both the pre-test and post-test.
- **X** represents the AR intervention applied exclusively to the experimental group.
- **–** indicates that the control group did not receive the intervention.

This design enables a detailed comparison between the two instructional methods, one integrating AR technology and the other relying on traditional approaches. By comparing pre-test and post-test results, the study seeks to analyze the effect of AR on students' creative reading skills and determine any differences resulting from the use of technology in educational contexts.

2.2 Study Sample

The study sample consisted of ten schools located in the northern region of Jordan, specifically schools for Syrian refugees, which include fifth and sixth-grade students for the second semester of the 2023/2024 academic year. These schools were selected purposively based on the approval and willingness of school principals to participate in the study, as well as the teachers' agreement to teach reading using Augmented Reality (AR) technology. This selection aimed to ensure the availability of all necessary conditions for successful implementation of the study, including the appropriate environment for using AR technology.

The sample was divided into two groups: the experimental group, consisting of 125 students distributed across five schools, and the control group, also consisting of 125 students distributed across five other schools. Students were chosen at random from the schools that were part of the study, with consideration given to the abilities of the students. In the studys cohort of students were grouped according to their achievements as follows. The experimental sample comprised 25 students (20%) at the "Excellent" level 30 students (24%), at the "Very Good" level 40 students (32%) at the "Good" level 20 students (16%) at the "Average" level and 10 students (8%), at the "Below Average" level. "In the control group that was being observed closely for comparison purposes the breakdown was such; 20 students (16%) excelling at the level 35 students (28%) performing very good, 40 students (32%) meeting the expected good, 20 students (16%) falling in the middle range and 10 students (8%), below Average level.

The sample demonstrates a commonality, in cultural and social aspects since all the chosen schools are schools located in the Irbid region of northern Jordan. An area recognized for its collective social and cultural traits among its residents. Moreover, the participants in this study consist of students aged between 10 and 11 years old which aids in lessening the influence of age-related factors, in the outcomes of the research. Most families in the area belong to a middle socio-economic status bracket which leads to homogeneity of the sample and less variation, in social and cultural backgrounds.

When it came to choosing classrooms, for the study participants were placed in five classes per group randomly to make sure there was a mix of genders ages and academic levels among students ensuring chances for all participants. This careful selection process aimed to provide a representation of the groups being studied while keeping a balance, in variables that could influence the outcome of the research.

2.3 Design and Preparation of Instructional Materials

This stage entails preparing educational materials focused on utilizing reality technology to boost students creative thinking skills. This is done by developing the teacher’s guide and the student’s handbook, ensuring alignment with the educational goals for using this modern technology. The step includes the following details:

2.3.1 Preparing the Initial Versions of the Teacher's Guide and Student's Handbook

2.3.1.1 Introduction

Both the teachers guide and the students handbook start off with an introduction that outlines the guides objectives and underscores its significance, in integrating reality technology into education settings. The introductory section strives to elucidate how this technology nurtures creative thinking skills by facilitating interactions, with digital components to enrich the learning journey. It underscores the impact of reality in reshaping the landscape into a more dynamic and captivating domain that inspires students to be actively involved in their learning journey. In this part it also explains the responsibility of the teacher, in applying this technology and ways to help students make the most of its advantages.

2.3.1.2 Definition of Augmented Reality Technology

In this section is where augmented reality technology is described and how it blends elements, with the real world to craft an engaging and interactive learning environment that feels real and immersive for learners. The section emphasizes the significance of using reality in education by showcasing its ability to enhance creative thinking abilities through hands on interaction, with educational content. Various instances are cited to showcase how this technology can facilitate a grasp of concepts by making the learning process more enjoyable and stimulating.

2.3.1.3 Steps for Implementing Augmented Reality in Education

In this section of the guidebook, for educators are tips on integrating reality into their teaching environments successfully. The process begins with getting prepared by gathering tools and materials like smartphones or tablets and AR apps. Subsequently follows the implementation stage where educators learn how to integrate AR applications into their teaching routines. For instance, by using them to simplify scientific ideas or enhance interactive learning experiences. In conclusion it talks about ways to assess how well students are learning with reality such, as quizzes during lessons or watching how students do in class and also getting feedback from the students themselves about their learning process and progress. It stresses the need for evaluation to keep tabs on how studentsre doing and make sure they're meeting the goals, for their education.

2.3.1.4 Educational Tools, Resources, and Activities

In this section of the guidebook aimed at teachers provides advice, for incorporating reality into their teaching settings. It all starts with preparation including collecting tools such as smartphones or tablets along, with AR apps. Then comes the stage of putting it into action where educators grasp the ins and outs of incorporating AR tools into their teaching practices.For instance enabling them to simplify concepts or enrich interactive learning opportunities. The closing remarks discuss methods to evaluate student learning effectively in ways such, as quizzes, within lessons or observing students performance in class and collecting feedback from students regarding their learning process and progress emphasized the necessity of assessment to monitor students' progress and ensure they are achieving objectives.

2.3.1.5 Timeline for Implementing Lessons in the Experimental Group

A precise timeline is developed for implementing the lessons using augmented reality with the experimental group of students. This timeline includes the distribution of activities and lessons over a specific period, ensuring that the educational objectives are met. Each activity and lesson is scheduled to allow sufficient time for students to engage with the content fully, while also ensuring variety in the types of activities to maintain continuous student interaction. The timeline also includes designated periods for review and assessment, allowing the teacher to monitor student progress and adjust the lessons as needed.

2.3.1.6 Assessment Methods

This section defines the assessment methods that will be used to measure the effectiveness of using augmented reality in achieving educational objectives. It includes continuous evaluation, which allows teachers to track student progress during the implementation of augmented reality activities. Final assessments are also included to measure the achievement of the learning outcomes. Assessment strategies such as direct class observations, self-reports from students, and objective tests are employed to evaluate students' understanding of the concepts taught. The section stresses the importance of diverse assessment methods, including self-assessment by students, encouraging them to evaluate their own experiences with augmented reality and how it has impacted their creative thinking development.

2.3.2 Presenting the Initial Drafts of the Teacher's Guide and Student's Handbook to Evaluators

The first versions of the teacher's manual and the student handbook are shown to a group of reviewers who specialize in curriculum planning teaching methods and language education expertise. These evaluators may consist of educators, instructional creators and specialists, in augmented reality. Their input is crucial for ensuring that the

materials meet goals. The evaluation primarily centers on assessing the accuracy and appropriateness of the content the clarity and user friendliness of the materials and how effective they are, in teaching. Reviewers analyze if the material aligns, with the intended audience and supports engaging learning experiences that creativity and critical thinking skills. This evaluation includes a focus on utilizing augmented reality technology.

The panel not evaluates the content only, but also examines how effectively the teachers guide and student handbook incorporate augmented reality technology into their teaching methods and learning materials. They make sure that the use of this technology is clearly described and useful, for both teachers and students while offering suggestions for enhancements. Furthermore, the reviewers assess how well the materials align with the specified goals by verifying that the tasks and materials support the growth of creative thinking and problem-solving skills. The review also considers how well the assessment methods in the materials offer feedback to students and support them in reflecting on their learning journey.

Upon receiving feedback from reviewers or assessors and incorporating their suggestions into the teachers guide and student handbook is essential, for improving their quality and usability effectively aligned with objectives It often entails tweaking the content language structure and possibly incorporating technology to enhance user friendliness Following these revisions the revised guides undergo refinement and testing to ensure they are well prepared for classroom implementation The assessment and editing procedure guarantees that the content aligns with criteria and can deliver an interactive and captivating learning journey, for students.

2.4 Creative Reading Skills Test

The Creative Reading Skills Test is designed to evaluate the impact of augmented reality-based learning on enhancing tenth-grade students' comprehension of the nature of science. This assessment is based on their study of three reading passages derived from the fifth and sixth-grade curricula. The researchers created the test based on their knowledge and a thorough examination of language assessments centered on creative thinking skills endorsed by the Jordanian Ministry of Education. The test includes 26 multiple choice inquiries designed meticulously to guarantee each question is linguistically and scientifically precise explicit and appropriate, for the development and age bracket of the students. The questions also cover creative thinking skills, like fluency, originality, and flexibility.

In order to make sure the test is reliable and validity, for evaluation purposes it was initially reviewed by a group of experts from universities in Jordan, who specialize in English language education technology and assessment. These experts gave their input which resulted in adjustments to questions to ensure they are suitable for the age group and closely related to the reading materials. The ultimate form of the test comprises guidelines for its implementation 26 items spread out over eight pages and an answer sheet for completion, by test takers. The length of the test was determined using a trial sample in which the time taken by everyone was added up and then averaged out to be 30 minutes – duration considered suitable, for the assessments scope.

To validate the Creative Reading Skills Test accurately; it was given to a pilot group of 25 students who were not part of the study sample group, for comparison purposes. The correlation coefficients of each test item were computed to assess their significance and efficiency in evaluating the desired skills. The discrimination coefficients for each item varied from 0.39 to 0.79 indicating how each question distinguishes between students, with abilities. Similarly, the difficulty coefficients ranged between 0.39 and 0.79 reflecting the level of challenge posed by the test items. All of these items were determined to be statistically important, with a significance level of 0.05. This indicates that the test items are both valid and reliable.

To make sure the reliability of the test, in our study process came two approaches into play; initially using the test method with a batch of 25 students taking the test twice over two weeks time span revealed correlation values between their responses, on both occasions ranging from 0.89 to 0.93 showcasing a high level of consistency in their performances; subsequently employing the Kuder Richardson Formula 20 (KR20) to assess the internal consistency of the test resulted in reliability coefficients falling between 0.69 and 0.83. This indicates the reliability and consistency of the test as a scale of creative thinking skills, within the realm of education enhanced by reality.

2.5 Data Collection and Analysis

Before commencing data collection, teachers in the experimental group underwent comprehensive training on the gamified learning strategy, emphasizing its application within the ninth-grade language curriculum. After the training session concluded both the experimental and control groups underwent an evaluation to ensure that they equivalence at a baseline.

Over duration of six weeks, with four sessions scheduled lasting 45 minutes each session totaling 28 sessions in all; the gamified learning method was consistently implemented as outlined in the study schedule during this timeframe.

Following the sessions conclusion; students, from both groups underwent a reassessment of their reading comprehension skills using the evaluation method as, in the initial assessment.

The data gathered was then inputted into the Statistical Package, for Social Sciences (SPSS) for analysis purposes. The performance of both groups on the sub levels and total scores of the Creative Reading Skills Test, for sixth graders was evaluated by calculating Arithmetic Means, Standard Deviations and Adjusted Means to answer the research question. The researchers used Multivariate Analysis of Covariance (MANCOVA) to see how different teaching methods affected aspects of the Creative Reading Skills Test. They also employed Analysis of Covariance (ANCOVA) to assess the influence of the teaching method on creative reading skills.

3. Results

The main objective of the research question was to examine whether there is a statistically significant difference in the performance of fifth and sixth-grade students on the Creative Reading Skills Test based on the teaching method (augmented reality-based English language instruction versus traditional instruction) at a significance level of ($p \leq 0.05$). To achieve this goal, the study calculated the arithmetic means, standard deviations, and adjusted means of the students' performance on the subcategories of the test and the overall score of the Creative Reading Skills Test, according to the teaching method used. The results of these calculations are presented in Table (1).

Table 1. Arithmetic Means, Standard Deviations, and Adjusted Means of the Fifth and Sixth-Grade Students' Performance on the Sub-levels and Total Score of the Creative Reading Skills Test According to the Teaching Method

Test Domains	Group (Learning Method)	Pre-test		Post-test		Adjusted Mean	No.
		Mean	Std. Dev.	Mean	Std. Dev.		
Fluency	Experimental Group	4.09	1.89	6.89	1.03	7.06	125
	Control Group	4.16	1.69	5.70	1.89	5.09	125
	Total	4.13	1.43	5.97	1.73	5.97	250
Originality	Experimental Group	3.55	1.12	7.78	1.03	4.83	125
	Control Group	3.49	1.23	3.01	1.03	3.03	125
	Total	3.41	1.10	4.53	0.98	3.78	250
Flexibility	Experimental Group	3.79	1.07	3.97	1.11	3.90	125
	Control Group	3.87	1.12	2.99	1.00	2.98	125
	Total	3.59	1.12	3.98	1.15	3.98	250
Total Creative Reading Skills Score	Experimental Group	14.13	2.07	19.79	3.01	19.49	125
	Control Group	13.07	2.01	13.37	2.94	14.47	125
	Total	13.69	3.57	18.89	3.667	17.47	250

Table (1) Table 1 displays differences, in the scores and variations in performance among fifth and sixth grade students based on the teaching methods used in the Creative Reading Skills Test sub levels and total scores analysis. Statistical significance of these differences was assessed using a multivariate analysis of covariance (MANCOVA) for sub levels and an analysis of covariance (ANCOVA), for the total score. Table (2) shows these results.

Table (2) shows statistically significant differences ($p \leq 0.05$) attributable to the effect of the teaching method in all levels, with the differences favoring augmented reality technology. Additionally, ANCOVA was used to examine the effect of the teaching method on the overall Creative Reading Skills Test. Table (3) presents these results.

Table 2. Multivariate Analysis of Covariance (MANCOVA) for the Effect of the Method on the Sub-levels of the Creative Reading Skills Test

Source of Variation	Level	Sum of Squares	Mean Squares	Df.	F Value	Sign.	Sign.	Effect Size (η^2)
Pre-test (Covariate)	Fluency (Post-test)	2.967	2.897	1	1.737	0.191	0.191	.019
	Originality (Post-test)	6.567	6.576	1	9.365	0.003	0.003	.094
	Flexibility (Post-test)	2.876	3.06	1	2.363	0.128	0.128	.026
Method, Hotelling's T^2 = .482 P=0.000	Fluency (Post-test)	47.765	49.564	1	27.848	0.000	0.000	.236
	Originality (Post-test)	10.897	11.70	1	15.387	0.000	0.000	.146
	Flexibility (Post-test)	16.896	16.79	1	14.503	0.000	0.000	.139
Error	Fluency (Post-test)	167.892	1.85	247				
	Originality (Post-test)	86.257	0.78	247				
Total	Flexibility (Post-test)	114.855	1.078	247				
	Originality (Post-test)	224.656		249				
	Flexibility (Post-test)	98.786		249				
	Flexibility (Post-test)	129.71		249				

Table 3. ANCOVA for the Effect of the Teaching Method on the Creative Reading Skills Test

Source of Variation	Sum of Squares	Mean Squares	F Value	Sig.	Effect Size (η^2)
Pre-test (Covariate)	61.077	634.45	5.87	0.0070	0.088
Method	325.32	250.07	42.45	0.0030	0.524
Error	657.69	7.61			
Total	1211.45				

Table (3) indicates a statistically significant difference ($\alpha \leq 0.05$) due to the effect of the method, with an F-value of 42.45 and a significance of 0.001, with the differences favoring augmented reality technology. To determine the effectiveness of augmented reality technology on the Creative Reading Skills Test, the eta-squared (η^2) was calculated to measure the effect size, which was found to be 0.524. This indicates that 52.4% of the variance in the performance of fifth and sixth-grade students is attributable to augmented reality technology, with the remaining variance due to other uncontrolled factors.

4. Discussion

The main goal of this study was to explore how the utilization of augmented reality technology affects the cultivation of reading skills (including fluency originality and flexibility), in English among elementary school children in

Jordan. The findings indicated that the application of augmented reality had a beneficial impact on improving these creative reading skills in students, at the primary education level. This result is consistent, with previous studies (Al-Barakat & AlAli, 2024; Aqel, 2017; Kasem et al., 2020; Guegan et al., 2015; Wedyan et al. 2022) which delved into the significance of augmented reality in improving English language skills based on teachers' viewpoints.To summarise the findings of the study; it revealed that augmented reality not boosts language skills only but lessens students' anxiety levels while enhancing their creativity and fostering greater collaboration and engagement.This positive outcome has resulted in a reception towards the integration of reality, in English learning.

The findings of this research highlight the importance of augmented reality (AR) technology, in improving creative reading skills within English education settings. ARs cutting edge features engage students. Boost their enthusiasm through immersive experiences that foster active involvement in learning. This method nurtures lasting learning by making educational content more captivating and stimulating for students helps them cultivate a passion, for reading and acquiring language skills.

Using reality technology goes beyond showing visually pleasing content, for students; it also lets them engage directly with virtual elements to improve their language skills and spark creativity within them This hands on approach enables students to practice scenarios they might encounter in real life and creates an engaging educational atmosphere that boosts their engagement and encourages active participation An example of this is when students interact with 3 dimensional text or animated images while reading This transforms reading into a multi sensory adventure that helps them grasp the content better and form a stronger bond, with the subject matter

Furthermore augmented reality (AR) greatly enhances the communication skills of students. It boosts their self-assurance by providing a space to hone their language skills. It exposes them to daily scenarios that encourage language use in realistic contexts, thus enhancing their readiness to communicate effectively in English. The experiential learning facilitated by AR extends beyond reading skills to develop both oral and written communication abilities, preparing students for real-world language use. Additionally, AR's adaptability allows for customized learning experiences tailored to each student's level, enabling educators to reshape educational content to align with individual learning needs and supporting more effective and comprehensive language learning.

The results of this study are consistent with previous research by researchers (Al-Hassan, 2012; Aqel, 2017; Baki, 2020; Cai et al., 2014; Cai et al., 2016; Hassan, 2018; McGeown & Smith, 2024; McGeown & Wilkinson, 2021; Miyamoto et al., 2019), which indicated that augmented reality techniques have multiple positive effects on students' reading skills. The implementation of reality notably enhanced reading understanding. Students, in the experimental group outperformed those in the control group with scores. This shows how effective the technology is, in boosting comprehension of texts.

5. Conclusions, Recommendations, Limitations, and Future Research Directions

By reviewing and discussing the study's findings, it can be concluded that augmented reality technology has significantly contributed to improving creative reading skills among students in Syrian refugee schools in northern Jordan. The use of this technology increased students' motivation and their desire to participate in reading activities, which was reflected in their improved ability to understand texts more deeply and comprehensively. The positive impact was not only on reading comprehension but also in enhancing linguistic interaction between students and teachers, providing more opportunities for idea exchange and effective analysis. Additionally, augmented reality expanded students' vocabulary through realistic contexts that allowed for vocabulary application and deeper understanding.

However, it is important to recognize some limitations that might influence the study's results. The sample was selected from Syrian refugee schools in northern Jordan, which may not fully represent the student population in other areas of Jordan or in other schools. The unique challenges faced by students in refugee schools, including social, cultural, and economic factors, may have influenced the results. Relying mainly upon classroom observation as the assessment method might restrict the grasp of the lasting impacts of augmented reality technology since such observations are subjective and can be swayed by the instructor's approach or the setting of the classroom – both of which can differ across classes.

Considering the promising outcomes discovered in the study entails broadening the incorporation of reality technology into educational environments, with a particular emphasis on English and other language instruction fields. This innovative technology enriches the learning process by delivering an engaging environment that fosters heightened student involvement and enables deeper content interaction. It is suggested to shift from conventional

language teaching approaches that might be lacking in excitement and motivational elements and prioritize technological resources such as augmented reality, for a more captivating and interactive learning experience.

However the constraints mentioned suggest the need, for research on how augmented reality technology can be used in different educational environments It is important for future studies to broaden the scope by including schools from different parts of Jordan like urban rural public and private schools to get a more thorough evaluation of its effectiveness in diverse educational environments Future research could also delve into the application of augmented reality beyond language learning to subjects like science history and mathematics to assess its viability, across multiple areas of the curriculum.

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Authors contributions

RMA and AAA conceptualized the manuscript's focus, proposed the aims, prepared the draft manuscript, and wrote all the sections. RMA and AAA also collected, analyzed, and interpreted the data. RMA and AAA were major contributors to writing the manuscript. All authors have read and agreed to the published version of the manuscript.

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