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Original Article

Does Integrating Augmented Reality App into Task-based Reading Instruction Pay?

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Abstract

Considering the significant role of innovated technology in learning processes, the present study focuses on the use of Augmented Reality (AR) in students' reading skills. Practitioners have started to use AR in different areas of language learning though a few studies examined the use of AR in reading skills. To this end, the present study explored the effect of integrated AR app into learners' task-based reading instruction (TBRI). Using Test of English as a Foreign Language (TOEFL) diagnostic test, 30 homogeneous senior high school students were selected, randomly divided in two groups of 15 each in Hamedan, Iran. Adopting the pre-test-post-test design with a control group, all participants were given a pretest including 5 sections and 30 items. The validity of questions was confirmed by 12 TEFL specialists, and their reliability coefficient was also confirmed using Cronbach's alpha test. During an academic term-long instruction of reading, the experimental group was taught using integrated AR app, iStormAR, into task-based instruction while the control group underwent task-based instruction with no AR app. Following the treatment, both groups took a previously validated post-test including 5 sections and 30 items. After collecting the data, the results were analyzed using analysis of covariance (ANCOVA). The findings emphasized the effectiveness of learning affordances of integrated AR app into TBRI, specifically in finding main idea questions, requiring that syllabus writers, material developers, and teachers consider the prominent potentials of AR technology for the development of students' English language.

Keywords: Augmented Reality, English Language, Reading Comprehension, School Students, Task-Based Instruction

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1. Introduction

The last few decades witness the growing development of innovative technologies in education which is generally believed to be effective in preparing creative and entrepreneurial people in various scientific fields. Meanwhile, pedagogical processes have been revolutionized by digital media. Augmented Reality, as highlighted by Azuma et al. (2001), represents a promising and innovative technology that blends real and virtual elements, offering a novel approach for educational applications. Before the advent of new technologies, the common method of teaching was direct communication between students and teachers, which usually took place in the classroom. Although the current teaching methods are successfully followed, the emergences of new technologies have provided potentials to improve learning.

Most of the existing multimedia applications for educational purposes use a combination of text, images, animation, and sound to make the subjects challenging for students. AR as the combination of the real world with virtual objects seems to give an advanced view of the environment (Zhang et al., 2001). As Koller et al. (2007) state, AR is a technology that improves or develops the user's perspective of the real world by adding information produced by the computer. This improvement is achieved through the acquisition of virtual geometric objects in the natural environment, or non-geometric information about real objects in the scene. This information can be image or text or sound. This technology should not be confused with technologies called "virtual reality". Virtual reality technology is capable of providing a fully immersive and realistic three-dimensional visual experience. By utilizing a specialized headset, users are able to observe and interact with a virtual environment that bears no resemblance to the physical world. In its most advanced form, virtual reality completely disconnects the user from their surroundings, creating a unique and captivating experience. In other words, in this special headset, the user experiences a completely virtual space that is completely visualized and animated by simulator software and user can interact with it. Therefore, the concept of virtual reality can have a completely different concept from AR. AR learning, therefore, is a continuum ranging from assisted reality to mixed reality based on the level of local presence (Rauschnabel et al. (2022).

AR, according to Carmigniani and Furht (2011), refers to the integration of virtual computer-generated information into real-world contexts. It has been demonstrated by

Zhang (2018) that AR can effectively support language teaching and learning. Therefore, there is an 'obvious connection between AR and current theories of second language acquisition which emphasize localized, contextual learning and meaningful connections to the real world' (Godwin-Jones, 2016, p.9).

Focusing on using authentic and interactive activities, task-based language teaching (TBLT) engages learners in meaningfully use of the target language (Ellis, 2017; Nunan, 1989; Skehan, 2003). The underlying concept of TBLT is that when focusing on the task rather than on the language, students' learning is more effective (Littlewood, 2004). TBLT as an effective method in the field of English language teaching has been proven to not only to have positive impact on learners' reading comprehension activities but Iranian English as foreign language (EFL) teachers have positive attitude towards its implementing (Bagheri et al., 2020). Integrating AR into activities based on TBLT seems to be an effective experience resulting in great learning consequences.

1.Literature Review

1.1.Augmented Reality

Today, the use of AR technology is widespread in many aspects of human daily life. Chen et al. (2022) used AR technology in their research to create a better safety environment for society and enterprises. Considering the unique features of this app, such as attracting the attention of the audience and creating a suitable level of immersion, it seems that the application of AR technology in areas such as education can be useful. This technology has special hardware requirements, some examples of which include: a tool for recording images and videos. Also, we need enough space to store the findings and a processor that is capable of combining real and virtual concepts and has the ability to play 3D images at any moment of time. 'The opportunities offered by AR technologies have offered practical ways to meet the needs of teachers' (Ozdemir, 2017, p. 165).

AR systems can be divided into two types: object/image-based systems and location-based systems. Object/image-based systems utilize an object or image as a trigger to overlay virtual elements through a smartphone. On the other hand, location-based systems use the geographical location of a mobile device's GPS sensor as a trigger for a virtual overlay (Wojciechowski & Cellary, 2013).

Considering the application of AR in all levels of education, Zhang (2018) found that "the number of published studies about AR in language learning has progressively increased year by year" (p. 121). Using image-based AR systems, Zhang found that studies mainly explored the effect of AR-enhanced systems on learners' alphabet learning, vocabulary, subjective experience like socio-affective relationships, and learners' proficiency level.

In certain educational institutions, the traditional approach to teaching revolves around the mere dissemination of information from the teacher to the students. However, this method often results in a disconnect between the material being taught and the students' individual needs. Consequently, students may become disinterested and bored with their learning experience. Furthermore, this conventional teaching style not only fails to foster effective knowledge construction, but it also inadvertently fosters scientific stagnation and discourages students from engaging in scientific activities. Therefore, it is imperative to recognize the necessity of implementing alternative teaching and learning methods in schools. "The unique features of AR technology have created a new type of user interaction with space and objects. Therefore, with these unique features, AR technology can be used in education that draws students' attention to the subject being taught" (Wang, et al., 2013, p. 6).

One of the necessities of today's global society is learning English because international communication, world trade, new sciences, applications and other things related to the expansion of the globalization process are all done in English. Everything is done in English. A large amount of data and information in the current period has increased the human need to learn an international language a hundredfold. Among the reasons for students' lack of interest in English language learning, the lack of use of technology in education, the use of outdated teaching methods, the uniformity of classrooms, the teacher-centeredness of classes, and such factors are very effective (Ghafari, et al, 2016).

AR technology as an innovative method, more than anything, helps students to understand the material and think better about it, while the current need of the society is the existence of a creative mind, in order to create new and effective ideas. Therefore, today, the AR technology is used to raise designer and creative children. Dempo et al. (2022), by using a task combining the flanker task with the oddball task, investigated the difference between monocular and binocular AR in terms of perception and cognition. The results of their

research revealed the participants' faster response in the binocular condition. Only when the flanking stimuli were in the opposite direction, the response was faster in the monocular condition.

Al-Azawi et al. (2019) investigated the potential of using AR and virtual reality in teaching science, technology, engineering, and math (STEM) and have described the application of AR technology as a new way to present content in three dimensions. Hong et al. (2019) in their research showed that the use of AR technology leads to an increase in cooperation among students. Lytridis et al. (2018) conducted research with the aim of using AR platform for interactive distance learning. They showed that the AR system is suitable for distance learning and increases self-learning and independent learning. Markamah et al. (2018) conducted research on the effectiveness of AR application to improve students' progress in learning. The results showed that the performance of students in learning improved significantly by using AR.

Considering the limitations of this technology, as Hsu and Huang (2011) state, while many participants in an AR learning exercise confirmed the usefulness of the AR tools, most participants denounced the efficiency of AR tools in reading textbooks. Although the AR tool itself was easy to operate, the participants found the procedure of image sending, recognizing the text and getting the meaning of the text time-consuming (Hsu & Huang, 2011). Employing a mixed method with 89 5th grade students, Bursali and Yilmaz (2019) found that in reading activities the experimental group using AR applications outperformed the control group using traditional methods. They not only felt more relaxed with the use of AR but showed learning permanency with a higher level of reading comprehension and expressed their satisfaction on their participation in AR-based reading activities.

Tobar-Mun˜oz et al. (2017) conducted a research to explore the impact of AR game-based instruction (ARGBI) on sixth graders' reading comprehension activities. Devising the AR games for elementary students seems to be more interesting though they found no difference to results from the more traditional approaches. As they analytically reject the usefulness of ARGBI, to determine the effectiveness of the game on leading students to correct choice of response in reading comprehension, they divided the test into two sections: questions dealt with in the game and questions that were out of the game realm. Children in

this study, however, displayed more interest and motivation in the activity and the activity was enriched as it promoted problem solving, exploration, and socialization behavior.

The research conducted in connection with AR, on the one hand, shows that its use in educational systems can be considered in the way of achieving goals, and on the other hand, it depicts the lack of studies in educational courses. Therefore, in this research, although very limited, it was tried to prove the application of AR in realizing the goals of the education system.

1.2. Related Works

Reading can be assisted by digital devices and digital tools. As Hutchison et al. (2012) dealt with, devices include, smartphones, E-readers, tablets or laptops, and tools include audiobooks, text-to-speech software, e-books, word-by-word tracking, assistive technologies, recording, mind mapping tools, and educational apps. Using digital texts and AR apps for readers when aligned with appropriate reading strategies, Green et al. (2014) found that AR provides learners with the opportunity to incorporate 3D models in promoting deeper comprehension.

Devising digital tools in terms of Augmented Books as one of the main ways of applying AR to learning (Yuen et al., 2011), few studies have dealt with reading comprehension activities involving AR (Tobar-Mun˜oz et al., 2017). Although some studies have investigated the use of AR for reading experiences, they are not implemented on reading comprehension ability of pre-intermediate EFL learners. Ramli and Zaman (2011), for instance, devised courseware with AR to investigate students' with Down Syndrome ability in tackling the problem of word recognition in reading activities, rather than reading comprehension.

Dunser (2008) explored the use of interactive AR with readings on a computer, rather than a mobile app, and this study was beneficial for the students who had problems reading traditional books. This study showed the conformity between AR technology and reading comprehension ability of new generation students.

Studying the impact of AR on children's reading skills, ChanLin (2018) used HP Reveal to develop the AR storybook library to link triggers with the stories in the story

database. Using mixed method including questionnaires and observations with 137 children, the study showed the positive reaction of most children toward using AR in reading experiences. Being fascinated by the visual tools, they were engaged in the guided reflection process in reading. Their engagement in the reading activity was adhered with qualitative observations. Utilizing AR provided learners with a vivid reading experience helping them enhance their reading skill.

Piriyasurawong (2020) explored the effect of Scaffolding Augmented Reality (SC-AR) on learners' deep reading skills and found that SC-AR model effectively improves learner's deep reading skills. Investigating the effect of AR on EFL learners' reading comprehension, self-efficacy, autonomy and attitudes, Alsowat (2017) stipulated AR potentials in providing dynamic interaction, any-time learning resources, real-life situations, and visual and auditory objects. Incorporating mobile-AR games into EFL classrooms, Wu (2019) showed a good impact of AR games on students' learning euphoria, motivations, and attainments.

A few studies explored the impact of utilizing AR technology on EFL learners' reading comprehension. Moreover, most of the studies have investigated the use of AR in learners' native language and few attempts have been made to explore reading comprehension question types integrated with AR apps. Corroborating the findings of a few earlier studies which focus on the impact of AR on the factors influencing EFL learners' reading comprehension, the present study is different from the aforementioned ones because not only it involves the use of AR integrated into task-based instruction for reading comprehension but it is implemented with the EFL learners with English reading and speaking competence adequacy. Furthermore, contrary to the aspects of the reading activity such as word identification (Ramli & Zaman, 2011), the present study involves some components of reading comprehension to which the students are supposed to comprehend and able to resolve the upcoming problems using AR app in their smart phone.

Although some controversial research dealt with the influential effect of AR on reading comprehension, few studies or no prior research to date has addressed the effect of integrated AR into task-based reading instruction (TBRI) activities and specifically on the test components of English reading comprehension, i.e., answering the questions of knowing the reference, answering partial questions starting with WH words, answering the questions of

recognizing the main idea, answering the questions of inserting the sentence in the text, and complete the table questions). To this end, this study sought to deal with the following questions:

1. Does integrated AR app affect students' ability to answer referential questions?
2. Does integrated AR app affect students' ability to answer partial questions?
3. Does integrated AR app affect students' ability to answer the questions of recognizing the main idea?
4. Does integrated AR app affect students' ability to answer the questions of inserting the sentence in the text?
5. Does integrated AR app affect students' ability to answer table completion questions?

2.Methodology

2.1. Design and Context of the Study

This research is done experimentally and as a survey using pre-test/post-test with randomization of groups to reduce the amount of systematic errors. Volunteers are solicited for a study on the impact of integrated AR on TBRI. The data for the present study were collected in 2023 over an academic term in Hamedan, Iran. Since one of the researchers was teaching in the same school, she had no problem dividing the participants into experimental and control group.

2.2.Participants

Using convenience sampling method, totally 30 female high school students, who declared their agreement beforehand, studying the Science in Amane high school, one of the nonprofit schools of Hamadan. Researchers were authorized to meet the students and conduct the research by school authorities, parents, and other legal tutors though one of researchers was teaching in the same school. The participants in the current study were accepted through special entrance exam. They were all in the same class and were assigned into two groups

of experimental and control of 15 students each, between the ages of 15 and 16. Phillips' (2001, p. 90) TOEFL diagnostic test was administered to check their homogeneity and divide them into two groups. None of the participants had experienced using AR technology before. Before performing the experiment, the students were instructed how to use AR.

2.3. Instruments

Before collecting data, to have homogenized groups Phillips' (2001) TOEFL diagnostic test containing 40 items of structure was administered and based on their scores participants were proven to possess pre-intermediate level of language proficiency since all of them had undergone English language learning in language institutes for three years. Running Cronbach's alpha, considering their mean score (30) and standard deviation (4.95), the test was reliable (0.86). To ensure the test normality, Kolmogorov-Smirnov test was administered with a significance coefficient of 1.01 greater than alpha (.05).

To collect the data of this research, researcher-made questions were used. Adapting from TOEFL junior reading comprehension questions which included 5 sections and 30 items, a series of questions were developed to be run as pre-test and post-test and the score was calculated out of 30. Five parts of the test were: reference, partial, main idea, sentence insertion, and table questions. The validity of the questions was confirmed by 12 instructors and specialists in English language teaching from Bu-Ali Sina, Arak, and Farhangian universities. The reliability coefficient of the questions was also confirmed using Cronbach's alpha test (0.73, 0.78, 0.79, 0.74 and 0.79, respectively).

This study employed an AR program in the book "Real Journey to the Heart of the Storm" written by Anita Gunnery in 2015. The book is accompanied with a mobile app called iStormAP downloaded and installed on students' and teacher's smart phones. The book contains twelve lessons on the different climates such as tornado, waterspout, blizzard, flood, drought, earthquake, tsunami, avalanches, volcanoes the planet undergoes. The natural phenomena included in the book makes it very unique since learners can experience a volcano, for instance, that could consume the page or a tsunami that washes the words away, or even a thunderstorm lightning.

2.3.1.Integrated AR Reading Tasks

Research shows that students' learning can be enhanced if the curriculum is connected with real life activities using various types of learning supports. (Burden and Kearney, 2016). On deciding how to adapt the curriculum to the real world activities, as Nakahama et al. (2001) state, due to an optimal linguistic and communicative environment learners prefer controlled task interactions, particularly those requiring a single convergent outcome such as information gap tasks over opened-ended ones such as opinion exchanges or free conversation. Considering their findings, it was significant to find some integrated AR activities, namely reading tasks, that incorporate students' real-world interactions to the selected AR syllabus in a structured way.

iStormAR is an AR app that helps the user to turn a simple poster on the page of the book into an AR experience. Given the intuitive interface of iStormAR, it is friendly user, and easy to access, and provides simple management options for users. Its installation on a smartphone or tablet takes a few seconds. Once it is installed, the iStormAR uses the camera of the portable devices, smart phone or tablet, to scan a marker on a poster located on the page of the book. Once the marker is loaded the special pictures on the page turn to virtual reality or live animation, the app allows students to express themselves in different ways by integrating multimedia with paper-based posters.

Considering the learners' proficiency level, and in order to provide students with more opportunities for the negotiation of meaning to achieve better outcomes, the fourth type of Ellis' (2017) classification of tasks was adopted, which is both focused to elicit the processing of specific pre-determined linguistic features and output-based requiring speaking and/or writing to achieve the outcome. Moreover, to make the task more collaborative and engaging, learners were assigned to do the tasks in group.

2.3.1.1. Pre-Task Activities

In order to effectively engage with iStormAR texts, there were several pre-task activities undertaken as follows: firstly, to establish a clear understanding of the purpose and context of the text the experimental group conducted a brief research on the topics of the iStormAR book to identify relevant background information and to familiarize themselves with any key concepts or terminology that might be encountered.

Then, to gain a preliminary understanding of the organization and main ideas of the text they previewed the texts by skimming through the content to get an overview of its structure, headings, subheadings, and any visual aids such as diagrams or charts. Additionally, to activate prior knowledge related to the topics the participants were to brainstorm or discuss with others about what was already known or to anticipate about the subject matter. By activating prior knowledge, the reader can make connections between their existing understanding and the information presented in the text, thereby enhancing comprehension and retention.

By engaging in these pre-task activities, individuals can effectively prepare themselves to engage with iStormAR texts, maximizing their understanding, enhancing concentration, and ultimately benefiting from the information presented.

2.3.1.2. While-Task Activities

While participants communicatively practice using the new words and structures of the reading passage in the classroom, their bilateral or multilateral relationship among participants was directed by the teacher in order not to deviate from the intended subject since finally, they were to answer the reading comprehension questions devised out of the taught subject.

Using their smartphones, to do comprehension exercises students were required to scan the pictures and to read an iStormAR text and answer a set of questions that assessed their understanding of the content. This included multiple-choice questions, short answer responses, or even open-ended questions that encouraged their critical thinking. Moreover, they were divided into groups and assigned a specific section of iStormAR text to collaboratively analyze and present to the class. Each group was required to identify the key themes and pictures to enhance their reading experience. Overall, by incorporating task activities that leverage the unique features of iStormAR texts, students could develop their comprehension skills, critical thinking abilities, and creativity while actively engaging with the material.

2.3.1.3.Post-Task Activities

Post-task activities as an essential component of the iStormAr reading texts served to reinforce the learning objectives and enhance comprehension. After reading the exciting texts, engaging in post-task activities allowed students to reflect on the material, consolidate their understanding, and apply what they have learned.

The whole class went over the pages with AR app to find out the correct answers to the questions previously devised by the researcher. This allowed students to discuss and share their thoughts and interpretations of the texts, promoting critical thinking and analysis, clarifying any prospective doubts or questions. In addition to discussions, vocabulary exercises provided students with opportunities to practice and reinforce the vocabulary and concepts learned from the text. In conclusion, post-task activities were crucial for consolidating learning and enhancing their comprehension. By engaging in these activities, students could deepen their understanding, improve their language skills, and make meaningful connections to the text.

2.4.Data Collection Procedure

After approaching the authorities of the school and accounting for the significance of the AR technology in learning and getting their consent, one of the researchers who was teaching in the same school started the interference program of teaching to both groups. Given the implementation of the AR program, first both groups were given researcher-made questions as a pretest. Then, the materials of the intended book were taught to the experimental group using the integrated AR app into TBRI, and the control group was taught the same subjects using task-based method with no integrated AR app. Students were trained during 16 sessions - 60 minutes twice a week. Meanwhile, the participants applied the new vocabularies and the relevant sentence structures while they are using iSmartAR app collaboratively.

At the end, to investigate the students of both groups' materials comprehension, a post-test including the same set of researcher-made questions out of the taught martials was run.

2.5. Data Analysis Procedure

To detect the differences between two groups data were collected and analyzed through analysis of covariance (ANCOVA) for general comprehension of the texts using descriptive statistics and inferential statistics. Since two-group pre-test/post-design was used the scores on the pre-test are treated as covariate to control for pre-existing differences between two groups.

Multivariate analysis of covariance (MANCOVA) was also administered for the questions of reading comprehension components. It was utilized to compare the continuous response variables of test scores and English comprehension by the level of their TBRI, controlling for covariate of number of hours spending learning during a semester. In other words, it showed whether their scores and comprehension varied by teaching. All the analyses were carried out using statistical software of SPSS version 22.

3.Results

The means and standard deviations of the variables in different groups are presented in Table 1 below. The findings revealed that the mean score of experimental group in five types of reading comprehension question (reference, partial, main idea, sentence insertion, complete the table) and their total score increased from pre-test to post-test.

Table 1.

Means and Standard Deviations of test components

		Experimental group		Control group	
components		Mean	*Std*. Deviation	Mean	*Std*. Deviation
Knowing the reference	Pre test	3.2000	.67612	3.6000	.82808
	Post test	5.0667	.79881	4.6000	.82808
Partial questions	Pre test	3.4000	.73679	2.8667	.74322
	Post test	5.0000	.75593	4.0000	.92582
	Pre test	3.2000	.56061	3.2667	.70373

Recognizing main idea	thePost test	5.3333	.61721	4.6667	.89974
Inserting sentence	thePre test	3.1333	1.06010	2.8667	.74322
	Post test	4.8000	.67612	4.0667	.79881
Completing table	thePre test	2.7333	.79881	3.1333	.74322
	Post test	4.7333	.96115	4.4000	.82808
Total score	Pre test	15.3333	3.26599	15.7333	3.45309
	Post test	21.3333	7.74289	21.7333	3.86313

As displayed by Table 1, the findings revealed that the experimental group's mean score in different components of reading comprehension test has increased; however, *inserting the sentence* component indicated more increase in the mean score of control group than that of the experimental group.

Before conducting the parametric test of multivariate analysis of covariance (MANCOVA) to test the hypotheses, tests of normality via Kolmogorov-Smirnov and Shapiro-Wilk test, homogeneity of error variances via Levine's statistic, homogeneity of regression slopes, linear relationship between pre-test and post-test scores and homogeneity of covariance matrices via Box's M, were used that all of the assumptions were met.

3.1. Homogeneity of Regression Slopes

This assumption examines the homogeneity of the regression slopes of comprehension and its components in the pre-test and post-test administered to the studied groups. In this research, a scatter plot was used to investigate this assumption presented below.

Figure 1.

Homogeneity of Regression Slopes in Partial in Groups

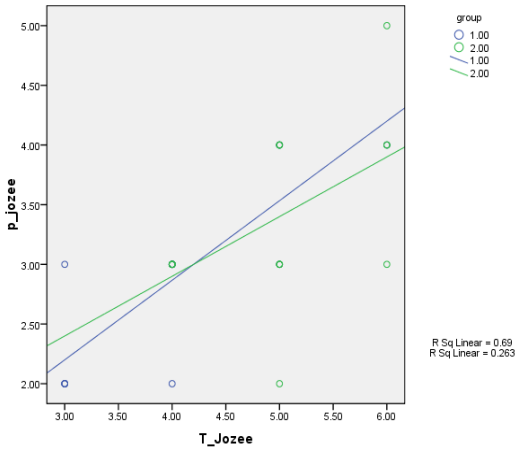


Figure 2.

Homogeneity of Regression Slopes in Reference in Groups

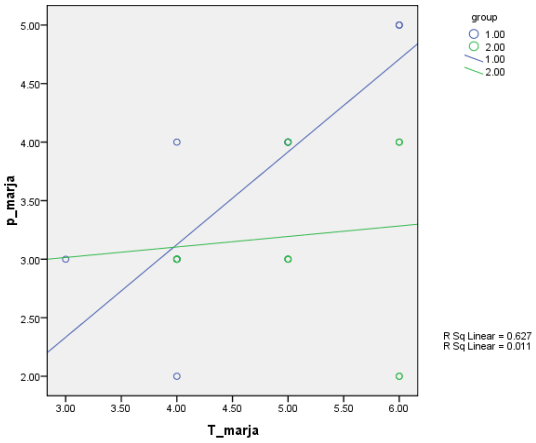


Figure 3.

Homogeneity of Regression Slopes in Sentence Insertion in Groups

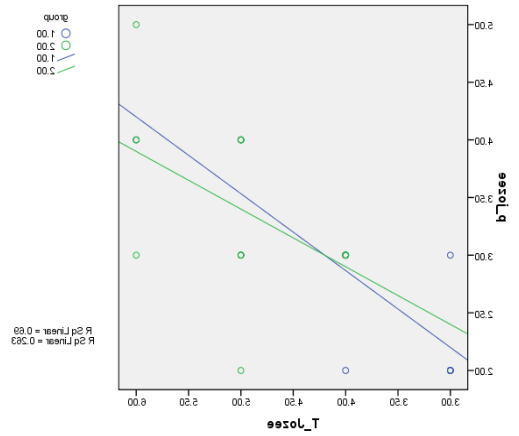
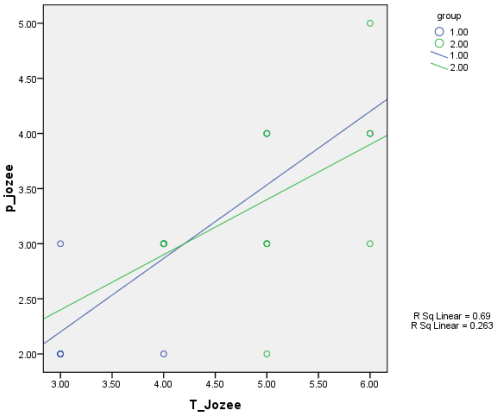


Figure 4.

Homogeneity of Regression Slopes in Main Idea in Groups



The value of Wilke's lambda statistic indicates a significant difference between the groups ($F_{(5, 19)}$) = 4.59, P = .006, Wilk's Λ = 0.55, ηp2 = 0.91).

Table 2.

Wilke's Lambda Results

Effect	Value	*F*	Hypothesis *df*	Error *df*	*Sig.*	Partial Eta Squared	Observed Power
Wilks' Lambda	.453	4.59	5	19	.006	.55	.91

3.2. Components of Questions

As for the first, second, third, fourth, and fifth research questions, the results of the multivariate analysis of variances (MANCOVA) for variables in two groups (see Table 3), revealed a significant increase in the mean score for all questions in the experimental group in comparison with the control group. They are as follows:

a. Questions of knowing the reference ($F_{1, 29}$) = 6.89, p = .015, ηp2 = 0.71),

b. Partial questions ($F_{1, 29}$) = 7.78, p = .010, ηp2 = 0.76),

c. Main idea questions ($F_{1, 29}$) = 5.25, p = .031, ηp2 = 0.59),

d. Sentence insertion questions ($F_{1, 29}$) = 14.8799, p = .001, ηp2 = 0.96),

e. Complete the table questions ($F_{1, 29}$) = 10.66, p = .003, ηp2 = 0.88).

In other words, teaching via AR technology had a positive effect on increasing students' mean scores in knowing the reference, partial, main idea, and sentence insertion and complete the table questions in the experimental group.

Table 3.

The MANCOVA of Test Components in Experimental and Control Groups

Source	Dependent Variable	Type III Sum of Squares	*df*	Mean Square	*F*	*Sig.*	Partial Eta Squared	Observed Power
	Knowing the reference	6.121	1	6.121	6.89	.015	.231	.710
	Partial questions	3.190	1	3.190	7.78	.010	.253	.761

Recognizing the main idea	1.459	1	1.459	5.25	.031	.186	.593
Inserting the sentence	4.137	1	4.137	14.79	.001	.391	.957
Completing the table	3.207	1	3.207	10.66	.003	.317	.878

3.3.Total score

The results of the ANCOVA for variables in two groups (see Table 4), revealed a significant increase in the mean score of reading comprehension in experimental group ($F_{1, 29}$) = 36.176, p = .0001, ηp2 = 0.573).

Based on the table 4, it is observed that the significance level of the research group is equal to 0.991, which is greater than 0.05. This indicates that the assumption of homogeneity of regression slopes was followed. The homogeneity of variances was also .091, greater than 0.05.

Table 4.

The ANCOVA of the Means of Comprehension in the Experimental and Control Groups

Source	Type III Sum of Squares	*df*	Mean Square	*F*	*Sig.*	Partial Squared	EtaObserved Power[b]
Corrected Model	309.491[a]	2	154.745	45.558	.000	.771	.991
Intercept	154.610	1	154.610	45.519	.000	.628	.968
Pretest. of reading comprehension	204.957	1	204.957	60.341	.000	.691	.991
group	122.877	1	122.877	36.176	.000	.573	.991
Error	91.709	27	3.397				
Total	17110.000	30					
Corrected Total	401.200	29					

It is evident from the above table (4) that there is a significant difference between scores in the experimental group and the control group. The level of significance is less than 0.05, indicating that students receiving integrated AR with TBRI had a higher overall score compared to control group. AR had a significant impact on improving the reading comprehension ability of experimental group with a size effect of 0.991.

4.Discussion

Considering the aim of the study, the obtained data of the research showed that integrating AR technology in TBRI is effective in Iranian tenth grade students' ability to answer English reading comprehension questions. According to the results of ANCOVA, it can be stated that the use of AR technology can positively impact and increase the ability of students to read and comprehend when answering questions, compared to the task-based method. It is worth mentioning that Iranian senior high school students are strong enough at answering main idea question with mean score and SD of 5.3333 and .61721, respectively while the control group's performance is no exception (4.6667, .89974).

Unlike the questions of finding the main idea (question 3) with which Iranian students are more familiar, the findings of the study, though showed a little increase in other post-test scores, didn't underpin the impact of AR on other types of test components including questions of knowing the reference (question No.1), partial questions (question No.2), sentence insertion questions (question No.4) and complete the table questions (question No.5). In other words,

the findings indicate that students are more familiar with finding main idea type of questions compared to other types. Additionally, there is a clear connection between their future academic horizons at Iranian universities, course books, and the universities entrance exam. Both their course books and the exams include questions requiring students to identify the main idea of reading passages. Furthermore, other types of TOEFL simulated questions are rarely included in Iranian students' textbooks and they are unfamiliar with these types of international questions. So, the importance of the questions of finding main idea outweighs the other types of questions.

The results of this research are consistent with the findings of Lytridis et al. (2018), Markamah et al. (2018). If integrated AR in reading text is considered as a game, the finding of the present study corroborates the study of Wu (2019) which confirmed that using location-based games of AR gives priority to virtual content over the real world. Playing the games, therefore, becomes more meaningful to players by focusing on the dimensions of sociality and imagination.

As Lytridis et al., (2018) state, the AR system is appropriate for distance learning and increases self-learning and independent self-regulated learning. Also, Mark Mah et al. (2018) showed that it increases student performance and independent learning. Also, they state that the performance of students in learning has improved significantly by using AR. According to the achievements of the researchers, the most important advantage of AR is its unique ability to create mixed educational environments using the combination of digital and physical objects, and it immerses the audience in the images as naturally and easily as possible, that is why the use of this technology can be very useful in education, both at low levels and higher levels for students. Today, with the advancement of technology, the use of AR technology in education to present course materials to students is considered one of the good methods of teaching and learning.

Contrary to the finding of Tobar-Mun˜oz et al. (2017) which rejected the useful impact of AR on students' reading comprehension ability, the finding of the present study confirmed the effectiveness of integrated AR into task-based instruction on various forms of reading comprehension questions. As Tobar- Mun˜oz et al. assert, the inefficiency of ARGBI lies in its coexistence with the book. Since it was considered as an equivalent to the reading experience using the book only, the learners, therefore, did not take it as a serious conducive learning tool.

According to the results of the ANCOVA, it can be concluded that the application of integrated AR technology has a positive impact and increases the ability of students in reading and understanding English reading passages. The use of AR was effective in adhering pedagogical activities since learners' general English comprehension increased and in all types of questions their scores were higher than those of control group. The integrated AR in TBRI, therefore, helped the students display 3D virtual objects on the pages and read the texts very easily. The finding of the current study is compatible with Bursali and

Yilmaz's (2019) finding in which they found that not only the experimental group using AR applications in reading activities outperformed the control group, but they felt more relaxed with the use of AR and showed learning permanency with a higher level of reading comprehension.

The result of the study was confirmed to be against the findings of Chen et al.'s (2020) study which investigated the impact of captions in an AR-enhanced as a theme-based contextualized learning activity administered on junior high school students' English learning comprehension, attitude, and motivation. Their findings showed that captions did not impact learners' comprehension knowledge while the finding of the present study confirmed the effectiveness of integrated AR in TBRI. However, as Chen et al. assert, the use of AR totally increased their English proficiency level since students' motivation toward contextualized learning process enhanced by AR was positive.

5.Conclusion

The current study was a very brief investigation of the AR apps learning affordances and its integration into pedagogical approaches, TBRI, in the real teaching-learning process of a classroom. It examined the effect of the use of AR app on Iranian students' English reading comprehension skills. AR technology can be very effective in developing students' understanding and strengthening their ability to participate in the learning process due to its features such as the combination of reality and permission, real-time interaction, recording in a 3D space and being original and attractive. AR technology not only stimulates students' interest and helps them retain information (Tobar-Mun˜oz et al. (2017), but it also creates a double motivation for students because it encourages them to experience learning and interact with virtual elements (Chen et al., 2020, Tobar-Mun˜oz et al., 2017). In fact, AR facilitated events that cannot be seen with the naked eyes (Green et al., 2014, Ozdemir, 2017). In a nutshell, as it increases students' motivation and helps them acquire better reading skills, learning takes place faster and due to its effect on students' enthusiasm it leads to a better understanding of the subject. Moreover, incorporating AR applications in education can greatly enhance the learning experience by providing interactive and immersive content.

This research was accompanied by some instrumental limitations, such as the limited familiarity of participants and teacher with the use of AR technology in the classroom, the

limitation of installing the AR app on some students' smartphones because of filtering restrictions. By examining the results of data analysis and confirming the significance of the hypotheses, the following suggestions are presented:

Future studies could investigate the impact or using of AR in other established pedagogical approaches such as theme-based language instruction and project-based learning. Researchers, language learning practitioners, syllabus designers and martial developers could also explore the best ways and strategies to integrate AR in other aspects of language learning, such as listening, speaking, writing, grammar, vocabulary and so on.

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