

أثر برنامج تعليمي قائم على تكنولوجيا الواقع المعزز في تحصيل طلبة كلية التربية الأساسية

في مقرر الاستيعاب القرائي

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**The Impact of An Instructional Program Based on Augmented Reality
Technology on Basic Education College Students' Achievement in
Reading Comprehension Course**

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Abstract:

The study aimed to identify the effectiveness of an educational program based on Augmented Reality Technology (ART) on developing students' achievement in reading comprehension subject. To achieve the objectives of the study, the researchers used the experimental method, and "Academic achievement test" has been applied to the experimental and control group students. It was applied to a random sample of (91) students of the second stage/English Department/College of Basic Education/Babylon University in Iraq. This sample was divided into (45) students for the control group and (46) students for the experimental group. The scientific material has been discussed through the following: the experimental group students were taught reading comprehension using the instructional program based on ART (EyeJack Creator Application) and the control group students were taught the same subject using the conventional method. The study found the following result: there is a statistically significant difference between the mean scores of the students of the two research groups in favor of the experimental group in the post-achievement test. This result indicates the superiority of the students of the experimental group who were taught according to the augmented reality technology over the students of the control group who were taught according to the conventional method. In light of the results of the study, the researchers recommended to use ART in the classroom because this technology is characterized by elements of attraction and suspense, eliminating the monotony of the educational situation, and stimulating the students to pay attention in order to participate actively during the learning process. Thus, this leads to the consolidation of information, and remaining the impact of learning for a longer period.

Key words: Instructional Program, Augmented Reality Technology (ART), Achievement, Reading Comprehension (RC).

الملخص:

هدفت الدراسة إلى التعرف على اثر برنامج تعليمي قائم على تكنولوجيا الواقع المعزز (ART) في تنمية تحصيل الطلبة في الاستيعاب القرائي. ولتحقيق أهداف الدراسة استخدم الباحثين المنهج التجريبي، وطبق اختبار التحصيل الدراسي على طلبة المجموعة التجريبية و المجموعة الضابطة. تم تطبيق الاختبار على عينة عشوائية قوامها (91) طالباً من المرحلة الثانية / قسم اللغة الإنجليزية / كلية التربية الأساسية / جامعة بابل في العراق. قسمت هذه العينة إلى (45) طالباً للمجموعة الضابطة و(46) طالباً للمجموعة التجريبية. تم تدريس الموضوع من خلال ما يلي: تم تعليم طلاب المجموعة التجريبية الاستيعاب القرائي باستخدام برنامج تعليمي قائم على تكنولوجيا الواقع المعزز (بأستخدام تطبيق EyeJack Creator)، وتم تعليم طلاب المجموعة الضابطة نفس الموضوع باستخدام الطريقة التقليدية. توصلت الدراسة إلى النتيجة التالية: وجود فروق ذات دلالة إحصائية بين متوسطي درجات طلبة مجموعتي البحث في الاختبار التحصيلي لصالح المجموعة التجريبية. و تشير هذه النتيجة إلى تفوق طلاب المجموعة التجريبية الذين تم تدريسهم باستخدام تقنية الواقع المعزز على طلبة المجموعة الضابطة الذين تم تدريسهم بالطريقة التقليدية. وفي ضوء نتائج الدراسة أوصى الباحثين بضرورة استخدام تقنية الواقع المعزز وتوظيفها من قبل المعلمين في الفصل الدراسي، لأن هذه التقنية تتميز بعناصر الجذب والتشويق والقضاء على رتابة الموقف التعليمي والتخلص من جموده ، وتحفيز الطالب على الانتباه من أجل المشاركة الفاعلة اثناء التعلم ، الأمر الذي يؤدي إلى توحيد المعلومات ، وبقاء أثر التعلم لفترة أطول.

الكلمات المفتاحية: برنامج تعليمي، تكنولوجيا الواقع المعزز، التحصيل الدراسي، الاستيعاب القرائي.

1.1 Introduction

The qualitative leap in the field of Information and Communication Technology (ICT) had a significant impact on the development of the educational technology system in general and e-learning in particular. Many terms, applications and techniques have emerged that have contributed to enrich the teaching and learning process, as well as to enrich educational technology tools and applications. Among these technologies is Augmented Reality (which is abbreviated as AR), which makes education more effective and achieves more capabilities that contribute to achieving the desired goals for learners, which helps them in activating basic intellectual processes such as attention, memory and perception, and facilitates their dealing with different subjects because this technology simplifies the study material for learners, in addition to making it available for use at any time and from anywhere.

The study of Cabero and Barroso (2016 : 44) indicates that “AR is a technology that permit users’ interaction with the physical and real world around them. AR combines the three dimensions (3D) of computer-generated objects and text superimposed on real images and video, it all in real time.” So, AR can be described as the real-time combination of digital and physical information i.e., the integration of the real world by means of a computer to show digital content such as images, videos, audios, three-dimensional shapes, and websites, which makes the student interact with digital content and can remember it better. Accordingly, AR includes four main elements, namely: a camera to capture the targeted information, markers which are the targeted information, mobile phones that are used to store and process information of the captured image, and finally digital content which will be displayed on the screen when the phone's camera is able to track the markers.

Chen et al. (2017: 68) agree that Augmented Reality Technology (ART) is one of the modern teaching methods based on the electronic environment and one of the

latest types of e-learning used in education in response to future needs, to benefit from its multiple advantages and various applications. These applications enrich the learning environment with information and educational experiences by a developed manner in an interactive rich educational environment of learning resources, and to help open many areas for self-learning and lifelong learning, which are necessary to confront the nature of this age.

ART has a number of advantages, including: its ability to encourage kinesthetic learning, and to support learning with a wide range of digital learning elements that help integrate learners into the learning process and increase their motivation towards learning (Diaza et al., 2015: 206).

Moreover, Reading Comprehension Achievement (RCA) has always been one of the most prominent subjects that needs to develop over the past years. As education pioneers see a bright future for ART, today there are clear steps for this technology in various subjects, courses, and topics, including reading comprehension, although these steps are timid in some countries, but its effects are clear in other countries. The instructional environment is a fertile environment for the application of ART, as it can be used to transform paper books into interactive display platforms via smart devices. Instead of reading a historical story about King Nebuchadnezzar, for example, a three-dimensional Babylonian cartoon character can be made that tells the story of this king and his achievements by displaying alive visual recordings as soon as the smart devices camera is directed towards the book.

As the developing of achievement in different educational stages is a goal that all educational institutions strive for and in all the courses they taught, the reading comprehension course is one of those courses that is concerned with the developing of the students' academic achievement and their creative abilities. These abilities require possessing higher thinking skills in dealing with images and texts included in the reading comprehension course. This can only be achieved by having a sufficient amount of achievement includes developing students' skills, knowledge, values and abilities , and moving away from imitation.

The researchers found a clear weakness in Basic Education College students' achievement in reading comprehension course, and this was evident in their low results, success rates and levels of achievement. The low scores of the tests clearly indicate that they have difficulties in academic achievement in reading comprehension course. In light of the foregoing, the researchers see, according to the presented studies that indicate the necessity of using and employing educational technology tools and techniques, that the modern innovations and techniques are an indispensable necessity to help learners develop their skills and raise the level of their academic achievement.

By reviewing of many innovations in educational technology, the researchers see that an instructional program based on AR technology can contribute to raise the level of Basic Education College students' achievement in reading comprehension course. Therefore, this study aims to know the impact of an instructional program based on augmented reality on Basic Education College students' achievement in reading comprehension course.

1.2 Problem of the study

In a trail to ensure the existence of the problem which the researchers felt i.e., weakness of the second stage Basic Education College students' achievement in reading comprehension course, the researchers did the following:

First, Reviewing the ratios and statistics that are collected from studies and researches concerning the achievement as well as the results of analyzing these ratios and statistics

that indicate a clear weakness and decrease in the level of learners, especially Basic Education College students in the reading comprehension course, as they find it is very difficult to implement the prescribed worksheets, which are represented in their inability to complete the implementation of the activities and exercises during the reading comprehension classes.

Second, Pilot study: The researchers conducted an exploratory study for the learners, where the exploratory study targeted a random group of learners in the second stage, Department of English Language. The sample consisted of 50 male and female students. The exploratory study represented in an achievement test to identify the actual level of learners in academic achievement for some texts selected from the reading comprehension course. The researchers actually found a clear weakness in mastering the cognitive aspect in the reading comprehension course that presented to them through these selected texts.

Third, Scientific conferences: The researchers reviewed a set of conferences recommendations related to the necessity to raise the level of achievement and the required skills that Basic Education College students can acquire. Among these conferences are “the First virtual International Scientific Conference of the College of Basic Education - University of Babylon” 2020 and “the Virtual International Scientific Conference of the College of Basic Education - University of Kufa” 2020. The most important general recommendations of these conferences were:

1. Adopting teaching methods and strategies based on modern technological innovations in developing academic achievement in different scientific subjects.
2. Directing the attention of educational institutions towards the necessity of employing technology in education i.e., working to support and provide technological programs and its digital applications in teaching and improving students' cognitive skills and academic achievement.
3. Focusing on improving e-learning systems and its various strategies to develop the skills of the twenty-first century, students' motivation, performance, and academic achievement.

According to what has been mentioned above, the problem of this study could be identified in second stage Basic Education College students' achievement weakness in reading comprehension course. Therefore, the current study attempts to investigate the impact of an instructional program based on augmented reality on Basic Education College students' achievement in reading comprehension course.

1.3 Questions of the study:

The current study requires answering the following main question to solve the research problem, which is:

- What is the impact of using an instructional program based on augmented reality technology on Basic Education College students' achievement in reading comprehension course?
- How does ART affect on Basic Education College students' achievement in reading comprehension course?

1.4 Aims of the study:

This study aims at:

- Raising the level of academic achievement in the reading comprehension course among the second stage English Department students, College of Basic Education, University of Babylon, through an application based on augmented reality and verifying its impact.

- Investigating the impact of an instructional program based on augmented reality on Basic Education College students' achievement in reading comprehension course.

1.5 Significance of the study

It is hoped that the current study would:

- contribute to presenting ideas in the theoretical and practical fields. On the theoretical field, this study provides information on the subject of augmented reality use in education in general, and in reading comprehension course, in particular, which helps teachers and those who are interested in the teaching, to submit the information and experiences students need in the course. As for the practical field, the results of the current research are expected to encourage researchers and those who are interested in educational technologies to do more research and experimentation in the educational field, as it provides a practical guide for education curricula planners to make the best use of it.
- Keep pace with the vision of Iraqi Ministry of Higher Education and Scientific Research and the Ministry of Education in modernizing teaching and training methods and activating the role of educational technology to improve instructional and training programs, in enriching the educational content through augmented reality activities.
- benefit the reading comprehension course teachers of knowing how to apply ART as a means to improve students' performance and achievement.
- Enrich Arabic research libraries with results about the applications of ART and its effect on developing students' achievement.

1.6 Hypotheses

The research hypotheses are as follows:

1. There is no statistically significant difference at the level of significance (0.05) between the mean scores of the experimental group students who are taught reading comprehension using the instructional program based on augmented reality technology and the mean scores of the control group students who are taught the same subject using the conventional method in the post-achievement test.
2. There is no statistically significant difference at the significance level (0.05) between the mean scores of the experimental group students who are taught reading comprehension using the instructional program based on augmented reality technology in pre and post achievement test.
3. There is no statistically significant difference at the level of significance (0.05) between the mean scores of the control group students who are taught reading comprehension using the conventional method in the pre-post achievement test.

1.7 Limits of the study

This study was limited to:

- Objective limits: This research was limited to knowing the impact of an instructional program based on augmented reality technology, using EyeJack Creator Application 2021, on Basic Education College students' achievement in Reading Comprehension Course.

- Human and place limits: This study was conducted on a sample of (91) second stage English department students, College of Basic Education, University of Babylon, Iraq.
- Time limits: The study was conducted in the second semester of the academic year 2020- 2021.
- Alexander's book entitled "Developing Skills: An integrated Course for Intermediate Students" (from passage 14 to 20).

1.8 Instruments of the study

The following instruments were administered after ensuring its validity and reliability:

- A pre-post achievement test for second stage English department students designed by the researchers.
- Intelligence Test (IQ) by Philip Carter (2005).

1.9 Procedures

The present study went through the following procedures:

1. Reviewing the literature and previous studies which are related to:
 - a. Augmented Reality Technology.
 - b. Achievement.
 - c. Reading comprehension.
2. Designing a pre-post test for the achievement in reading comprehension, required for second stage English department students, and verifying its validity and reliability.
3. Designing an instructional program based on Augmented Reality Technology in the light of the scheduled curriculum for second stage English department students.
4. Selecting a sample of second stage English department students. (n=91) randomly and dividing it into two groups: one acts as the control group (n=45), whereas the other constitutes the experimental group (n=46).
5. Administering the pre-post achievement test to both the experimental and the control groups before the experiment.
6. Teaching the assigned passages (from passage 14 to 20) of Alexander's book entitled "Developing Skills: An integrated Course for Intermediate Students to the students of the experimental group through using the proposed instructional program based on Augmented Reality Technology and to the control group through the regular method of instruction.
7. Administering the achievement test to both the experimental and the control groups after conducting the experiment.
8. Analyzing the obtained data statistically.
9. Presenting recommendations and suggestions for further research.

1.10 Basic Terms of the study

- **Augmented Reality Technology (ART):**

According to a definition provided by Azuma (1997:356), AR helps users to see virtual objects and digital information superimposed on the real world. Moreover, he adds that AR is defined as having three main characteristics: (1) combination of real and virtual, (2) real-time interactivity, and (3) 3D registration. It is construed that AR does not replace reality but supplements and enriches it.

Operationally, AR is defined as a technology that combines real and virtual worlds, supplementing the real world with computer-generated virtual objects in real-time, i.e. it allows the development of content of the reading comprehension book scheduled on the second stage , in a technological way, yet adding graphical elements that an EyeJack Creator application recognizes and that, when displayed, had been programmed to activate additional elements of explanation (for instance: 3D files, audios, explanatory videos and/or images). Therefore, the instructional program based on AR uses an application of EyeJack Creator to add digital information to the printed environment (second stage student's book), such as images, links, and videos, in multi-dimensional forms.

- **Achievement:**

Steinmayr (2014) as cited in (Narvaez et. al, 2019:49) mentions that academic achievement mainly represents performance outcomes, which in turn, shows the level achieved by students towards specific goals set for different activities within instructional environments, i.e., elementary school, college or university. Thus, academic achievement should be considered to be a multifaceted assemble comprising different domains of learning.

The academic achievement, in this study, is operationally defined as set of knowledge, concepts, skills, and facts, that second stage students of English department acquire in Reading Comprehension subject, measured by the degree (i.e., the average marks obtained by the students in the final examination) that the students get through their response to the items of the prepared achievement test for the purposes of the study by the researcher.

- **Reading Comprehension (RC)**

Muliawati (2017:94) defines reading comprehension as “a tool for checking the understanding of what has been read. It is the process of making meaning from texts. It means that readers do not make meaning from printed words that are placed directly into paragraphs or texts, but rather build meaning from pieces of information, from whole sentences linked together in those paragraphs”.

The operational definition: Reading comprehension is a mental process aims at obtaining and acquiring meaning. It is a complex process of a number of sub-processes carried out by the second stage students to elicit meaning, where the student interprets the readable material based on his knowledge background and previous experiences. Therefore, this process requires concentration, attention, analysis, inference, criticism and judgment on what has been read.

2. Literature Review

2.1 Augmented Reality (AR)

Owen et al. (2011: 16) define AR that it is a term describing those technologies that allow the real-time mixture between computer-generated digital content and the real world.

Chiang et al. (2014:253) define AR as a technology that enriches human senses and mixes real and virtual environments, leading to a new, more informative and stimulating environment where the user can interact in real time. AR can also be defined as being an overlay or superimposing of digital data visualized on top of the real view of the surrounding environment.

AR is a technology that layers computer generated enhancements atop an existing reality in order to make it more meaningful through the ability to interact with it. Today, AR applications use the camera of the smartphone producing a live view of the real world in combination with relevant, context-appropriate information such as text, videos, audios or images. It can be concluded from these definitions that AR is an attractive interactive technology that brings a virtual object (texts, graphics, video, or sounds) or a composite of them in a three-dimensional form to a real environment with a digital dimension added to it, designed and developed by the computer to perform many purposes in the fields of life such as medicine, education, engineering and others.



Fig.(1): The combination of real-world and computer/mobile generated data.

Several studies, such as Mehta et al. (2017), Das et al. (2017) and Acosta et al. (2019), indicated the need to generalize the use of ART in teaching for various educational levels, in addition to the need for educational institutions to adopt projects to disseminate augmented reality technology, and the need to pay attention to the development of augmented reality application programs. Pérez-López, et al. (2010:174) add that "AR enhances learner's cognition and interaction, making learning more effective. AR is a type of image recognition technology derived from Virtual Reality (VR). VR attempts to create an entirely virtual space. Users then experience and explore this space through multiple interaction modes, including auditory and tactile stimulation. Unlike the virtual environment created by VR, AR layers virtual information on top of real-world objects in the form of AR markers. AR is characterized by immediacy and interactivity, creating diverse modes of human-computer interaction". Fig. (2) shows the Reality-Virtuality Continuum of Milgram et al. (1995) . At the left-hand extreme of the continuum, there is the real environment and at the other extreme there is the virtual environment (virtual reality) and in-between them is the mixed-reality zone (augmented reality and augmented virtuality). Travelling along the continuum from left to right represents diminishing reality (or real objects) and increasing virtuality (virtual objects) and at the point of virtual reality, there are no longer real objects. That is, at the virtual reality end of the continuum, the environment (world) is completely made up of virtual objects or marked by a lack of real objects.

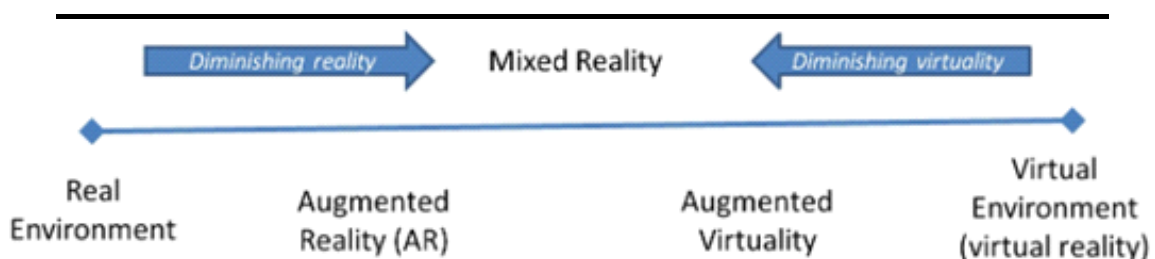


Fig. (2): Milgram's Reality - Virtuality Continuum

2.1.1 The Characteristics of ART

AR is one of the innovations in educational technology that allows for individualizing educational situations and enriching them by feeding them with several different sources and alternatives that collectively form an integrated system unit aimed at achieving ideal learning characterized by a great deal of effectiveness, efficiency and proficiency. Anderson & Liarokapis (2010:10) indicate that among the characteristics of augmented reality are the following:

1. ART provides a process of mutual active interaction between the learner and the presented educational content (the program), and in light of this process, the learner can dialogue with the technological device, and move between the different parts of the program as he chooses many alternatives in a situation learning.
2. It is simple and robust.
3. It provides the learner with clear and concise information.
4. It enables the educator to input information in a simple and effective manner.
5. It enables easy interaction between learners and educators.
6. It makes complex procedures transparent to the learners and educators.
7. be cost effective and easily extensible.
8. It helps to individualize education so that it tends to self-learning: the innovations of educational technology allow the individualization of educational situations; because it provides sufficient opportunities for the learner to learn by himself, as the learner can control the response time between displaying the material on the device screen and his response to it.
9. AR enriches learning situations through the alternatives offered.

2.1.2 Types of ART

There are many types of augmented reality, including what was reported by Patkar et al. (2013:64). Mainly, there is a classification into two main groups: marker-based AR and markerless AR, the former being the most primitive version of this technology. In turn, within markerless AR there are 5 types: location-based AR, projection-based AR, overlay-based AR and contour-based AR.

1- Marker-based AR:

The applications of this type use target images (markers) to position objects in a given space. These applications are linked to a specific physical image pattern marker in a real-world environment in order to superimpose the 3D virtual object on it. Thus, the smartphone camera must continuously scan the input and place a marker for image pattern recognition in order to create its geometry. In case the camera is not properly focused, the virtual object will not be displayed. Consequently, a marker-based image recognition system requires several modules, such as camera, image capture, image processing and marker tracking, among others. The bottom line is this type of AR is based on the principle of recognizing the stereoscopic shape by recognizing the angles, borders and curves of a specific shape such as the face or the body, to provide additional virtual information to the body in front of it in real reality.

2- Markerless AR (AR without markers):

There are five categories of Markerless AR

1. Projection-based AR :It is the most common type of augmented reality, and it depends on the use of artificial images and projecting them on the actual reality to increase the percentage of details that the individual sees through mobile and smart phones.
2. Location-based AR: It is a way used to determine locations in conjunction with other software, such as: the Global Positioning System (GPS) and the triangulation

technology, which serve as the first guide in guiding vehicles such as a car, ship or individual to the desired point to reach it.

3. Outline-based AR: It is a way of merging between augmented reality and virtual reality, based on the principle of giving a person the possibility of merging the outlines of his body or any selected part of the body with another virtual object, which gives the opportunity to deal, touch or capture fake objects that do not exist in reality.
4. Overlay-based AR: Typically, this AR type is used to replace the original view of an object with an updated virtual image of that object for the human eye. Overlay-based AR provides multiple views of a target object with the option to display additional relevant information about that object.
5. Contour-based AR: this type, through the use of special cameras, is used for human eyes to outline specific objects with lines to facilitate certain situations. For example, it can be used for car navigation systems to enable safe driving in low visibility situations.

2.1.3 How does ART work?

Dunleavy (2014:28) divided augmented reality in terms of how it works into two parts:

- 1- Location-based augmented reality: This type provides digital media to users via smart phones or mobile devices with GPS location feature, and multimedia (such as text, graphics, audio files, video clips and 3D shapes) to provides the physical environment with information related to the location.
- 2- Vision-based augmented reality: This type provides users with digital media after a specific object is photographed by a mobile phone camera or smart devices such as (QR codes and multi-dimensional images) so that the camera can capture and distinguish it to display the associated information.

It must be emphasized that AR technology depends on the system's recognition to link features from the actual reality with the appropriate virtual element that is previously stored in its memory, such as geographic coordinates, location information, introductory video, audio, image or any other information that enhances the real reality. AR software relies on using a smartphone or tablet camera to see the real reality, then analyze it according to what is required and work to integrate virtual elements with real environment.

From this standpoint, in this study, the researchers adopted the "Image Recognition" type to display the information, by using the EyeJack Creator application 2021, to obtain an augmented reality of the texts and passages prescribed for second stage students in the book of reading comprehension.

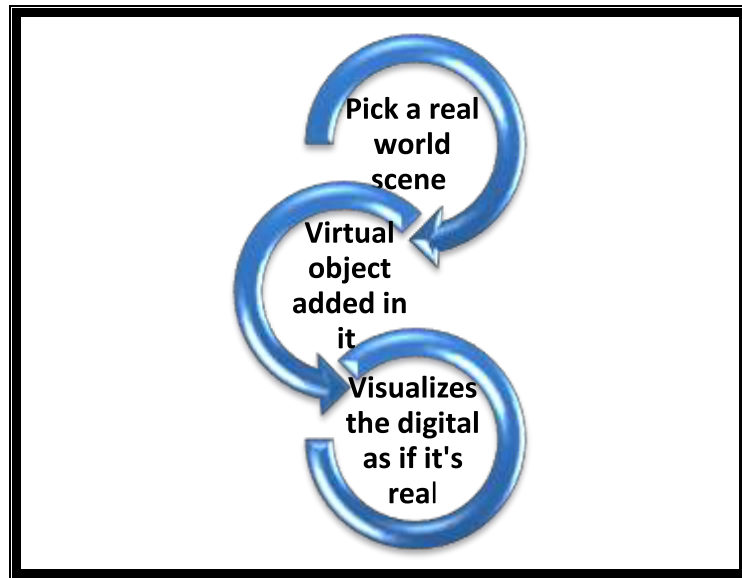


Fig.(3): How does augmented reality technology work?

2.1.4 Using ART in Educational Settings

ART presents a number of unique possibilities for teaching practices and learning opportunities in educational settings. Educational researchers and teaching staff are gradually realizing many of the useful affordances that ART offers in instructional environments. Antonioli et al. (2014:98) demonstrated that "ART allows flexibility in use that is attractive to education. ART can be utilized through a variety of mediums including desktops, mobile devices, and smartphones. The technology is portable and adaptable to a variety of scenarios. AR can be used to enhance content and instruction within the traditional classroom, supplement instruction in the special education classroom, extend content into the world outside the classroom, and be combined with other technologies to enrich their individual applications". ART offers a number of advantages to the present generation of learners that gives rise to informal multi-sensory learning environments that necessitate mental and physical investment, creating more immersive experiences. In many instances, ART applications put forth challenges that require learners to develop problem-solving strategies, while providing feedback and assessment.

Studies such as (Smith et al., 2021; Altamimi, 2019; and Diegmann et al., 2015) explain that ART apps are powerful learning tools to boost engagement and motivation across subject areas. Teachers can use ART on smartphones and tablets to:

- Experience a more realistic scenario using 3D content and more immersive practices.
- Spark engagement through movement and lifelike exploration.
- Tell stories in a whole new way.
- engage a wider range of learning styles, as well as having a positive effect on motivation and performance, especially in project-based learning.
- Interact with resources otherwise not available
- Visualize and experiment with abstract concepts.
- Go deeper into hidden layers and systems.
- See both the big picture and the details.

Based on the above findings of the studies described in this section, the impact of ART in education can be summarized as follows:

- ART can allow learners and teachers to explore information about the surrounding environment at his/her own pace, and to construct his/her own knowledge.
- ART can add excitement and entertainment to the learning activities, thus increasing motivation among participants of the learning experience.
- ART is well suited for demonstrating spatial and temporal concepts and it provides advantages over traditional media.

2.2 Academic Achievement

In our educational institutions, academic achievement is taken as a key criterion to evaluate learner's total capabilities and potentialities. It occupies a very important place in teaching and learning process. Now a day, in measuring learner's ability, the tests on achievement have gained significant importance. To measure nature and extent of students learning in a particular subject, an achievement test is used. In a particular field, various factors and conditions affect the achievement of a particular student.

Verma (2016: 75-76) states that achievement refers to:

- what and how an individual has learnt qualitatively and quantitatively after a period of instruction given.
- the outcome of education that is commonly measured by examination or continuous assessment.
- a key principle to judge one's total capacities and potentialities.

According to Oxford Advanced Learners Dictionary (2010), "Achievement is a thing that somebody has done successfully; especially using his/her own efforts and skills." Moreover, Kohli (1975) as cited in (Nouri,2015:574) defines the academic achievement as the level of proficiency attained in academic work or as formally acquired knowledge in the school subjects which is often represented by percentage of marks obtained by the students in examination.

Shah (2009: 69-70) mentions that researchers have shown that besides being the criteria of promotion into the next class, academic achievement is an index of all future success in life. Superior achievers in the academic world generally tend to maintain their level of achievement in the occupational field also. Moreover, he reports that academic achievement also has a significant effect on self-evaluation of learners.

2.2.1 Conditions and Factors Affect the Academic achievement

Joseph (2017:10) states that different conditions and factors affect the achievement of a particular student in a particular field. Sometimes quite deserving students may not achieve as can be expected on the basis of their abilities. Students' interest in the field of endeavor, teachers' methodology of teaching, socio-economic conditions and family set up and some other psychological factors also affect students' achievement directly or indirectly. Farooq (2011:2) explains educators and researchers have long been interested in exploring variables contributing effectively for quality of performance of learners. These variables are inside and outside school that affect students' quality of academic achievement. These factors may be termed as student factors, family factors, school factors and peer factors. The formal investigation about the role of these demographic factors rooted back in 17th century.

Further, findings of Woodfield and Earl-Novell study (2006:357-358) have shown that "students' effort, previous schooling, parent's educational background, family income, self-motivation of students, age of student, learning preferences and entry qualification of students are important factors that have effect on student's academic achievement in higher institutions of learning".

In line with what has been said, there are many factors that affect the academic achievement of the learner, which must be recognized and evaluated constantly, and appropriate solutions are found to treat them so that the learner can improve his/her abilities and obtain the highest levels of performance in the classroom. These factors include health and mental problems, mental disorders, attention deficit hyperactivity disorder, the nature of the school environment, the presence of learning difficulties, IQ and mental abilities, age, gender, geographical belongingness, socioeconomic status (SES), parents' education level, parental profession, language, and income.

2.2.2 Teaching Using ART and Tts Relationship to Academic Achievement

As an emerging technology, AR is expected to achieve widespread adoption in teaching-learning processes. Hence, a clear need accrues in how AR applications are being adopted within teaching-learning processes. Some researchers emphasize that "except supplementing a wide variety of sensory modalities, there is a vast amount of research on revealing the potential benefits of the use of AR in education, such as, improving students' academic achievement (Estapa & Nadolny, 2015:40; Lu & Liu, 2015:535), motivation, knowledge retention, and engagement (Bressler, & Bodzin, 2013:505)". To achieve such critical learning outcomes during the teaching-learning processes, Thornton et al. (2012: 18) suggest that "teacher must constantly utilize contemporary and cutting edge technological applications, one of which is ART".

ART has gained so much support in the field of education as it is viewed as having numerous potentials to change educational settings, such as, enhancing progressive pedagogies, instructional strategies, and the arrangement and delivery of content (Saltan & Arslan, 2016:505). Furthermore, the use of AR applications is considered to improve students' cognition and interaction which results in more effective learning (Lu, & Liu, *ibid*: 538). By using AR applications, educators should also take consideration into the idea of how such applications might be integrated with instructional strategies or pedagogical approaches in higher education. Studies revealed that the use of ART in higher education might enable educators to combine those applications with various pedagogical approaches, such as, self-learning , learning by discovery, inquiry-based learning, learning by modeling, blended learning, and flipped learning.

Moreover, some researchers have been interested in investigating the impact of augmented reality technology on the educational process, and specifically the academic achievement of learners. The study of Pérez-López & Contero (2013) showed the positive impact, which aimed to use ART to deliver multimedia content to support the teaching and learning process on the digestive and circulatory system at the level of primary schools in Spain. The experimental method was used, and it was found that there are statistically significant differences between the mean scores of the post achievement test, in favor of the experimental group. Yen et al. (2012) study that examines the effect of providing learners with diverse approach of simulation-based instructional design, 2D animation, 3D simulation, and ART on students' academic achievement. The results showed that: (a) all of the three approaches could enhance learners' performance on academic achievement. (b) students in 3D and AR approach demonstrate higher motivation and concentrate their attention on the learning tasks. El-Sayed's (2011) study also aimed to use ART as a technical application in the field of education on a sample of middle school students in Egypt. The results of this study showed that there are differences in favor of the experimental group in the post-achievement test, due to the fact that the augmented reality technology helped to increase interactive and self-learning and increase the ability to identify and imagine

through the use of three-dimensional models. And in a study conducted by Chiang et al. (2014) on the use of augmented reality to improve academic achievement and motivation in learning natural sciences, this study was applied to school students in Taiwan. The results of this study concluded that there are differences in favor of the experimental group in the post achievement test, due to the fact that the augmented reality technology worked to increase the motivation to learn and reduce the cognitive load of students. The study of Kucuk et al. (2014) also aimed to reveal the effect of ART in teaching English on the achievement, behavior and cognitive load of secondary school students in Turkey. The results of the study showed an increase in academic achievement and a decrease in the cognitive load as a result of the use of ART.

The study of Gün & Atasoy (2017) aimed to investigate the effects of an ART application on students' spatial ability and academic achievement, and to analyze the opinions of students and their teacher concerning augmented reality environments. The results of the study showed that the difference between the pre-test academic achievement mean score of the experimental group students and their post-test score was significant. This shows that the use of AR materials in the educational environment increased the students' academic achievement.

And in the same regard ,the study of Erbas & Demirer (2019) aimed to investigate the effects of ART activities on students' academic achievement and motivation in a biology course. Consequently, it was found that the motivation and achievement of the students in the experimental group increased more than that of the students in the control group. The teacher and the students stated that ART activities might be effective in increasing course success and motivation.

Based on the foregoing, the researchers of the current study can conclude the following:

- 1- By using ART, some results of the above studies indicated that students were satisfied with the learning activities and achieved the target knowledge.
- 2- Some results showed that AR affected students' learning and views positively.
- 3- By using ART, students enhanced their thinking skills and developed positive attitudes towards different subjects.
- 4- It was found that ART increases students' achievement levels and decreases their cognitive load levels.
- 5- Some findings showed that ART increases students' spatial thinking levels.

In light of the foregoing positive results of ART on academic achievement, the importance of measuring academic achievement in reading comprehension course using ART becomes clear, as it is an indicator of the success of the educational process.

2.3 Reading Comprehension Course in College of Basic Education

The Reading Study Group (RAND, 2002: 11) explains that Comprehension means the process of simultaneously extracting and constructing meaning through interaction and involvement with written language. The RAND adds that reading comprehension involves four components: the reader, the text, the activity, and the situational context . The first three essential components - the reader, the text, and the task - occur within the fourth component of reading comprehension - the situational context.

Reading comprehension is a mental process aimed at obtaining and acquiring meaning. It is a complex process of a number of sub-processes that the reader performs to elicit meaning. The reader interprets the reading material based on his knowledge background and previous experiences. Comprehension is a process of interaction

between the reader and writer, and it is a complex process that depends more on mental perception than on sensory perception. Therefore, it requires focus, attention, analysis, conclusion, linkage, criticism and judgment .

Reading comprehension is the focus of the reading process that the educational system in Iraq seeks to provide to the learner. In order to rise to the level of awareness and perception, the learner is considered a reader who possesses the actual functional reading skills that enable him to understand the readable text, within the advanced levels, which lead him to have a degree of awareness, a more accurate understanding of the readable text, and the ability to understand and analyze the writer's goal; to issue objective judgments on what s/he reads in light of his/her high reading comprehension.

The Iraqi Ministry of Higher Education and Scientific Research has been developing the public education system according to a future vision, with the aim of bringing up a student who achieves his highest potential and has an integrated personality, through a high-quality educational system, to keep pace with the scientific and technological progress witnessed by developed countries. This vision was translated through the establishment of scientific conferences, seminars and training workshops, whose objectives were to improve curricula, teaching methods and evaluation processes, which would have a positive impact on students' learning. In order to achieve the recommendations and suggestions that were put forward in these conferences and scientific workshops, some developmental transformations resulted in the curricula of Colleges of Basic Education in general, including the curricula of English language departments, which was represented by the reading comprehension course for the first, second and third stages. Among these developmental transformations were: transformations related to the roles of the teacher and the roles of the learner, the instructional content and its link to technological reality, teaching strategies and methods, and evaluation methods. In the current study, the selected content of the reading comprehension subject in Alexander's book entitled "Developing Skills: An integrated Course for Intermediate Students" of the second stage students, consists of seven topics :A Noble Gangster, Sixpence Worth of Trouble, Mary had a Little Lamb, The Greatest Bridge in the World, Electric Currents in Modern Art, A Very Dear Cat, and Pioneer Pilots. Therefore, the researchers of this study will work hard to link this scientific content with the instructional program based on ART, and measure the effect of this technology on students' achievement in reading comprehension.

3. Methodology

3.1 Stages of Building and Preparing the Proposed Program

The researchers adopted the instructional design model (ADDIE Model) because it is a practical model for the design of various software, applications and educational situations, and because of its simplicity and the possibilities of using it for any of the learning theories, and also because it contains all the operations included in other models, as well as being flexible and clear. Within the framework of this model, the instructional content was designed in an augmented reality environment as follows:

1- Analysis: The analysis phase is the basis for the remaining phases of the instructional design. The steps of this stage can be illustrated and explained as follows:

- Determining of the research problem: The research problem was identified in the low academic achievement of second stage students, Department of English, College of Basic Education which requires researching the possibility of making

- use of modern technologies to increase students' achievement in reading comprehension course, using Augmented Reality Technology.
- Analyzing of the students' needs: It is necessary to identify the needs of the students of the second stage in the subject of reading comprehension as an important step in design of the proposed instructional program. The researcher prepared two survey questionnaires, in each of them he asked an open question. The first questionnaire was from the point of view of the students , and the other questionnaire was from the point of view of the teachers. After collecting the responses of two survey questionnaires, it became clear that there is an urgent need to design an instructional program based on AR technology for developing and increasing the students' achievement in reading comprehension course.
 - Determining of the instructional goals: The goals that were used by the researcher in the proposed program are divided into: general goals and behavioral or procedural objectives.
 - Determining of the instructional content: The instructional content was topics for second stage students , English Language Department - College of Basic Education - University of Babylon, in the course of study "Reading Comprehension", Alexander's book entitled "Developing Skills: An integrated Course for Intermediate Students", which is implemented now for those students, so seven topics of this book have been identified.
 - Analyzing of the learners' characteristics: The characteristics of the students (the research sample) were identified and the following was found:
 - Age: The ages range between (20-21) years.
 - Gender: Male and female.
 - Number: 91 second stage students, Department of English, College of Basic Education.
 - Students have smart devices and are able to use various mobile applications.
 - They have not undergone any similar instructional program before (no similar instructional program has been applied to them before).
 - Analyzing of the learning environment: The most important requirements necessary to conduct the research experiment were identified, and the following was found:
 - The target group of the experiment are students of the second stage of the Department of English - College of Basic Education.
 - The total number of the second stage students of the English language department is 236 students.
 - The time for teaching reading comprehension is limited to two hours per week.
 - The place of implementing the teaching of the instructional program was in a blended learning method: some lectures were in the classrooms of the English Department, and others were electronic on the Google Classroom platform due to the conditions of the spread of the Corona pandemic (COVID-19).
 - The duration of implementation the instructional program is a full semester.
 - All students own a smartphone, 80% of their phones run on Google's Android operating system, and 20% of their phones work on Apple's iOS system. Also, all students have access and communication via the internet, either by a free network provided by the teacher for them to use during the experiment in cooperation with the presidency of the English Language Department or through their own network.
 - Providing an appropriate learning environment that is characterized by cooperation, respect and calm dialogue.

2- Design: This phase uses the results of the Analysis phase, to plan a strategy for developing the instruction.. The design phase went through the following steps:

- Designing and organizing of the digital content: The content was organized according to the order of behavioral objectives through the seven topics mentioned before:
 - Topic 1: Passage 14 "A Noble Gangster".
 - Topic 2: Passage 15 "Sixpence Worth of Trouble".
 - Topic 3: Passage 16 "Mary had a Little Lamb".
 - Topic 4: Passage 17 "The Greatest Bridge in the World".
 - Topic 5: Passage 18 "Electric Currents in Modern Art".
 - Topic 6: Passage 19 " A Very Dear Cat".
 - Topic 7: Passage 20 " Pioneer Pilots".

To ensure the authenticity of the content, it was presented to some of the experts in the field of teaching methods and educational technology. The content was chosen on which 80% agreed, with some modifications such as rephrasing and rearranging of some elements to make the content ready in its final form.

- Determining of the content presentation methods: The augmented content was presented through using Image Recognition Software (Eye Jack Creator application) to display the content.
 - Designing of the instructional activities: The instructional activities were determined based on the educational objectives to be achieved. Two types of activities are presented:
 - Classroom activities: They take place in the classroom, such as assigning students to solve a printed worksheet that supports the events of story.
 - Electronic activities: assigning students to answer some questions online.
 - Determining of the instructional techniques and strategies: In order to determine the teaching strategies and methods that are compatible with the reading comprehension course, the researcher prepared a questionnaire consisting of a set of strategies and techniques, and presented it to a group of experts and specialists in curricula, teaching methods, and psychology. These strategies and techniques have been identified for the reading comprehension course. Among the most important of these educational strategies and techniques are the following: -
 - Monitoring comprehension strategy.
 - Blended learning strategy.
 - The Round Robins strategy.
 - Determining of the instructional resources, aids and multimedia: a search was made by a researcher on the internet to get appropriate instructional resources that could be used in ART. The researcher obtained some resources, namely, videos, visual texts, audio texts, static and animated images, GIF Maker program and presentations. All these resources were in need of modification and were modified using Adobe Photoshop Cs for images, and Camtasia Studio to process video footages. On the other hand, the most important instructional aids and applications that were used in teaching the program are the smartphones, tablets, data show, computers and smartboard.
- 3- Development:** This stage went through the following steps:
- Determining of the multimedia programs: The researcher relied on a number of programs to produce the multimedia used, namely:
 - Adobe Photoshop Cs5.

- social networking sites such as Whatapp and Telegram.
- Word processor MS Word 2013.
- PowerPoint.
- Paint program.
- GIF Maker program.
- Production of multimedia: The researcher designed the multimedia required for Augmented Reality Technology, and it consisted of the following:
 - Texts: Using Microsoft Word to write texts..
 - Static and GIF animated images: the researcher used Adobe Photoshop to produce some images, and add text and annotations, then save the images with the extension (jpg), which is suitable for publishing on the internet in terms of size and clarity.
 - Graphics, audios, and videos.
- Determining of the Augmented Reality authoring system: The EyeJack Creator Application has been identified as a system for authoring the proposed program based on Augmented Reality Technology, which has the advantage that any real object can be read (book page, image ...). This application also integrates the virtual information with the real world; and adds a set of useful information to visual perception. The application is free.
- Designing of augmented reality learning based on EyeJack Creator Application (Image Recognizing):

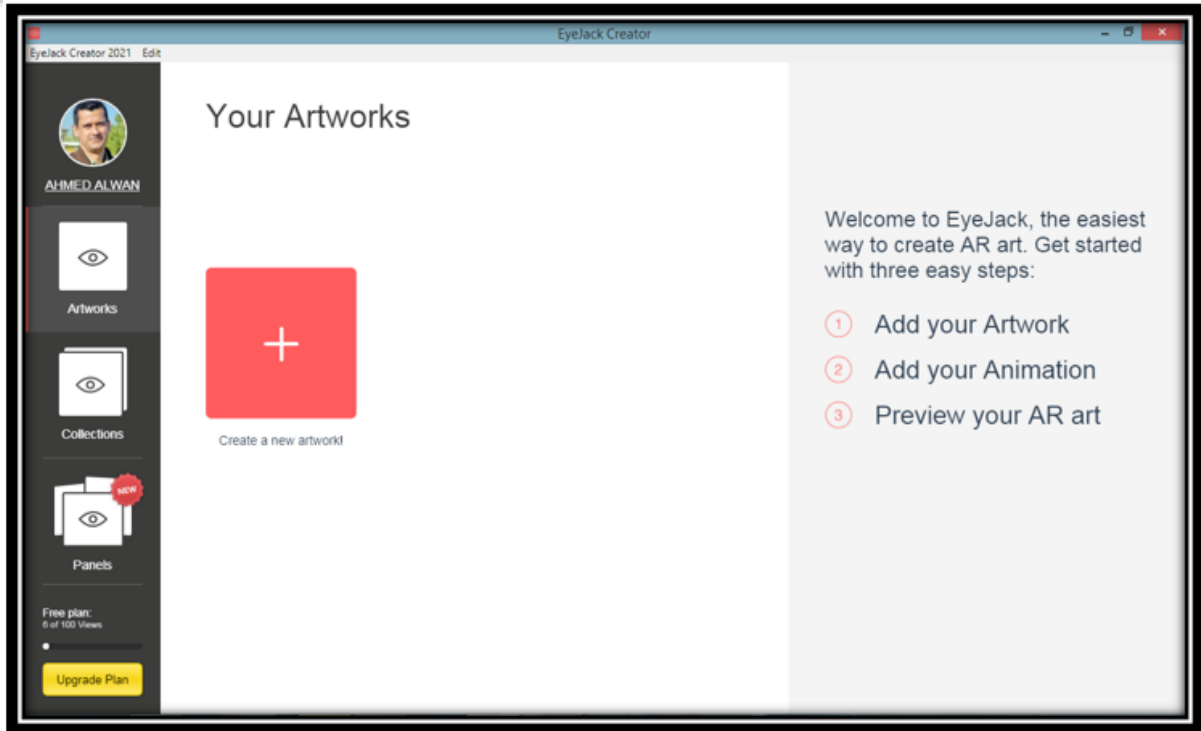
EyeJack Creator supports videos, animated GIFs or PNG sequences. The researcher could create videos or GIF images using his smartphone or if he wants to try something more advanced, he recommend using programs like Adobe Photoshop, Animate or After Effects programs to create animations and to help start animating in AR. EyeJack Creator allows the instructor to create AR experiences using his own material. Instructors animate the topic of reading comprehension by adding GIFs, movie files and music. The AR EyeJack Creator application is used to teach the reading comprehension course, and we can get started with it through the following steps:

- Step 1: Download the EyeJack Creator application on the computer as well as on the smartphone. It can be downloaded from Google Play or Apple store.

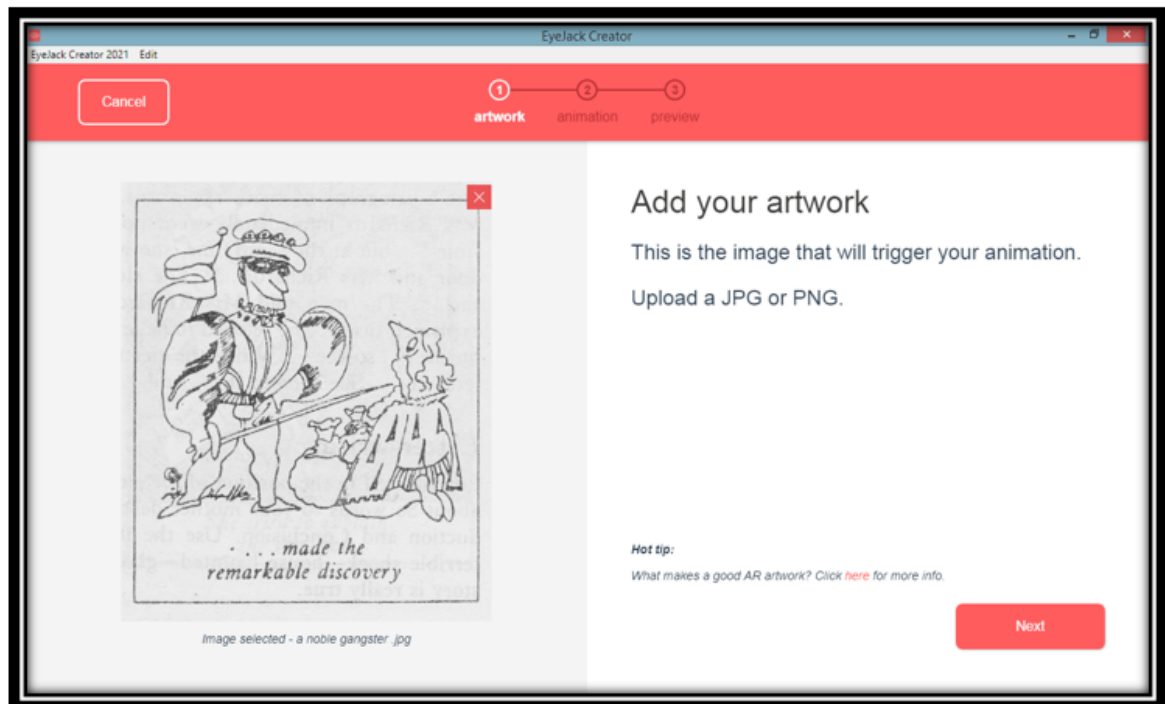


Figure (4) :Icon of EyeJack Creator application

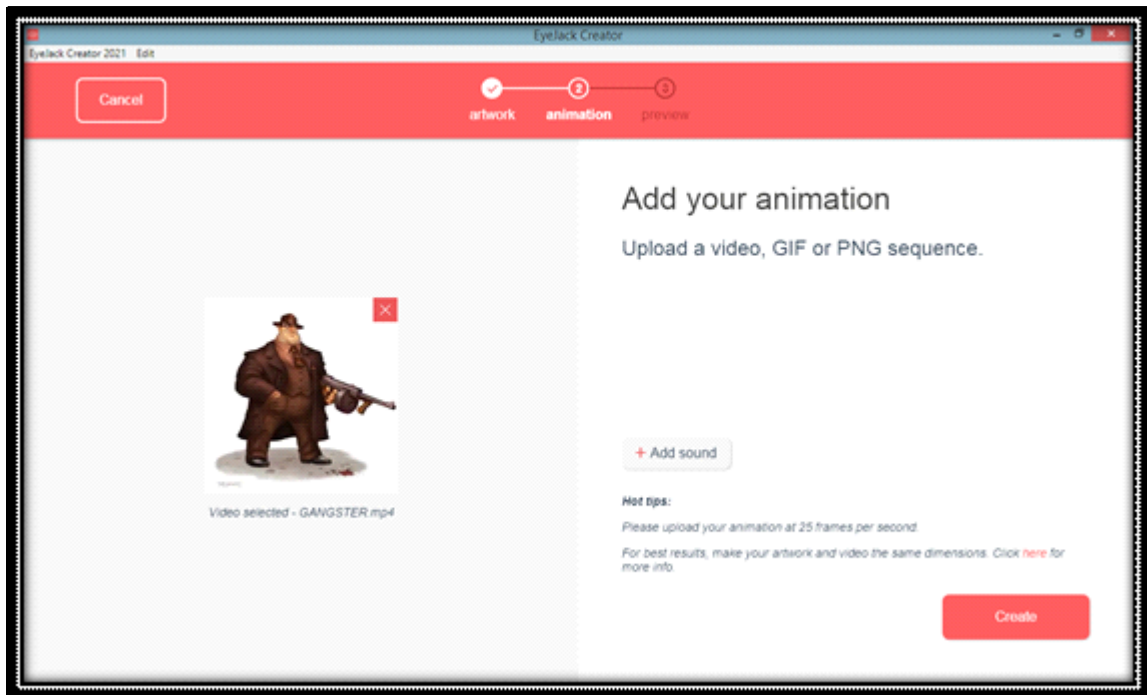
- Step 2: Open the EyeJack Creator application on your computer and click “Create artwork.”



- Step 3: Upload the image we want to transform and click “Next.”



- Step 4: Upload your video, GIF or PNG sequence and click “Create.”



- Step 5: Open the EyeJack Creator application on your phone and tap the EyeJack icon to test your AR content or material.
- Step 6: Share this QR code along with your material to play the video or animated image.



- Step 7: Direct the smartphone camera on the selected book page, where the application will open the new augmented reality page of the book image in a format of video or Gif or PNG.

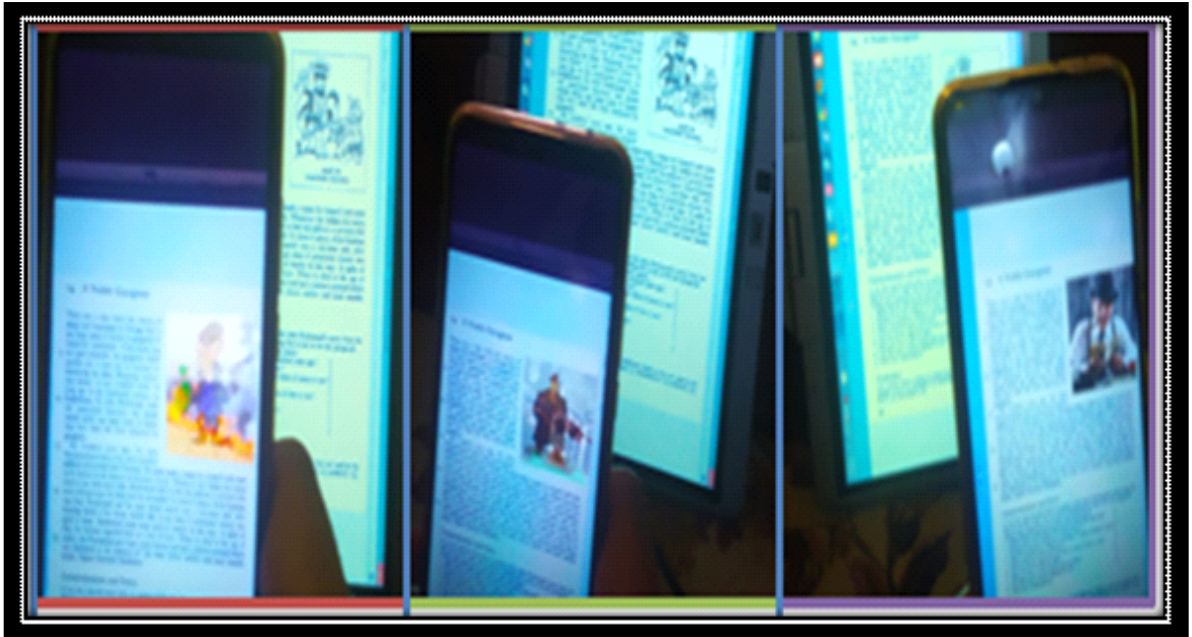


Figure (5): Displaying the AR Content of the Reading Comprehension Topics for the Second Stage Students in Format of Video

- 4- **Implementation:** It is the start of the learning process, all the materials created in the Development phase are introduced to the target learners. In this phase, the researchers conducted an exploratory experiment on students: EyeJack Creator application was applied to a sample of (25) students from the second stage of department of English (outside the basic research sample), in order to ensure the safety of the application and make the necessary adjustments to be applicable (to identify the problems that students may face in learning with ART).
- 5- **Evaluation:** This phase measures the effectiveness of the instruction. The evaluation phase went through the following step:
- Presenting the proposed program based on the Augmented Reality Technology (ART) to a jury of specialists in methods of teaching and educational technology to verify its validity. After completing the preparation of the proposed program in its initial form, it is supposed to present it to a group of experts in order to ensure its suitability and ability to achieve the required goals, and then modifying based on the opinions of experts. Among the most important criteria that must be taken into account in building the proposed program are the following:
 - Safety of educational content.
 - Relevancy of goals and the possibility of achieving them.
 - Appropriateness of activities to the level of the target group (second stage university students - Department of English Language - College of Basic Education).
 - Submitting any suggestions that contribute to enriching the program.

3.2 Choosing the Experimental Design:

In this study, the experimental design with partial control was chosen for the two groups (experimental and control) with achievement test and intelligence test, as shown in the following table (1):

Table (1): The experimental design used in the research

Group	Equivalence	Independent Variable	Dependent Variable	Final Post Test
Experimental	Age	Instructional Program Based on ART	Achievement	Achievement Test
Control	Intelligence Test Achievement Test	Classical/traditional Instruction		

3.3 Sample of the study:

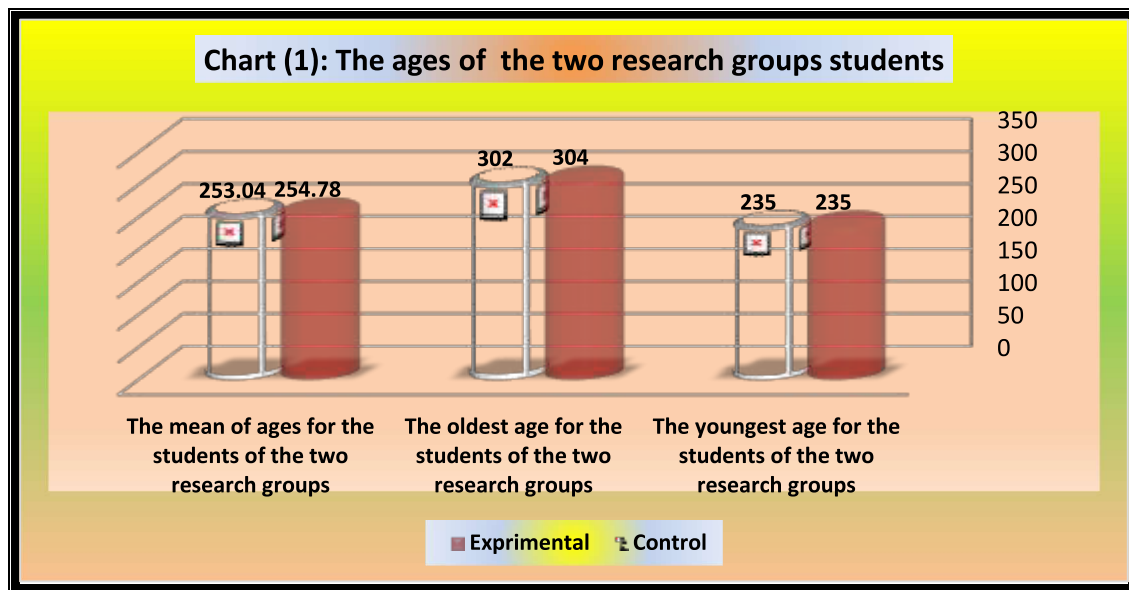
The sample of study was (91) of the second stage students in department of English, College of Basic Education / University of Babylon, to implement the study experiment .It was randomly selected two sections, one of which represents the Experimental Group (EG) numbering (46) students and the other represents the Control Group (CG) numbering (45).

3.4 Equivalence of the two research groups: The researcher chose the two research groups at random and decided to make sure that they were statistically equal through the following variables:

- **Participants' Age:** To ensure that the students of the two research groups are equivalent in this variable, the researcher used the T-test for two independent samples. After analyzing the results, the researcher concluded that the average age of the experimental group was (254.78) and the mean of the control group was (253.04), and this indicates that the difference is not statistically significant at the level (0.05) at the degree of freedom (89). As the calculated t-value (0.49) was smaller than the tabulated t-value of (1.98), which indicates that the two research groups are equivalent in age. The table (2) and chart (1) illustrate this:

Table (2) : The equivalence of the two groups scores in the age

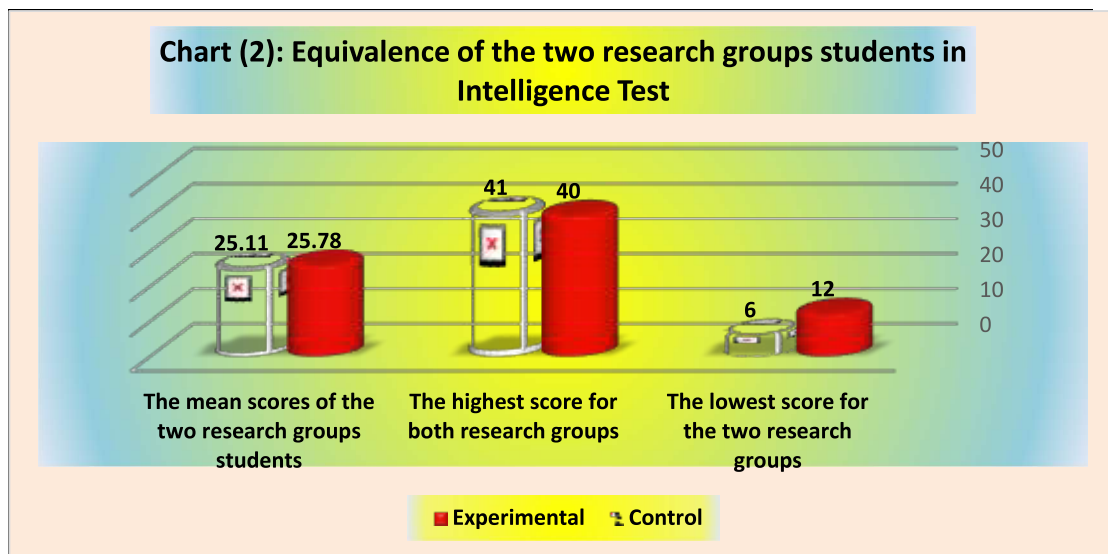
Group	No	Mean	Standard Deviation	t- Test Value		Degree of Freedom	Level of significance at (0.05)
				d Calculate	d Tabulate		
EG	46	254.78	17.70	0.49	1.98	89	Not statistically significant
CG	45	253.04	15.82				



- Intelligence Test (IQ):** For the purpose of achieving equivalence between the students of the two research groups in the variable of intelligence and after reviewing the literature and previous studies, the Philip Carter IQ test which is prepared for university students was applied. The test consists of (50) items of multiple-choice forms. Each item has four alternatives, one of which is correct. The test contains instructions for answering and a separate answer sheet. T-test formula of two unequal independent samples was used by the researcher for both groups (EG) and (CG) to find out if there is a significant difference between (EG) and (CG) in the variable of intelligence. After calculating the mean and standard deviation of the students of the two research groups, it was found that the mean scores of the experimental group students reached (25.78) with a standard deviation of (7.45), while the mean scores of the control group were (25.11) and with a standard deviation of (8.81). The calculated t-value is (0.39), which is smaller than the tabulated t-value (1.98) at (89) degree of freedom and at a significance level of (0.05). This indicates that there is no statistically significant difference between the students of the two groups, and accordingly, the two groups are equivalent in the intelligence test before conducting the experiment as shown in the table (3) and the chart (2).

Table (3): Equivalence of the two research groups students in intelligence test

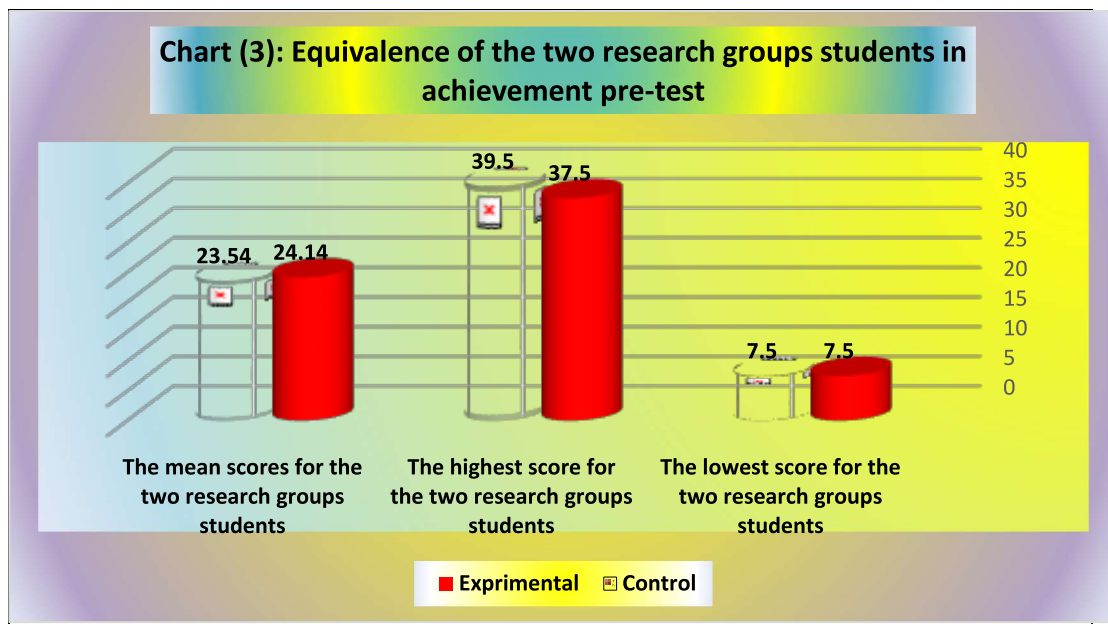
Group	No	Mean	Standard Deviation	t- Test Value		Degree of Freedom	Level of significance at (0.05)
				Calculated	Tabulated		
EG	46	25.78	7.45	0.39	1.98	89	Not statistically significant
CG	45	25.11	8.81				



- Achievement pre-test in reading comprehension:** The researcher used the pre-achievement test for the purpose of equivalence between the experimental and control groups. He prepared a pre-achievement test consisting of (5) questions which are distributed as follows: (2) multiple-choice questions, (2) open-ended questions and an essay question. After correcting the answers and using the t-test for two independent samples to find out the significance of the statistical differences, the mean scores and standard deviation were calculated, as the mean scores of the experimental group was (24.41) and with a standard deviation (7.63), while the mean scores of the control group was (23.78) and with a standard deviation (8.15). It was found that the difference is not statistically significant at the level of significance (0.05), as the calculated t-value amounted to (0.38), which is smaller than the tabulated t-value (1.98) at degree of freedom (89). This indicates that the experimental and control groups are statistically equivalent in the achievement test. The table (4) and chart (3) illustrate this:

Table (4) : t-test results of achievement pre-test in reading comprehension

Group	No	Mean	Standard Deviation	t- Test Value		Degree of Freedom	Level of significance at (0.05)
				Calculated	Tabulated		
EG	46	24.41	7.63	0.38	1.98	89	Not statistically significant
CG	45	23.78	8.15				



3.4 Standardization of the achievement test:

- **Difficulty level of the items:** After calculating the difficulty coefficient for each of the test items, the researcher found that its value ranges between (0.28 - 0.63) with an average of (0.47), and therefore all items are acceptable if the degree of difficulty ranges between (0.20 - 0.80) (Allam, 2009: 288). By applying the formula, the difficulty coefficient was calculated for the items.
- **Discriminative power:** After calculating the discriminatory power for each of the test items, the researcher found that the value of discrimination ranges between (0.27 - 0.75) for the items of the test. By applying the item discrimination power formula, the discrimination coefficient was calculated. It is ranged between (0.27 - 0.75) with an average of (0.56), and therefore all items are acceptable, as Brown indicates that the item is good and desirable if the degree of discrimination exceeds (0.20) (Allam, 2009: 293).
- **Validity of the test :** The test was presented to a number of experts and specialists in curricula and teaching methods and educational psychology to seek their views on the validity of the items. The percentage was calculated with the agreement of the experts on the items, it was amounted to (88%). In light of their observations and suggestions, the modification was made and the test was ready to be applied.
- **Reliability of the Test:** The achievement test was administered online twice to a sample of 30 second stage students, English language department, College of Basic Education, University of Kufa. The second time of administration was after two weeks. Those students were excluded from the whole experiment. Reliability of the test was estimated by comparing the scores of the students in the first and second administrations using Pearson's correlation coefficient. The reliability coefficient was (0.94), which means that the test was reliable. Therefore, the test could be considered a reliable one for the purpose of the current study.
- **The final form of the achievement test**
The achievement test of the current study consists of 25 test items, which were divided as follows:
 - Two multiple-choice questions: ten items (four-alternative) were corrected by giving two marks for the correct answer and zero for the wrong or left answer.

- Two short answer questions: ten items were corrected by giving two marks for the completed answer, one mark for the incomplete answer, and zero for the incorrect answer.
 - Two essay items were corrected by giving five marks- for each item- for the completed answer, three marks for the incomplete answer, and zero for the incorrect or left answer.
- Thus, the total score of the achievement test is 50 marks, and the lowest score is zero.

3.5 Difficulties involved when using EyeJack Creator application

While 35 (76%) of the experimental group students stated that they did not encounter any problems using the application, 11 of them (24%) stated that they faced some difficulties. Among these difficulties are the following:

1. Some of the students who stated that they experienced problems specified difficulties related to the perception of the (object) markers. Because of an excessive amount of light in the environment, the surfaces of the markers glittered, and this caused some problems in the pilot study.
2. Another difficulty experienced by the students relates to their unfamiliarity with the AR materials.
3. Poor internet speed: This is due to the use of a web browser that contains add-ons and secondary features that consume more internet, which slows down the internet speed.

All these challenges and problems have been overcome and addressed by the researchers.

4. Presentation and interpretation of results

3.1 The results of the first null hypothesis:

- 1- To verify the results of the first null hypothesis which states that (there is no statistically significant difference at the level of significance (0.05) between the mean scores of the experimental group students who are taught reading comprehension using the instructional program based on augmented reality technology and the mean scores of the control group students who are taught the same subject using the conventional method in the post-achievement test). The researcher applied the final achievement test to the students of the experimental and control groups, and after correcting the answers and analyzing them statistically, the mean, variance and standard deviation of the students of the two research groups were calculated. By using the t-test for two independent samples, it was shown that the mean scores of the experimental group students was (34.17) with a standard deviation (5.68), while the mean scores of the control group students reached was (24.35) with a standard deviation (7.48), and the calculated t-value (7.05) was larger than the tabulated t-value (1.98) with a degree of freedom (89). This means that there was a statistically significant difference between the experimental group students who are taught reading comprehension using the instructional augmented reality technology and that of the control group students who are taught the same subject using the conventional method in the post-achievement test, in favor of the experimental group at the level (0.05). Thus, the null hypothesis is rejected and the alternative hypothesis is accepted. The table (5) illustrates this:

Table (5): t-test results of the two research groups in the post achievement test.

Group	No	Mean	Standard Deviation	t- Test Value		Degree of Freedom	Level of significance at (0.05)
				Calculated	Tabulated		
EG	46	34.17	5.68	7.05	1.98	89	statistically significant
CG	45	24.35	7.48				

It is noticed from the previous table that there is a statistically significant difference between the mean scores of the students of the two research groups in the achievement test in favor of the experimental group. This result indicates the superiority of the students of the experimental group who were taught according to the augmented reality technology over the students of the control group who were taught according to the conventional method. Thus rejecting the first null hypothesis and accepting the alternative hypothesis.

2- Calculating the effect size (the extent of effectiveness) of the independent variable on the variable dependent(academic achievement):

The researcher used the Eta square (η^2) equation to extract and calculated the effect size of the independent variable on the dependent variable. The effect size was (0.36), which is an appropriate value to explain the effect size and by a (large) amount for the teaching variable with augmented reality technology in the achievement test in favor of the experimental group, as shown in the table (6). In determining the effect size, the researcher relied on the classification set by (Cohen, 1988) and the table (7) explains that:

Table (6): The effect size of the independent variable (ART) on the dependent variable (achievement)

Independent Variable	Dependent Variable	Value of effect size η^2	Effect Size
Augmented Reality Technology	Achievement	0.36	large

Table (7): Effect size and its values according to Cohen's classification

Values of Effect Size	Significance
(0.01) – (0.06)	Small
(0.06) – (0.13)	Medium
(0.14) –	Large

4.2 The results of the second null hypothesis:

1- To verify the results of the second null hypothesis, which states that (there is no statistically significant difference at the significance level (0.05) between the mean scores of the experimental group students who are taught reading comprehension using the instructional program based on augmented reality technology in pre and post achievement test). The researcher applied the pre and post achievement test to judge the students of the experimental research group. After correcting the answers and analyzing them statistically, the mean, variance and standard deviation of the students of the research group were extracted. By using the t-test for two correlated samples, it was found that there is a statistically significant difference in favor of the experimental group for the post-test at the level (0.05). It appeared that the mean scores of the experimental group students in the pre visual intelligence test was (24.41) with a standard deviation (7.63), while the mean scores of the experimental group students in the post visual intelligence test reached (34.17) with a standard deviation (5.68). The calculated t-value (15.65) was larger than the tabulated t-value (2.02) with a degree of freedom (45), and this indicates the superiority of the students of the experimental group after conducting the experiment and introducing the independent variable (the instructional program based on augmented reality technology) on them. Thus, rejecting the second null hypothesis and accepting the alternative hypothesis. The table (8) illustrates this:

Table (8): Mean scores and t-values (calculated and tabulated) of the experimental group students in the pre and post achievement test

Group	No	Test	Mean	Standard Deviation	t- Test Value		Statistical significance	Degree of Freedom	Level of significance at (0.05)
					Calculated	Tabulated			
EG	46	Pre	24.41	7.63	15.65	2.01	0.00	45	statistically significant
		Post	34.17	5.68					

It is noticed from the previous table that there is a statistically significant difference between the mean scores of the students of the experimental research group in the pre-post achievement test in favor of the post-achievement test. Thus rejecting the second null hypothesis and accepting the alternative hypothesis.

2- Calculating of the effect size (the extent of effectiveness) of the independent variable on the dependent variable (pre and post achievement) of the experimental group. The researcher used Cohen's equation to extract the effect size (d) for the independent variable on the dependent variable (academic achievement), and the effect size (d) reached (2.31), a value that explains the effect size with a (large) amount of the teaching variable using augmented reality technology in developing the achievement, and the table (9) explains this. In determining the effect size, the researcher relied on the classification set by (Cohen, 1988) and the table (10) explains that:

Table (9): The effect size of the independent variable (ART) on the dependent variable (for pre and post achievement test) of the experimental group.

Independent Variable	Dependent Variable	Value of effect size d	Effect Size
Augmented Reality Technology	Achievement	2.31	large

Table (10): Effect size and its values according to Cohen's classification

Values of Effect Size	Significance
(0.2) – (0.4)	Small
(0.4) – (0.7)	Medium
(0.8) –	Large

The researchers attribute these results to the teaching method that was carried out using AR technology. This technology is characterized by taking into account individual differences and encourages individualization of education and meets the needs and tendencies of students. It also encourages active participation with peers and teamwork to reach the goal, and to increase the spirit of free directed competition.

4.3 The results for the third null hypothesis:

1- To verify the results of the third null hypothesis, which states that (there is no statistically significant difference at the level of significance (0.05) between the mean scores of the control group students who are taught reading comprehension using the conventional method in the pre-post achievement test). The researcher applied the pre and post achievement test to judge the value of development in achievement on the students of the control research group. After correcting the answers and analyzing them statistically, the mean, variance and standard deviation of the students of the research group were extracted. By using the t-test for two correlated samples, it became clear that there was no statistically significant difference at the level (0.05), as it appeared that the mean scores of the control group students in the pre-achievement test was (23.77) with a standard deviation (8.15), while the mean scores of the control group students in the post-achievement test was (24.35) with a standard deviation (7.48). The calculated t-value (1.33) was smaller than the tabulated t-value (2.01) with a degree of freedom (44). This means that there is no statistically significant difference in favor of the post-test in the control group, and this indicates that this result does not indicate that there is a development in achievement among the students of the control group who are taught according to the conventional method. Thus, accepting the third null hypothesis and rejecting the alternative hypothesis. The table (11) illustrates this.

Table (11) : The mean, variance and t-test value (calculated and tabulated) for the scores of control group students in the pre and post test of achievement

Group	No	Test	Mean	Standard Deviation	t- Test Value		Statistical significance	Degree of Freedom	Level of significance
					Calculated	Tabulated			
CG	45	Pre	23.78	8.15	1.33	2.01	0.19	44	Not statistically significant

It was noted from the previous table that there is no statistically significant difference between the mean scores of the students of the control group in the pre and post achievement test. Thus, accepting the third null hypothesis and rejecting the alternative hypothesis.

2- Calculating the effect size (the extent of effectiveness) of the independent variable on the dependent variable (pre and post achievement) of the control group:

The researcher used Cohen's equation to extract the effect size (d) for the independent variable on the achievement dependent variable, and the value of the effect size (d) was (0.29). This value explains that the effect size is (small) for the teaching variable using the traditional method in developing the achievement variable, and the table (12) explains this. In determining the effect size, the researcher relied on the classification set by (Cohen, 1988) .

Table (12) : The effect size of the independent variable on the dependent variable (pre and post achievement test) of the control group.

Independent Variable	Dependent Variable	Value of effect size d	Effect Size
Conventional method	Achievement	0.29	small

4. Conclusions and Recommendations

5.1. Conclusions:

The analysis of the results of the present study has revealed the following conclusions:

1. Employing the proposed program based on AR technology in teaching reading comprehension course helped learners to be able to deal with and perceive information easier, and it can also provide them with different ways to represent information in a dynamic and visual manner that helps to question, explore, collaborate, and communicate their knowledge rather than just follow directions and memorize information.
2. The use of AR technology has contributed to the growth of academic achievement among the students of the experimental group, with statistically significant differences of that of the control group.

3. AR could be incorporated into the classroom as a supplemental learning tool. This would allow teachers and students to gain familiarity with the technology and allow more research to be conducted. In the short run, AR could bring experiential and location-based learning to students by supplementing their surroundings.
4. Providing positive encouraging non-boring environment during teaching the topics of reading comprehension helped students participate freely.

5.2 Recommendations:

In the light of the present study results, the researchers suggest the following:

- 1- ART must be employed and used by teachers in the classroom because it is characterized by elements of attraction and suspense, eliminating the monotony of the educational situation, getting rid of its rigidity, and stimulating the student to pay attention in order to participate. This leads to the consolidation of information, and remaining the impact of learning for a longer period.
- 2- The necessity of training the instructors in universities and schools on the production and design of AR content and its use in the educational process.
- 3- Adopting ART as a basic teaching method in teaching various subjects and at all academic levels.
- 4- Providing the experience of this technology on internet browsers and on social networking sites to attract users.
- 5- On the other hand, the vision of the Iraqi education system of was expressed by the Ministry of Higher Education and Scientific Research (2020) as to integrate the education system with advanced technologies, should be applied to support with innovations, to continuously evaluate them, to provide student-centered and project-based education using AR technology.

5.3 Suggestions:

- Further research is needed to investigate the impact of ART with other student's populations at different levels of education.
- Conducting studies based on ART to find out the effectiveness of suggested program on learners' education with special needs.
- Conducting studies to investigate the impact of learners' participation in building digital content with ART on the development of their achievement and motivation.

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