فاعلية التدريس بتكنولوجيا الواقع المعزز في تنمية مهارات الذكاء البصري لدى طلبة كلية التربية الأساسية

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كيفية اقتباس البحث

القره غولي ، احمد علي علوان، منى محمد عباس الخطيب، امير كاظم هادي ، فاعلية التدريس بتكنولوجيا الواقع المعزز في تنمية مهارات الذكاء البصري لدى طلبة كلية التربية الأساسية، مجلة مركز بابل للدراسات الانسانية، تشرين الاول 2022،المجلد:12 ،العدد:4 .

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The Effectiveness of Teaching with Augmented Reality Technology on Developing Visual Intelligence Skills among College of Basic Education Students

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الملخص:

هدفت هذه الدراسة إلى معرفة فاعلية برنامج تعليمي مقترح قائم على تكنولوجيا الواقع المعزز في تنمية مهارات الذكاء البصري لطلاب المرحلة الثانية في مادة الاستيعاب القرائي . تكونت عينة الدراسة من (75) طالباً و طالبة من كلية التربية الاساسية، قسم اللغة الانجليزية، جامعة بابل في العراق للفصل الدراسي الثاني من العام الدراسي ٢٠٢٠ – ٢٠٢١. كانت أداة الدراسة اختبار لمهارات الذكاء البصري مكون من (٤١) فقرة. كما أعد الباحثون بيئة قائمة على تكنولوجيا الواقع المعزز لتدريس المادة وفقًا لنموذج ADDIE الذي يمتاز ببساطة التصميم

وسهولة الاستخدام والملاءمة للمرحلة العمرية للطلبة. اعتمد الباحثون في الدراسة الحالية على المنهج التجريبي و ذلك لمعرفة اثر المتغير المستقل (فاعلية التدريس بتكنولوجيا الواقع المعزز) على المتغير التابع (مهارات الذكاء البصري) على عينة الدراسة. أظهرت نتائج الدراسة تفوق المجموعة التجريبية التي درست باستخدام البرنامج التعليمي القائم على تكنولوجيا الواقع المعزز على المجموعة الضابطة التي درست بالطريقة التقليدية. وفي ضوء نتائج الدراسة، أوصى الباحثون بضرورة دمج وتوظيف تكنولوجيا الواقع المعزز في مناهج وزارة التربية و وزارة التعليم العالي و البحث العلمي ، وتصميم الكتب والمناهج التعليمية بما يتوافق مع هذه التكنولوجيا. كما اقترحت الدراسة زيادة الاهتمام بإجراء المزيد من الدراسات حول تكنولوجيا الواقع المعزز في مراحل التعليم المختلفة. و قد خلص الباحثون إلى أن تكنولوجيا الواقع المعزز هي أداة فعالة في تنمية مهارات الذكاء البصري، حيث أسفرت الدراسة عن تفوق طلبة المجموعة التجريبية الذين تعلموا باستخدام هذه التكنولوجيا على زملائهم في المجموعة الضابطة في اختبار مهارات الذكاء البصري البعدي. علاوة على ذلك ، يساهم استخدام تكنولوجيا الواقع المعزز في تزويد الطلاب بقدر أكبر من المعلومات مقارنة بالطريقة التقليدية.

Abstract:

This study aimed to find out the effectiveness of a proposed instructional program based on Augmented Reality Technology (ART) on developing visual intelligence skills of second stage students in the subject of reading comprehension. The study sample consisted of (75) male and female students, from College of Basic Education, Department of English Language, University of Babylon , Iraq for the second semester of the academic year 2020-2021. The study tool was a test of visual intelligence skills consisting of (41) items. The researchers prepared an ART environment according to the ADDIE Model for simplicity of design, ease of use and suitability for age stage of the students. In the current study, the researchers relied on the experimental method in order to find out the effect of the independent variable (the effectiveness of teaching with augmented reality technology) on the dependent variable (visual intelligence skills) on the study sample.The results of the study showed the superiority of the experimental group that was taught using the instructional program based on Augmented Reality Technology over the control group that was taught in the conventional way. In light of the results of the study, the researchers recommended the necessity of integrating and employing ART in the curricula of Ministry of Education and Ministry of Higher Education and Scientific Research, and designing textbooks and instructional curricula in accordance with ART. The study also suggested increasing interest in conducting more studies on ART in the different stages of education. The researchers also concluded that augmented reality technology is an effective tool in developing visual intelligence skills, as the study resulted in the

Journal of Babylon Center for Humanities Studies: 2022, Volume: 12, Issue: 3

superiority of the experimental group students who were taught using this technology over their colleagues in the control group in the visual intelligence skills post-test. Moreover, the use of ART contributes to providing students with greater amount of information compared to the traditional method.

Introduction

The importance of teaching methods and strategies highlights the role they play in developing students' capabilities and preparations. However, instructors usually rely on the method of presentation, dialogue and discussion in lectures, in order to reach information and facts for students. These methods, despite their effectiveness, do not take into account individual differences between students. The nature of human beings differs among themselves in shape and color as well as in thinking patterns and at different levels of intelligence. This fact led scientists and researchers to refuse to accept the existence of one intelligence in the traditional concept, so Gardner's theory, the Multiple Intelligences (MI), appeared to reconsider the concept of intelligence and to change the teachers' view of the students' different mental abilities and how to deal with the types of intelligences. MI Theory is highly applicable and appreciated in modern education due to its main claim that every individual has eight intelligences and they all work together in a unique way.

Brand (2010: 3) states that today's learners rely to a great extent on visual learning. Literature of educational research supports the claim that using visuals in teaching results in a greater degree of learning as the learners seem to concentrate better and for more sustained periods of time. Besides, Bitter and Legacy (2008: 23) also point out that learners would retain more information with the help of sufficient visual content in their learning materials. One of Gardner's intelligences is visual-spatial. Šafranj & Zivlak (2018:72) emphasize that visual intelligence is the ability to visualise space and objects within the mind´s eye. People who prefer to use this kind of intelligence would rather draw a picture than write a paragraph. They notice colour, shapes and patterns and how light falls on the object, and comprehend mental models. Further, studies such as (Diezmann & Watters, 2000: 303) and (Heming, 2008:6-7) reported that visual-spatial intelligence has capabilities that enable learners to remember through graphics and diagrams, use metaphors in language, find out the meanings through looking at the pictures more than reading them, and determin direction in unfamiliar places.

Cai et al. (2012: 83) argue that traditional learning is considered to be a boring process, whereas the emergence of technological innovations totally revolutionized people's ideas about learning. Vritual and augmented learning environments have brought completely new experience for learners. According to Chittaro and Ranon's research (2007), compared with traditional learning method, virtual learning

environments help to reduce learners' cognitive load and increase achievement during their learning process.

Our daylife is witnessing many rapid changes, as a result of the emergence of educational technology developments, which attempt to bridge the gap between the expected (reality) and the desired (hoped), and contribute to find solutions that integrate technology with education effectively and efficiently with the aim of reforming and developing education. Hence the emergence of e-learning started, which is one of the recent trends in learner-centered education, as it includes new media and methods, including Augmented Reality Technology (ART).

Chen et al. (2019: 2-3) mention that "Augmented Reality Technology (ART) is a kind of technology that can put the virtual objects together such as 3D objects generated by the computer into the real world. Principally, AR refers to an interactive system, which meets the following criteria: the integration of real world with virtual information, interaction with virtual objects at a real time and users' experience in three dimensions."

ART plays an important role in the educational process, as it is one of the technological innovations that have appeared recently and have spread widely in various fields of education. It also represents the most important applications of using mobile phones and smart devices. So, many educational institutions and universities have turned to the use of this technology in education. The implementation of ART in education settings can support students at a personal level and develop both their motivation and engagement. Moreover, The effectiveness of ART in higher education was exemplified in a study of Küçük et al. (2016). They found that undergraduate students' academic achievement was increased and cognitive loads were low because of using ART applications in teaching those students. The study showed that 79% of the students agreed that ART facilitated their learning of the topics.

Based on the findings of most studies such as (Estapa and Nadolny 2015; Küçük et al. 2016; Buchori 2017; and Özerbaş 2019), the enhancement of students' learning outcomes in terms of academic achievement, engagement, motivation, satisfaction, attitude, and developing skills are some of the advantages of using ART in education.

The current education in College of Basic Education suffers from visual illiteracy, as it relies on verbal education that focuses on acquiring language skills and developing linguistic intelligence, and this leads to neglecting abilities and other non-verbal skills, including visual ability. This contrasts with what the study of the current research requires in reading comprehension subject to improve the learner's visual intelligence and develop his abilities in translating the visual language carried by the written text. By conducting an exploratory study conducted by the researchers on a sample of students of English Language Department, they noticed a shortcoming and weakness in their visual-spatial intelligence skills, as the development of the visual aspect of the

Journal of Babylon Center for Humanities Studies: 2022, Volume: 12, Issue: 3

student is one of the important factors that help to develop his/her visual thinking and improve his/her performance. Therefore, the use of ART- which is based on the use of images, videos, 3D interactive graphics, animation, writing , and music with virtual reality to activate the process of visual perception- is an important source in the educational process for the acquisition of learning and creating an effective learning atmosphere . This actually helps the current researchers know the levels of visual intelligence among their students, which formed an incentive and a need for a scientific study concerned with knowing the effectiveness of teaching with ART on developing the necessary visual intelligence skills for second stage English language department students in College of Basic Education, as this would increase their abilities to master the process of visual understanding of the forms and images in reading comprehension texts, forming a mental image of the written text, imagining topics and events from different angles, and realizing the relationships between the visual forms and elements of written texts in reading comprehension subject. Therefore, this will enable those students to produce mental images and imaginations to solve problems creatively.

1.1 Problem of the study

The main motives that led the researchers to choose this topic can be identified in a number of points, which can be summarized as follows:

First, Reviewing the ratios and statistics that are collected from studies and researches concerning the developing of multiple intelligences in general and visual-spatial intelligence in particular as well as the results of analyzing these ratios and statistics that indicate a clear weakness and decrease in the level of learners.

Second, Exploratory 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. The sample consisted of (40) male and female students.The exploratory study represented in a visual intelligence test to identify the actual level of learners of visual intelligence skills in some texts selected from the reading comprehension course. The researchers actually found a clear weakness in mastering these skills. The results indicated that about 85% of the students had a low understanding of visual forms, pictures and maps, and the inability to perceive visual relationships.

According to what has been mentioned above, the problem of this study could be identified in second stage Basic Education College students' visual intelligence skills weakness. Therefore, the current study attempts to investigate the effectiveness a proposed instructional program based on augmented reality technology on developing the visual intelligence skills among College of Basic Education students in reading comprehension course.

1.2 Aims of the study:

This study aims at:

●Developing visual intelligence skills of the second stage English Department students, College of Basic Education, University of Babylon,
●Investigating the effectiveness of an instructional program based on augmented reality on developing the visual intelligence skills among College of Basic Education Students in reading comprehension course.

1.3 Significance of the study

It is hoped that the current study would:
●Draw the attention of educators to employe ART in education.
●Keep pace with the vision of Iraqi Ministry of Higher Education and Scientific Research in modernizing teaching and training methods and activating the role of educational technology to improve instructional and training programs and to enrich the educational content through using augmented reality activities.
●Direct the attention of reading comprehension instructors to the importance of achieving urgent goals - other than achievement - among which is the development of the student's ability in visual intelligence skills through teaching this subject at different academic levels.
●Be a developmental research in the field of educational technology, and it keeps pace with modern trends in teaching various subjects for this sample of students.

1.4 Hypotheses of the study

The study hypotheses are as follow:
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 visual intelligence skills test.
2.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 in the pre-post visual intelligence skills test.
3.There is no statistically significant difference at the level of significance (0.05) between the mean scores of control group students who are taught reading comprehension using the conventional method in the pre-post visual intelligence skills test.

1.5 Limits of the study

This study was limited to the following limits:
●Objective limits: This research was limited to knowing the effectiveness of an instructional program based on augmented reality technology, using QR Reader Application, on developing the visual intelligence skills among College of Basic Education students in reading comprehension subject.

Journal of Babylon Center for Humanities Studies: 2022, Volume: 12, Issue: 3

●Human and place limits: This study was conducted on a sample of (75) second stage English department students, College of Basic Education, University of Babylon, Iraq.
●Some visual intelligence skills, including (visual discrimination, visual prediction, analyzing visual information, interpreting visual information, and inferring meaning)
●Time limits: The study was conducted in the second semester of the academic year 2020- 2021.
●Alexander's textbook entitled "Developing Skills: An integrated Course for Intermediate Students".

1.6 Tools of the study

The following instrument was administered after ensuring its validity and reliability:
●A pre-post visual intelligence skills test for second stage English department students designed by the researchers.

1.7 Procedures

The present study went through the following procedures:
1.Reviewing the literature and previous studies which are related to: Augmented Reality Technology (ART) and Visual Intelligence (VI).
2.Designing a pre-post visual intelligence skills test and verifying its validity and reliability.
3.Designing an instructional program based on ART (using QR Codes Reader Application) in the light of the scheduled curriculum of second stage English department students.
4.Selecting a sample of second stage English department students. (n=75) randomly and dividing it into two groups: one acts as the control group (n=37), whereas the other constitutes the experimental group (n=38).
5.Administering a visual intelligence skills pre-post test to both the experimental and the control groups before the experiment.
6.Teaching the assigned passages and texts to the students of the experimental group through using the proposed instructional program based on ART and to the control group through the conventional method.
7.Administering the visual intelligence skills pre-post 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.

1.8 Terms of the study

●**Effectiveness:** The extent to which the suggested instructional program achieves the educational goals as measured by the visual intelligence test through the statistically significant difference between the mean scores of the study group members in the pre-test and their mean scores in the post-test.
●**Instructional program**: Sabry (2009:15) defines the instructional program as a set of procedures, steps, instructions and rules that are followed to transfer specific experiences, (these experiences may be read,

audio or visual, direct or indirect) to an individual or group of individuals or a large audience, in one place or separate places to achieve specific goals.

In this study, the instructional program is defined operationally as an instructional plan of the second stage students, Department of English, College of Basic Education, and its implementation takes an entire semester. This instructional plan includes a set of steps, procedures, lessons, activities, and evaluation methods based on augmented reality technology, which students of the second stage must receive and learn in reading comprehension course in a specific period of time.

●Augmented Reality Technology (ART):

Solak & Cakir (2015:52) defined Augmented Reality as a technology that AR combines real and virtual worlds, supplementing the real world with computer-generated virtual objects in real-time.

In the current study, ART is defined operationally as providing an instructional environment that integrates the real world (text content) with the virtual world (electronic content of the learning environment) through the camera of smart devices (mobile phones - tablets), to enable the second stage students of English language department to view digital content that includes: (images, animations, graphics and videos with the inclusion of audio files and text information) for controlling and interacting with that content, using the QR Reader Application based on the response code marker. This is done by scanning the barcode (QR) with a mobile phone camera to display the educational content that is based on augmented reality technology for the selected text in reading comprehension course in an easy and interesting way.

●Visual-Spatial Intelligence:

Gardner (2004:1) defined visual-spatial intelligence as "capacity to think in images and pictures, to visualize accurately and abstractly".

In this study, visual-spatial intelligence is defined as a system of processes that translate the second stage students' ability to read the visual form, convert the visual language carried by the form into a written or spoken language, and extract information from it. It is the ability to understand the visual information, through imagination, with the ability to mentally process images before they are translated into reality by reading a set of images of reading comprehension textbook scheduled for the second stage students of English language department, as well as imagining (visualizing) the events of the stories and texts of it. It is estimated by the degree that the student obtains in the visual intelligence skills test prepared for this.

2. Literature Review

2.1 Augmented Reality Technology(ART)

ART is one of the most modern information visualization technologies. There are several definitions of ART, Iatsyshyn et al. (2020: 184) define it as " a technology that allows to combine layer of virtual reality with physical environment. This technology is necessary

Journal of Babylon Center for Humanities Studies: 2022, Volume: 12, Issue: 3

for visualization of objects or visual supplement of textbooks , fiction and educational books, tutorials, printed products – newspapers, booklets, magazines, maps, etc. Supplementary information can be in the form of text, images, videos, sound, three-dimensional objects. Labels are scanned using tablets or smartphones for browsing, and then content is added".

Dunleavy & Dede (2006:7) define ART as a term that describes technology that allows the simultaneous integration of digital content of software and computerized objects with the real world.

According to Klopfer and Squire (2008), ART is "a situation in which a real world context is dynamically overlaid with coherent location or context sensitive virtual information" (p.205).

While Glockner et al. (2014:3) define it as expanding the real reality by adding layers of computer-generated information to the real environment, and this added information can be text, graphics, video, audio, or GPS.

So, the researchers of the current study maintain that ART can be thought as a bridge between virtual and real world that allows converting real two-dimensional images into virtual images and interactive three-dimensional graphics on the screen of smart devices, that is, it is a combination of real reality and digital information.

From the previous definitions, it becomes clear to the researchers that:

- ART integrates the real world and the virtual world into a real environment. It works by adding unrealistic layers to the actual reality, and this is certainly done through tools that are capable of making this addition and mixing, including the smartphone.
- The possibility of interaction between the two parties, such as: the teacher and the learner.

With the rapid development in technological devices and virtual environments, it is originated several names and terms, such as: virtual world, virtual reality, augmented reality, mixed environments, and the augmented virtuality, which are used by some as one term while, in fact, it shows different worlds. Milgram & Kishino (1994:1324) indicated that there are several environments that locate between real reality and virtual reality, and they differ in the degree of integration of virtual elements within the environment (Figure 1).

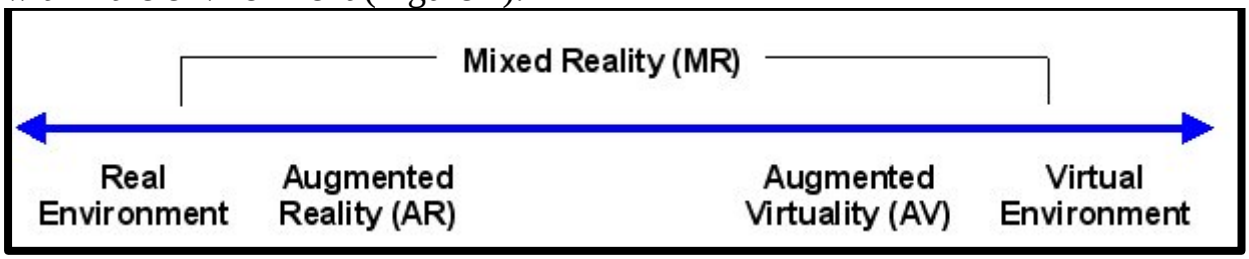

Figure (1): Reality-Virtuality (RV) Continuum by (Milgram, 1994)

2.1.2 Augmented Reality Characteristics

The literature agreed and emphasized on three important characteristics, as mentioned by Azuma (1997:2). He indicated these are blending of real and virtual worlds in a real environment (combines real and virtual), real-time interaction (Interactive in real time), and accurate 3D registration of virtual and real objects.

Anderson & Liarokapis (2014:2) added the following characteristics:

-ART provides clear and accurate information.
-ART has the ability to enter information in an easy and effective manner.
-ART provides powerful information despite its simplicity of use.
-ART makes complex procedures easy for users.
-ART is easily expandable.
-ART is inexpensive.

The researchers of the current study can add to the previous characteristics the following:

-ART makes the educational process fun, easy, and interesting for both teachers and students.
-ART aims to increase digital efficiency in the teaching and learning activity.
-ART focuses on developing and using new methods and techniques for effective learning.
-ART shifts the focus from the teacher to the learner in the learning and teaching process.
-ART provides guidance and technical assistance to solve many of education problems.
-It makes education and access to information much easier compared to traditional education.
-ART develops the learner's ability to imagine.
-ART develops self-learning skills.
-ART has the potential to save time and money in the case of highcost educational needs.
-ART does not need special laboratories to implement it. The applications of this technology can be used anywhere, whether inside or outside the learning environment (it can be used to extend content into the world outside the classroom).
-ART also fosters a spirit of innovation and experimentation in learning through the use of new research findings.
-

2.1.3 Types of Augmented Reality

ART can be classified into marker-based or markerless, depending on how the virtual and the real objects are aligned with each other.There are two types of augmented reality, as mentioned by Shushan (2018:43), Munoz-Cristóbal et al. (2018: 507), Attar and Kansara (2015: 189) as follows:

- ***The first type (Marker-based)*** which uses markers so that the camera can capture and mark them to present information required.

- ***The second type (Markerless)*** which does not use markers, but rather resorts to the geographical location of the camera through the map service (GPS) or image recognition programs (Image Recognition) to provide information**.**

Moreover, Sinha (2021) argues that there are four different categories of markerless ART: Projection-based ART, Superimposition – based ART, Location-based ART , and Outlining-based ART:

▪***Projection-based ART:*** It is one of the most common types of augmented reality, and it depends on the use of artificial images and projecting them onto the actual reality to increase the details that the individual sees through smart devices.

▪***Recognition-based ART(Superimposition):*** This type is based on the principle of recognizing the shape ,angles and borders of the object presented.

▪***Location-based ART:*** It is used to identify the location through communication with maps, and it is a way that is employed to determine locations in conjunction with other software, including GPS and Triangulation Technology, which serves as a guide in directing the vehicle or ship or the individual to the desired access point.

▪***Outlining-based ART:*** It is one of the types of ART that enables a person to merge the outlines of his body or any selected part with another virtual body, which gives an opportunity to touch virtual objects that do not exist in reality.

The researchers confirm that the current study falls under the first type of augmented reality, as the researchers designed a set of markers (QR barcodes) and linked each one with a specific content (a Google Site link that contains pictures, videos, audios, texts, and animations that related to topics of reading comprehension textbook) that appears as soon as the smart device's camera is directed towards the QR barcode.

2.1.4 Augmented Reality in Educational Contexts

ART has turned from a technological vision of the future, which could often be found in science fiction movies, to a technological achievement of the present, which can now be created by our smart phones and tablets devices.

Some justifications of using ART in education were determined by Radu (2012:313) and Yoon & Wang (2014:49) , they indicated that among these justifications are the following:

-Easiness of displaying content in an interesting way. AR can be used to enhance
content and instruction within the traditional classroom.

-Availability of learning at all times and from anywhere.

-Developing the participation and cooperation between the learners.

-Increasing learners' understanding of educational content through software-related support such as images, videos, graphics, and three-dimensional shapes.

-Retaining information in memory for a longer period, as what the learner acquires through AR applications lasts in memory more than what is gained by traditional methods.

Cipresso et al. (2018) as cites in Krüger (2019:412) move further that this development concerning the access to the necessary technology creates novel opportunities for applying AR in different fields. One area that many recent studies concerning AR focus on is education. The study of Lytridis et al. (2018: 1-2) analyzes that education is one of the most promising areas for applying AR and various studies have shown the utility of AR, especially in the field of education, where it has been observed that learning results are improved. Some of these studies have focused on the opportunities that AR as a way of visualizing information has to offer for both individual and collaborative learning settings. Positive effects that have been found when using AR in education are enhanced learning performance and motivation, higher enjoyment and engagement, more positive attitudes towards the learning material, and a better collaboration between learners.

Furthermore, the role of ART in education can be clarified as indicated by Lee (2012:19) in the following points:

- ART provides an innovative learning space by integrating digital learning materials with various forms of means and tools, which are direct parts of the physical space or the so-called physical environment, thus creating an opportunity for learners to enjoy (situational learning).
- ART goes hand in hand with constructivist learning concepts, which leads to students gaining greater skill and knowledge.
- ART is able to bridge the gap between theoretical and applied education, and focuses on the way in which the real and virtual worlds can be integrated together, thus achieving the various goals and requirements of e-learning.
- ART adds a new extra dimension to teaching concepts compared to other teaching methods. It achieves tangible results in collaborative and experiential learning processes, and the methods provided by AR in education include: physical cognition, embodied cognition, situational learning, and mental work.
- ART can motivate students to participate because it combines fun and knowledge at the same time, and this would motivate them to discover more in the instructional content.

It can be said that employing ART in education is considered one of the important and contemporary issues, because of its effectiveness in the process of teaching and learning. Educational AR applications can transfer the learner to the world of educational information, to test its foundations and causes by himself in a stimulating and interesting realistic experience, instead of dealing with this information in a fixed text template.

2.1.5 Challenges of using ART in education

There are some challenges facing the application of ART, Khan et al. (2019:3) point out to some of these challenges:

▪Usability: The use of ART within a learning environment requires multitasking, as students need to engage with large amounts of information and various technological tools and devices to accomplish complex tasks.This may result in a cognitive overload and a feeling of being confused. Moreover, the combination of virtual and real objects may cause confusion as learners may encounter difculty navigating between fantasy and reality.

▪Stability of mobile ART is not guaranteed, and difculties may be encountered if the technology lacks welldesigned interfaces and guidance as this may result in the technology being too complicated.

▪Learners may also need time to get familiar and comfortable with AR technology.

Rabbi & Ullah (2013: 33-34) add that some of these challenges can be categorized as "performance challenges, alignment challenges, interaction challenges, mobility/portability challenges and visualization challenges".

Lee (2012: 40) mentions the most important obstacles of ART as follows:

▪Lack of availability of specialists and experts in augmented reality technology.

▪There is no conviction by companies or schools about the effectiveness of ART compared to traditional methods.

Radu (2012: 314) adds the following to the previous obstacles:

▪Inability to obtain financial resources to start a project using modern technologies.

From the researchers' pointview of the current study, the most prominent obstacles to use ART in education are the following:

A.Obstacles related to teachers:

-The lack of moral and financial incentives that limits teachers' desire to use ART applications in the classroom.

-Facing difficulty in employing ART applications due to the lack of workshops and training courses in this field.

-The lack of specialists in designing and producing Arabic ART applications which limits its use in students' learning.

-Fear of changing the traditional educational techniques currently used with students and replacing them with modern technological techniques.

B.Obstacles related to lerarners:

-The limited electronic skills of some learners do not support the use of augmented reality technology applications.

-Students' low motivation that limits effective participation to use ART applications.

-Using ART may not be an effective instructional strategy for students.

C.Financial and technical obstacles:

-Poor internet infrastructure impedes the use of augmented reality technology applications in education students.
-The need for a high budget to create ART applications which limits its use in students' learning.
-Content portability: user-created AR application needs to work in parallel with all platforms and devices. In practice, it is impossible to have the same quality of AR content on any device.
-Using AR in the classroom requires a certain resource base, for example, not all students have smartphones capable of supporting AR applications.
-Technical issues with tracking the appearance of digital content, objects not displaying correctly, visual distortion, etc.

The researchers suggest the following ways to overcome these challenges, including:

●Educating instructors and learners with ART and informing them of its importance in facilitating teaching and learning.
●Holding intensive courses for instructors and educational specialists, which further improves the level of performance using ART i.e., holding training courses for instructors to use ART and integrate it in curricula, and encouraging the spirit of innovation and creativity.
●Converting the textbook from a boring book to another full of vividness that includes videos, audios, interactive texts, animations and three-dimensional images (interactive book).
●In order to overcome the financial problems, ART can be employed through the computers and with free programs that support this technology instead of expensive tablets.
●Providing technical instructional content suitable for all ages.
●Educating the community with modern technologies that support the educational process in order to eradicate technological illiteracy.

2.2Visual-Spatial Intelligence

Visual-Spatial intelligence is defined by Heming (2008:6) as the capacity to perceive the visual world accurately through transforming, modifying and recreating the aspects of one's individual real world. Armstrong (2009:7) adds this intelligence involves sensitivity to shapes, colors, lines, spaces, forms and the relationships that exist between these elements. It includes the capacity to visualize, and to graphically represent visual or spatial ideas.

Rogers (1995) as cited in Diezmann & Watters (2000:302) indicates that visual intelligence can be inferred from the ability to invoke and use particular representations and reasoning. In addition to imagery, visual representations include images, maps, diagrams, drawings and models. Reasoning with visual representations differs substantively from the sequential reasoning used with linguistic representations, such as text and involves cognitive interaction with spatial information to solve problems. Spatial intelligence includes an ability to perceive and

represent the visual-spatial world accurately and to form and manipulate mental images.

According to Šafranj & Zivlak (2018), visual-spatial intelligence "is the ability to visualise space and objects within the mind´s eye. People who prefer to use this kind of intelligence would rather draw a picture than write a paragraph. They notice colour shapes and patterns and how light falls on the object, and comprehend mental models"(p.72).

People with highly-developed visual intelligence usually)Alwan, 2016: 22-23):

-Solve visual puzzles (they enjoy doing puzzles).

-Like books with pictures (While reading, they pay more attention to pictures than words).

-Recognize shapes, colors, details and scenes(they show a high sensitivity to colour, line, shape, composition, space, and the relationships between these objects).

-Learn by observing.

-Use visual images as an aid in recalling information (they excel at making illustrations).

-Visualize what they think and hear (enjoy doing activities that require visual memory and imagination).

- Have the ability to visualize shapes or ideas (create mental images), and also to describe these visual images that are clear to them in their imagination.

2.2.1 Visual intelligence skills:

The term of "Visual intelligence Skills" appeared when the professor of psychology Hans Furth introduced the concept of visuospatial intelligence as an aspect of intelligence. He suggested that intelligence could be dynamically developed by combining visual activities with an emphasis on cognitive perception (Coulter, 2014: 212).

Mahdi's study (2006(and Dabour's study (2016) indicated a set of skills and steps that lead to the mechanism of teaching with visual intelligence by integrating visual perceptions with cognitive perception, to reach an integrated mental language, these skills include:

- **The skill of visual form recognition**: It is the identification of visual form (their nature and dimensions), and distinguishing them from other forms. The visual form represents the information for which it was developed, whether this visual form is symbols, pictures, graphs, or maps.

-**The skill of linking relationships in the visual form**: It is the ability to link the relationships of visual forms and place them in the space, in proportion to the forces and laws of nature of balance and rhythm, as well as the study of two- and three-dimensional shapes.

-**The skill of analyzing visual form**: It is the ability to:

✔focus and pay attention to the details and dimensions of forms and elements.

✔see the relationships between these forms as a total structure.

✔segment the visual form into its basic components.

-**The skill of interpreting visual form**: It is the ability to interpret, analyze and understand each part of the visual form.

-**The skill of extracting meaning**: It is to arrive at new concepts, principles and meanings through the visual form, taking into account its inclusion of the previous steps.

The Researchers can add some of visual intelligence skills that will facilitate learners' understanding of the subjects, enhance learners' visual abilities in distinguishing information and ideas represented visually, and encourage them to use their intellectual powers. These skills include the following:

- ***Visual perception and spatial awareness skill***: It is the way in which we perceive visual stimuli and add meaning or interpretation to the visual sensory stimulus.
- ***Visual-spatial visualization skill***: It is the ability to receive images, think about them, recognize shape and space (what it contains of colors, lines, and drawings), and transfer visual and spatial ideas from memory to use them to construct meaning.
- ***Visual description skill***: It means the ability to reformulate the elements and components of the visual form (picture or illustration) from visual language to equivalent spoken and written language.
- ***Visual comparison skill:*** It is the visual ability to identify similarities and differences between expressed objects, events, or relationships in one or more pictures or illustrations, in light of certain criteria such as size, color, length, shape, type, function, use, theme, etc.
- ***Visual classification skill***: It refers to the learner's ability to gather and classify the expressed objects and events related to visual form given, in two or more groups on the basis of one or more criteria.
- ***Visual arrangement skill***: It refers to the visual ability to arrange the components or elements of an illustration, image, chart, or map according to a sequence of events, to express an idea or concept.
- ***Visual prediction skill***: It is the learner's ability to anticipate a specific situation expresses an idea or concept that will be expressed in an illustration or chart with a mention of reasons upon which the learner's prediction is based.

2.2.2 Visual Strategies used to develop visual intelligence skills in reading comprehension subject

Reading comprehension (RC) using visual strategies is understanding the text through the use of pictures, imagery, and graphic organizers. This means the learner connects his/her thoughts into visual representations to better understand the text. Ishmael & Thomas (2006:274) mentioned there is an old saying that "a picture is worth a thousand words," which suggests that "seeing" reveals things that words alone cannot describe. When it comes to comprehension, this saying might be paraphrased, 'a visual display helps readers understand, organize, and remember some of those thousand words.

Rakes et al. (1995:47-51) report there are many learner-generated visuals strategies and teacher can use it in the classroom in several ways:

A.Visual Before Reading Strategies

●***Build Prior Knowledge***: Prior knowledge is using previous experiences to connect or predict upcoming events•

●***Predict***: Use prior knowledge to talk about what is going to happen in the story or text. Example: While looking at the image of the book below, what do you think is going to happen in the story?

●***Picture Walks***: Going through images only from the text to familiarize the student with the story's contents.

●***Vocabulary Identification***: Have students go through the text and identify the unknown vocabulary. Students can then create pictures to illustrate the meaning of the vocabulary before they read. Example: Students illustrate science vocabulary words to help them with the meaning.

B.Visual During Reading Strategies

●***Highlight Important Facts:*** As students read, have them underline or highlight the important facts of the text . They can highlight the story elements, important vocabulary , and main topics of the text under each heading.

●***Creating charts and graphs (graphic organizer):*** Using graphic organizers and charts can help students sequence and organize thoughts about a story as they read it.

●***Picture Cues:*** As the student is reading, have them look at the pictures to help them understand what is going on in the text.

●***Using internal visual images (Stop and Check with Visualization):*** Have students read a sentence and describe what it looks like in their mind. Example, a student stops while reading his/her story to picture the words as images in his/her mind.

C.Visual After Reading Strategies

●***Sequencing*** **:**Have students create visual drawings or story maps of what occurred during the story after they have read it.

● **Using illustrations to summarize text**: After students experience the drawing strategy, teacher can ask their students to draw pictures of the most important events in a selected text or to evaluate the illustrations created by their peers . Simplicity or lack of artistic quality does not interfere with the effectiveness of the strategy. So, too much detail may actually divert attention away from the text. It is important for students to understand that they are not evaluated on the quality of their drawings and that the process is more important than the final product.

●***Readers Theater***: Students role play events from the text by creating the images they "see" while reading. Example, the students can role play the events from a story they just finished reading.

●***Response to text or story***: Visual clues to help children make connections from the text to themselves, real world, and the text.

Moreover, Epçaçan et al. (2010:1668) suggested some of the visual strategies considered to enhance reading comprehension and meaningful learning are: making narrating texts visual with pictures, composing intellectual indicators while reading, using pre-learnings including visual indicators, using map chart summarizing written texts like picture and chart with visual objects, using concept maps, and supporting lesson activities with caricatures.

Based on what is mentioned above, students can remember information better when it is represented visually. These strategies help students of all ages to better manage learning objectives and achieve academic success.

2.2.3 ART and Visual-Spatial Intelligence

The most important thought processes come directly from our perception of the world, where sight is the first sensory system that provides the basis for our cognitive processes and forms them, and therefore the spatial visual imagination is a primary source of thinking. Studies have proven that the human brain can absorb 36000 images per minute and that more than 80% of the information received by the brain comes through sight. From the constructing of this information and its integration with the visual processes through the sense of sight, it was found that each person has a different way of obtaining visual knowledge than the other.

Learning with pictures, shapes and drawings is one of the most important visual intelligence teaching methods, as the mind responds faster to pictures. In kaya's study (2012), it was proved that teachers who use pictures that belong to texts in textbooks, their students have the ability to predict the topic of the lesson through studying pictures and content prediction before reading the text.

So, we can say that visual intelligence is the assimilation of information from visual formats. Learners understand information better in the classroom when they see it. Information related to visual intelligence lesson can present in different formats, such as images, video, flowcharts, graphs, diagrams, simulations, cartoons, coloring books, posters, presentations, movies, flash cards and games. Teacher can use the above mentioned formats to display large amounts of information in ways that are easy to understand and help reveal relationships and patterns.

On the other hand, AR is a useful visualization technique to overlay computer graphics on the real world. AR can combine visualization method to apply to many applications, i.e. ART consists in overlaying computer-generated images with a learner's view of the real world. These virtual objects can be 2D or 3D images, sound, videos, and animations. AR learning also can help students to develop visual intelligence skills, which is a learning style whereby the learner comes better to understand and retain information better by associating words, ideas, events, topics and concepts with images, video, music, 3D images etc. Visual

Journal of Babylon Center for Humanities Studies: 2022, Volume: 12, Issue: 3

information of AR learning is presented through 3D visual environments and various interactive visual tools, such as ARCore, echo3D, Unity, Vuforia, Wikitude, Spark AR Studio, Kudan, EyeJack Creator, and ARToolKit.

We can conclude that the use of AR-based instructional visual digital environments, supports the development of visual intelligence skills includes visual reading and visual discrimination, and these involve other kind of visual processes, such as visual prediction, analyzing visual information, interpreting visual information and inferring meaning.

3.Methodology

This chapter includes a presentation of the research method and experimental procedures. The researcher relied on the descriptive and experimental approaches. He adopted the descriptive approach in building the instructional program according to the technology of augmented reality in reading comprehension of the second stage students / Department of English Language. The experimental approach was adopted to demonstrate the effectiveness of the program on developing the visual intelligence skills among the second stage students.

3.1 Construction of the Instructional Program Based on ART

The researchers prepared an ART environment according to the ADDIE Model for simplicity of design, ease of use and suitability for age stage of the students. The following is an explanation of ADDIE Model stages in light of the instructional design of Augmented Reality Technology:

A.Analysis: This stage included analyzing the characteristics of the second stage students , English language department, College of Basic Education, analyzing the students' needs, reviewing previous studies, determining the theoretical design of the program, determining the general objectives of the program, determining the entrance behavior of students, determining the appropriate content, formulating behavioral objectives, defining educational means and activities, and studying the reality in which the program will be applied.

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 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 textbook 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.

-The time for teaching reading comprehension is limited to two hours per week.

-The way of implementing the teaching of the instructional program was on Google Classroom platform. All the lessons were electronic 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.
-Providing an appropriate learning environment that is characterized by cooperation, respect and calm dialogue.

B.Design: 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 seven lessons: Lesson 1: Passage 14 "A Noble Gangster", Lesson 2: Passage 15 "Sixpence Worth of Trouble", Lesson 3: Passage 16 "Mary had a Little Lamb", Lesson 4: Passage 17 "The Greatest Bridge in the World", Lesson 5: Passage 18 "Electric Currents in Modern Art", Lesson 6: Passage 19 " A Very Dear Cat", and Lesson 7: Passage 20 " Pioneer Pilots".

▪***Determining of the content presentation methods***: The augmented content was presented through QR Code Quick Responses Application by providing code-augmented content.

▪***Designing of the instructional activities***: Electronic activities: assigning students to answer some questions online.

▪***Determining of the instructional techniques and strategies:*** A multiple and integrated combination of visual integrated strategies based on AR learning were used. Among the most important educational strategies and techniques that were used are the following:
-Visual Before Reading Strategies
-Visual During Reading Strategies
-Visual Before Reading Strategies

▪***Determining of the instructional resources, aids and multimedia:***
A search was made by a researchers on the internet for appropriate instructional resources that could be used with ART. The researcher obtained some resources, namely, written texts, videos, visual texts, audio texts, static and animated images, GIF images, and presentations, that were produced to be linked with the traditional textbook. All these resources were in need of modification and were modified using Adobe Photoshop Cs for images, and Camtasia Studio to process video footages. The researchers also employed and used the Google Sites to design and display the required digital instructional content . On the other hand, the most important instructional aids that were used in teaching the proposed program are the smartphones, tablets, and computers.

C.Development: This stage went through the following steps:

▪***Determining of the multimedia programs:*** The researchers relied on a number of programs to produce the multimedia used, namely:
-PowerPoint.

Journal of Babylon Center for Humanities Studies: 2022, Volume: 12, Issue: 3

-Word processor MS Word 2013.
-Paint program.
-QR Code Generator.
-GIF Maker

▪***Production of multimedia*:** The researchers designed the multimedia required for the content of ART, and it consisted of the following:

-Texts: Using Microsoft Word to write texts, taking into account the compatibility between the font size and the screen size as a whole, and the area allocated for displaying text on the screen.

-Static and animated images: the researchers used GIF Maker 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.

-QR Codes.

▪***Determining of the Augmented Reality authoring system:*** In the current study, the QR Code Reader Application has been identified as a system for authoring the instructional program based on ART, 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 add a set of useful information to visual perception. The application is free. The teaching process using QR Code is done by designing and placing a special barcode for each selected story or text in the reading comprehension textbook. The instructor asks his students to scan the barcode by pointing the mobile phone camera at the barcode to be read. After reading and scanning the barcode, a link appears, then the students click on this link and it takes them to a new page for that story or text that contains digital educational content based on augmented reality. This digital content contains images, videos, audios, graphics, diagrams, story map and a set of educational activities for that story or text.

▪***Designing a quick response based on QR codes in Augmented Reality Learning (ARL):***

QR application was chosen because it allows creating and sharing an individual's augmented reality experiences in an easy, simple, and interesting way. In addition, it is available on all operating systems of all mobile phone systems for all students. The QR Icons and QR Images based on quick response are designed in ARL through the following steps:

-Selecting the target image or icon (Static or dynamic).
-Merging the image or icon with the content of the printed material.
-Designing the QR Code through the QR Stuff Code Generator Platform, which allows adding links and code information, then the QR Code image appears and downloads in several different formats as it has shown in the figure below:

Figure (2): QR Stuff Code Generator Platform

-Downloading the QR Code and save it as an image and merging the code with the content of the printed material.

-Reading and Scanning: in which the code is scanned using the smartphone camera and is read by directing the mobile phone camera to the code to guide the learner to the link that contains the various learning resources of reading comprehension. The smartphone will automatically scan and read the code to show the digital learning media on the smartphone. The QR Code Reader requires a smartphone equipped with a camera, has an internet connection, and one of the QR Code reading applications is installed on it. The QR Code Reader application has been used due to its ease of use and its availability on all different operating systems in smartphone for all students.

▪***Designing of ARL based on Google Site:*** Google Sites is a free website builder that can let the educators effortlessly create and share web pages for his/her projects. It is one of the most effective ways to launch educator's online presence. It provides a ready-made platform that consists of a drag and drop feature for all the materials we need, whether it is texts, images, videos or even entire presentations. The researchers designed the digital content of the seven lessons of reading comprehension course by using Google Sites:

Journal of Babylon Center for Humanities Studies: 2022, Volume: 12, Issue: 3

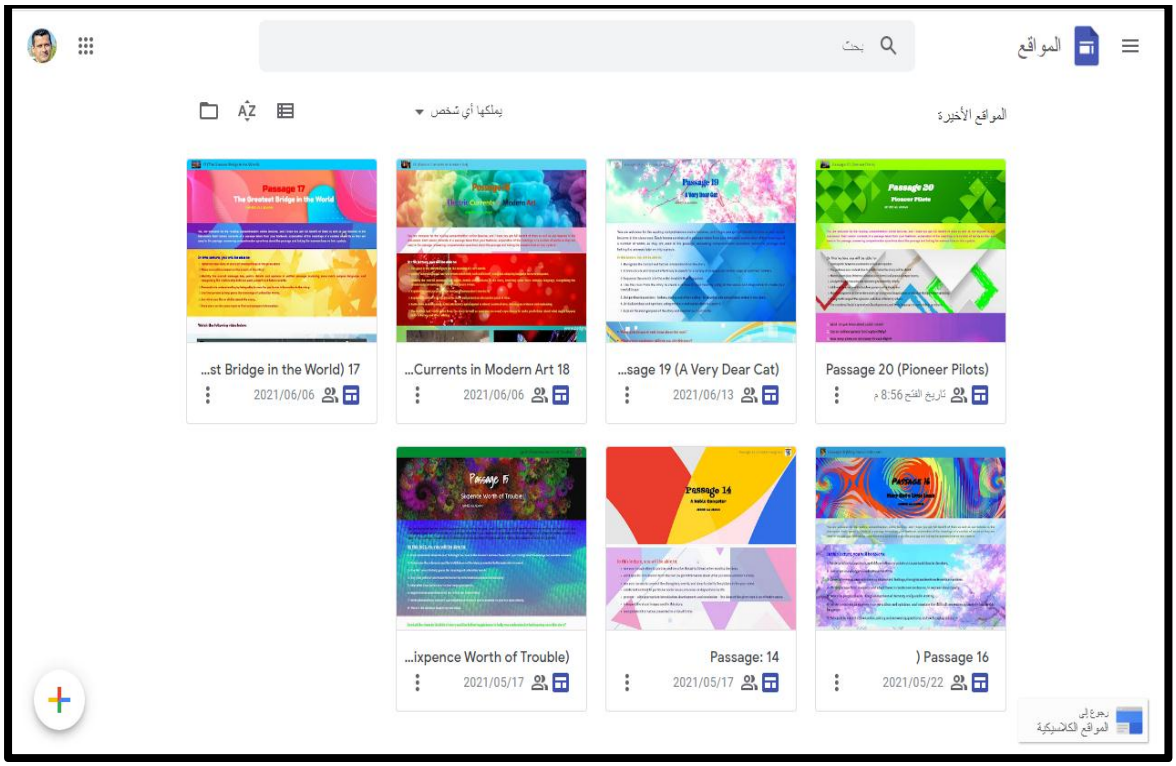

Figure (3): Seven lessons based on ART designed by the researchers on Google Sites

Once the researcher has created the web page, a QR code can be used to redirect his second stage students to their sites. It can be used for an interactive learning based on ART. Simply use QR Stuff's Web Page URL data type and see it live upon scanning the QR code.

How To Generate a QR Code For Google Sites:

1.Go to https://www.qrstuff.com/?type=websiteurl and have the "Website URL" data type pre-selected from the Data Type section.
2.In the Content section, enter your Google Sites URL.
3. Click the "Download QR Code" button and the QR code for Google Sites is ready for use.

D.Implementation: The implementation phase went through the following steps:

▪ ***Linking the multimedia to the pages of the paper textbook is done through QR Code Reader Application***: Every QR code consists of a number of black squares and dots which represent certain pieces of information. When smartphone scans this code, it translate that information into something that can be easily understand by students. This process is done by placing the barcode on the textbook page, and when the camera scans the barcode, it will transfer the student to a link on Google Sites. After that, the student clicks on the link, and then the material required for the presentation will appear in the form of (videos,

images, audios, or presentations). This is done by displaying the required material on Google Site. The process of quick responses based on QR codes, is done through the two-dimensional QR-Code that is assigned to a website or online media link, and it is scanned and read via the smartphone camera.

▪ ***Conducting the exploratory experiment***: The proposed instructional program based on ART was applied to a random sample of (25) students from the second stage of department of English (those students were excluded from the whole experiment), in order to ensure the safety of ART and make the necessary adjustments to be applicable (to identify the problems that students may face in learning with proposed instructional program based on ART).

E.Evaluation: The evaluation phase went through the following step:

▪Presenting the proposed program based on ART to a jury of specialists in methods of teaching and educational technology to verify its validity and modifying it according to the suggestions and opinions of the jury members. In light of the opinions of experts, some backgrounds of ART have been modified to be suitable for images displayed. Among the most important criteria that must be taken into account in constructing the proposed program are the following:

-Safety of educational content.

-Relevancy of educational goals and the possibility of achieving them.

-Appropriateness of the educational activities to the level of the target group (second stage university students - Department of English Language - College of Basic Education).

3.2 Research procedures: To achieve the two aims of the research, the researchers adopted the experimental design with partial control, which is the design with pre-test and post-test. The experimental design consists of two groups, the first is experimental group (EG), is taught according to the instructional program, and the second is a control group (CG), is taught in the traditional way. At the end of the experiment, the two groups are subjected to a test of visual intelligence skills in reading comprehension course, and the table (1) shows this:

Table (1): Experimental design of the study

Group	Independent Variable	Final post-test
EG	Instructional program basrd on AR	Visual intelligence
CG	Conventional instruction	

Population: The current study population included the second stage students of English language departments, Faculties of Basic Education in the middle Euphrates governorates for the academic year 2020-2021.

Sample: The participants of the present study comprised (75) second stage students chosen randomly from University of Babylon, College of Basic Education, Departmemt of English Language. They were assigned

to an experimental group (n=38) and the control group (n=37). The table (2) shows this:

Table (2): Two research groups

Section	Group	Total number
A	Experimental	38
B	Control	37
Sum		75

Equivalence between the two groups: The researchers chose the two research groups at random and decided to make sure that they were statistically equal through the following variables (chronological age in months, intelligence (Carter's test), and the academic achievement of fathers and mothers). The two groups were equivalent in these variables as follows:

- **Participants' Age:**

To ensure that the students of the two research groups are equivalent in this variable, the researchers used the t-test for two independent samples. After analyzing the results, the researchers 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, and table (3) illustrates this:

Table (3) : The equivalence of the two groups scores in age

Group	No	Mean	Standard Deviation	t- Test Value		Degree of Freedom	Level of significance at (0.05)
				Calculated	Tabulated		
EG	38	254.78	17.70	0.49	1.98	89	Not significant
CG	37	253.04	15.82				

- **Parental Academic Education**

Fathers' Education Level: The researchers conducted a statistical equivalence in fathers' academic level of education for two research groups to find out if there is a significant difference between (EG) and (CG) in fathers' academic level of education. After collecting the data of fathers' education level from the students and analyzing it, the researchers used the Chi-square formula, and the findings show that the calculated Chi-square value was (2.80) which is less than tabulated Chi-square value (9.48) at (4) degree of freedom. This means there is no significant difference between the (EG) and (CG) at (0.05) level of significance. It is

also indicates that the two groups are statistically equivalent in this variable. The table (4) shows this.

Table (4): The frequencies of fathers' level of education for the two research groups, the degree of freedom, the calculated and tabulated Chi-square values, and the level of significance*

Group	Fathers' Education Level							DF	Chi-value		Level of significance at (0.05)
	NO	Illiterate	Primary	Intermediate	Preparatory	Diploma	B.A, M.A,Ph.D	4	Calculated	Tabulated	Not significant
EG	38	1	8	10	8	6	13		2.80	9.48	
CG	37	2	12	8	10	5	8				

*** (Illiterate) and (Primary) have been merged because the number of frequencies is less than (5).**

Mothers' Education Level:

For mothers' education level, the researchers has done the same procedure in gathering data for mothers' education level**.** They also conducted a statistical equivalence in mothers' academic level of education for two research groups to find out if there is a significant difference between (EG) and (CG) in mothers' academic level of education. After collecting the data of mothers' education level from the students and analyzing it, the researchers used the Chi-square formula, and the findings show that the calculated Chi-square value (1.21) was smaller than the tabulated Chi-square (9.48) at (4) degree of freedom. This means there is no significant difference between the (EG) and (CG) at (0.05) level of significance. It is also indicates that the two groups are statistically equivalent in this variable. The table (5) shows this.

Table (5): The frequencies of mothers' level of Education for the two research groups, the degree of freedom, the calculated and tabulated Chi-square values, and the level of significance*

Group	Mothers' Education Level							DF	Chi-value		Level of significance at (0.05)
	NO	Illiterate	Primary	Intermediate	Preparatory	Diploma	B.A, M.A,Ph.D	4	Calculated	Tabulated	Not significant
EG	38	6	14	12	8	4	2		1.21	9.48	
CG	37	5	15	8	10	4	3				

*** (Illiterate) and (Primary) have been merged because the number of frequencies is less than (5).**

- **Intelligence Test (IQ)**

T-test formula of two unequal independent samples was used by the researchers 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 (6)

Table (6): Equivalence of the two research groups students in the intelligence test

Group	No	Mean	Standard Deviation	t- Test Value		Degree of Freedom	Level of significance at (0.05)
				Calculated	Tabulated		
EG	38	25.78	7.45	0.39	1.98	89	Not significant
CG	37	25.11	8.81				

- **Visual intelligence pre-test:** The test was applied to the students of the two research groups. 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 (44.76) and with a standard deviation (15.48), while the mean scores of the control group was (48.16) and with a standard deviation (13.20). It was found that the difference is not statistically significant at the level of significance (0.05), as the calculated t-value amounted to (1.06), 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 visual intelligence skills test. The table (7) illustrates this:

Table (7) : t-test results of the visual intelligence pre-test

Group	No	Mean	Standard Deviation	t- Test Value	Degree of Freedom	Level of significance at (0.05)

				Calculated	Tabulated		
EG	38	44.76	15.48	1.06	1.98	89	Not significant
CG	37	48.16	13.20				

Study supplies:

- ***Identification of the scientific material***: the scientific material was identified by passages and narrative texts (from passage 14 to 20) of reading comprehension booktext for second stage in English Language Department.
- ***Formulation of behavioral objectives***: 53 behavioral objectives have been formulated, distributed on Bloom knowledge levels in (remembering, comprehension, applying and analysing), then these objectives and the content of the instructional material were presented to a group of experts and specialists to verify their coverage of the level and the accuracy of its formulation.
- ***Preparation of teaching plans***: In light of content of the passages and the narrative texts of reading comprehension textbook for the second stage, and based on the behavioral objectives that were prepared, the researchers prepared (14) teaching plans for the experimental and control groups (7 plans for each group). Samples of the plans were presented to a group of specialized arbitrators, and based on the arbitrators' observations and suggestions, the plans became in the final form to be implemented.

The study tool:

Visual -spatial intelligence test: it is prepared by the researcher, whose number of items reached (41) items of the type of multiple choice, short answer, matching, completion. The researcher extracted its psychometric properties, face validity and content validity by presenting it to experts and arbitrators. He also extracted the reliability coefficient, the discriminatory power of the items and the effectiveness of the incorrect alternatives.The process of its construction proceeded to reach the final form according to the following:

- Determining the aim of the test: The test aims to measure the visual intelligence skills of the second stage students - English Language Department (the research sample).
- Construction of visual intelligence test: The visual intelligence test consists of 41 test items distributed as follows:

-22 short answer items represented by questions (3- 5- 6- 7- 10) , 20 of them were corrected by giving two marks for each item when the answer is correct, one mark when the answer is incomplete, and zero when the answer is incorrect or left out. These items were evenly distributed in each of the following questions (3, 5, 6, and 7) .The other two items, in question 10, were corrected by giving 5 marks for each item when the

answer is correct, 3 marks when the answer is incomplete, and zero when the answer is incorrect or left out, and thus the total score of 22 short answer items is 50 marks.

-10 matching items represented by question (8), as the items were corrected by giving one mark for each item when the answer is correct and zero when the answer is incorrect or left out. Thus, the total score of 10 matching items is 10 marks.

-5 completion items represented by question (9), as the items were corrected by giving two marks for each item when the answer is correct and zero when the answer is incorrect or left out. Thus, the total score of 5 completion items is 10 marks.

-4 essay items represented by the questions (1-2-4), as the items were corrected by giving 10 marks for each item when the answer is correct, 5 marks when the answer is incomplete, and zero when it is correct or left out. The total score of 3 essay items is 30 marks.

Thus, the total score of the visual intelligence test is 100 marks, and the lowest score is zero.

Piloting of the test

The exploratory application was carried out on a random sample of 50 second stage male and female students, College of Basic Education. This exploratory study was carried out in order to ensure the validity of the test instructions, to know the way of response, the time taken to answer the test, to ensure the validity of the test (the coefficient of difficulty or ease, validity, reliability and objectivity), and identify deficiencies of the test application procedures. As a result of the application, it was found that the time taken is 90 minutes,

Statistical analysis of the test items:

-**Validity of the test**: The researchers verified the validity of the test using face validity. *Face validity*: It is the general appearance of the test in terms of the type of vocabulary, how it is formulated, and the extent of its clarity. It also deals with the test instructions, its accuracy, degree of clarity, objectivity, and the extent to which the test is suitable for the purpose for which it was developed.

In order to verify the face validity, the researchers presented it to a group of experts and specialists in curricula and teaching methods, to give their opinions and observations about the general form of the test and the validity of its items In light of their observations and suggestions, the modification was made and the test was ready to apply it.

-**Difficulty coefficient**: The difficulty coefficients of the test items ranged between (0.28 - 0.73) with an average of (0.51), and therefore all items are acceptable, as Bloom sees that the items are valid for application if the difficulty coefficient ranges between (0.20 - 0.84) (Allam, 2009: 288).

-**Discriminative power**: The discrimination coefficients of the test items ranged between (0.45 - 0.80) with an average of (0.59), and therefore all items are acceptable, as Brown indicates that the item is good and

Journal of Babylon Center for Humanities Studies: 2022, Volume: 12, Issue: 3

desirable if the degree of discrimination exceeds (0.20) (Allam, 2009: 293).

-Reliability: It is the degree of homogeneity or agreement between two measurements of one thing, i.e., the respondent scores are similar under slightly different measurement conditions (Arvin and William: 2003:335). To measure the test reliability coefficient, the researchers used two methods:

First, reliability over time: Two weeks after the first correction, the researcher re-corrected the test without placing a sign or mark indicating the correction, and the correlation coefficient between the researcher and himself over time reached (0.98).

Second, reliability with another corrector (rater): To find the reliability of the test correction with another corrector, the same test sheets were corrected with another corrector (rater) who has experience in correcting the test, and it was agreed with him to hide the score and not to put signs and marks on the answer sheets to reduce the effect of the corrector. The correlation coefficient between the researcher and the other corrector was (0.95)

4.Presentation, analysis and interpretation of results

Results related to 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 visual intelligence skills test). The researchers applied the post visual intelligence skills test to the two research groups students (experimental and control). After correcting the answers and analyzing them statistically, the mean, variance and standard deviation of the two research groups students were calculated. By using the t-test for two independent samples, it was found that there was a statistically significant difference in favor of the experimental group at the level (0.05). It was appeared that the mean scores of the experimental group students was (66.80) with a standard deviation (11.85), while the mean scores of the control group students reached (49.80) with a standard deviation (13.26), and the calculated t-value (6.45) was larger than the tabulated t-value (1.98) with a degree of freedom (89). The table (8) illustrates this:

Table (8): t-test results for two independent samples of the two research groups in the post-visual intelligence skills test.

Group	No	Mean	Standard Deviation	t- Test Value		Degree of Freedom	Significance	Level of significance at (0.05)
				Calculated	Tabulated			

EG	38	66.80	11.85	6.45	1.98	89	0,00	statistically significant
CG	37	49.80	13.26					

It was noticed from the previous table that there is a statistically significant difference between the mean scores of the two research groups students in the post visual intelligence skills test in favor of the experimental group. This result indicates the superiority of the experimental group students (who are taught according to the educational program based on augmented reality technology) on the control group students (who are taught according to the conventional method) in post visual intelligence skills test. Thus, rejecting the first 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 (visual intelligence):

The researchers used the Eta square equation to extract the effect size (η^2) for the independent variable on the dependent variable. The effect size (η^2) was (0.32), which is an appropriate value to explain the effect size by a amount of (large) for the teaching variable by the instructional program based on augmented reality technology in development of visual intelligence in favor of the experimental group, as shown in the table (9). In determining the effect size, the researchers relied on the classification set by (Cohen, 1988) and the table (10) explains that:

Table (9): The effect size of the independent variable (augmented reality technology) on the dependent variable (visual intelligence)

Independent Variable	Dependent Variable	Value of effect size (η^2)	Effect Size
Augmented reality technology	Visual intelligence	0.32	large

Table (10): 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

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 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 in the pre-post visual intelligence skills test). The researchers applied the pre and post visual intelligence skills test to judge the value of development in visual intelligence skills on the experimental research group students. After correcting the answers and

analyzing them statistically, the mean and standard deviation of the research group students were extracted and calculated. By using the t-test for two correlated samples, it was found that there was a statistically significant difference in favor of the experimental group for the post-test at the level (0.05). It was appeared that the mean scores of the experimental group students in the pre-skills test were (44.76) with a standard deviation (14.37), while the mean scores of the experimental groups students in the post-skills test were (66.80) with a standard deviation (11.85). The calculated t-value (22.39) was larger than the tabulated t-value (2.02) with a degree of freedom (45). This indicates a high level of development of visual intelligence skills among the experimental group students in favor of the post-test, i.e. these skills were developed among experimental group students after conducting the experiment and inserting 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 (11) explains that:

Table (11): The mean and t- test value (calculated and tabulated) for the scores of the experimental group students in the pre and post visual intelligence skills test

Group	No	Test	Mean	Standard Deviation	t- Test Value		Degree of Freedom	Statistical significance	Level of significance
					Calculated	Tabulated			
EG	38	Pre	44.76	14.37	22.39	2.01	45	0.00	statistically significant
		Post	66.80	11.85					

It was noticed from the previous table that there is a statistically significant difference between the mean scores of the experimental research group students in the pre-post visual intelligence skills test in favor of the post- skills test. Thus rejecting the fifth 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 visual intelligence skills test) of the experimental group students. The researchers used Cohen's equation to extract the effect size (d) for the independent variable on the dependent variable (visual intelligence skills), and the effect size (d) was (3.30), which is the value of the interpretation of the effect size with a large amount for the teaching variable using the instructional program based on augmented reality technology in developing visual intelligence skills, as shown in the table (12). In determining the effect size, the researchers relied on the classification set by (Cohen, 1988) and the table (13) explains that:

Table (12): The effect size of the independent variable (ART) on the dependent variable (visual intelligence skills test) of the experimental group

Independent Variable	Dependent Variable	Value of effect size (d)	Effect Size
Augmented reality technology	Visual intelligence skills	3.30	large

Table (13): 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 results of 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 students who are taught reading comprehension using the conventional method in the pre-post visual intelligence skills test). The researchers applied the pre-post skills test to judge the value of development in the visual intelligence skills on the control research group students. After correcting the answers and analyzing them statistically, the mean 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 is no statistically significant difference in favor of the control group at the level (0.05). It was appeared that the mean scores of the control group students in the pre visual intelligence test were (48.15) with a standard deviation (16.11), while the mean scores of the control group students in the post visual intelligence test were (49.80) with a standard deviation (13.26). The calculated t-value (1.45) was smaller than the tabulated t-value (2.01) with a degree of freedom (44), which means that there was no statistically significant difference between the means of the two tests in the control group. This indicates that this result does not indicate that there is a development in the visual intelligence skills of the control group students who are taught according to the conventional method. Thus the third null hypothesis is accepted and the alternative hypothesis is rejected. The table (14) explains this:

Table (14): The mean and t- test value (calculated and tabulated) for the scores of the control group students in the pre and post visual intelligence skills test

Gr	N	Tes	Me	Stand	t- Test	Degre	Statis	Level of

ou p	o	t	an	ard Devia tion	Value		e of Freed om	tical signifi cance	significan ce
					Calculate d	Tabulated			
C G	37	Pre	48.1 6	16.11	1.4 5	2.0 1	44	0.16	Not significan t
		Pos t	49.8 0	13.26					

It was noted from the previous table and graph that there is no statistically significant difference between the mean scores of the control group students in the pre- post skills test, and thus the sixth null hypothesis is accepted and the alternative hypothesis is rejected.

2- Calculating of the effect size (effectiveness) for the independent variable on the dependent variable (pre and post skills test) of the control group. The researcher used Cohen's equation to extract the effect size (d) for the independent variable on the variable dependent in visual intelligence (for correlated groups). The amount of the effect size (d) reached (0.22), which is a value that explains the effect size with small amount of the variable of teaching in the conventional method on the variable of visual intelligence. In determining the effect size, the researchers relied on the classification set by (Cohen, 1988) and the table (15) explains that:

Table (15): The effect size of the independent variable on the dependent variable (pre-post visual intelligence skills test) of the control group

Independent Variable	Dependent Variable	Value of effect size (d)	Effect Size
Conventional way	Visual intelligence skills	0.22	Small

5.Conclusions, Recommendations and Suggestions:

1-Conclusions : The current study has resulted the following conclusions:

-ART is an effective tool in developing visual intelligence skills, as the study resulted in the superiority of the experimental group students who were taught using this technology over their colleagues in the control group in the visual intelligence skills post-test.

-The use of ART contributes to provide the students with greater amount of information compared to the traditional method.

2-Recommendations: The current study has produced the following recommendations:

Journal of Babylon Center for Humanities Studies: 2022, Volume: 12, Issue: 3

-The necessity of integrating and employing ART in the curricula of the Ministry of Higher Education and the Ministry of Education.
-Designing textbooks and instructional curricula in accordance with ART.
-Preparing instructional courses and taining workshops for instructors about ART, and using its latest applications in education.
-Guiding experts in charge of building and designing English language curricula by including activities that develop students' visual intelligence skills.
-Benefiting from the list of visual intelligence skills prepared by the researchers to develop visual skills in different subjects.

3-Suggestions:

-Conducting more studies and research on ART in the different stages of education.
-On the basis of the results obtained in this study, research topics such as the impact of a simulation-based AR environment on other multiple intelligences can be proposed to be investigated by other researchers.
-Designing an electronic learning environment based on ART and its impact on developing digital learning skills for university students.

Footnotes

1-Brand (2010: 3)
2-Šafranj & Zivlak (2018:72)
3-Diezmann & Watters (2000: 303)
4-Heming (2008:6-7)
5-Cai et al. (2012: 83)
6-Chittaro and Ranon (2007)
7-Chen et al. (2019: 2-3)
8-Küçük et al. (2016)
9-Estapa and Nadolny (2015)
10-Buchori (2017)
11-Özerbaş (2019)
12-Sabry (2009:15)
13-Solak & Cakir (2015:52)
14-Gardner (2004:1)
15-Iatsyshyn et al. (2020: 184)
16-Dunleavy & Dede (2006:7)
17-Klopfer and Squire (2008:205)
18-Glockner et al. (2014:3)
19-Milgram & Kishino (1994:1324)
20-Azuma (1997:2)
21-Anderson & Liarokapis (2014:2)
22-Shushan (2018:43)
23-Munoz-Cristóbal et al. (2018: 507)
24-Attar and Kansara (2015: 189)
25-Sinha (2021)
26-Radu (2012:313)
27-Yoon & Wang (2014:49)
28-Cipresso et al. (2018)

29-Krüger (2019:412)
30-Lytridis et al. (2018: 1-2)
31-Lee (2012:19)
32-Khan et al. (2019:3)
33-Rabbi & Ullah (2013: 33-34)
34-by Heming (2008:6)
35-Armstrong (2009:7)
36-Rogers (1995)
37-Diezmann & Watters (2000:302)
38-Šafranj & Zivlak (2018:72)
39-Alwan (2016: 22-23)
40-Coulter (2014: 212)
41-Mahdi (2006)
42-Dabour (2016)
43-Ishmael & Thomas (2006:274)
44-Rakes et al. (1995:47-51)
45-Epçaçan et al. (2010:1668)
46-kaya (2012)

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Journal of Babylon Center for Humanities Studies: 2022, Volume: 12, Issue: 3

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