

The Effect of Using a Developed Software Based on (Augmented Reality) On the Achievement and Acquisition of Scientific Concepts in Learning Science Among Eighth-Grade Students in Saudi Arabia

By

Yahya Al-Asmary

Ph.D. Student/ School of Educational Sciences/ The University of Jordan/ Amman, Jordan

Email: yumd123@gmail.com

Muhannad Al-Shboul*

Full Professor/ School of Educational Sciences/ Department of Curriculum and Instruction/
The University of Jordan/ Amman, Jordan

Email: malshboul@ju.edu.jo

Abstract

This study aims to identify the impact of teaching using Augmented Reality software on the achievement and acquisition of scientific concepts in learning Science among eighth-grade students in the Kingdom of Saudi Arabia using the quasi-experimental approach. The Augmented Reality software was applied to the experimental study group, and a specialized test was done to compare it with the control study group, for which the traditional methods were used in their education. The results concluded that there are apparent differences for the total score of the performance of the two study groups on the post-test of achievement in science, which means that there is an effect of teaching using developed software based on Augmented Reality on students' acquisition. Also, there are apparent differences for the total score of the performance of both groups on the post-test of scientific concepts acquisition in science.

Introduction

In light of the continuous and tremendous development in the technical fields, and the emergence of the mobile phone and wireless devices due to wireless revolution at the end of the last century and the beginning of the current century, the world is undergoing radical changes in various fields and sectors, especially in the educational field, as this technology has become present in everything around us, which leads to promising future.

The rapid changes affected the educational field and the educational systems as a whole. Education through traditional methods based on: memorization, indoctrination, and reliance on the teacher as the focus of the educational process, and the book as a basic source of knowledge, is no longer the most appropriate model for learning. Therefore, it was necessary to bring about new changes in the educational system, and to find an educational pattern that is characterized by: flexibility, efficiency, and effectiveness, to achieve comprehensive development by integrating technology with education, so that it becomes a major component of the educational process. (Al-Hajri, 2018).

In light of the recent technological development, e-learning is considered one of the modern trends in the education system, where communication mechanisms from a computer, its networks, and its multimedia of: sound, image, and graphics, are used in delivering

information to the learner with: the shortest time, the greatest benefit, and the least effort. (Al-Mallah, 2010)

Augmented Reality technology is one of the modern applications of e-learning that has begun to be used on a wide range of education at the present time. The applications of Augmented Reality technology have developed in a way that enables its users to exploit it to support the educational process by using computers, mobile phones, and portable digital devices. Nowadays, the technology is more available, and its use is more practical, and the problems of its application and high costs are less complicated. (Kerawalla, Luckin, Selgeflot & Woolard, 2006).

Khattabiya (2011) confirms that scientific concepts are one of the most important aspects of the study of science, and educators emphasize the need to develop scientific concepts because it facilitates and helps students understand science, and achieve scientific understanding and communication.

The use of Augmented Reality in education has benefits, especially in the field of teaching difficult terminology related to some academic subjects. Also, this technology adds a new dimension to its teaching compared to traditional teaching methods, as it includes: sound, pictures, three-dimensional shapes (3D), and video as the core elements in the simulation. This forms the basis for creating Augmented Reality, which may increase students' motivation towards learning these concepts. (Al-Husseini, 2014).

Achievement is one of the topics that are related to the developed educational software. This is because it accurately reflects the amount of information or skills that the student obtains, expressed in grades in the test prepared in a way that can measure the specific levels after employing this software. (Hasan, 2019).

Yuen, Yaoyune, and Johnson (2011) indicated that the use of Augmented Reality technology in teaching motivates students and helps them to learn educational material information from several perspectives, thus increasing their motivation to learn using different technologies, and this was confirmed by Al-Ghamdi's 2013 study.

Hence, the researchers believe that Augmented Reality may have an effective role in communicating information in an interesting and easy way. This will help the learner to learn easily and increase his ability to comprehend and acquire scientific concepts in learning Science. The researchers considered that the use of multimedia technologies to organize learning processes may constitute a growing trend.

As far as the researchers know, there are no research and studies that dealt with the impact of developed software based on Augmented Reality on achievement and the acquisition of scientific concepts in learning Science in the Kingdom of Saudi Arabia. This constituted a major factor that pushed the researcher towards this study to identify the impact of this developed software which will potentially provide a new solution, and that this study will be the beginning of other studies in this field.

Study Problems and Questions

The problem of the study consisted in employing Augmented Reality software in the educational process, as well as revealing the impact of this technology on the achievement and acquisition of scientific concepts in science among eighth-grade students in the Kingdom of Saudi Arabia. Accordingly, this research aims to answer the following question:

What is the effect of using a developed software based on Augmented Reality on the achievement and acquisition of scientific concepts in learning Science among eighth-grade students in the Kingdom of Saudi Arabia?

The following questions stem from the last question:

What is the effect of teaching using developed software based on Augmented Reality on the achievement of eighth-grade students in Science in the Kingdom of Saudi Arabia?

What is the effect of teaching using a developed software based on Augmented Reality on the acquisition of scientific concepts in science among eighth-grade students in the Kingdom of Saudi Arabia?

Study Objectives

This study aims to achieve the following:

1. To identify the effect of teaching using a developed software based on Augmented Reality on the achievement of eighth-grade students in Science in Saudi Arabia.
2. To identify the impact of teaching using a developed software based on Augmented Reality on acquiring scientific concepts in science among eighth-grade students in Saudi Arabia.

Study Importance

The importance of this study stems from its compatibility with modern trends that emphasize the necessity of employing modern technology in supporting the educational process and achieving the desired goals. Also, it lies in the results of previous studies on the importance of employing modern technology in the field of education in increasing achievement in learning Science and acquiring scientific concepts. Therefore, the importance of this study is shown in the following aspects:

The Theoretical Aspect

The study derives its importance from the results it will reach, as this study will be a reference for researchers in the Kingdom of Saudi Arabia and the Arab world in the field of e-learning in general, and in education through developed software based on Augmented Reality in particular. Moreover, due to the possibility of generalizing the software experience to the rest of the schools in the Kingdom of Saudi Arabia, as well as the possibility of generalizing the experience in the Arab world later, this study may help achieve development in the educational field and pave the way for new research and studies through other aspects of the subject.

The Practical Aspect

The importance of this study lies in providing solutions that serve the educational process in getting rid of many technical and skill problems that hinder students' learning on the one hand, as well as getting rid of the problem of boredom that affects students in the usual learning methods on the other hand. Furthermore, it aims to identify the advantages of using developed software based on Augmented Reality in the educational process to encourage the teaching staff of teachers in educational institutions to employ them in the educational process. The main importance of this study is to reveal the effect of using developed software based on Augmented Reality in the achievement and acquisition of scientific concepts in learning Science subject based on their learning patterns among eighth-grade students in a school affiliated to the Ministry of Education in the city of Riyadh.

Study Terms and Procedural Definitions

Augmented Reality: Attar and Kansara (2015) defined it as: the technology that allows simultaneous realistic integration of digital content, including software and computer objects, with the real world. It is defined procedurally as: the software developed by the researchers based on Augmented Reality technology that integrates digital content such as: images, 3D shapes, videos, and others, with the student's real environment. It also enhances it with virtual additional information that increases the capabilities of eighth-grade students, their interaction with it, and their understanding of the educational content of science through it. Its application will be limited to the lessons of temperature, heat transfer, engines and refrigerators, and investigation.

Achievement: It is defined as: the outcome of knowledge and information acquired by students as a result of specific educational experiences, and it is measured by teachers, or by the degree that the student obtains in achievement tests (Allam, 2000). The researcher defines it procedurally as: the score obtained by the eighth-grade students in the achievement test prepared by the researcher.

Acquisition of Scientific Concepts: Attia (2008) defined it as: the ability of students to retain the concept and try to modify it and employ it in new situations. It is defined procedurally as: the ability of eighth-grade students to retain the concepts in science, and scientific concepts in this study will be measured by the total score that students will record in the scientific concepts test prepared by the researchers.

Study Delimitation

1. **Spatial Delimitations:** Its location is limited to Omar Al-Mukhtar Intermediate School, which is affiliated to the Ministry of Education in the city of Riyadh.
2. **Temporal Delimitations:** The implementation time is limited to the first semester of the academic year 2022-2023.
3. **Human Delimitations:** The study is limited to eighth-grade students who study the Science course in schools affiliated to the Ministry of Education in the city of Riyadh.

Theoretical Framework and Previous Studies:

The theoretical framework of the study deals with four main aspects as follows:

The First Aspects: Augmented Reality:

Augmented Reality is the merging of two- or three-dimensional virtual objects with the real world, and physical objects display information that users cannot directly identify or even identify using their senses (Ivanova & Ivanov, 2011).

Since the Augmented Reality technology integrates the virtual world with the real world and interacts with it through wearable or portable devices, it helps to further consolidate the scientific material in the minds of students, and increases their interaction inside the classroom (Al-Husamiyya, 2020).

Many studies have found a positive impact from the use of Augmented Reality technology in education, as it represents an effective, more interesting and exciting way for learners' motivation, and helps in their interaction. In addition, Noh (2010) believes that this technology in education provides unlimited potential, and that it has a positive impact on the academic achievement of learners. (Aal Souban, 2019; Khalifa, 2019).

The main role of Augmented Reality in education is to develop and improve the innovative aspects of the student and the teacher, as it is compatible with the basic educational goals and affects them in the creative aspect. It also creates an active learning environment that distances the student from the usual atmosphere, in addition to translating constructivist theory into a tangible and applicable reality (Kesima & Ozarslanb, 2012; Hajjaj, 2019).

The Second Aspect: Achievement

The concept of academic achievement is related to learning and study, as it determines the student's progress in learning by measuring the level of his academic achievement, which is expressed in the degree that the student obtains after undergoing an achievement test that measures the degree of his learning.

This degree is the indicator for parents of the level of achievement for their children, hence the need to follow up on academic achievement through all levels and different directions. The importance of academic achievement and its benefits is shown through the student's personality, and it also prepares the student for his social life, especially in the future. (Al-Hasan, 2013).

The Third Aspect: Acquisition of Scientific Concepts

The acquisition of scientific concepts represents the level of building scientific basic knowledge, and the construction of other levels depends on this level. These concepts are among the most important learning outcomes through which the learner's scientific knowledge can be organized in a way that gives it meaning. This is due to the importance of acquiring scientific concepts and their place in teaching various subjects, as well as the need to learn scientific concepts correctly. (Hasan, 2019; Mohsen, 2020).

Al-Muqdadi (2019) defines the scientific concept as a set of information between which there are relationships about a specific thing that is formed in the mind and includes the common and distinctive characteristics of this thing. Labib also defines the scientific concept as: "an abstraction of common elements between several situations or facts, and this abstraction is usually given a name or a title; he also confirms that the concept is not the word, but rather the content of this word and what it means."

The concept of acquiring scientific concepts expresses abstract mental perception in the form of: symbols, words, or sentences, which are used to represent: a specific object, topic, or phenomenon, which makes them comprehensible and to be explained and applied in new situations.

A concept consists of attributes or symbols and their literal connotations; the literal meaning is all things that have weight and occupy space; the acquisition of scientific concepts shows how learners shape the meaning of scientific concepts and the role of comprehension in organizational concepts. One of the important levels of classification in the cognitive structure of thought is the person and his perceptions, as well as his data regarding a specific phenomenon; thus, the concepts help the individual and enhance his ability to learn with unlimited basic knowledge. (Al-Mohtaseb, 2019; Ziyadna, 2021).

Hence, the researchers believe that Augmented Reality has an effective role in communicating information in an interesting and easy way, and helps the student in learning easily, and increases his ability to collect and acquire scientific concepts in learning Science subject among eighth-grade students in Saudi Arabia. The researchers considered that the

employment of developed software is based on Augmented Reality to organize learning processes constitutes a growing trend, since the perception of new information depends on diversifying the methods of presenting this information to the learner, because the desire for education increases when visual and audio effects are added to the education system.

Second: Previous Studies

Majeed (2021) conducted a study to identify the obstacles that prevent the use of Augmented Reality technology in developing social skills among primary school girls with intellectual disabilities from the point of view of teachers in Jeddah. The researchers used a questionnaire to measure the most important factors that impede the use of Augmented Reality in the learning process of students.

The study sample consisted of (58) intellectual education teachers to determine the differences between them in assessing the most prominent obstacles that limit the use of Augmented Reality technology, and the results revealed the most prominent obstacles arranged in descending order as follows:

Technical and material barriers, obstacles faced by female teachers, and obstacles faced by female students.

Al-Tohamey (2020) conducted a study to understand the effect of using a proposed program based on constructivism to develop textual analysis and creative writing skills, and its impact on the achievement of third-grade students in the English language department. The study used a single group design, pre- and post-test design.

The study sample consisted of (90) male and female students in the third year of the English Language Department at the Faculty of Education, Minia University, who studied the program in terms of constructive activities.

The study tools also include testing in: text analysis skills, creative writing skills, and achievement. The results showed that there were statistically significant differences in the post-achievement test of the supported learning tools, which indicates the success of the program in enhancing creative writing and achievement.

Abdul Hamid (2019) conducted a study aimed at developing self-regulation and achievement skills among first-grade female students through the use of Augmented Reality technology. The sample was divided into two equal groups:

The first: a control group which taught female students in a traditional way, and the second: was conducted using Augmented Reality technology, and the study relied on a quasi-experimental design. The study found that when examining the cognitive performance of Biology courses for first-year students, the average scores of the experimental group and the control group were significantly different, and the experimental group was better than the control group.

Bani Younes and States (2017) presented research aimed at knowing the impact of teaching using computerized educational software based on the strategy of guided induction on the acquisition of scientific concepts among third-grade students. The study sample consisted of (25) third-grade students, and the results showed that there was a statistically significant difference in students' acquisition of scientific concepts attributed to the method and in favor of the experimental group. Also, they showed that there was no statistically significant

difference in students' acquisition of scientific concepts due to gender.

As for the study of Salem (2017), it aimed to determine the dual impact of the interactions between learning methods and knowledge within the Augmented Reality environment presented by a smart device on the cognitive results of special education students in the Faculty of Education, and their attitudes towards using e-learning techniques for people with special needs. The sample consisted of (64) individual in the e-learning course for people with special needs at the Faculty of Education, Northern Border University, in the Kingdom of Saudi Arabia.

The descriptive approach and the experimental approach were adopted for this study, and it was concluded that there is a positive and statistically significant effect of the interaction between learning styles within the Augmented Reality environment presented by smart devices and the cognitive style on students' cognitive achievement, and their attitudes towards using e-learning techniques for people with special needs.

Chang et al (2010) conducted a study aimed at identifying the impact of Augmented Reality technology on improving students' achievement and their preference for investigation activities in the natural sciences. The sample included (57) fourth-grade students in northern Taiwan, and the study used the proposed approach. The results of the study revealed that the proposed curriculum has the ability to improve students' academic achievement, and that students who learned using Augmented Reality technology showed clearly higher motivation towards learning compared to those who learned in the traditional way.

Commenting on the Previous Studies

The majority of previous studies focused on children and the primary stage, such as: Majeed's study (2021), Abdul Hamid's study (2019), and Al-Hujaili's study (2019), while the current study focused on eighth-grade students from the upper primary stage. Moreover, there were many tools that were applied in previous studies, such as the diagnostic test and the cognitive test in the study of Abdul Hamid (2019), the study of Salem (2017), and the questionnaire in the study of Chang et al (2010). Thus, the current study agrees with the study of Bani Younes and Al-Dawlat (2017) in using Science subject test, and it differs from it by topics such as: Acquisition of concepts and the content of the test, as the current study relied on the acquisition of scientific concepts test as a tool for data collection. In addition, it differs from it by using a developed software based on Augmented Reality.

This study agreed with all previous studies in using the experimental approach with a quasi-experimental design, except for the study of Salem (2017), which used the descriptive approach, and the study of Chang et al (2010), which used the paired approach. The current study also converged with a number of studies in the scientific field but differed in the academic stage and its uniqueness in the variables of achievement, the acquisition of scientific concepts, the use of developed software based on Augmented Reality, the use of an achievement test, and a test in the acquisition of scientific concepts. The current study focused on the developed software based on Augmented Reality only. It has benefited from previous studies in identifying the most prominent sources and references that the researcher can refer to and related to the field of study. It also benefited from them in building the study tools and relied on the results of some of them in confirming the problem of the study and in discussing the results that were reached.

As for what distinguishes the current study from most of the previous studies, it relied

on the use of three variables: an achievement test, and a test in acquiring scientific concepts, as there are no studies that dealt with these skills together. Previous studies dealt with each skill separately as Tohamey's study (2020), Al-Hujaili's study (2019), Beni Younes and Al-Dawlat's study (2017), Salem's study (2017), and the study of Chang et al (2010). The current study was also characterized by investigating the effect of using a developed software based on Augmented Reality on the achievement and acquisition of scientific concepts among eighth-grade students in Science in the Kingdom of Saudi Arabia, which has not been subjected to in any study in Jordan and the Kingdom of Saudi Arabia - as far as the researchers know - and with reference to libraries and search engines.

Methods and Procedures

Study Methodology

The researchers used the quasi-experimental approach, where the study subjects were divided into two groups: experimental and control, as the two groups underwent a pre- and post-test, and developed software based on Augmented Reality was applied to the experimental group, and the control group was taught in the traditional way. After completing the teaching, data was collected and compared to find out the effect of teaching according to the Augmented Reality software on achievement and the acquisition of scientific concepts among eighth-grade students in Science in the Kingdom of Saudi Arabia.

Study Population

The study sample consisted of (84) students from Omar Al-Mukhtar Intermediate School, where the researchers randomly selected two classes from the eighth grade. One of them is an experimental group, consisted of (42) students who studied according to the developed software method based on Augmented Reality, and the other is a control group, consisted of (42) students who studied according to the traditional method during the first semester of the academic year (2022-2023).

Study Tools

First: Science Achievement Test

The two researchers limited the achievement mark in science to: (remembering, comprehension, application, and analysis), and indicators were set for each level of it, and specific lessons were selected to conduct an achievement test about them, which are mentioned in the second part of the eighth-grade Science book for the academic year (2022- 2023). The number of questions in the test was (20), and they were of the type of essay questions, and each indicator was assigned one mark (1).

The researchers prepared a science test aimed at measuring the extent to which the study individuals possessed the levels of achievement, which are: (remembering, comprehension, application, and analysis) that were adopted in the study and the behavioral indicators indicating them. The researchers prepared the test according to the following steps:

1. Refer to theoretical literature and previous studies to determine reading achievement skills and their behavioral indicators.
2. View the Science Curriculum document and the teacher's guide to review the outcomes of eighth-grade achievement skills to benefit from them in preparing a specification table for that.

3. Refer to the second part of the textbook (Science) for the eighth grade for the academic year (2022-2023) to determine the test questions.
4. Preparing the test in light of the specification table that was prepared for that. The number of questions was (20), and each question measures an indicator of each of the achievement skills, and its validity and reliability have been verified.

The validity of the test of achievement skills in science subject for the eighth grade

In order to verify the validity of the list of the achievement skill and the validity of the test, it was reviewed by a group of arbitrators in the Department of Curricula and Teaching Methods, and those with specialization in the field of science to express their opinion on it.

The stability of the test of achievement skills in science for the eighth grade

The researchers applied the test to an exploratory sample from the study community and outside its members, which numbered (20) students from the eighth grade in Omar Al-Mukhtar Intermediate School, which is affiliated to the schools of the Ministry of Education in Saudi Arabia in Riyadh. Then, the researchers re-applied it two weeks after the first application on the same exploratory sample. The stability of the test was verified by the (test-r-test) method, then the Pearson correlation coefficient was calculated between the students' estimates in the two times, and it reached (0.82); this value was considered appropriate for the purposes of this study.

Criteria for Scoring the Achievement Test

The researchers identified the following criteria:

Comprehension: The percentage of information among students was adopted. The new information in comprehension that increased among students exceeded (80%) of the total responses of the students got one mark, while the new ideas that decreased among the students exceeded (20%) of the total responses of the students got two marks.

Application: The researchers adopted the number of correct applications of scientific concepts for each question as the basis for scoring them.

Analysis: The researchers relied on the number of categories, mental shifts, and correct analyzes to which the responses belong, which the student made as the basis for scoring them, as the criterion for obtaining the mark is the number of mental shifts made by the student and not the number of responses.

The total mark for the achievement levels test was determined, and it was (20 marks) by adding the marks obtained by the students in each of the achievement skills: (comprehension, application, and analysis).

Second: Test of Acquisition of Scientific Concepts of Science for the Eighth Grade

The researchers prepared a test in the acquisition of scientific concepts aimed at measuring the extent to which the study individuals possess scientific concepts in science, which are represented by: (facts, scientific rules and laws, and scientific theories) that were adopted in the study and the behavioral indicators that indicate them. The researchers prepared the test according to the following steps:

1. Referring to theoretical literature and previous studies to identify scientific concepts and their behavioral indicators.

2. Viewing the Science Curriculum document and the teacher's guide to view the outcomes of the eighth-grade scientific concepts in order to benefit from them in preparing a table of specifications in this regard.
3. Referring to the second part of the textbook (Science) for the eighth grade for the academic year (2022/2023) to determine the lessons for the scientific concepts acquisition test
4. Preparing the test in the light of the specification table that was prepared for that, and by adopting (facts, laws, and scientific theories). A total score of (20) marks was set for the test, and its validity and reliability were verified.

The validity of the scientific concepts acquisition test

To ensure the validity of the test, it and the list of skills were presented to a number of arbitrators specialized in science curricula, and in a number of Jordanian universities and universities in the Kingdom of Saudi Arabia, as well as educational supervisors and Science teachers who have experience in this subject. The test score was (20) marks as a whole, and modification of these concepts were allocated accordingly.

The stability of the acquisition of scientific concepts test

The test was applied to an exploratory sample of (20) eighth-grade students. The sample was chosen from outside the study population at Omar Al-Mukhtar Intermediate School, which was affiliated to the Saudi Ministry of Education schools in Riyadh. Then, the researchers re-applied it two weeks after the first application on the same study sample. Its stability was verified by the stability of the two correctors, and the stability coefficient between them was (82%), which is a suitable percentage for the purposes of this study.

Criteria for Scoring the Scientific Concepts Acquisition Test

The researchers identified the following criteria:

1. Facts: The researchers depended on the percentage of information among students. The new information that increased among students to (80%) of the total students' responses got one mark, while the new ideas that were less than (20%) among the students' total responses got two marks.
2. Scientific rules and laws: The researchers adopted the number of correct responses belonging in the light of the specific requirements for each question as the basis for scoring them.
3. Scientific theories: The researchers relied on the number of categories and mental shifts to which the responses belong, which the student made as the basis for scoring them, and not the number of responses he presented.

And the total score for the skill test of acquiring scientific concepts was determined, and its score was (20) marks by adding the marks obtained by the student in each of the scientific concepts that include: (facts, scientific rules and laws, and scientific theories).

Augmented Reality Based Software:

The impact of the developed software based on augmented reality was prepared according to the following stages:

1. Design stage: The developed software based on Augmented Reality for teaching science is from the eighth-grade science book.
2. The preparation and preparation stage, which includes:

Determining the general objective of the software, and the software aims to identify its impact on the achievement and acquisition of scientific concepts among eighth-grade students in science subject. The achievement and acquisition of scientific concepts is of great importance. This is because they represent the correct basis for every educational goal in science, as they help in directing educational work to the desired results that we seek to achieve. They also constitute a criterion for testing, implementing, and developing the content of curricula and teaching programs.

1. Choosing the educational content in the design phase of the developed software based on Augmented Reality: The science book, part two, was selected for the academic year 2021-2022 AD, which includes (6) units, from which (3) were taken for application.
2. The researchers reformulated the content of the previously specified lessons for the application to match the developed reality-based software by enriching what was formulated with: pictures, written passages, sounds, colors, and videos.
3. Accurately identifying the sub-skills of achievement by analyzing the scientific material into the basic educational points for each lesson.
4. Dividing the content of each lesson into its first educational elements in the form of scientific concepts. this also includes scientific concepts that make up the science book, each of them separately.
5. Putting achievement levels and sub-scientific concepts of science within a developed software based on Augmented Reality.
6. Determining the general and specific objectives of the developed software based on Augmented Reality.

It included two types of goals: the general goals of the Augmented Reality software, and then the goals for each of the lessons to be applied to it. The general objectives represent the outputs that the eighth-grade students are expected to reach after completing the study of lessons through multimedia and the application of their activities.

3. The script writing stage, which includes

1. Writing the titles of the units and lessons in the introduction to the program.
2. Developing instructions and instructions for the eighth-grade teacher before starting to use it.
3. Writing the title of each developed software lesson based on Augmented Reality on a separate slide.
4. Putting a list of achievement and scientific concepts to be acquired in a separate slide at the forefront of each multimedia lesson.
5. Treating each software lesson as a mini unit that sequentially contains special objectives and educational content that includes pictures, graphics, audio clips, educational and enrichment activities, and a final evaluation.
4. Implementation stage: The set of lessons was prepared to be presented to the eighth-grade students based on developed software based on reality, and to design the developed software based on Augmented Reality, a programmer specializing in the following programs was hired:
 6. (Arloopa) program.
 7. (Word) text editing program.
 8. (Power point) program.
 9. Learn anatomy program from (Google play).
 10. Designing the developed software guide based on Augmented Reality that includes

- detailed information about the software.
11. Experimental phase: After making the necessary modifications to the developed software based on augmented Reality based on the observations of the arbitrators, the researchers experimented with the developed software based on Augmented Reality on a survey sample consisting of (25) students.

The validity proof of the developed software based on Augmented Reality

The software was presented to a group of specialized arbitrators from the faculty members at the University of Jordan, and the researchers made the necessary modifications to produce the developed software based on Augmented Reality in its final form.

The process of teaching the experimental group developed software based on Augmented Reality was as follows, Table No. (1) shows this:

Table (1). *Distribution of roles of science teacher and students in the implementation of Augmented Reality*

Students' role	Science teacher's role
Students going to the computer lab.	Distribution of students / computers.
Clicking on the program name.	Providing a simplified explanation of the nature of the developed software based on Augmented Reality
Clicking on the title of the lesson to be reviewed	Discussing the lesson with the students
Students following the steps of the developed software based on Augmented Reality and implementing what is required of them.	Correcting the students' answers to the exercises.
Reading the lesson on the computer.	Science teacher's supervision over students
Solving the exercises by achievement and scientific concepts.	Helping students when facing any emergency.
The student closing the developed software based on Augmented Reality	Displaying Skills

Study Procedures

1. Reviewing the educational literature related to the use of developed software based on Augmented Reality, by referring to the sources from: research, studies, and books specialized in this research as a study to benefit from in preparing the developed software based on Augmented Reality, and in limiting achievement and scientific concepts and verifying their validity and stability. A list was designed for: achievement, scientific concepts, and performance indicators indicating them, and verifying their validity and stability to benefit from them in the preparation of the two tests, namely: (comprehension, application, and analysis) for academic achievement, and (facts, scientific rules and laws, and scientific theories) for the acquisition of scientific concepts.
2. Preparing the developed software based on Augmented Reality to be used in achievement and the acquisition of scientific concepts in science lessons from the academic year 2021-2022, to be applied with the experimental group, while the control group was taught the same subjects, but in the traditional way.
3. Preparing the two study tools represented by a pre- and post-test, one for achievement,

as the title of the lessons was defined as: achievement test, and the other for acquiring the scientific concepts mentioned in the second part of the science book for the eighth grade of the academic year (2021-2022). This was according to the list of scientific concepts to be acquired which have been verified for their validity and stability, according to their own table of specifications.

4. The application of the pre-test on the two groups (experimental and control) for science students, the achievement test, the acquisition of scientific concepts, and the developed software based on augmented Reality in other subjects.
5. The researchers met the "teacher" of the experimental group and determined the educational material to be cut in a specific period for him. The researchers trained the teacher of the experimental group on the steps of implementing the lessons using the developed software method based on Augmented Reality.
6. The teacher of the experimental group taught Science lessons according to the developed software based on Augmented Reality, and the control group were taught the same lessons according to the traditional method. The teaching of both groups began on Sunday (9/30/2022- 9/10/2022) until Thursday (9/30- 9/10/2022), with three teaching sessions per week.
7. Follow up the procedures of conducting the experiment with the teachers.
8. Applying the post-test after the expiration of the trial period for both groups (experimental and control) during the period between (9/30/2022- 9/10/2022), scoring it according to the scoring procedures and criteria, and monitoring the students' scores on both tests.
9. Entering the collected data into the computer's memory, using the appropriate statistical treatment of the study questions, extracting the results in an organized manner, and making the necessary recommendations.

Study Variables

First: The Independent Variables:

The teaching method, which is two methods: (the developed software method based on Augmented Reality, and the traditional teaching method).

Second: Dependent Variables:

dependent variables, which are

1. Achievement and its levels: (comprehension, application, and analysis).
2. Acquisition of scientific concepts based on: (facts, scientific rules and laws, and scientific theories).

Study Design

O ₁ O ₂	X	O ₁ O ₂	EG:
O ₁ O ₂	—	O ₁ O ₂	CG:

Whereas:

1. EG: Experimental Group.
2. CG: Control Group.
3. O1: Post-Achievement Test.
4. O2: Post-Test for the Acquisition of Scientific Concepts.
5. X: Statistical Processing (Developed Software Based on Augmented Reality).
6. (-) = Traditional Method.

Statistical Processing

The Statistical Package for Social Sciences (SPSS) program was used, as it conducted

the following statistical treatments:

1. Cronbach's alpha coefficient: (Cronbach-Alpha), Pearson's correlation coefficient, and the Kodor Richertson 20 equation to check the stability and internal consistency of the study tools.
2. Pearson correlation coefficient to verify the structural validity of the study tools.
3. T-test for independent samples (t-test) to verify the equivalence of the two study groups on the study tools.
4. One Way ANCOVA to answer the research questions: first, second, and third, and test the associated hypotheses.

Viewing the Results of the Study

First: The results related to the first question: “What is the effect of teaching using developed software based on Augmented Reality on the achievement of eighth-grade students in learning Science in the Kingdom of Saudi Arabia?”

In order to answer this question, the arithmetic means and standard deviations of the total score for the performance of the two study groups on the achievement test in the pre- and post-applications in science were extracted, and Table (1) shows the results.

Table (1). *The arithmetic means and standard deviations of the total score for the performance of the two study groups on the achievement in the pre- and post-test for science subject*

Group	Number	Total Score of the Test	Pre-		Post-	
			Arithmetic Mean	Standard Deviation	Arithmetic Mean	Standard Deviation
Experimental	42	20	11.14	1.52	17.12	2.06
Control	42		10.76	1.61	14.14	1.51
Total	84		10.95	1.57	15.63	2.34

Table (1) shows that there are apparent differences in the total score of the performance of both study groups on the post achievement test in science, where the highest arithmetic mean was for the experimental group, as it reached (17.12), and the arithmetic mean for the control group was (14.14). In order to make sure whether or not the difference between both arithmetic means is statistically significant, One Way ANCOVA has been applied, and Table (2) shows the results:

Table (2). *One-Way ANCOVA for the difference between both arithmetic averages of the total score of the two study groups' performance on the post-test of science achievement*

Source of Variance	Sum of Squares	Degrees of Freedom	Mean of Squares	The Calculated Q Value	Significance Level	Eta Squared
Pre-test	1.392	1	1.392	0.423	0.517	
Teaching Method	179.346	1	179.346	54.581	0.000	0.403
Error	266.156	81	3.286			
Total	453.56	83				

Table (2) shows that there is a statistically significant difference between both arithmetic means of the total score of the performance of both study groups on the achievement post-test in Science subject based on the calculated (Q) value of (54.581), with a level of significance equal to (0.000); with this result, the null hypothesis which states: “There are no statistically significant differences at the level of significance ($\alpha = 0.05$) between the average scores of the students of both experimental groups (which are taught using developed software based on Augmented Reality), and the control group that is taught in the traditional way) in achievement in Science subject among eighth-grade students, according to the method of teaching.” is rejected.

To determine in favor of which group the difference was by extracting both adjusted arithmetic means and their standard errors, the results are shown in Table (3):

Table (3). *The arithmetic means and standard errors of the total score for the performance of the two study groups on the post-science achievement test*

Group	Number	Total Score of the Test	Arithmetic Mean	Standard Error
Experimental	42	20	17.10	0.28
Control	42		14.16	0.28

Table (3) shows that the difference was in favor of the adjusted arithmetic mean of the experimental group, because it is the highest, as it reached (17.10). However, the adjusted arithmetic mean of the control group was the lowest, as it reached (14.16). This means that there is an effect of teaching using developed software based on Augmented Reality on the achievement of eighth-grade students in learning Science in the Kingdom of Saudi Arabia. This is confirmed by the value of the Eta squared of (0.403), which expresses the size of the impact of the teaching method using developed software based on Augmented Reality on the percentage of variation in the achievement test in Science subject caused by the experimental method, which is equal to (40.3%), and this means that the remaining percentage, which was (59.7%), is due to factors not studied in the current study.

Second: Results Related to the Second Question

What is the effect of teaching using a developed software based on Augmented Reality on the acquisition of scientific concepts in Science among eighth-grade students in the Kingdom of Saudi Arabia?

The arithmetic means and standard deviations of the total score for the performance of both study groups were extracted on the test of acquiring scientific concepts in science in the pre- and post-applications, and table (4) shows the results.

Table (4). *The arithmetic means and standard deviations of the total score for the performance of both study groups for the acquisition of scientific concepts in the subject of pre- and post-test of science*

Group	Number	Total Score of the Test	Pre-		Post-	
			Arithmetic Mean	Standard Deviation	Arithmetic Mean	Standard Deviation
Experimental	42	20	10.76	3.64	17.05	1.72
Control	42		9.86	3.65	13.45	3.03
Total	84		10.31	3.65	15.25	3.05

Table (4) shows that there are apparent differences in the total score of the performance of both study groups on the post-test of acquisition of scientific concepts in science, as the highest arithmetic mean was for the experimental group, which was (17.05), and the arithmetic mean for the control group was (13.45). To make sure that the difference between both arithmetic means is statistically significant, One Way ANCOVA was applied, and Table (5) shows the results.

Table (5). *One Way ANCOVA for the difference between both arithmetic means of the total score of both study groups' performance on the post-test for the acquisition of scientific concepts in science*

Source of Variance	Sum of Squares	Degrees of Freedom	Mean of Squares	The Calculated Q Value	Significance Level	Eta Squared
Pre-test	83.473	1	83.473	16.299	0.000	
Teaching Method	231.24	1	231.24	45.151	0.000	0.358
Error	414.836	81	5.121			
Total	769.75	83				

Table (5) shows that there is a statistically significant difference between both arithmetic means of the total score of the performance of both study groups on the test of acquiring scientific concepts in post-test in science subject based on the calculated (Q) value of (45.151), with a significance level of (0.000). With this result, the null hypothesis which states: "There are no statistically significant differences at the significance level ($\alpha = 0.05$) between the average scores of the students of both experimental groups (which are taught using developed software based on Augmented Reality), and the control group (which is taught in the traditional way) in acquiring scientific concepts in the Science subject among eighth-grade students is attributed to the teaching method" is rejected.

To determine in favor of which group was the difference, both adjusted arithmetic means, and their standard errors were extracted, and the results are shown in Table (6).

Table (6). *The arithmetic means and standard errors of the total score for the performance of both study groups on the post-test of the acquisition of scientific concepts in Science*

Group	Number	Total Score of the Test	Arithmetic Mean	Standard Error
Experimental	42	20	16.92	0.35
Control	42		13.58	0.35

Table (6) shows that the difference was in favor of the adjusted arithmetic mean of the experimental group, because it is the highest, as it was (16.92), while the arithmetic mean of the control group was the lowest, as it was (13.58). This means that there is an effect of teaching using developed software based on Augmented Reality on the acquisition of scientific concepts in science among eighth-grade students in the Kingdom of Saudi Arabia. This is confirmed by the value of the Eta squared of (0.358), which expresses the size of the effect of the teaching method using developed software based on reality in the percentage of variation in the test of acquiring scientific concepts in science subject caused by the experimental method, which is equal to (64.2%). This means that the remaining percentage, which is (35.8%), is due to factors not studied in the current study.

Discussion of the Results and Recommendations

First: Discussing the Results Related to the First Question

The results of the first question showed that there are apparent differences in the total score of the performance of both study groups on the achievement post-test in science. This means that there is an effect of teaching using developed software based on Augmented Reality on the achievement of eighth-grade students in Science in the Kingdom of Saudi Arabia in favor of the experimental group.

The researchers attribute these differences between the performance of both experimental groups that were taught in the Augmented Reality method, and the control group that was taught in the traditional way in the post-test application of the achievement in favor of the experimental group to the Augmented Reality. This includes defining the goals that are expected to be achieved after completing the lesson, then developing an appropriate introduction, and then presenting the scientific concept in a sequential way that contains attractive colors, movements, images, and sound effects. All of which contributed to emphasizing the element of suspense and drawing attention to the experimental sample, which positively affected their academic achievement. This result is consistent with the study of Abdul Hamid (2019): there was a statistically significant difference at the level (0.05) between the means of both study groups in the cognitive achievement test related to the Biology course for first-year secondary school students in favor of the experimental group, as well as with the

study of Chang et al. , 2010) It was found that the proposed approach is able to improve the academic achievement of students, and that students who learned using Augmented Reality technology showed significantly higher motivation towards learning compared to those who learned in the traditional way. The study resulted in the success of Augmented Reality technology in developing achievement and historical thinking skills using computerized techniques among students. Also, this agreed with the study of Abdul Hamid (2019), whose results indicated that there is a statistically significant difference at the level (0.05) between the average scores of the members of both study groups in the measure of self-regulation of learning for first-year secondary school students in favor of the experimental group, as well as the study of Chang et al. , 2010), which concluded that the proposed curriculum is able to improve students' academic achievement, and that students who learned using Augmented Reality technology showed significantly higher motivation towards learning compared to those who learned in the traditional way.

Second: Discussing the Results Related to the Second Question:

The text of the second question: "What is the effect of teaching using a developed software based on Augmented Reality on the acquisition of scientific concepts in Science among eighth-grade students in the Kingdom of Saudi Arabia?"

The results of the second question showed that there are apparent differences in the total score of the performance of both study groups on the post-test of the acquisition of scientific concepts in science subject, as the higher arithmetic mean was for the experimental group. This means that there is an effect of teaching using developed software based on Augmented Reality in the acquisition of scientific concepts in science among eighth-grade students in the Kingdom of Saudi Arabia.

The superiority of the students of the experimental group over the students of the control group may be attributed to the fact that acquiring scientific concepts requires new educational attitudes and activities that are among the characteristics of Augmented Reality, which contributed positively to enabling students to understand difficult scientific concepts through interaction and listening to different interpretations and predictions. In addition, this was due to the dialogues and discussions presented within the augmented reality, which are reflected in the level of discussion and dialogue between them, which helped them present their ideas related to the written concepts in the Augmented Reality, which were presented in a three-dimensional image, electronic papers, and various training tasks, to them.

This result can be explained by the fact that the Augmented Reality put the students in front of real situations related to their academic problems, including the difficulty in acquiring scientific concepts, which enabled them to express themselves fluently and flexibly. The researchers noticed - during the implementation done by the teacher - the students' enjoyment of what is presented in the Augmented Reality, and their willingness to learn by performing the various tasks that were asked of them. As a result, this aroused their interest, and improved: the spirit of competition, questioning, dialogue and discussion, which made them more vital in dealing with scientific concepts of varying difficulty, as well as expanding in their details, which in turn increased their motivation to acquire new scientific concepts.

This result is consistent with the results of the Bani Younes and Al-Dawlat (2017) study, which concluded that there was no statistically significant difference at ($\alpha = 0.05$) in the third-grade students' acquisition of scientific concepts due to gender, and to the interaction between

method and gender. It also agrees with Tohamey's study (2020), which showed that there were statistically significant differences in favor of the post-test of the study tools, which indicates the success of the program in developing the skills of text analysis, creative writing, and achievement.

Recommendations and Suggestions

Based on the study's procedures and findings, the researchers recommend a set of recommendations, as follows:

1. Adopting Augmented Reality in the different school stages that employ more than one sense in learning, due to its clear positive impact on achievement and the acquisition of scientific concepts.
1. Encouraging male/female teachers to adopt modern methods of teaching, and to employ software based on Augmented Reality in the learning process.
2. Drawing the attention of those in charge of curricula to the need to include Augmented Reality in educational software and curricula, and to produce electronic courses commensurate with the spirit of the technological era.
3. Conducting future studies dealing with scientific concepts among students in different educational stages.

References

- Aal Souban, Abdullah. (2019). The effect of using Augmented Reality technology on the achievement of primary school students in teaching science in Al-Aflaj Governorate, *Journal of the College of Education*, 38, (181), 22-24.
- Abdul Hamid, Fatima Mohamed Abdul Aleem. (2019). The effect of using Augmented Reality technology on the development of self-regulation skills and achievement among first-year secondary school students, *Arab Studies in Education and Psychology*, 10, 206-228.
- Al-Ghamdi, Najia. (2013). The embodiment of the other dimension in education, retrieved on 11/28/2019 from the following website:
- Al-Hajri, Sarah Bint Suleiman. (2018). The effect of using Augmented Reality on the development of academic achievement and practical performance skills in the jurisprudence course for intermediate first-grade students in the city of Riyadh, *Journal of the College of Education in Zagazig*, (98), 127-211.
- Al-Hasan, Essam. (2013). The effectiveness of using blended learning on academic achievement in the biology course of second-grade students in private secondary schools in Omdurman and their attitudes towards it. *Journal of Educational and Psychological Research*, 5 (36), .58-85
- Al-Hujaili, Samar. (2019). The effectiveness of Augmented Reality in achievement and motivation development in the computer and information technology course for secondary school students, *Arab Journal of Specific Education*, 9, (2), 22-23.
- Al-Hussamiya, Rahmah. (2020). The Impact of Augmented Reality Technology on Academic Achievement and Visual Thinking for Third Grade Science Students in Qweismeh District - Amman, unpublished Ph.D. thesis, Middle East University, Jordan.
- Al-Husseini, Maha Abdul Moneim. (2014). The effect of using Augmented Reality technology in the computer course unit on the achievement and attitude of secondary school students. Unpublished master's thesis, Umm Al-Qura University, Makkah Al-Mukarramah, Saudi Arabia.
- Al-Khalifa, Hassan Jaafar. (2007). *An introduction to curricula and teaching*, (2nd Edition).

- Riyadh: Al-Rushd Library.
- Allam, Salah Al-deen. (2000). Educational and psychological measurement and evaluation, its foundations, applications and contemporary trends. (Issue 1). Cairo: Dar Al-Fikr Al-Arabi for publication and distribution.
- Al-Mallah, Mohamed Abdul Karim. (2010). The electronic school and the role of the Internet in education, Amman: House of Culture.
- Al-Masharawi, Hassan. (2018). The effectiveness of employing Augmented Reality technology in teaching second-grade intermediate students in developing motivation towards learning and academic achievement in technology in Gaza, Journal of Al-Quds Open University for Educational and Psychological Research and Studies, 9, (25), 18-19.
- Al-Mokdadi, Ilham. (2019). The effect of using Frayer's teaching model on acquiring scientific concepts among sixth-grade female students in science in the light of their motivation towards learning science, unpublished Ph.D. thesis, Al al-Bayt University, Jordan.
- Al-Muhtasib, Areej. (2019). The effect of interactive exercises in the dry laboratory on acquiring scientific concepts in science for ninth-grade female students in Palestine in the light of their thinking patterns, Journal of the Islamic University for Educational and Psychological Studies, 27, (5), 44-46.
- Attar, Abdullah, and Kansara, Ihsan Muhammad. (2015). Learning Objects and NATO Technology, (1st edition). Mecca: King Fahd National Library.
- Attiya, Mohsen. (2008) The Modern Strategy for Effective Teaching, 1st edition. Amman: Dar Safaa for publication and distribution.
- Bani Younes, Abdullah Ali Muhammad, and states, Adnan Salem. (2017). The effect of employing computerized educational software based on the guided induction strategy on acquiring scientific concepts among third-grade students. Journal of the Islamic University for Educational and Psychological Studies, 25 (4), 521-543.
- Chang, G, Morreale, P. & Medicherla, P. (2010). Application of Augmented Reality Systems in Education. In Gibson & B. Dogge, Proceeding of International Conference, 1380-1385.
- El Sayed, N., (2011). Applying Augmented Reality Techniques in the Field of Education. Unpublished Master's Thesis, Benha University, Benha, Egypt.
- Hajjaj, Ismail. (2019). The effect of the interaction between the two types of infographic display and timing in the Augmented Reality environment on the development of website production skills for students of higher institutes, Journal of Education Technology, 40, (2), 13-16.
- Hasan, Amal Hassan. (2019). A proposal to employ Augmented Reality technology for deaf students according to the TAM Technology Acceptance Model, Journal of Studies in University Education, 45, (4), 17-19.
- Hasan, Taghreed. (2019). The impact of Driver's model on acquiring scientific concepts in mathematics among fifth-grade students in the applied branch, Educational Journal, 58, (1), 22-28.
- http://el-way.blogspot.com/2013/01/blog-post_1.html
- Ivanova, M.; Ivanov, G, (2011). Enhancement of Learning and Teaching in Computer Graphics through Marker Augmented Reality and Technology.
- Kerawalla, L. Luckin, R. Selgeflot, S. Woolard, A. (2006). Making It Real: Exploring the Potential of Augmented Reality for Teaching Primary School Science. Virtual Reality, 10(2-4), 163-174.
- Kesima, M. & Ozarslanb, Y.)2012(. Augmented Reality In Education: Current Technologies And The Potential For Education. Procedia-Social And Behavioral Science, 47, (22): 297-302.

- Khalifa, Ali. (2019). Augmented Reality through the survey strategy (directed / undirected) and its impact on developing the concepts of technological innovations among general diploma students at the College of Education and their ability to use it, *Journal of Educational and Social Studies*, 25, (8), 17-19.
- Khamis, Mohamed Attiya. (2015). Virtual Reality Technology, Augmented Reality Technology, and mixed Reality Technology. *Journal of the Egyptian Society for Educational Technology*, 25 (2), 1-3.
- Khattabiya, Abdullah. (2011). *Science Education for All*, 3rd Edition. Amman: Dar Al Masirah for publication and distribution.
- Khuder, Widad Ismail. (2015). The impact of the strategy of the metacognitive learning course on acquiring and retaining scientific concepts among students of the Institute of Earth and Environmental Sciences at Al al-Bayt University. Unpublished master's thesis, Al al-Bayt University, Mafraq, Jordan.
- Majeed, Razan. (2021). Obstacles to the use of Augmented Reality technology in developing the social skills of female students with intellectual disabilities in the primary stage from the point of view of their teachers in the city of Jeddah, *The Arab Journal of Disability Sciences and the primary stage from the point of view of their teachers in the city of Jeddah, The Arab Journal of Disability Sciences and Giftedness*, 5, (15), .12-17
- Ministry of Education. (2016). *Computer and Information Technology*, Riyadh, Ministry of Education.
- Mohsen, Waheed. (2020). The effect of the Woods model on acquiring scientific concepts among fifth-grade biological science students of physics and their inferential thinking, *Journal of the College of Basic Education*, 26, (109), 14-18.
- Noh, k.; Jee, H., Lim, S. (2010). Effect of Augmented Reality Contents Based Instruction on Academic Achievement, Interest and Flow of learning. *The Journal of the Contents Association*, 10(2), 1-13.
- Salem, Mustafa. (2017). The impact of the interaction between learning styles within the environment of Augmented Reality displayed by smart devices: tablets and smart phones, and the cognitive style, on the cognitive achievement of special education students, teachers at the Faculty of Education, and their attitudes towards using e-learning techniques for people with special needs. *Journal of Arab Studies in Education and Psychology*, 92. (1), .23-76
- Tohamey, Al, Shimaa (2020). Using a Suggested Program Based on Constructivism for Developing 3rd year English Majors' Discourse Analysis Skills, Creative Writing and motivation towards Them, *University Faculty of Education Journal*, 22, (4), 66-69.
- Yuen, S., Yaoyune, G., & Johnson, E., (2011). Augmented reality: An overview and five directions for AR in education. *Journal of Educational Technology Development and Exchange*, 4(1), 1-15
- Ziyadna, Wijdan. (2021). The effectiveness of using educational theater in acquiring scientific concepts and attitudes of kindergarten children towards learning science in Mafraq Governorate, an unpublished doctoral dissertation, Al al-Bayt University, Jordan.