أثر التدريس وفقاً لتقنية الواقع المعزز في مهارات التفكير البصري لدى طلاب الصف الخامس العلمي في مادة علم الأحياء

أ.د حيدر مسير حمد الله   الباحث :مصطفى علي حسين الدليمي

جامعة بغداد/ كلية التربية للعلوم الصرفة/ أبن الهيثم قسم علوم الحياة

طرائق تدريس علوم الحياة

The Effect of Teaching According to the Augmented Reality Technique on theVisual Thinking Skills to Scientific Fifth-Grade Students for Biology

The student masters: Mustafa Ali Hussein AL-Dulaimi

t.mustafaali١٨١٨@gmail.com

Supervised by: Prof. Dr. Haider Maseer Hamadallah

Dr.Hayder.m@yahoo.com

Baghdad University-College of Education for Pure Science / Ibn Ibn Al-Haitham

Methods of teaching biology

Abstract

The research aims to identify the effect of teaching according to the augmented reality on the technique of the visual thinking skills among scientific fifth-grade students in a biology course. In order to achieve the goal of the research, the researcher adopted the experimental approach with the partial set of the two equal groups with the dimensional test of visual thinking skills, The research population represented all the scientific students of the fifth grade for morning government schools affiliated to the General Directorate of Education of Baghdad / Karkh II, alshakerin preparatory for boys was chosen intentionally, in which two groups were chosen for this study, one group is chosen randomly as the control group via lottery, whereas the other group is chosen to be as the experimental group. The total number of students are (53) students by (26) students are chosen for the experimental group that were taught according to the augmented reality technique. The other group is the control group consisting of (27) students that were taught according to the traditional way. The results showed there is statistically a significant difference for the experimental group in the visual thinking skills test.

Keywords: augmented reality technique, visual thinking skills.

The First Chapter: The general framework of the research

Research problem

The educational reality in educational institutions has faced many challenges in all aspects of social ،economic and cultural life ،perhaps the most important of which are population explosion ،cognitive development ،changing teacher role ، scientific and technological progress ،as well as the adoption of methods and traditional methods of teaching ،than called the specialists to pay attention to modern educational techniques ،and the most important products and methods of scientific and technological progress ،the emergence of smartphones and tablets ، which made the wide scope for learners to get information with ease ،and there's a tendency to take advantage of these innovations in the service of the educational process .Education technology has been the biggest role in keeping pace with this development ،whether it is devices ،equipment or educational programs and the most important basic forms of e−learning ،mobile education or distance learning and virtual and interactive learning environments.The usual teaching methods are heavily relied upon in the delivery of educational material to learners ،including the two ways of throwing and lecture which often brings boredom among learners ،so that relying on conservation ،indoctrination and listening ،and neglecting other aspects particularly thinking skills ،so there were many weaknesses points in teaching biology in the preparatory stages in general and the scientific fifth grade In particular.To confirm the existence of a problem ،the researcher presented a questionnaire to a number of teachers of biology who had at least (١٠) years of experience in the field of teaching biology for the Scientific fifth grade ،and their number (١٢) Teachers as he distributed the open questionnaire to them and discussed them guided by their opinions ،and the results of the questionnaire were as follows:

1. ٩١ %of teachers did not have accurate information about visual thinking skills and how to use them in teaching biology to the Scientific fifth grade although the content of the scientific material is full of images ،which promotes visual thinking

among learners ،which must be enhanced by modern technological techniques ،
which prompted the researcher to solve such a problem.

1. ٩١ % of teachers use only the classical method of teaching.

2. ٨0 % of teachers do not use smart devices ،tablets or the Internet.

3. ١٠٠ % of teachers do not have knowledge of augmented reality technique
   because the teaching methods are traditional methods limited to preservation
   and indoctrination and then show it to the learners without linking what they learn
   to their daily lives ،environment and what they face of problems.

Therefore ،the problem of research can be identified in answering the following
question (What is the effect of teaching according to the technique of augmented
reality in the visual thinking skills of the scientific fifth graders in biology)?

Second :The importance of research:

The importance of research lies in:

1. The importance of this research comes from the existence of many previous
   studies that emphasize the importance of employing e-learning to improve the
   educational process.

2. The results of the research may benefit the Ministry of Education –Directorate
   General of Education of Baghdad Al-Karkh / II if it proves effective.

3. It provides the teacher with the opportunity to diversify the education of learners
   to increase their interaction ،and motivate them towards self-employment
   through activities and out-of-school work

4. The proposed research is part of the field of studies on visual thinking skills in
   Scientific fifth graders.

5. The research results may reveal to researchers in the future about in-depth
   studies of visual thinking and skill.

Third: Research Aim:

The research aim to identify (the effect of the using of augmented reality
technique on visual thinking skills in fifth graders in biology).

Fourth :Research hypothesis

There is no statistically significant difference at level (٠'٠٥) between the average scores of experimental group student who studied according to augmented reality technique ،and the scores of the students of the control group who studied according to the classical method of visual thinking skills test.

Fifth :Research limits:

The research was limited to:

1. Students in the Scientific fifth grade in Baghdad province within one of the schools belonging to the General Directorate of Education of Baghdad /Al-Karkh II.

2. The last three chapters (5th ،6th ،7th) of the Book of Biology for the Scientific Fifth Grade accredited teaching، (2018)، Ministry of Education ،Republic of Iraq.

3. second semester ٢٠٢٠-٢٠١٩

Sixth: Determination of Basic Terms

6,1: Augmented Reality:

Joan (٢٠١٥ : 8) defines Augmented Reality as a direct and indirect view of an actual environment in the real world ،where its elements are augmented by sensory inputs created by computer or mobile phone such as audio ،video ،or graphics that mimic the real world.

Procedural definition :Introducing the scientific material of the biology course to scientific fifth graders through techniques based on integrating real-world images and videos with the virtual world through ٣D computer graphics via internet-connected smartphones ،making the student interact with the content better.

6,2: Visual thinking skills:

Tarawneh (٢٠١٤:24) defines visual thinking skills as: A set of skills that enable the individual to be able to visually distinguish ،perceive spatial relationships ،interpret and analyze information ،and deduce meaning.

Procedural definition :Is the total degree obtained by scientific fifth-grade students of biology as a result of their response to paragraphs of visual thinking skills test and it made up of five skills, which are (figure recognition and description ،shape

analysis skill ،information binding skill ،the skill of realizing and interpreting ambiguity ،and the skill of Conclusion of meaning) where the researcher prepared (٣٠)objective ltem of a multi-choice type with four alternatives and each skill (٦) questions for the purposes of this research.

The Second Chapter: Background theory and previous studies:

٢,1: Augmented reality concept:

Augmented reality technique is a term that describes technique that allows the simultaneous integration of digital content from software and computer objects with the real world (Dunleavy & Dede, 2006:7), and that the user of augmented reality technology can combine real and virtual objects, and the using of appropriate information from the external environment in a digital environment that mimics the truth. The recent uses of augmented reality technique makes it possible to use it in all areas of education and entertainment, thereby finding new ways and tools to support learning and education in formal and informal circles, for example: when teaching natural events and historical dignitaries can re-enact monuments or archaeological sites To be mimics the reality, and then added it to the real world (Shelton,2002:1-2).

(Rattanarungrot & et al, 2014) defines it as "a concept for displaying composite digital content in the form of realistic scenes that can significantly enhance user learning experiences" (Rattanagrotrun & et al, 2014: 327).

(Cabero & Barroso,2016) also defines it as "blending digital and physical informations in the real reality through different technical devices, using a range of technical devices that add virtual information to physical information, adding a virtual part to what is real."(Cabero & Barroso,2016: 44)

٢,2: How augmented reality works:

Augmented reality technique can attract the attention of learners because it works to display information on the reality ground using Portable devices such as tablets and smartphones, as the real environment is scanned with the camera by the user and the information added to it is shown from digital objects such as

images, videos and texts, and there are two ways to make augmented reality technology:

1. The first method: It is done by using markers, which are captured and distinguished by the phone's camera, and then display the information that have integrated into on the screen to the user.

2. The second method: by running a GPS service, to identify the user's location or using image highlighting software to display previously-stored information in the database. (Tamemizi, 2010: 156)

٢,٣: Features of augmented reality technology:

The highlights of augmented reality technique in education are:

1. Combining imagination and reality in a real environment.

2. 3D view.

3. Interactive in time when used.

4. Simple and effective provides the learner with clear and concise information.

5. The teacher can to enter and communicate his information and data in an easy way.

6. Allows for smooth interaction between the teacher and the learner.

7. Easily expandable.

8. Makes the actions between the teacher and the learner clear.

(Auderson & Liarokapis,2014 :2)

٢,٤: Justifications for using augmented reality technique:

The most important justifications for using augmented reality technique in education are:

1. Participate and motivate learners to discover educational materials information from different angles.

2. Augmented reality helps learners teach school materials that learners cannot easily touch or perceive only through a real first-hand experience, for example: astronomy and anatomy.

3. Encourage the creativity of the learner and expand his imagination and awareness of facts and concepts.

4. Helps learners control the way they learn through education according to their understanding and their preferred way.

5. Provides a reliable learning environment suitable for multiple learning styles for different ages (Yuen et al., 2011:119-140)

٢,٥: Uses of augmented reality technique in teaching and education:

Augmented reality technique used to teach and learn various sciences (biology, medicine, chemistry, physics, astronomy, mathematics, engineering):

The application of augmented reality in the field of biology and anatomy contributes by showing the composition of the organs of living organisms in detail, where the learner can examine the body parts and know their composition and how each of their members work (Lee, 2012:1), and in the field of medicine by displaying a 3D diagram of nerves to facilitate neurosurgery (Cho, 2020:186) . In the field of chemistry, augmented reality technique allows learners to interact and understand amino acids, as well as the opportunity for learners to understand chemical compositions more simply and clearly, because their models are easy to apply (Ivanov & Ivanova,2011:17), while in the field of physics the augmented reality technique explains the different characteristics of objects, and their movement (speed and acceleration). Augmented reality applications can communicate abstract concepts to learners, and mimic natural phenomena and their interactions that may not be evident in real life (Lee, 2012:16) , And also in the field of astronomy, this technique helps learners to display animated 3D images of cosmic objects, the learner sees these images as if they are alive in front of him, and controls them through the movement of his hands in their positions, and adds and deletes them, to verify the theory or review any cosmic phenomenon (Johnson & et al,2010:21) .In addition to its use in the field of mathematics and engineering, where it has helped the students of engineering studies in the design of stereoscopic models, which help them to express their ideas, which saves time and effort in design, as well as

allowing the study of the characteristics of multi-surface objects in the world of mathematics, and examining the different characteristics of engineering forms (Abu Khater, 2018: 28).

٢,٦: Visual thinking:

Visual thinking is a series of mental processes performed by the human brain when exposed to a stimulus and then received by the sense of sight, as these processes help the individual to reach the meaning of this exciting, respond to it, store it in memory, and retrieve it from them when needed (Abu Zaida, 2013: 58) .Visual forms, therefore, play an important role in the representation of knowledge not as guiding and pedagogical tools, but as features that link thinking to learning, shapes, images and drawings which require eye training to focus in order to detect the relationships in it and then express them verbally (Abdelkader, 2018: 37) . Visual thinking is also a system of processes that translate the learner's ability to read the visual form, convert the visual language he carries into a verbal (written) language, and extract information from it (Rizuki et al., 2016: 290).

٢,٧: The importance of visual thinking:

Through visual thinking, what is known as verbal padding is replaced by visual thinking, and the importance of visual thinking is highlighted by the following points:

1. Helps develop problem-solving skills for learners.
2. Develop the ability to understand the visual messages surrounding learners as a result of scientific and technological advances.
3. Increases learners' self-confidence.
4. Works to increase the motivation of learners towards educational subjects.
5. Help to understand the world and the environment around learners.
6. Helps to develop different types of scientific processes such as (observation, interpretation, analysis, conclusion).

(Massoudi and Sanabel, 2018: 254)

٢,٨: Visual thinking skills:

After the researcher's knowledge of several studies, visual thinking skills summarized as follows:

1. Skills to recognize and describe the shape: It is the ability of the individual to recognize the dimensions, nature, and all the apparent characteristics of the visual stimulus display.

2. Spatial relationship perception skill: It refers to the ability to recognize the position of objects in space, their different location depending on the location of the person that he is looking at, as well as the study of two-dimensional and three-dimensional shapes.

3. The skill of understanding and interpreting information (ambiguity): The ability to clarify the meanings of words, symbols, and signals in shapes is also the ability to clarify gaps and fallacies in relationships and the convergence of them.

4. Information analysis skill: It means focusing on fine details and attention to partial and aggregate data, meaning the ability to divide the visual form into its core components.

5. The skill of extracting meaning: the ability of the individual to deduce new meanings and to come up with scientific concepts and principles through a visual stimulus presented.

٢,٩: Previous studies:

A) Studies on augmented reality technique

Table (١) Previous studies on augmented reality technique

N	Study	The country of study	The aim	Sample	Tools	Statistical means	Results
١	(AlZain, 2018)	Saudi Arabia	A proposed educational program to develop augmented	30 Primary school students with	List of educational design skills, augmente	(t.test) Cooper Equation, Alphakron bach	The results showed that female students were able to the proposed

			reality technique design skills for female students at Princess Noura Bint Abdul Rahman University and its impact on increasing their motivation to learn.	learning disabilities in Tabuk area.	d reality product rating card, motivation measure.	Coefficient, Pearson Correlation Coefficient	educational program and the results showed an increased motivation for learning among female students.
٢	) Chen,20 (13	United States	The impact of augmented reality technique and its ability to facilitate learning chemistry for students (learning	96 Organic Chemistry Student at the University of Washington	The government's ability to support the And the measure of self-efficiency. and education test	(t-test)	The results showed that the group of students who studied using augmented reality technology performed much better than students who studied in the

| | | | protein structure). | | | | usual way in the achievement test and self-efficiency measure. |

Table (٢) Studies on visual thinking skills

N	Study	The country of study	The aim	Sample	Tools	Statistical means	Results
١	Yasin,) (٢٠١٧	Iraq	The impact of the C.M.S strategy in modifying alternative perceptions of the biological concepts of intermediate second students in biology and their visual thinking skills.	٧٥ Middle-class second-grade rs.	Diagnostic test for alternative perceptions of multiple test type and visual thinking skills test	Test (t-test) Difficulty and excellence factor for substantive paragraphs Kweder-Richardson ٢٠ Alpha-Kronbach Equation	The results showed that students of the experimental group studied in the C.M.S. strategy outperformed those of the control group, which was studied in the usual way in the test of modifying alternative perceptions and testing visual thinking skills.

	Group		Equivalence	Independent		Dependent	dimensional
٢	(Longo & Anderson, 2002)	United States	To know the impact of the use of visual thinking networks on achievement and the ability to solve problems in ninth graders in earth sciences	٥٦ Ninth graders that they are studying earth scien.ces	The achievement test , Problem solving test	Test (t–test) Kay Square , Pearson Correlation Coefficient , Anti–Spearman Factor , Kuder–Richardson ٢٠n– Equation	The results showed that students of the experimental group studied according to visual thinking networks outperformed the students of the control group that studied in the usual way in the achievement test and the proble solving test

B) The benefits from previous studies can be summarized as follows:

1. The researcher has crystallized the problem and importance of the current study.

2. the search community and choose the search sample.

3. Identify the appropriate statistical means to achieve the goal of research and to reach and interpret the results.

The Third Chapter: Research methodology and procedures:

First: Experimental design:

The researcher adopted an experimental design with partial control appropriate to the current research conditions, so the design came as follows:

			variable	variable	test
Experimental	1-Time age ٢-Intelligence ٣-Testing visual thinking skills		technique according to augmented reality technology	Visual thinking skills	testing visual thinking skills
Control			the traditional way		

Table (3) Experimental Design for Research

Second: Identifying the research community and Sample

Research community:

1. Representing the research community all the scientific Students of the fifth grade for daytime government schools affiliated to the General Directorate of Education of Baghdad / Karkh II, for the academic year (2019 – 2020).

2. Research Sample:

To apply the experiment, the researcher has chosen intentionally (Al-Shakirin Boys School) as a sample of schools for the facilities provided by the school administration to the researcher, the presence of several divisions for the one stage, and its proximity to the residence of the researcher.

Table (4) Distribution of students to the two research groups before and after exclusion

N	Division	Group	Number of students before exclusion	Number of excluded students	Number of students after exclusion
١	A	Experimental	٣٢	٦	٢٦
٢	B	control	٣١	٤	٢٧
Total			٦٣	١٠	٥٣

Third: Equivalence of the two research groups:

Before applying the experiment, the researcher was keen on the equivalence of the two research groups statistically in some of the variables that the researcher believes may affect the integrity of the experiment, as the process of parity between students was carried out in the following variables:

1. Time age in months:

Table (5) t-test results for students of the two time-variable research groups calculated in months

Group	Number of sample members	Average arithmetic	Standard deviation	T value		Statistical indication at level (٠.٠٥)
				calculated	tabular	
Experimental	٢٦	٢٠٥.٩٦١	١٣.٠٣٦	٠.٤٤٠	٢.000	Non-indication
control	٢٧	٢٠٧.481	١٢.١١٢			

2. Intelligence:

Table (6) t-test results for students of two intelligence variable research groups

Group	Number of sample members	Average arithmetic	Standard deviation	T value		Statistical indication at (٠.٠٥) level
				calculated	tabular	
Experimental	٢٦	31.٧٦٩	٩.٩٠٨	٠.٠٥٦	٢.000	Non-indication
control	٢٧	31.926	١٠.٥٣٥			

3. Testing visual thinking skills:

Table (7) test results (t-test) for students of the two research groups in the visual thinking skills test

Group	Number of sample members	Average arithmetic	Standard deviation	T value		Statistical indication at level (0.05)
				calculated	tabular	

Experimental	٢٦	٨٠٨.١٣	١٠٧.٥	0.٢٦٢	2.٠٠٠	Non-indication
control	٢٧	١٤٨.١٤	٣٢٩.٤			

Fourth: Preparing the requirements for research:

The scientific subject covered by the research, which will be taught to students of the two research groups during the experiment, was identified in accordance with the vocabulary of the biology book to be taught to students of the Scientific fifth grade, and includes the last three chapters that will be taught in the second course of the school year (2019-2020) , Chapters (5, 6, 7) and (252) cognitive behavioral purposes were formulated divided between levels (recall, assimilation, application, analysis, composition, and calendar), presented to a group of experienced and specialized arbitrators, and accepted goals that received an agreement ratio (80%), More expert opinions were subsequently included in the teaching plans, as well as (24) teaching plans for each group of (3) classes per week, in the light of the content of the subject, a teaching plan for the experimental group in accordance with the technique of augmented reality, And a teaching plan for the control group in the usual way, and models of teaching plans were presented to a group of experts and specialists for the purpose of knowing their opinions and observations about them and in light of these opinions have been adopted

Fifth: Research tool:

Testing visual thinking skills:

The purpose of the test:

1. The main goal of the test is to determine the extent to Scientific fifth-grade students have visual thinking skills.

2. Identify visual thinking skills:

After briefing the several sources of thinking books and their types and previous studies that dealt with visual thinking skills. Consulting a supervisor who agreed on which skills suit the level of visual thinking for scientific fifth graders. It is distributed into five skills (skill of identifying and describing the form, skill of analysis

of form, skill of linking information, skill of knowledge and interpretation of ambiguity, skill of extracting meanings).

1. Drafting of test Items:

The test Items of (30) objective Items of the multi–choice type were constructed with four alternatives divided into (5) skills

Table (8) Distribution of visual thinking skills test Items

N	Skill	Number of questions	Paragraph numbers
١	The skill of recognizing and describing the visual form	٦	٦-١
٢	The skill of understanding spatial relationships	٦	١٢-٧
٣	The skill of understanding and interpreting information (interpreting ambiguity)	٦	١٨-١٣
٤	Information analysis skill	٦	٢٤-١٩
٥	The skill of inferring meaning	٦	٣٠-٢٥

2. Drafting test instructions and including answer instructions and correction:

The researcher has formulated many instructions, which are necessary guidelines to make the method of answering the test clear and understandable to the students, where the test is considered a choice type of multiple with four alternatives and is a type (0. 1) for this degree is given for the correct answer, and score (0) for the wrong and abandoned answer, and thus the maximum score (30) degree.

3. Validity of the test Items:

(A) Face Validity

The face Validity verification was obtained by offering the test to a group of arbitrators specialized in the field of education, teaching methods, measurement,

calendar and psychology, and was accepted by Items that received an agreement (80%) from the opinions of the arbitrators.

B) Constructive Validity

Constructive Validity verified by finding the correlation in the following methods:

- The coefficient of correlation of the total degree of each paragraph with the total degree of skill: Done through using pearson's correlation coefficient between each paragraph of skill Items and overall degree of it, and for all visual thinking skills, the correlation coefficient ranged (0.282-0.698).

- The skill correlation coefficient for the overall degree of the test: Done through The Pearson's Correlation Coefficient found the five skills correlation coefficient for visual thinking at the overall degree of the test, with The correlation coefficient ranged (0.715-0.848).

1. Exploratory application for the test:

A. The first exploratory application for the test:

The visual thinking skills test was applied to an initial exploratory sample of (30) students of the scientific fifth grade in the Al-Hakim Boys Preparatory of the Directorate General of Education of Baghdad Al-Karkh/ II to determine the time needed to answer the test and the clarity of its Items and instructions and the diagnosis of the mysterious Items of it, and it was agreed with the school administration on the date of the test conducted on Tuesday (11/2/2020), as the average time to answer (45) minutes.

B) The second exploratory application for the test:

After ascertaining the clarity of the Items and their suitability and calculating the time required to answer, the researcher's attention is directed to apply the test to the sample of statistical analysis of (120) students of the scientific fifth grade of the students of al-Ahrar High School for Boys, and Al-Ebtekar Preparatory for Boys, on Wednesday, (12/2/2020), the researcher himself supervised the application with the help of some fellow teachers in the school, which was conducted in the application,

as the students' answers to the two research groups were analyzed to extract the characteristics of psychometric.

1. psychometric characteristics:

A) Items difficulty factor:

The researcher adopted the special equation for calculating the difficulty factor of the objective Items, and found that they ranged from (0.43−0.64), where the Items with a difficulty coefficient of (0.20−0.80) were within acceptable limits (Odeh, 1998: 297).

B) Items Discrimination factor:

The Items discrimination factor was calculated using the special equation for the objective Items discrimination coefficient, and it was found that the coefficient of discrimination between (0.25−0.75) and thus all Items are considered to have an acceptable coefficient of discrimination, as the pedagogical literature indicates that a Items with a discriminatory strength factor of less than (0.20) is best to be deleted (Allam, 2000, 289).

G) Effectiveness of false alternatives:

The researcher calculated the effectiveness of the wrong alternatives to the visual thinking skills test paragraphs, and was between (0.06−0.375−).

1. Test stability:

A) half−fragmentation method:

Stability was calculated in the half−fragmentation method ،reaching (٠.٧١) and after a correction by the Spearman−Brown coefficient reached the stability factor (٠.٨٢)and indicates that the test is high for stability ،as the stability rate is high if it is more than (%٧٠) (return,١٩٩٨:٢٧٩).

B) kuder – Richard son equation−20

The researcher applied the equation (Kéder−Ratcharson−20) and reached stability (٠.86), which is an acceptable stability factor, indicating (Allam, 2009) that the value of the stability coefficient of (0.70) and above is acceptable in the case of unregulated tests (Allam, 2009: 543).

Sixth :Procedures for applying the experiment

1. Teaching online via google classroom started on Sunday, 8/3/2020 and the trial lasted for (8) weeks at three classes per week for each two group, and ended on Sunday, 10 /5/2020.

2. The Visual Thinking Skills Test was applied on Sunday, 10/5/ 2020.

Seventh: Statistical means

In analyzing the results of his research, the researcher used the statistical era (spss-v25) and the data processing software (Microsoft Office Excel 2019).

The Fourth Chapter: Presenting, interpreting and discussing the results:

First: View the results

To verify the zero hypothesis that "there are no statistically significant differences at the level of (0.05) between the average grades of the experimental group students who studied by the technique of augmented reality, and the grades of the students of the control group who studied according to the classical method of testing thinking skills". The answers of the two research groups

(experimental, control) were corrected and processed statistically using Spss-V25, calculating the arithmetic average, standard deviation and variance of the two research groups, as shown in table (9) and figure (1).

Table (9) test results (t-test) for students of the two research groups in the visual

Group	Number of sample members	Average arithmetic	Standard deviation	Contrast	T value		Statistical indication at the level of (۰.۰٥)
					Calculated	Tabular	
Experimental	٢٦	٢٢.١٩٢	٣.٣٣٥	١١.١٢٢	٢.٩٢٩	٢.٠٠٠	Function
control	27	185.19	086.4				

thinking skills test

Figure (1) compared the arithmetic average between the two research groups in the visual thinking skills test
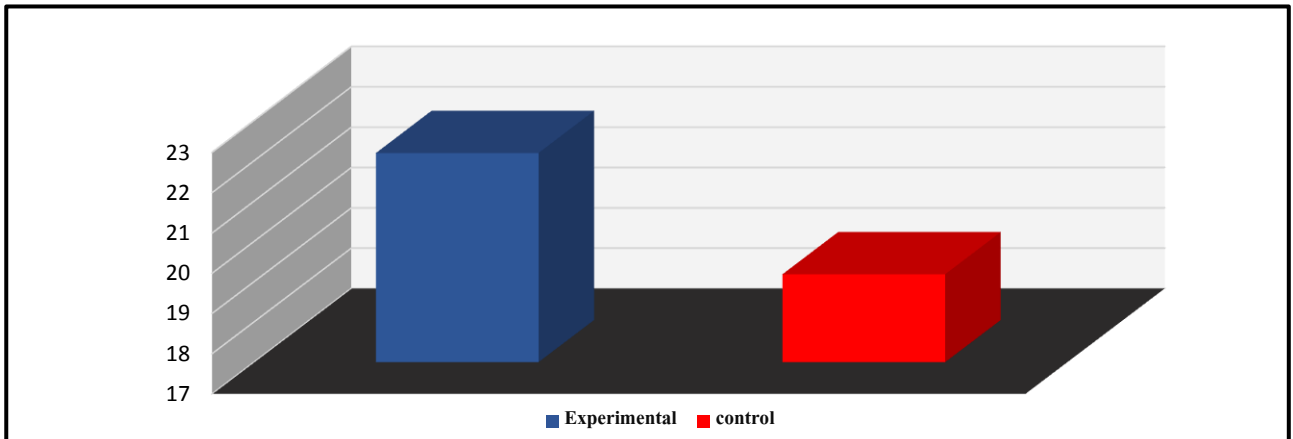
From table (9) and figure (١), we note that there is a statistically significant difference between the average grades of the two groups, and for the benefit of the experimental group who studied biology according to augmented reality technique, at the expense of the control group who studied biology in the usual way of testing visual thinking skills, thereby rejecting the zero hypothesis and accepting the alternative hypothesis.

Impact size

Impact size (d) was calculated to show the effect of the independent variable (augmented reality technique), in the dependent variable (visual thinking skills) for scientific fifth-grade students, as shown in table(١٠).

Table (١٠) value ($\eta 2$) and corresponding value (d) and the magnitude of the impact on visual thinking skills

Independent variable	Dependent variable	T value	Degree of freedom	(η^2)	Value (d)	Impact size
Augmented reality technique	Visual thinking skills	٢.٩٢٩	٥١	٠.١٤٣	٠.٨٢	Large

It is clear from table (١٠), that the value (d) is equal to (0.82), which is appropriate for interpreting the magnitude of the impact and by a significant amount of the augmented reality technique variable in visual thinking skills, as indicated by Cohen (Cohen,1988), as noted (kiess, 1996:164), as this result indicates a practical indication of the adoption of augmented reality technique in biology teaching to upgrade visual thinking skills.

Second: Interpreting the results

The results show the superiority of the students of the experimental group who studied according to the technique of augmented reality on the students of the control group who studied according to the usual method of testing the visual thinking skills of the subject of biology in scientific fifth-grade students due to the reasons:

▪ Teaching students to adopt augmented reality technique has greatly increased students' visual thinking skills, as the educational media of 3D images, videos and graphics make the educational process more enjoyable and interesting, increasing the interaction between students and content and each other, and gaining students from the experimental group motivation to participate in the subject by providing them with visual perceptions as well as making them realize, analyze, learn and interpret the relevant concepts related to the subjects of the study.

▪ The inclusion of augmented reality technique for interactive visual presentations gave students the opportunity to learn about subjects from different aspects, as well as students' individual or collective interaction, which allowed students to think visually and see the stereoscopic from all directions and motion ,it led to students feeling real ,and helped students to build scientific concepts in an orderly manner and link them to their previous knowledge, which made the learning process meaningful.

▪ The results of this study are consistent with the findings of studies that used different strategies and techniques such as the study (Ghazal,2015), which showed

the superiority of the experimental group in the visual thinking skills test, as well as other studies using different strategies such as study (Yasin, 2017), study (al-Mubahh,2019) and study (Longo& Anderson, 2002) which used other variables in visual thinking skills testing .

Third: Conclusions

In the light of the results of the current research, the researcher reached a set of conclusions:

A positive effect of augmented reality technique in improving the visual

1. thinking skills of scientific fifth graders compared to the usual teaching method.

2. The adoption of augmented reality technology has had an impact on the understanding of scientific concepts through the enhanced presentations offered by this technology.

Fourth: Recommendations:

1. Using the augmented reality technique in education in general and in the teaching of biology in particular.

2. Conducting training programs for teachers at all levels of education on the use of augmented reality technique in the teaching.

3. The need to introduce thinking education programs, especially visual thinking skills in curricula and activities in preparatory schools.

Fifth: Suggestions:

1. Conducting studies similar to this research on other subjects.

2. Conducting studies to compare the use of different patterns of augmented reality.

3. Conducting studies to uncover the obstacles which facing teachers in employing technological innovations in the educational process and finding appropriate solutions.

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