

Impact of Augmented Reality on Pattern Designing Using Origami-Style among Clothing and Textile Students

N. A. A. Elwan^{1*}, H. S. E. A. Abdelaal^{1,2}, R. A. M. Elshiekh¹, H. A. A. Alnawawy¹, and E. H. A. Rezk¹

¹Department of Clothing and Textile, Faculty of Home Economics, Al-Azhar University, Tanta, Egypt

²Department of Fashion Design and Arts Department, College of Design and Applied Arts, Taif University, Taif, Kingdom of Saudi Arabia

Received: 4 May 2023, Revised: 9 Jul. 2023, Accepted: 17 Jul. 2023.

Published online: 1 Aug. 2023.

Abstract: The study aimed to examine the effects of augmented reality technology on the development of origami-style pattern designing skills among female students in the clothing and textile field, as well as to explore their attitudes towards this technology. The quasi-experimental approach was employed to achieve the research objectives, with a sample of 24 female students from the Fourth Grade of the Department of Clothing and Textile, Faculty of Home Economics at Al-Azhar University. The participants were divided into two groups: a control group of 12 students who studied in the traditional way, and an experimental group of 12 students who used augmented reality technology to learn. The study was conducted in the second semester of the academic year 2020/2021. The results showed that there was a statistically significant difference (at a significance level of 0.01) between the average scores of the control group and the experimental group in both cognitive achievement and skill performance, with the experimental group performing better. Additionally, the retention of learned information was higher among the experimental group, and they had a more positive attitude towards using augmented reality technology in learning.

Keywords: Augmented Reality, Pattern Designing, Origami.

1. Introduction

In today's technological era, the educational process relies greatly on modern tools used in composing and publishing interactive educational curricula using both traditional and modern educational methods, making the content of educational materials and methods of presentation different from what they used to be in the past [1].

Scientific achievements continued until the advent of the Internet, which has become commonly used in the teaching and learning processes and has contributed to changing the way in which scientific content is presented to students.

A new type of modern e-learning application, that is Augmented Reality (AR), has emerged as an extended modern technology of e-learning. It is also one of the contemporary concepts added by information technology, which refers to the integration of the real environment with virtual reality within the real environment [2].

This is done by using multimedia, such as, 2D and 3D images, as well as audio and visual effects to create a virtual learning semi-realistic environment, by adding digital data to the surrounding real environment. From a technological perspective, this is often associated with augmented reality wearable kits, or smart devices that can be carried [3].

Augmented Reality (AR) is a relatively new technology through which a complete learning environment can be handled with educational capabilities and advantages not provided by other interactive learning environments [4].

Originally developed for desktop computers with a screen and camera, AR has now made its way into smartphones, tablets, and wearable glasses, allowing mobile devices to design augmented reality applications with mobility embedded as an integral part of the design [5].

Augmented Reality: is a system that integrates virtual reality and real-world environments through special technologies and methods, allowing individuals to discover theories, phenomena, and behaviors as well as features not normally available in a traditional classroom environment [6,7].

Augmented reality is a form of virtualization in conjunction with real-world physical information, which has been shown to be useful - for example - to motivate learning in different educational settings [8].

There are many studies that discussed the effectiveness of learning using augmented reality technology in education, including the study of [9], which aimed at measuring the impact of using augmented reality technology and the use of

*Corresponding author e-mail: nafesaelwan.el.8.409@azhar.edu.eg

artificial intelligence among students on developing visual thinking skills. The study stated the positive effect of learning using augmented reality technology on the skill and knowledge of the trainees on artificial intelligence programs easily without restrictions or conditions and increasing the motivation of the students, which helped them to continue training. The videos contributed as well to increase the focus and awareness among students, as well as making the training environment rich in interaction and encouraging learners.

The study of Hamada [10], aimed at pinpointing the effect of using augmented reality applications in developing cognitive achievement and creative thinking skills related to the science course for fourth-grade students. It concluded that the cognitive achievement and creative thinking skills of the experimental group have developed greatly.

The study of Al-Shami & Al-Qadi [11], aimed at identifying the impact of a training program using augmented reality technology in the design and production of e-lessons on third-grade female students at the Faculty of Home Economics, Al-Azhar University. It found out that there is a statistically significant difference between the mean scores of the research group students in the cognitive and skill test in favor of the post-application. The scores indicate the strength of the training program in increasing the level of students in the skill and knowledge aspects by using augmented reality technology.

As for the study of Abdel Qader & Ahmed [12], it aimed at revealing the effectiveness of using an educational unit based on augmented reality technology in developing achievement, cognitive aspects, and performance of scientific skills in an educational unit of chemistry among secondary school students. Its results state that there are statistically significant differences at the level of 0.01 between the mean scores of the experimental and control groups in the post-application of each of the cognitive achievement tests, practical skills, and observation in favor of the experimental group.

As for the study of Khan et al [13], it aimed at measuring the impact of the mobile phone augmented reality application on the learning motivation of undergraduate health sciences students at the University of Cape Town.

It concluded that the use of the augmented reality application for the mobile phone increased the learning motivation of the students and increased the factors of satisfaction and confidence.

The study of Zaqout [14], aimed at identifying the scientific concepts and thinking skills to be developed among students, and measuring the effectiveness of learning using augmented reality in developing the scientific concepts and thinking skills. It reached that the program is effective in developing scientific concepts and thinking skills, and that using augmented reality, with its educational media, helps students to increase attention and focus. The students also accepted to learn using the AR application as it is fun, interesting, and easy to download and use. As for the study of Sahin & Yilmaz [15], it aimed at identifying the impact of educational materials developed using augmented reality technology on the achievement of middle school students and their attitudes towards the curriculum. It recorded positive opinions of the students in the experimental group towards the use of augmented reality technology.

The study of Hajjaj [16], aimed at detecting the effect of using augmented reality technology "smart cards" on the skill of drawing mannequins (women - men - children) in different poses, using the latest mannequin drawing tools, which is the "mannequin ruler set" in addition to identifying students' attitude towards this technology. The results revealed that there was a statistically significant difference at the level of (0.01) between the mean scores of the students of the experimental and control groups in the post-skill test of drawing the mannequin in favor of the students of the experimental group. The study of Kamel & Mohammed [17], aimed at determining the most appropriate pattern of learning by discovery (directed/free) in the environment of augmented reality enhanced by flipped classroom and its impact on the development of cognitive achievement, and the impact of learning among students at higher institutes. The study revealed the lack of a statistically significant difference at the level of (0.05) between the average grades of students at higher institutes in the application of post and delayed achievement testing due to the main impact of the difference of the two patterns of learning by discovery (directed/free) in the augmented reality environment in the flipped classroom.

The study of Al-Suwailem [18], aimed at knowing the obstacles to the use of augmented reality technology in the education of students with intellectual disabilities in Riyadh schools. It detected the existence of statistically significant differences in the response of study sample members toward the obstacles associated with augmented reality technology, school-related obstacles, and teacher-related obstacles in different age groups. As for the study of Abdellah et al. [19], it aimed at identifying the effectiveness of using augmented reality with a modular (HP Reveal, QR Code) in developing the academic achievement of the fashion history course among home economics students. It found out that there is a statistically significant difference between the mean scores of the experimental group that studied using the barcode pattern and the HP Reveal pattern in the pre- and post- application of the achievement test in favor of the post-application.

There is also a statistically significant difference between the average scores of the first experimental group that studied using the barcode pattern and the average scores of the second experimental group that studied using the HP Reveal pattern in the post-application of the achievement test in favor of the first experimental group that studied with the barcode pattern.

The study of Khamis [20], aimed at identifying the effect of using augmented reality technology on the academic achievement of second-grade students in the Library and Information Department, Faculty of Arts, Menoufia University, in the "Scientific Research Methods" course, in order to find out the students' attitude towards using the augmented reality technology in teaching. It concluded that learning using augmented reality technology achieved an increase of 85% in understanding and comprehension, which confirms the effectiveness of using augmented reality technology in teaching.

As for the studies that used patterns in general, such as, the study of Elwan & Ahmed [21], which aimed at designing and making a group of clothes characterized by an elegant appearance that met the acceptance of consumers. They concluded that the designs of the proposed patterns achieved a new design thought different from what is common in the market, depending on the formulation of the single pattern in more than one way to wear and benefit from the techniques of laser cutting technology in making designs that give a unique character to the clothing product.

As for the study of Hasan & Al-Zaki [22], it aimed at preparing a program for the development of clarification strategies for the development of pattern design skills in the hearing impaired. It recorded the existence of a statistically significant difference between the mean scores of the students of the experimental group and the control group in the design of women's clothing.

The study of Hassanein & Al-Khattabi [23], aimed at designing a website for training the skills of preparing women's outerwear patterns. Its results stated the effectiveness of the proposed website, and the presence of statistically significant difference in the scores of the students of the experimental group and the control group in the pre- and post-test at a level of (0.01) in favor of the post-test.

Through reviewing the previous studies concerned with using the technology of augmented reality in the field of pattern designing, there is a scarcity in this field, which called for the adoption of technological innovations, including augmented reality technology. Students learn pattern designing skills in the style of origami because of its many characteristics, including: Providing 3D content, aligning virtual and real objects with each other, easy access to virtual objects from anywhere at any time, seamless interaction between teachers and learners, and a simple and effective tool [24].

Research Problem

It is clear that the use of augmented reality technology as a method of teaching is one of the strategies for active and collaborative learning. Augmented reality is one of the most appropriate strategies to embody and link all aspects of the educational process to suit the capabilities and multiple intelligences of the learners.

Therefore, the current research attempts to answer the following main question:

What is the impact of using augmented reality technology on the development of pattern designing skills using the origami style among clothing and textile female students?

This main question is divided into the following sub-questions:

- 1- What is the impact of using augmented reality technology on the development of cognitive achievement of pattern designing skills using the origami style among clothing and textile female students?
- 2- What is the impact of using augmented reality technology on the development of the performance of pattern designing skills using the origami style among clothing and textile female students?
- 3- What is the impact of using augmented reality technology on the retention of learned information with regard to cognitive achievement and skill performance associated with pattern designing using the origami style among clothing and textile female students?
- 4- What is the impact of using augmented reality technology on the attitude of clothing and textile female students towards the use of technological innovations?

Research Objectives

The research aims at identifying the impact of using augmented reality technology:

- 1- On the development of cognitive achievement of pattern designing skills using the origami style among clothing

and textile female students.

- 2- On the development of the performance of pattern designing skills using the origami style among clothing and textile female students.
- 3- On the attitude of clothing and textile female students towards the use of technological innovations?

Research Importance

- 1- Identifying the most important tools and programs used in augmented reality technology.
- 2- Contributing to raising the level of the learners technically and urging them to keep pace with technological innovations in education.
- 3- Adopting new approaches in teaching practical skills such as origami style pattern designing skills.
- 4- Contributing to exploring optimal ways to integrate technologies into educational processes.

Research Limitations

- 1- Students of the Fourth Grade, Department of Clothing and Textile.
- 2- Pattern designing using the origami style.
- 3- Augmented Reality Environment.

Research Hypotheses

- 1- There is a statistically significant difference at the level of (0.01) between the average scores of the control group and the experimental group in post-cognitive achievement.
- 2- There is a statistically significant difference at a level of (0.01) between the average scores of the control group and the experimental group in post-skill performance.
- 3- There is a statistically significant difference at a level of (0.01) between the average scores of the experimental group in the post- and delayed cognitive achievement and skill performance.
- 4- There is a statistically significant difference at the level of (0.01) between the average scores of the control group in the post- and delayed cognitive achievement and skill performance.
- 5- Students have positive opinions regarding the use of augmented reality technology in developing pattern-designing skills using the origami style.

Research Sample

The current research was applied to a sample of 4th Grade Clothing and Textile female students who studied pattern designing using the origami style.

Research Methodology

The current research follows the quasi-experimental approach to know the impact of the independent variable (augmented reality) on the dependent variables (development of cognitive achievement and skill performance in pattern designing using the origami style.)

Research Tools

- 1- Achievement test to measure the knowledge and skills associated with pattern designing using the origami style. (Prepared by the researchers)
- 2- Skills test to measure the skills associated with pattern designing using the origami style. (Prepared by the researchers)
- 3- A rating scale. (Prepared by the researchers)
- 4- A measure of the attitude of female students regarding the use of augmented reality technology. (Prepared by the researchers)

Research Terminology

Augmented Reality Environment: Combine real and virtual realities, and interact with them in real-time, while the individual is doing the real job [24].

Karakus, Ersozlu, and Clark define it as a direct or indirect real-time presentation of a real-time setting enhanced by computer-aided virtualization technologies [25].

It is procedurally defined as: a technology that integrates reality with virtual learning objects to enhance the content of learning and make it interesting and attractive to the learners, by providing an infinite number of auxiliary tools to be immersed in the learning process, in order to transform the learner from a passive recipient to a seeker of information.

Pattern Designing: is the ability to organize the pins to control the lines of fabric and the folds, and balance the straightness of lines, where both the design of the pattern and fine-tuning are based on the same base of the pin [26].

Origami: is a Japanese word that dates back to more than a thousand years; the word Ori- means (fold) and -gami means (paper), and the goal of this art is to convert the two-dimensional form into a three-dimensional form. The idea of Origami has become of great influence on fashion and a source of inspiration for many designers worldwide [27].

2. Theoretical Framework

2.1. Augmented Reality Technology

Transforming real-world reality into digital data where it is synthesized and imaged using digital presentations that reflect the real-world reality surrounding the digital object [28].

It is a form of technology that enhances the real world through computer-generated content, allowing the addition of digital content seamlessly to perceive the user's perception of the real world, where two- and three-dimensional shapes are added, and the inclusion of audio, video, and textual information files, since these effects enhance the understanding of individuals of what is going on around them [29].

It enhances the user's real environment through content produced through smart devices, allowing the addition of digital content in the form of graphical objects and the inclusion of voiceover, which increases interaction with the physical world around [30].

Augmented reality is a form of virtualization in conjunction with information from real-world reality to motivate learning in different educational settings [8].

Augmented Reality Main Features

Among the main features of using augmented reality are the following:

- Improving learners' level of understanding of the presented material when compared to traditional strategies.
- Easy delivery of the required information on time and in the language used without any difficulty.
- Combining pleasure and knowledge motivates learners to participate and discover new information [18].
- Helping the teachers and enabling them to enter and communicate data easily.
- Allows for seamless interaction between both the teacher and the learner [1].
- It allows the user to see the real world in a better way by creating virtual objects that integrate with the real world.
- Allows learners to observe events that are not observable with the naked eye.
- Positively influence students' attitudes and increase their motivation.
- Provide students with a natural experience in the learning environment.
- Involves students in lessons and prevents distractions, increases interaction, contributes to social development, and ensures learning through experience.
- It allows the subjectivity of learning and the individualization of education to suit the abilities and aptitudes of the learners and their levels of intelligence [17,30 ,31,32].

By reviewing the main features of using augmented reality, it is clear that it serves the educational process in general and the learners in particular. Thus, augmented reality technology is the best choice for students in the future, which makes it a must for educational institutions to deploy this technology for the benefit of the teacher, the learner, and the educational institutions.

Reasons for Using Augmented Reality

There are many reasons that justify using augmented reality technology, which include:

- Students' high enthusiasm and satisfaction when applying augmented reality in education, and their desire to re-use augmented reality applications [33].
- Retention of information for the longest time as the content is saved in the memory as a result of using augmented reality.
- Teaching subjects that students cannot easily perceive except through real first-hand experience.
- Motivating students to participate in discovering the information about the subjects from different angles [34].

The Difference between Augmented Reality and Virtual Reality

Some consider augmented reality as one of the branches of virtual reality, but this is not true. Augmented reality is an extension of it, and there are some differences between them that can be explained in the following table:

Table 1: The Difference between Augmented Reality and Virtual Reality

The comparison factor	Augmented Reality (AR)	Virtual Reality (VR)
Real-world Environment	Closer to the real world, it allows the user to see the real world around them.	It replaces the real world with the virtual world, where it dominates the user so that they cannot see the real world around them.
User Senses	The user interacts via what is carried or worn with multidimensional virtual objects.	The user immerses himself in the virtual environment and interacts with it.
Established Environment	It integrates reality with the digital environment where it gives an imaginary sense to a real setting.	Gives a realistic tone to an imaginative setting, it gives a 100% virtual environment.
Necessary tools	It represents the real-world environment and needs devices and smartphones with a camera.	It needs VR glasses, and virtual labs.
Synchronization level	It is synchronous and requires the presence of virtual objects and real environment objects at the same time.	It is Asynchronous, and the user can access it at any time.

[28]

Augmented Reality Applications

There are many applications for augmented reality available to Android users on the Google Play Store, including QR Code Reader, Elements, Layer, Zapper, HP Reveal, Word Lens, and Goggle Googles. The QR Code Reader has been used in this search.

Augmented Reality Technology

Projection-Based Augmented Reality: It is the most common type of augmented reality and depends on the use of virtual images and projects them in a real-world environment to increase the percentage of details that the learner sees through smart devices. Broadcasting different sports games is one of the most fields that use this type of augmented reality, where the movement of the athlete is tracked with small points for analysis [30].

Marker-Based Augmented Reality: This type provides users with digital media after they have captured something with their mobile phone's camera (such as QR Codes or 2D images).

Location-Based Augmented Reality: As users move through a physical range by their smartphones equipped with GPS positioning, multimedia, such as, text, graphics, audio and video files, and 3D shapes provide the physical environment with navigational academic information and tracks related to their specific location [3].

Contour-Based Augmented Reality (Outlining AR): Augmented reality is integrated with virtual reality, based on the principle of giving the possibility to a person to merge the outlines of their body or any selected part of their body with another virtual body. This gives them the opportunity to deal with or pick up imaginary objects that do not exist in the real-world environment [35].

2.2. Pattern Designing Using the Origami Style

Pattern designing is a method in which a model designer uses a basic pattern that has been prepared to fit a specific person or standard size as the basis for making innovative and distinct designs.

The design of the flat pattern is flexible as it is used in the production of patterns used for different purposes (e.g commercial – individual – educational – training), reflecting the individual style of the model designer by adapting their own ideas.

The basic flat pattern can be transformed into a custom or standard model by drawing the pattern on it, adding the necessary extensions, cuts, and folds, and preparing it to be placed on the fabric.

There are several stages to prepare the design of the pattern for a piece of clothing until it reaches its final shape: Drawing a sketch for the design, then drawing a basic pattern, then the first design of the pattern, and then designing the final pattern [26].

2.3. Origami

Origami is a Japanese word that dates back to more than a thousand years; the word Ori- means (fold) and -gami means (paper), and the goal of this art is to convert the two-dimensional form into a three-dimensional form. The idea of Origami has become of great influence on fashion and a source of inspiration for many designers worldwide [27].

3. Research Steps

First: The Survey

It was conducted with the aim of ensuring the validity and reliability of the research tools.

The Survey Sample

The augmented reality strategy for educational videos teaching pattern designing using the origami style was deployed via QR Code Reader on a survey sample consisting of (6) female students of the Fourth Grade, Clothing and Textile Department, Faculty of Home Economics, Al-Azhar University, during the academic year 2020/2021.



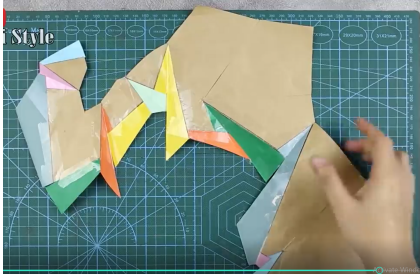
Thus, the survey sample is of the same origin as the research core sample for which the strategy was prepared, and who prove their lack of knowledge of the subject of learning, by conducting a cognitive and skill achievement test before learning. The students answered some questions on the cognitive test, and most of them were random answers. As for the skill test, they admitted that they have no experience in pattern designing using the origami style.






Second: Research Tool Construction

1- Specialized references, studies, and previous studies related to the research topic have been reviewed, analyzed, and benefited from.

2-The learning subject was identified, where the skills of pattern designing using the origami style were selected for the female students of the Fourth Grade, Clothing and Textile Department. A code was made for each model using the QR Code Reader application, then these codes were printed on separate cards. Using their smartphones, the female students scanned the code, and the video of each model appeared. The following table shows the codes, models, and their respective patterns using the origami style:

Table 2: Codes, models, and their respective patterns using the origami style

M	Code	Model	Pattern Designing Using the Origami Style
1			

2			
3			
4			
5			



3-Identifying Learning Objectives: The learning objectives of the proposed models were defined, i.e. the behavior that the female student is expected to show after the end of the learning process using augmented reality technology. These objectives were divided into general objectives and procedural objectives (cognitive-skill-emotional).

4- Designing Evaluation Tools:

Various evaluation methods have been prepared that include cognitive and skill aspects to evaluate the acquired knowledge and skills, which included the following:

A- Building the Cognitive Achievement Test

Determining the Purpose of the Test: The cognitive achievement test was prepared with the aim of evaluating the students' acquisition of knowledge and skills related to pattern designing using the origami style before and after the learning process, achieving the predetermined cognitive behavioral learning objectives. Appendix (1)

Choosing the Type of Questions: The questions are concise, specific, and objectively measurable. They were (65) multiple-choice questions.

Test Instruction: General instructions were developed at the beginning of the test to clarify the purpose of the test and how to answer it.

Preparing the Correct Answer Key: An answer key was prepared to correct the cognitive test to ensure its objectivity, determining the required model answers for each question, and specifying one score for each correct answer for the total score of the achievement test to be (65) marks. Appendix (2)

Cognitive-Test Validity

The cognitive achievement test and the answer key were presented to a group of expert arbitrators (Appendix 3), specialized in the field of clothing and textile, as well as curriculum designing and teaching methods, to express their opinions regarding the validity of the test so as to ensure the validity of its content, according to what it aims to measure. The amendments that they referred to were made, and the percentage of agreement between the arbitrators ranged between (80%) to (84%), which is a high percentage, and this is an indication of the validity of the test.

Cognitive-Test Reliability

The Test-Retest method was used to calculate the reliability of the test. The test was applied to the female students right after the learning process, and then the test was re-applied to the same sample after (15) days. The correlation coefficient between the students' scores was calculated in the two tests as in the following table:

Table 3: Correlation Coefficient (immediate Vs delayed)

Cognitive Acquisition	Statistical Test	P-Value Sig.	Level of Significance
Immediate Application	0.984	0.000	Significant at (0.01)
Delayed Application			

Table (3) shows that the correlation coefficient between the immediate application and the delayed application is (0.98), which is a significant value at the level of (0.01) and indicates the reliability of the cognitive achievement test and its validity for application.

B- Building a Skill Performance Test

The skill test was built according to the following:

Determining the Purpose of the Test: The skill test was used as a tool to evaluate the effectiveness of the learning process using augmented reality technology to raise the skill performance of female students in pattern designing using the origami style.

Choosing the Skill-Test Questions: The skill test included six questions about pattern designing using the origami style. Appendix (4)

C- The Rating Scale: The rating scale has been prepared as follows:

Objective: The skill test is aimed at evaluating the skill of each individual student to measure their acquisition level of the skills.

Themes and Items: The rating scale was designed by setting standard phrases, which represent criteria that measure the performance of the individual student in each standard skill. Performance levels were also determined in a three-level gradient; the first is good and is given three grades (proficient), the second is average and is given two grades (somewhat proficient), and the third is weak and is given one grade (not proficient).

The scale included (63) items, with a total of (189) degrees. Appendix (5)

Rating Scale Validity: The rating scale was presented to a group of expert arbitrators for the purpose of expressing their opinions regarding its statements, and the researcher limited the percentages of the arbitrators' agreement on each item, provided that the ones which 80% of the arbitrators did not agree with were excluded. The arbitrators stated its validity for application after making some amendments to become in its final form, and the comments of the arbitrators were positive towards the scale, and this was considered evidence of the validity of the rating scale and its applicability.

Rating Scale Reliability: The Pearson correlation coefficient was applied and the correlation coefficient value of the two corrections for the rating scale for female students was (0.991), which is a significant value at the level of (0.01). This indicates a strong correlation, and an indicator of the reliability of the rating scale and its validity for application.

D- A Measure of the Attitude of Female Students Regarding the Use of Augmented Reality Technology: This questionnaire aims to identify the opinions of the female students of the experimental group that studied using augmented reality technology. The questionnaire contained several statements related to the students' views on augmented reality technology as an individual self-learning method, and the questionnaire contained (16) statements. Appendix (6)

Validity of The Measure of the Attitude of Female Students Regarding the Use of Augmented Reality Technology:

The measure was presented to a group of expert arbitrators to express their opinions regarding the statements of the female students about the use of augmented reality technology as a method of learning. The points on which at least (80%) of the arbitrators did not agree at were excluded. The comments of the arbitrators were positive, and there were no amendments needed. This was considered evidence of its validity and applicability.

The Attitude-Measure Reliability: The Cronbach's Alpha test was applied, and the coefficient value was (0.84). It demonstrates the reliability of the measure and its applicability.

Third: The Survey Applying Steps

A- Applying the cognitive and skill test in a pre-application.

B- Explaining the skills of the origami-style pattern-designing using augmented reality technology.

C- Applying the cognitive and skills test after applying it to the female students.

Fourth: The Main Study Area

The basic experiment of the research was applied to a random sample of female students of the Fourth Grade, Clothing and Textile Department, Faculty of Home Economics, Al-Azhar University. The number of the sample was (24) students, after excluding the female students of the survey sample, and the group was randomly divided into two groups. Thus, two groups were obtained in a random way, an experimental group, and a control group as follows:

Experimental Group (12) female students who used augmented reality technology in their learning process.

Control Group (12) female students who followed the traditional learning methods (practical demonstration).

- The age was adjusted by selecting the sample from one study group, their ages are very close, which means that the age variable is homogeneous in the two groups.

Group Efficiency

This factor was set by the pre-test (cognitive, and skills) on all the tests in the two groups (experimental, and control) before starting to learn the subject of the educational unit, in order to ensure that the two groups are equal in the level of cognitive and skills achievement, by processing the grades obtained by the students in the pre-test application for both tests by conducting the "T" test, as follows:

Table 4: Independent Sample T-Test (Pre-Experimental – Pre-Control)

variable	Group	Average	(T) value	Degrees of freedom	Probability value P. Value (sig.)	Level of Significance
Cognitive Achievement	Control group	5	0.012	22	0.999	(Not Significant at 0.05 level)
	Experimental group	5.75				
Skill Performance	Control group	8.25	0.146	22	0.885	(Not Significant at 0.05 level)
	Experimental group	8.42				

Table (4) indicates that the value of "T" reached (0.012), which is not statistically significant at a significant level of (0.05), which indicates that there are no fundamental differences between the averages of the control and experimental groups in the pre-application of the achievement test, which indicates the equivalence (homogeneity) of the two samples in the cognitive achievement. The value of "T" was (0.146), which is not statistically significant at a significant level of (0.05), which indicates that there are no fundamental differences between the averages of the control and experimental groups in the pre-application of skill performance, which indicates the equivalence (homogeneity) of the two samples in the skill performance. The following diagram illustrates it:

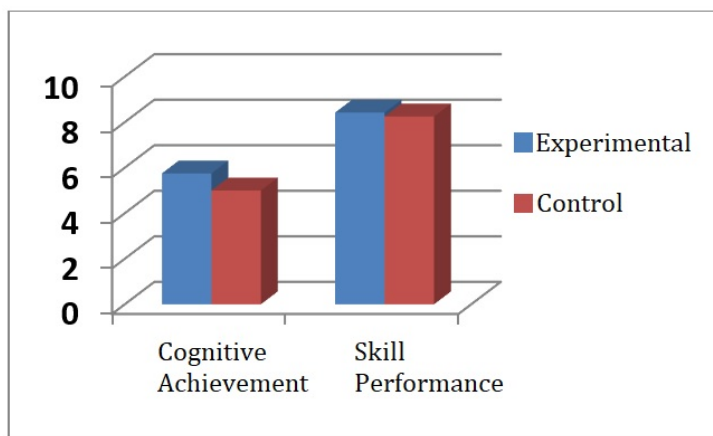


Fig. 1: Average scores of female students for the control and experimental groups in the cognitive achievement and skill performance pre-test

4. Research Results

First: Verifying the distribution and homogeneity of variance for both groups:

The data distribution and homogeneity between the two groups were examined using the Shapiro-Wilk test, using the following table:

Table 5: Shapiro-Wilk test to show the normal distribution of the sample survey data

	Statistical Test Statistic	Degree of freedom df	Probability value Sig.	Significance
Grades of pre-application (cognitive achievement)	0.988	6	0.985	All values are non-significant at 0.05
Grades of post-application (cognitive achievement)	0.943		0.680	
Grades of delayed application (cognitive achievement)	0.913		0.460	
Grades of pre-application (skill)	0.971		0.896	

performance)			
Grades of post-application (skill performance)	0.960		0.817
Grades of delayed application (skill performance)	0.982		0.962

Table (5) demonstrates that the level of significance of the Shapiro-Wilk test for each of the (cognitive achievement test – skill performance test) was greater than 0.05, which means that there is homogeneity between the two control and experimental groups and moderation in the distribution of data. Accordingly, laboratory tests will be used to verify the validity of the hypotheses.

Second: Validating the Hypotheses

The First Hypothesis: 1- There is a statistically significant difference at the level of (0.01) between the average scores of the control group and the experimental group in post-cognitive achievement" To test the validity of this hypothesis, a T-test was applied for independent samples, and the results were as in the following table:

Table 6: The value of the "T" test for independent samples to indicate the differences between the mean scores of female students of the control and experimental groups in post-cognitive achievement

variable	Group	Average	(T) value	Degrees of freedom	Probability value P. Value (sig.)	Level of Significance
Cognitive Achievement	Control group	48.25	3.365	22	0.003	(Significant at 0.01 level)
	Experimental group	57.50				

Table(6) indicates that the value of "T" to test the difference between the mean scores of the experimental and control groups in cognitive achievement reached (3.365) and this value is statistically significant at a level of significance (0.01), which means that there is a statistically significant difference between the two groups and that difference in favor of the experimental group, as shown by its mean value of (57.50), which is higher than the mean of the control group, where its value reached (48.25), thus accepting the first hypothesis. This means the effectiveness of augmented reality in raising the level of cognitive achievement among the students of the experimental group. This result is consistent with the studies [10,11 ,23,32]. Figure (2) illustrates that:

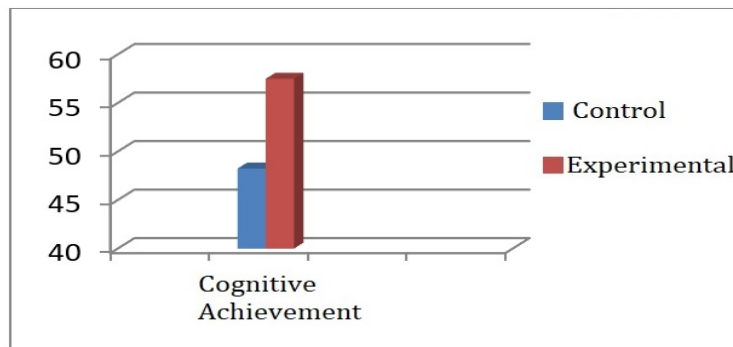


Fig. 2: Average scores of female students for the control and experimental groups in the post-cognitive achievement

The Second Hypothesis: 2- There is a statistically significant difference at the level of (0.01) between the average scores of the control group and the experimental group in post-skill performance" To test the validity of this hypothesis, a T-test was applied for independent samples, and the results were as in the following table:

Table 7: The value of the "T" test for independent samples to indicate the differences between the mean scores of female students of the control and experimental groups in post-skill performance

variable	Group	Average	(T) value	Degrees of freedom	Probability value P. Value (sig.)	Level of Significance
Skill Performance	Control group	162.17	2.113	22	0.046	(Significant at 0.05 level)
	Experimental group	171.50				

Table(7) indicates that the value of "T" to test the difference between the mean scores of the experimental and control groups in skill performance reached (2.113) and this value is statistically significant at a level of significance (0.05), which means that there is a statistically significant difference between the two groups and that difference in favor of the experimental group, as shown by its mean value of (171.50), which is higher than the mean of the control group, where its value reached (162.17), thus accepting the first hypothesis. This means the effectiveness of augmented reality in raising the level of cognitive achievement among the students of the experimental group. This result is consistent with the studies [16, 23]. Figure (3) illustrates that:

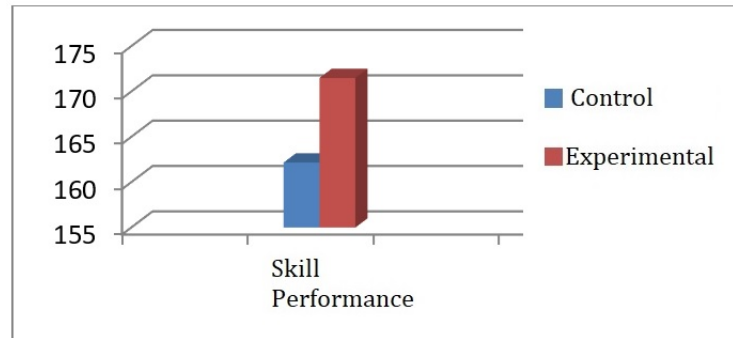


Fig. 3: Average scores of female students for the control and experimental groups in the post-skill performance

The Third Hypothesis: 3- There is a statistically significant difference at the level of (0.01) between the average scores of the experimental group in the post- and delayed cognitive achievement and skill performance" To test the validity of this hypothesis, a T-test was applied for independent samples, and the results were as in the following table:

Table 8: The value of the "T" test for samples associated with the survival of the learning effect to indicate the differences between the average grades of female students in the post- and delayed application of cognitive achievement and skill performance of the experimental group

Variable	Application	Average	(T) value	Degrees of freedom	Probability Value P. Value (sig.)	Level of Significance
Cognitive Achievement	Post	57.50	2.028	11	0.067	(Not Significant at 0.01 level)
	Delayed	56.92				
Skill Performance	Post	172.15	1.954	11	0.075	(Not Significant at 0.01 level)
	Delayed	171.23				

Table(8) indicates that the value of "T" amounted to (2.028) in cognitive achievement and this value is not statistically significant at the level of (0.01), which indicates that there is no difference between the grades of female students in post and delayed cognitive achievement, which means that the third hypothesis is rejected and the null hypothesis is accepted, which states that "there is no statistically significant difference at a significant level (0.01) between the average grades of the experimental group n the post- and delayed application of cognitive achievement and skill performance." This means that the learning effect of both post and delayed cognitive achievement and skill performance in the group's students remains after studying using the augmented reality strategy, and this is consistent with the study of Zaqout [14]. Figures (4) and (5) illustrate this:

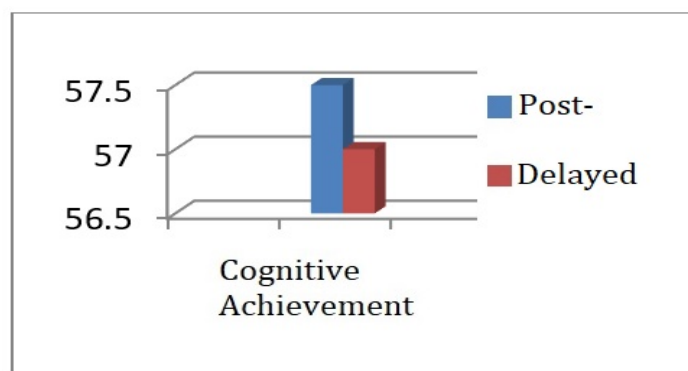


Fig. 4: Average scores of female students for the experimental group in the post- and delayed cognitive achievement

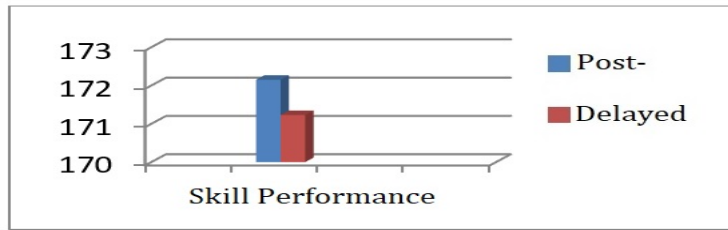


Fig. 5: Average scores of female students for the experimental group in the post- and delayed skill performance

The Fourth Hypothesis: 4- There is a statistically significant difference at the level of (0.01) between the average scores of the experimental group in the post- and delayed cognitive achievement and skill performance" To test the validity of this hypothesis, a T-test was applied for independent samples, and the results were as in the following table:

Table 9: The value of the "T" test for samples associated with the retention the learned information to indicate the differences between the average grades of female students in the post- and delayed application of cognitive achievement and skill performance of the control group

Variable	Application	Average	(T) value	Degrees of freedom	Probability Value P. Value (sig.)	Level of Significance
Cognitive Achievement	Post	48.25	5.610	11	0.000	(Significant at 0.01 level)
	Delayed	45.42				
Skill Performance	Post	162.17	4.643	11	0.001	(Significant at 0.01 level)
	Delayed	158.67				

Table (9) indicates that the value of "T" reached (5.610) in cognitive achievement, and this value is statistically significant at the level of (0.01), which indicates that there is a difference between the grades of female students in post- and delayed cognitive achievement, which means that the effect of learning among female students does not remain for the control group, and the value of "T" (4.643) in the skill performance, which indicates that there is a difference between the grades of female students in post- and delayed skill performance, which means that the effect of learning among female students does not remain for the control group, and thus accepts the fourth hypothesis. This is consistent with the study of Kamel & Mohammed [17]. Figures (6) and (7) illustrate this:

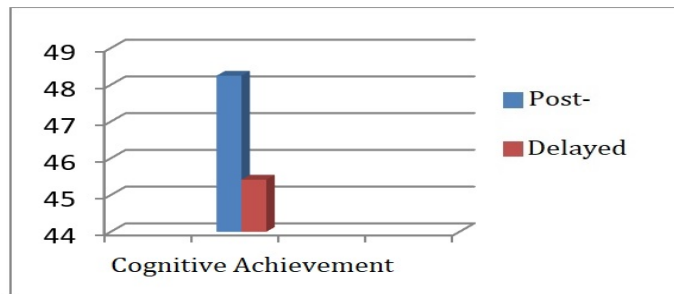


Fig. 6: Average scores of female students for the control group in the post- and delayed cognitive achievement

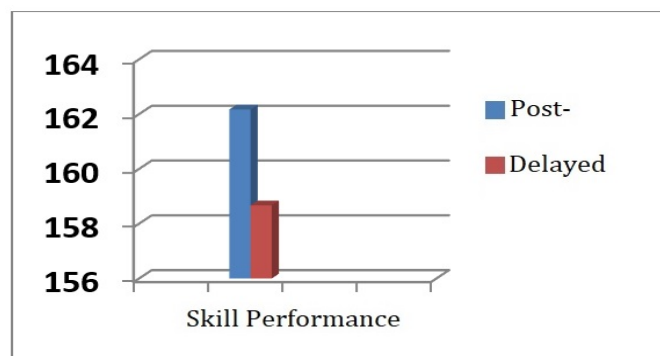


Fig. 7: Average scores of female students for the control group in the post- and delayed skill performance

The Fifth Hypothesis: 5- Students have positive opinions regarding the use of augmented reality technology in

developing pattern designing skills using the origami style. To test the validity of this hypothesis, the Chi-Square Test was applied to test the goodness of fit, and the results were as follows:

Table 10: The Chi-Square Goodness-of-Fit Test

Sr.	sentence	Agree		Disagree		Neutral		Statistical Test Chi-Square	Probability Value Sig.	Significance
		Frequency	Percent	Frequency	Percent	Frequency	Percent			
1	Augmented reality helped me clarify difficult information.	9	75%	2	16.66%	1	8.33%	9.5	0.009	0.01
2	I find it difficult to use augmented reality technology.	10	83.3%	1	8.33%	1	8.33%	13.5	0.001	0.01
3	Augmented reality helped me accomplish educational tasks.	11	91.66%	1	8.33%	0	0%	8.3	0.004	0.01
4	My education level decreased with the application of augmented reality technology.	3	25%	8	66.66%	1	8.33%	6.5	0.039	0.05
5	I forget what I have learned by applying augmented reality technology quickly.	8	66.66%	2	16.66%	2	16.66%	6	0.05	0.05
6	My level of achievement has increased through the application of augmented reality technology.	10	83.3%	0	0%	2	16.66%	5.3	0.021	0.05
7	I find it interesting to use augmented reality technology.	10	83.3%	0	0%	2	16.66%	5.3	0.021	0.05
8	I prefer to learn through the traditional way rather than learning through using the augmented reality technology.	8	66.66%	2	16.66%	2	16.66%	6	0.05	0.05

9	I find it stressful to use augmented reality technology.	9	75%	1	8.33%	2	16.66%	9.5	0.009	0.01
10	Using augmented reality in education attracts the attention of the students.	8	66.66%	2	16.66%	2	16.66%	6.5	0.039	0.05
11	I find it difficult to understand the material through using the augmented reality technology.	11	91.6%	1	8.33%	0	0%	8.3	0.004	0.01
12	Augmented reality technology increases my motivation to learn	8	66.66%	1	8.33%	3	25%	6.5	0.039	0.05
13	Augmented reality technology saves student time and effort	10	83.3%	0	0%	2	16.66%	5.3	0.021	0.05
14	I need a long time in training to deal with augmented reality technology	9	75%	1	8.33%	2	16.66%	9.5	0.009	0.01
15	The use of augmented reality technology in education is a waste of time.	8	66.66%	1	8.33%	3	25%	6.5	0.039	0.05
16	I want to use ready-made augmented reality applications	11	91.66%	0	0%	1	8.33%	8.3	0.004	0.01

Table (10) indicates that the value of Chi-Square ranges between (5.3) and (13.5), which is significant at (0.01), except for statements No. (4,5,6,7,8,10,12,13, and 15), which are significant at (0.05). This indicates that augmented reality learning has a positive role for the students of the experimental group, and this proves the validity and acceptance of the fifth hypothesis. The results of this hypothesis are consistent with the studies [1,14,15,16,18,20].

5. Discussion

The study's findings indicated that augmented reality technology was a more effective method for improving the cognitive achievement and skill performance of female students in pattern designing using the origami style, as well as enhancing their retention of learned information and overall positivity towards the learning strategy. The success of this approach can be attributed to its ability to present educational content in a more engaging manner than traditional methods, utilizing various media to capture students' attention and increase their motivation to learn. Additionally, the ease of accessing information at any time and learning at their own pace enabled students to achieve higher levels of

6. Recommendations:

- 1- The need to educate students and faculty members about the strategy of augmented reality in terms of its importance and its application in other courses.
- 2- The need to choose from modern teaching methods and educational activities which suit the needs and desires of the learners.
- 3- The need to conduct similar studies to reveal the impact of augmented reality on other courses.
- 4- The need to include augmented reality strategies within the teaching methods used in Egyptian universities and schools.
- 5- The need to design and provide the necessary laboratories, devices, and tools required for the application of augmented reality in various university departments.

Conflict of interest

The authors declare that there is no conflict regarding the publication of this paper.

References

- [1] K. A. M. M. Al-Nafisi, The effectiveness of augmented reality technology using the strategy of Claire and its impact on the satisfaction of students of the course of informatics for the tenth grade in the State of Kuwait, *Educational Journal*, 449- 455 (2018).
- [2] H. A. Al-Zahrani, The impact of the use of augmented reality technology in the development of higher thinking skills among middle school students, *Journal of Educational and Psychological Sciences* 2, 70 (2018).
- [3] D. A. S. K. Attia, Enhanced Book Technology, *Educational Technology*, Egyptian Society for Educational Technology 30, 3 (2020).
- [4] D. M. A. M. Sweifi, M. I. Desouki, and M. A. R. Morsi, Augmented reality technology and its relationship to the development of 3D educational film production skills using the “C4D” program among educational technology students, *Journal of Research in the Fields of Specific Education*, 23- 43 (2019).
- [5] C. B. D. Lima, S. Walton, and T. Owen, A Critical Outlook at Augmented Reality and Its Adoption in Education, *Computers and Education Open* 3, 100103 (2022).
- [6] C. Moro, J. Smith, and E. Finch, Improving Stroke Education with Augmented Reality: A Randomized Control Trial, *Computers and Education Open* 2, 100032 (2021).
- [7] K. Nawfal, *Virtual Reality Technology and its Educational Uses*, Dar Al-Monjough Publishing and Distribution, Amman, 60 (2010).
- [8] J. M. Krüger, K. Palzer, and D. Bodemer, Learning with Augmented Reality: Impact of Dimensionality and Spatial Abilities, *Computers and Education Open* 3, 100065 (2022).
- [9] I .J. A. Ahmed. Effectiveness of a program based on augmented reality technology in developing visual thinking skills in the field of science among ninth grade students in Gaza. M.A. Thesis, Al-Azhar University, Gaza,T (2016).
- [10] A. I. I. Hamada, The impact of the use of augmented reality applications on mobile devices on the development of achievement and creative thinking skills among fourth grade primary students, *Educational Technology - Studies and Research*, Arab Society for Educational Technology,303 (2017).
- [11] A. M. Al-Shami and L. M. M. Al-Qadi, The impact of a training program for the use of augmented reality techniques in the design and production of e-learning courses for the student teacher at the Faculty of Home Economics, Al-Azhar University, *Journal of the Faculty of Education*, , 1,124 (2017).
- [12] F. A.-Z. M. Abdel Qader and Y. S. M. Ahmed. The effectiveness of using an educational unit based on augmented reality technology in the development of achievement and practical skills in chemistry among secondary school students. M.A. Thesis, Qassim University, Buraidah, 211 (2018).
- [13] T. Khan, K. Johnston, and J. Ophoff, The Impact of an Augmented Reality Application on Learning Motivation of Students, *Advances in Human-Computer Interaction*, e7208494 (2019).

- [14] Y. J. M. Zaqout. The effectiveness of an augmented reality technology-based program in developing scientific concepts and practical thinking skills in science and life among fifth grade basic students in Gaza. M.A. Thesis, Islamic University, Gaza, T (2019).
- [15] D. Sahin and R. M. Yilmaz, The Effect of Augmented Reality Technology on Middle School Students' Achievements and Attitudes towards Science Education, *Computers & Education* **144**, 103710 (2020).
- [16] M. A. H. M. F. Hajjaj, The impact of the use of augmented reality technology "smart cards" on the skill of drawing mannequins in different situations and the direction of students of the Department of Clothing and Textile, *Journal of Research in the Fields of Specific Education*, 433 (2020).
- [17] H. S. R. Kamel and S. S. I. Mohammed, The two types of learning by "directed/free" discovery in the environment of reality enhanced by flipped classroom and their impact on the development of achievement and the retention of the impact of learning among students of higher institutes, *Journal of Research in the Fields of Specific Education*, 287- 311 (2020).
- [18] I. M. N. Al-Suwailem, Obstacles to the use of augmented reality technologies in the education of students with intellectual disabilities in Riyadh schools, *Journal of Human Sciences*, 11- 14 (2021).
- [19] O. Abdellah, M. Zidane, H. Ghazi, R. Haikal, and A. W. Elsayed, The impact of different patterns of infographic-based enhancer on achievement and trends in fashion history among home economics students, *Journal of Home Economics*, 185 (2021).
- [20] F. I. Khamis, The impact of the use of "augmented reality" technology in teaching the course "Scientific Research Methods", *International Journal of Library and Information Sciences*, **9**, 155 (2022).
- [21] N. A. A. Elwan and R. A. M. M. Ahmed, The impact of model design and laser cutting technology on the enrichment of produced clothing, **8**, 289 (2018).
- [22] M. A.-S. M. Hasan and G. M. Al-Zaki, Effectiveness of using illustration strategies in developing the skills of designing and implementing "Patterns" among hearing-impaired students, *Journal of Science and Arts , Studies and Research*, **23**, 7 (2011).
- [23] A. M. A. Hassanein and M. M. S. Al-Khattabi, Designing a website for training in women's outerwear designing skills, *International Design Magazine*, **12**, 41 (2022).
- [24] M. H. H. Hassan, Developing an exhibition of augmented images in an augmented reality environment based on the patterns of discovery learning (directed- semi-guided- free) and its impact on the development of self-regulation and curiosity skills among students of educational technology, *Educational Technology, the Egyptian Society for Educational Technology*, **29**, 170-171 (2019).
- [25] M. Karakus, A. Ersozlu, and A. C. Clark, Augmented Reality Research in Education: A Bibliometric Study, *Eurasia Journal of Mathematics, Science and Technology Education*, **15**, 1 (2019).
- [26] W. M. Ibrahim and S. I. M. Mehran, Flat Pattern Design, *Dar Al Fikr Al Arabi, Cairo*, 52-53 (2016).
- [27] A. A. I .Khattab, A Suggested program based on origami and kirigami art for gifted pupils with Learning disabilities and its effect on Developing their geometric thinking and epistemological beliefs, *Journal of Mathematics Education*, 17-22 (2014).
- [28] A.O. A. Al-Mubarak, Adopting augmented reality technology in the education of the Kingdom of Saudi Arabia, *Educational Scientist, Arab Scientific Consultancy and Human Resources Development Foundation* **4**, 120- 122 (2018).
- [29] R. H. H. Hedayah, The impact of the difference in the design of the learning environment based on augmented reality technology using electronic mind maps on the development of skills for the production of digital learning units among graduate students at the Faculty of Education, *Journal of the Faculty of Education*, **3**, 1165 (2019).
- [30] A.M. M. ElBaradei and A. A. F. ElEkia, The impact of the interaction between the pattern of tracking and the technology of integration with augmented reality technology on the development of cognitive achievement and skill performance and trends towards the learning environment among students of educational technology, *Journal of the Faculty of Education*, **30**, 434-445 (2019).
- [31] F. Arici, P. Yildirim, Ş. Caliklar, and R. M. Yilmaz, Research Trends in the Use of Augmented Reality in Science Education: Content and Bibliometric Mapping Analysis, *Computers & Education* **142**, 103647 (2019).
- [32] F. Arici and M. Yilmaz, An Examination of the Effectiveness of Problem-Based Learning Method Supported by

- [33] I. Radu, Why Should My Students Use AR? A Comparative Review of the Educational Impacts of Augmented-Reality, in 2012 IEEE International Symposium on Mixed and Augmented Reality (ISMAR), 313–314 (2012).
- [34] S. C.-Y. Yuen, G. Yaoyuneyong, and E. Johnson, Augmented Reality: An Overview and Five Directions for AR in, Education Technology Development and Exchange, **4**,119 (2011).
- [35] K. H. Khalawi, The impact of the use of augmented reality technology on the development of design skills among students of the Faculty of Education at Jazan University and their trends towards the use of technological innovations, Educational Journal, **68**, 2084 (2019).