Information Sciences Letters

Volume 11
Issue 5 *Sep. 2022*

Article 35

2022

Designing a Program using Augmented Reality Technologies and some Interactive Educational Aids to Simplify Science of Remote sensing for Elementary School Students

Mohamed Bayoumy Zahran
National Authority for Remote Sensing and Space Sciences, Egypt, mohamedbadawy377@gmail.com

Ghada Atta Youssef
National Authority for Remote Sensing and Space Sciences, Egypt, mohamedbadawy377@gmail.com

Eman Wefky Ahmed
Faculty of Education, Sohag University, 82524 Sohag, Egypt, mohamedbadawy377@gmail.com

Ghada Mahmoud Ouf
National Authority for Remote Sensing and Space Sciences, Egypt, mohamedbadawy377@gmail.com

Information Sciences Letters
An International Journal

http://dx.doi.org/10.18576/isl/110535

Designing a Program using Augmented Reality Technologies and some Interactive Educational Aids to Simplify Science of Remote sensing for Elementary School Students

Mohamed Bayoumy Zahran[1], *Ghada Atta Youssef*[1], *Eman Wefky Ahmed*[2], *Ghada Mahmoud Ouf*[1], *Mona Ahmed Elazony*[1], *Mohamed Badawy Mohamed*[1*]

[1]National Authority for Remote Sensing and Space Sciences, Egypt
[2]Faculty of Education, Sohag University, 82524 Sohag, Egypt

Received:1 Jan. 2022, Revised: 10 Feb. 2022, Accepted:1 Mar. 2022.
Published online: 1 Sep. 2022

Abstract: The present research aims to develop innovative methods that simplify science. The author adopts the descriptive analytical approach by designing an electronic educational system that involve some electronic games that contribute to spreading awareness and culture of sensing and space in the Egyptian society. Teaching methods have been devised to motivate children and develop their skills, mix science with imagination and use interactive education based on Augmented Reality (AR) to search for minerals and rocks with satellite images. Thus, there is an interactive educational method based on augmented reality with cartoons and interaction to simplify sensor and space sciences. Augmented reality (AR) has gained increased recognition in various fields; learning via augmented reality technology will help learners comprehend learning content in a more creative frame of mind than ever before. It is substantial to understand the dynamics of augmented reality adoption to encourage students to employ this highly innovative and impactful type of technology in learning process.

Keywords: Augmented Reality, Augmented reality in education, Remote Sensing.

1 Introduction

Scientific culture, represented in identifying the major facts on the results of science, is an essential part of the general culture. The problem of the research is the difficulty of children's comprehension of modern science, as remote sensing and space technology are among the most modern sciences and students' passion, which required simplifying these sciences to attract students' attention and encourage them to learn it and passion in order to learn more information in this science. This research aims to develop innovative methods to simplify science, through the design of an electronic educational system that includes a variety of comics and electronic games that contribute to spreading awareness and culture of remote sensing and space science in the Egyptian society, through the use of augmented reality technologies, and thus grow Stimulating creativity in children, motivating them and developing their skills. Where in this way, science is mixed with entertainment and imagination, and in this way, children use interactive education based on augmented reality to search for rocks and minerals in satellite images, and thus children get a lot of information indirectly, which depends on the interactive educational method based on augmented reality and drawings animation.

STATEMENT OF THE PROBLEM:

The research problem is the difficulty of children's comprehension of modern sciences, including Remote Sensing and Space Sciences, which requires the researchers to create a method that simplifies sensor science to capture their attention, encourage them to learn and develop their skills while mixing science and imagination.

OBJECTIVES:

The research aims to develop innovative methods that simplify science to maximize students' comprehension and assimilation of modern sciences using augmented reality technology that simplifies remote sensing and space science.

SIGNIFICANCE:

CHILDREN WILL BE ABLE TO:

- Learn about the distance and receive the visuals inside the cartoon.
- Understand the components of the satellite images in the form of a Basel assembled.

*Corresponding author e-mail: mohamedbadawy377@gmail.com

- Learn how to extract minerals and rocks from satellite images in the form of a three-dimensional game using augmentative technology.
- Increase their level of self-learning and interaction.
- Increase their ability to identify and imagine using 3D models**.**

QUESTIONS:

What is the effect of the proposed program of augmented reality technologies and some interactive educational aids on developing understanding of modern sciences, including Remote Sensing and Space Sciences?

REVIEW OF THE LITERATURE:

Azzam Abdel Razek (2021) addressed using augmented reality technology in developing scientific concepts and information search skills for middle school students in the State of Kuwait. The results showed adopting augmented reality technology contributed to the growth of scientific concepts and information search skills among the students of the experimental group with statistically significant differences compared to those of the control group.

Judeh (2018) Using Augmented Reality for Development Computational problems Solving Skills and Emotional Intelligence among Disabilities Pupils in Learning Mathematics at Primary School in Kingdom of Saudi Arabia (KSA). She has been used Math problem solving skills test - emotional IQ Scale. Results were the effectiveness of Using Augmented Reality for Development Computational problems Solving Skills among Disabilities Pupils in Learning Mathematics at Primary School in Kingdom of Saudi Arabia (KSA), (the study group), and the effectiveness of Using Augmented Reality for Development Emotional Intelligence among Disabilities Pupils in Learning Mathematics at Primary School in Kingdom of Saudi Arabia (KSA).

Al-Dahasy (2017) aimed to identify the effect of using augmented reality in developing mathematical thinking skills. The author adopted the descriptive analytical approach. The sample consisted of (120) primary school mathematics teachers in Dammam. A questionnaire was employed as a tool to collect data. The results demonstrated that augmented reality technology in mathematics education helped increase students' cognitive abilities, considering the individual differences between students, and develop their love of knowledge as well as created positive attitudes among primary school teachers towards using augmented reality technology in developing mathematical thinking.

Shea (2014) aimed to identify the students' perception of utilizing the portable augmented reality game in language learning and its impact on communication. The results demonstrated that the portable augmented reality game offers a successful way to learn language outside the classroom and positively affects students. The study recommends activating this technology within schools.

Perez-Lopez and Contero (2013) aimed to use augmented reality technology to deliver multimedia content to support teaching and learning process on the digestive and circulatory system at the primary school level in Spain as well as identify its impact on knowledge retention. The author adopted the quasi-experimental approach. Tools involved an achievement test and questionnaires. The sample comprised (39) students: (19) females and (20) males from the class. The results showed a greater retention of knowledge by the students who used multimedia content with augmented reality technology, unlike the students who followed the traditional curriculum. El Sayed (2011) aimed to use augmented reality technology by presenting augmented reality business card as a technological application in the field of education. Augmented reality has been extensively adopted in educational domains to promote positive educational practices and outcomes (Alkhattabi, 2017; Elmqaddem, 2019 ; Kaur, 2020).

Definition of Terms:

Augmented Reality: Many definitions and descriptions of augmented reality have appeared in literature. However, the most common one is that computer-generated digital content is projected in a real-world environment (P.A. Werner, 2019). (AR) technology consists of two fundamental aspects: Real-world objects and digital content. However, how to blend them in a manner that creates an interactive environment is a real challenge, particularly when applied in learning contexts (T. Aitamurto, 2018; . B. Joseph, 2016).

Augmented Reality in Education: Virtual reality is an alternative world filled with computer generated images that respond to human movements. These simulated environments are usually visited with the aid of head-mounted goggles and fiber-optic data gloves (Steuer, 1992). For instance, some of the main characteristics of virtual reality are immersion and presence, which focus on generating the sensation of being present in a simulated place. This allows to give a focused viewpoint in terms of human experience rather than technology to virtual reality. However, the concept of presence does not refer to what surrounds one, as in the physical world, but to the perception of the environment through an automatic and controlled mental process (Gibson, 2014). For example, the glasses are used by placing a mobile device in the back and making the visualization through the lenses in the front (MacIsaac et al., 2015; Laffont et al., 2016). Generally speaking, education is an area in which virtual reality is used through the creation of teaching and learning situations, allowing large groups of students to interact with each other in three-dimensional environments (Helsel, 1992). Information technologies take a leading position in the development of novel IT-based digitized formats that can be launched into educational environments to achieve

greater performance, efficiency and productivity. Currently, with its innovative technology, enormous features and intelligent design, augmented reality will rightfully lead the stride in revolutionizing and transforming the educational system to help the next generations learn more effectively in highly motivating environments. Moreover, augmented reality has become relevant to educational practices because (AR) technology has important and valuable features that are favorable and adaptable to learners and learning processes. The technology has a rich platform for providing enhanced teaching and learning model, as well Augmented Reality is the best way to engage the students. Technology is the most attractive concept for kids, With AR apps you can teach complex concepts to the students easily.

Remote Sensing: Remote sensing is the science of acquiring information about an object or phenomenon by measuring emitted and reflected radiation. Remote sensing is a type of geospatial technology that samples emitted and reflected electromagnetic (EM) radiation from the Earth's terrestrial, atmospheric, and aquatic ecosystems in order to detect and monitor the physical characteristics of an area without making physical contact. This method of data collection typically involves aircraft-based and satellite-based sensor technologies, which are classified as either passive sensors or active sensors. Passive sensors respond to external stimuli, gathering radiation that is reflected or emitted by an object or the surrounding space. The most common source of radiation measured by passive remote sensing is reflected sunlight. Popular examples of passive remote sensors include charge-coupled devices, film photography, radiometers, and infrared. Active sensors use internal stimuli to collect data, emitting energy in order to scan objects and areas whereupon a sensor measures the energy reflected from the target. RADAR and LiDAR are typical active remote sensing tools that measure the time delay between emission and return in order to establish the location, direction, and speed of an object. The remote sensing data gathered is then processed and analyzed with remote sensing hardware and computer software (for example energy analytics and energy business intelligence), which is available in a variety of proprietary and open source applications.

Methodology:

The most difficult challenge is the incorporation and integration of the AR within learning settings to support creating interactive and associative teaching mechanisms to make the learning processes more effective, and considering that technology should remain a catalyst to learn and preserve the learned materials (B. Joseph, 2016). The author adopted the descriptive analytical approach by designing an electronic educational system that comprises several comic stories and electronic games that contribute to spreading awareness and culture of sensing and space in the Egyptian society using augmented reality techniques and applying to remote sensing techniques. Because the era of the revolution of science and technology, the scientific culture represented in knowing the basic facts about the results of science is an essential part of the general culture. It is also substantial for the development of children's abilities. Hence, simplification of science and its wide dissemination is the foundation of the scientific culture. As a part of the state's efforts to reform the educational system, the Ministry of Scientific Research and Higher Education seeks to cooperate with the Ministry of Education and Technical Education to develop innovative methods to simplify science and increase students' understanding and assimilation of these modern sciences through studies, and research projects. This simplifies remote sensing sciences represent one of the most modern sciences and a passion for children. Remote sensing is the science of collecting information about the Earth's surface without direct contact with this surface. This is conducted by sensing and recording the emitted or reflected energy and the subsequent processing, analysis and storage of the captured data to process digital images that help obtain the spectral fingerprints of objects.

Tools:

To extract the information content of the Earth's surface (Barrett N. & Rock F. H. Goetz, 1985), an electronic educational system, which involves several comics and electronic games that contribute to spreading awareness and culture of remote sensing and space science in the Egyptian society, has been designed. It comprises the following three stages:

First: Designing an awareness-raising cartoon.

Second: It is represented in the interaction of students by participating in some games manufactured (puzzles) of a satellite image.

Third: Using interactive education based on augmented reality (AR) to search for minerals and rocks with satellite images. Thus, the complete educational system can be achieved to instruct children about remote sensing sciences. The presence of visual elements and interaction has contributed to attracting children's attention and understanding faster (Sadek, 2007).

Sampling

The Virtual Reality Academy of the National Authority for Remote Sensing and Space Sciences received (79) students aged (10-11) from the Egyptian Nile schools. Children at Nile schools were specially selected for the experiment because these schools offer courses that contain remote sensing technology for children in the primary stage. The results of the researchers' investigation of science books in the fourth, fifth and sixth grades illustrate some concepts, importance and various applications of remote sensing technology. The information is presented in a theoretical and illustrative way.

Implementation of the experiment:

The visit occurred throughout (2) weeks. The research depends on creating innovative educational means to motivate children and develop their skills in the field of remote sensing by blending science with imagination,

which develops the capabilities of creativity and imagination that stimulate and encourage innovation and global competition through the following stages:

First: Presentation

Presentation shows a definition of remote sensing technology and space sciences and the relevant applications within an hour.

Second: Cartoon Film Design:

This stage depends on designing an introductory cartoon for children for (2:52 minutes), in which children are introduced to the concept of sensor science and how space data analysis is received inside the ground station through the following steps:

Choosing the Idea

The idea of the film was based on two fictional cartoon characters from space called Zika and Professor Narso (Fig. 1) looking for minerals and rocks from the surface of the earth (iron, manganese, phosphate, and limestone) and obtained through satellite imagery.

Fig.1: The cartoon characters.

Scenario of Work

The dialogue was based on the Arabic language to clarify the idea of sensing and the concept of remote sensing and how space data is received and analyzed inside the ground station (Figure. 2).

Fig.2: The scenario and dialogue of the characters and the place.

Film Implementation

The film was implemented in (2) minutes in scenes drawn inside the data analysis station and the ground station for receiving satellite data to clarify for the children a simplified idea on how to reach the locations of minerals and rocks (iron, manganese, phosphates and limestone) from the satellite image of Egypt (Fig. 3)

Fig.3: Some scenes in the movie.

Third: Interactive Participation

The students interacted by participating in some games created by Mozaic for the map of the Arab Republic of Egypt, as follows:

Obtaining mosaic of satellite images of Egypt (ETM (2001) Datum (WGS 84) Zones (35-36-37). The image consists of (7) scenes (Figure. 4), illustrating the mosaic of Egypt used in the puzzle and the creation of augmented reality on the tablet.

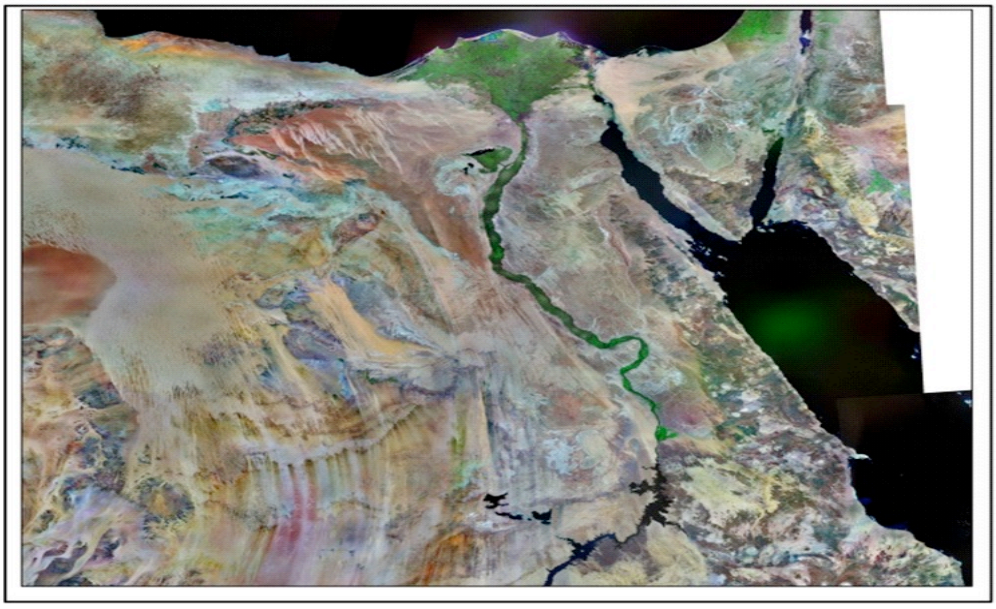

Fig.4: The mosaic of Egypt used in the puzzle and the creation of augmented reality on the tablet.

Fourth: The application of augmented reality to search for minerals and rocks

This implies application of augmented reality to replicate the real environment represented in the search sites for rocks and minerals on the tablet and enhancing it with virtual data that was not part of it by enhancing the real reality with additional information. When the child uses this technology to look at the satellite image, it is equipped with (virtual scene), which is information about the locations of rocks, minerals and mountains in the region (Figure-5). They are not present in the picture in an integrated way that aims to simulate the actual reality in the desert to explore those elements.

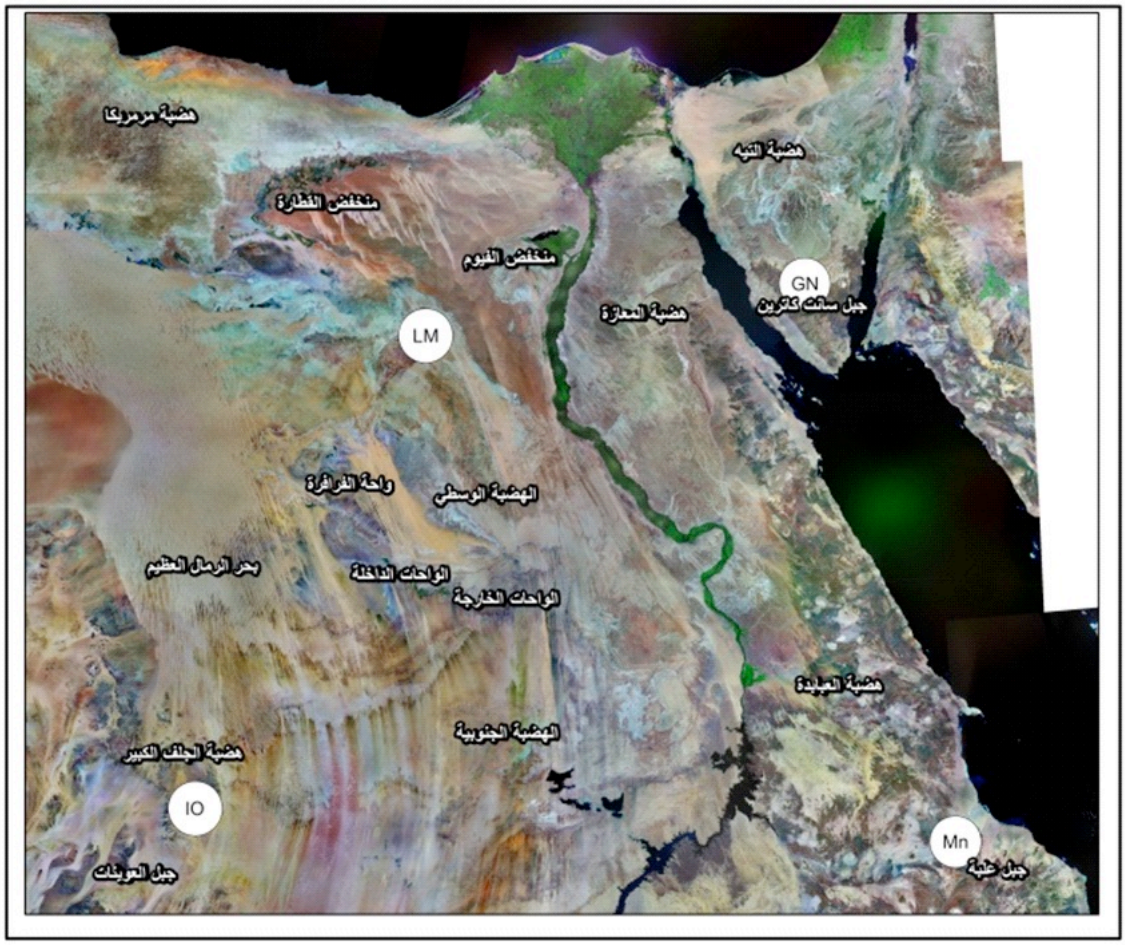

Fig.5: A picture of Egypt; a site in which rocks and minerals are located.

This involves the following steps:

Defining the locations of rocks and minerals; the locations of rocks and minerals (iron, manganese, phosphate and limestone) were distributed. They are considered one of the most distinctive rocks and minerals in Egypt and whose locations can be determined through their spectral fingerprint (M.F.Sadek, 2007). Three-dimensional design of rock and mineral sites as a simulation of reality To simulate reality, a detailed and accurate drawing of the areas, where minerals and rocks have been identified, must be carried out. To obtain the contour maps, we relied on digital elevations model (ASTR30) by drawing curvilinear maps of the area showing the altitude levels of the mountains for each area above sea level (Fig. 6).

The mountains for each region above sea level.Then, a three-dimensional stereoscopic model of the mountain is designed with the same height levels on the (3D) program, guided by the realistic shape of the mountain (Figure-7).

2. Implementation of Augmented Reality Technology

In this experiment, the augmented reality technology relied on linking landmarks from the real reality of the mountains as a virtual element that was drawn in three dimensions and its location as geographical coordinates as information on the place. Then, augmented reality software was adopted to integrate the virtual elements with the satellite image that was assembled as Basel (Figure-8).

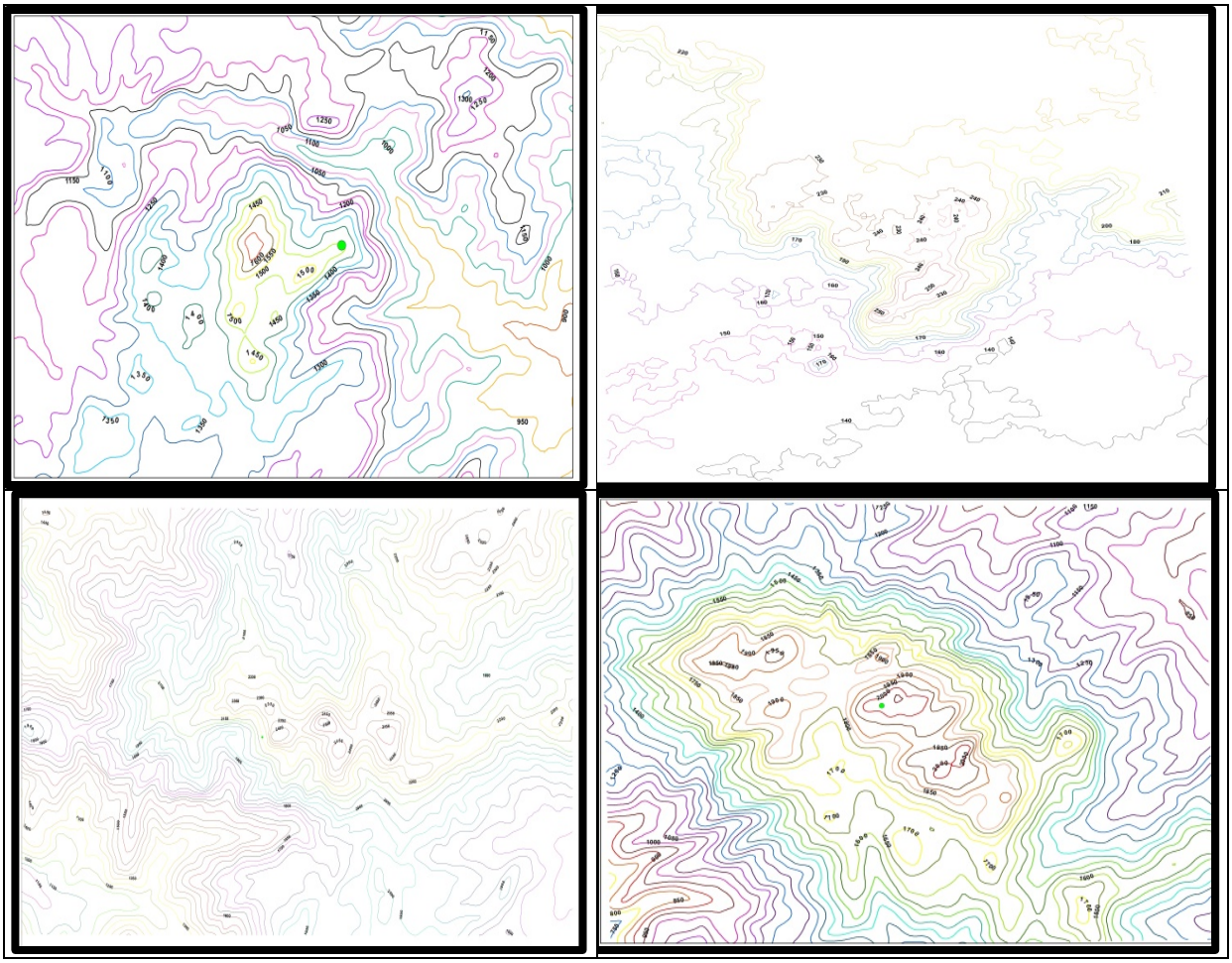

Fig.6: A curvilinear mapping of the region showing the elevation levels

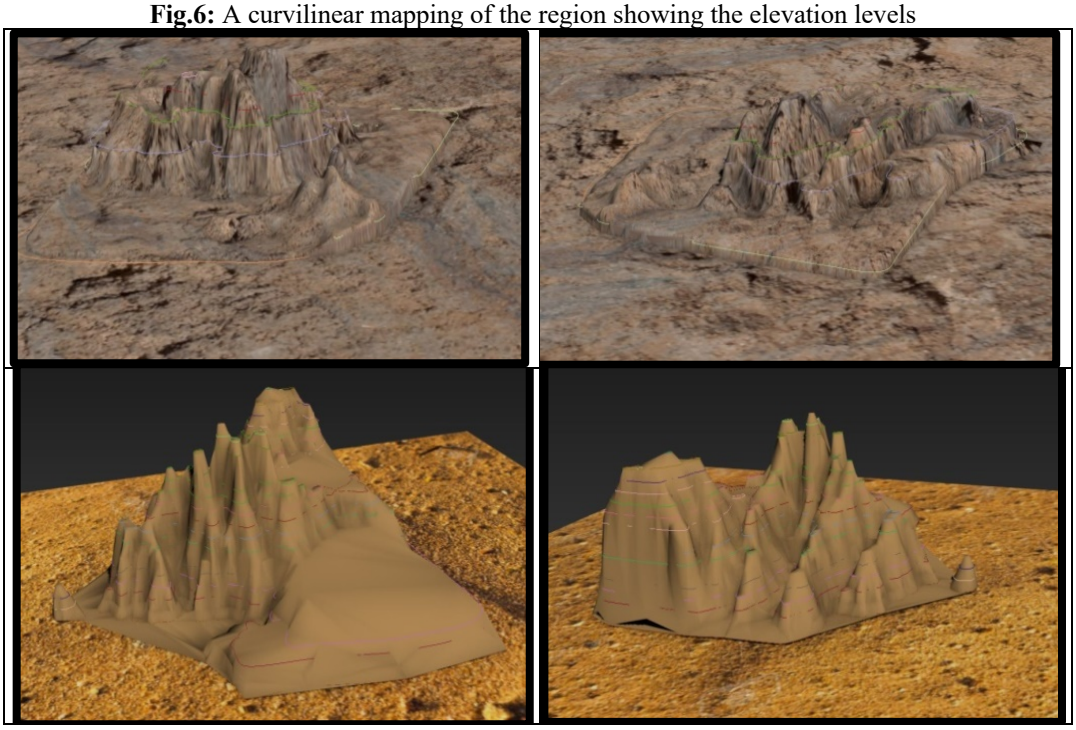

Fig.7: Designing a three-dimensional stereoscopic model of the mountain with the same height levels on the (3D) program guided by the realistic shape of the mountain.

Fig.8: Using augmented reality software to integrate virtual elements.

Two methods were used to make augmented reality: The first method depends on the use of (Markers) that the camera can capture and distinguish to display the information related to it through the tablet, and the second method was used by geographical location through the service (GIS) (GPS) as well as image recognition programs (Image Recognition) to display the information.

Satellite image assembled Kabazel

After the experiment, a questionnaire was adopted to measure the extent to which students benefited and how much information was obtained during the experiment. The ages of the students who took the survey ranged from 10 to 11 years.

3 Results

A questionnaire and an achievement test were also conducted for the children after the experiment to answer the research question: What is the effect of the suggested program of augmented reality technologies and some interactive educational aids on developing understanding of modern sciences, including Remote Sensing and Space Sciences?

Table 1: Questionnaires to know the impact of the proposed program for augmented reality technologies and some interactive educational aids on developing an understanding of remote sensing and space sciences.

After conducting the experiment				
#	Phrase	Yes %100	Maybe 50%	No (0)
Puzzle				
1	Using the puzzle helps learn the information easily and excitedly.			
2	The satellite image is clearly recognized.			
Cartoon				
1	Did you enjoy cartoon characters?			
2	Visual elements (images - animations) are used effectively.			
3	Viewing the animated film helped clarify the idea.			
Augmented reality				
1	The scientific content of the Remote Sensing is presented in a simple and an attractive way.			
2	Augmented reality helped access information easily and conveniently.			
3	I enjoyed the experience of merging reality with fantasy.			
4	I wish the syllabuses were presented in this way.			
5	The difference between virtual reality and augmented reality is clear.			

The questionnaire achieved high rates of children's enjoyment of cartoon characters and the method of dialogue to simplify science and clarify information. This indicates that the use of cartoons increased children's knowledge of remote sensing technology and space science.
shows that using cartoons to increase children's knowledge of remote sensing technology and space sciences makes information clearer and easier for children. This appeared through the previous questionnaire that shows their enjoyment of cartoon characters and the method of dialogue that simplifies science. (64) students enjoyed cartoon characters, while (8) students did not enjoy them; (67) agreed that visual elements (images and animations) are used effectively and (66) agreed that viewing the animated film helped clarify the idea.

The blue column denotes “Yes”, the red column represents “Maybe” and the green column signifies “No”. The experience of the puzzle proved successful with the children, as they got acquainted with the satellite images of Egypt and its composition through the participation of the children in its installation in the form of a puzzle, which simplifies the information through games. Table (1) shows that (65) students state that learning using puzzle helps learn the information easily and excitedly and (64) agree that the satellite image is clearly recognized.

Augmented Reality

Table (4) and Fig. (11) show that (73) students state that the scientific content of remote sensing is presented in a simplified and an attractive way. Moreover, the augmented reality helped children access information easily and smoothly as the children showed their enjoyment in terms of merging reality with imagination. This appeared by wishing that all the courses were presented in this way. With the actual experience, the children could distinguish between virtual reality and augmented reality technologies. Finally, we can conclude that the augmented reality technology made the educational process enjoyable and stimulated the learner's enthusiasm and creativity using innovative and diverse patterns and methods in education.

Table 2: Using cartoons to increase children's knowledge of remote sensing technology and space sciences makes information clearer and easier for children.

Cartoon			
Item	Yes 100%	Maybe	No
Did you enjoy cartoon characters?	`67	4	8
Visual elements (images and animations) are used effectively.	64	9	6
Viewing the animated film helped clarify the idea.	66	8	5

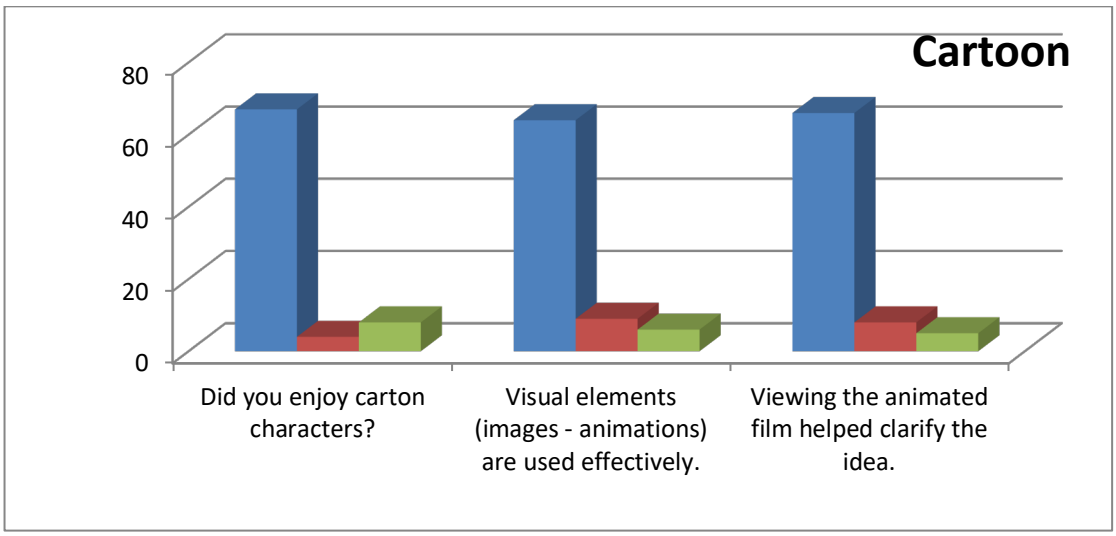

Fig.9: Students' results of cartoon questionnaire after the experiment.

Table 3 and Fig 10: Puzzle questionnaire for children after the experiment. The blue column represents the answer "YES", The red column represents the "MAYBE" answer and the green column "NO" answer.
green column "NO" answer

Puzzle			
Item	**yes 100%**	**Maybe**	**No**
Learning using the puzzle helps learn the information easily and excitedly	65	8	6
The satellite image is clearly recognized	64	8	7

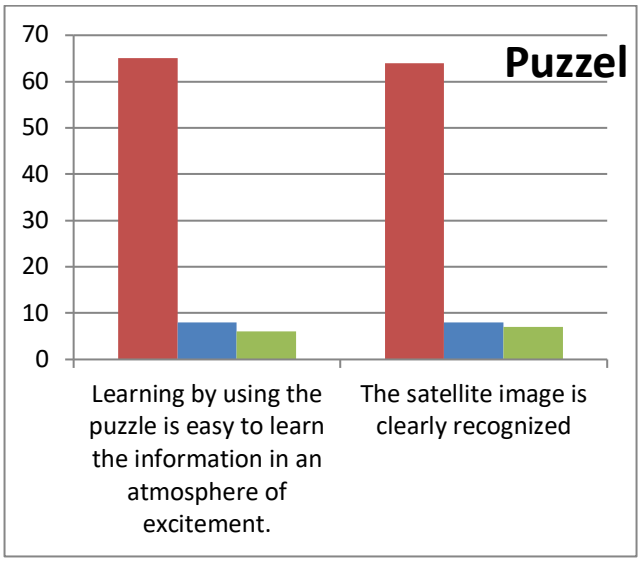

Table 4: show that the students state that the scientific content of remote sensing is presented in a simplified and an attractive way.

Augmented Reality			
Item	Yes	Maybe	No
Scientific content of remote sensing is presented in a simple and an attractive way.	73	4	2
Augmented reality helped access information easily and conveniently.	68	8	3
I enjoyed the experience of merging reality with fantasy.	68	7	4
I wish syllabuses were presented in this way.	76	3	0
The difference between virtual reality and augmented reality is clear.	77	2	0

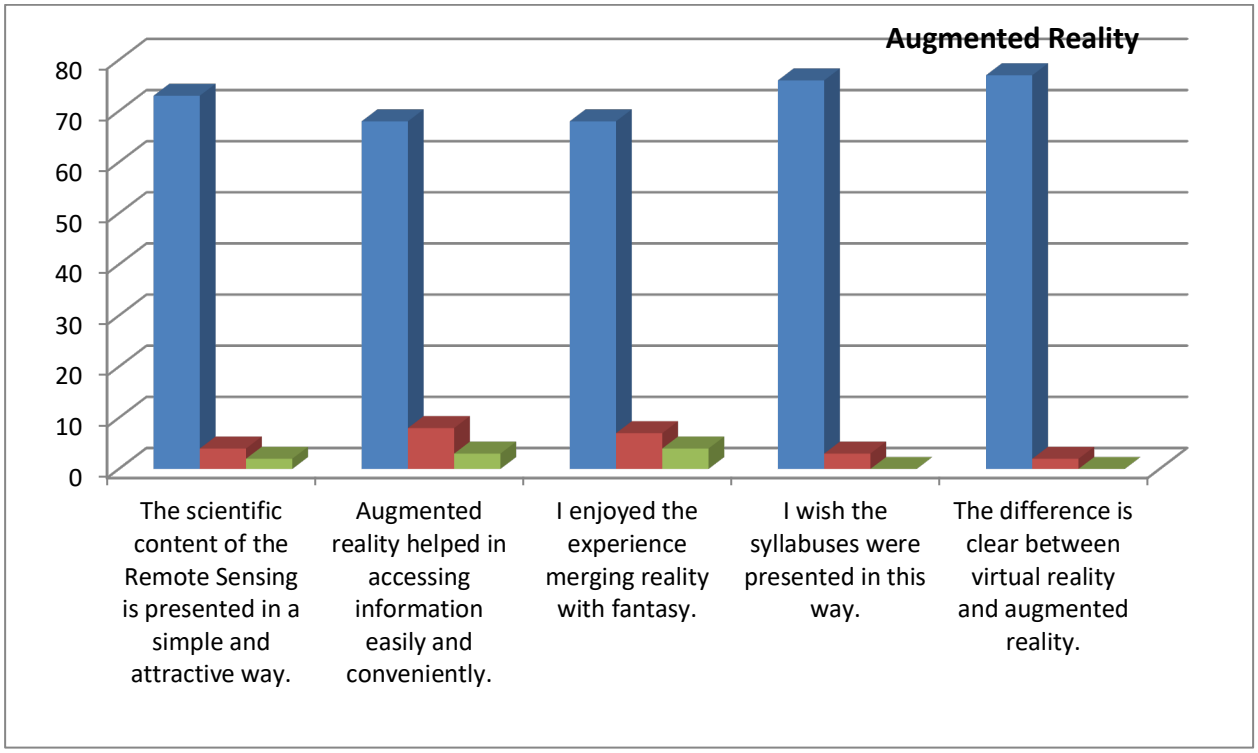

Fig.11: Augmented Reality questionnaire for children after the experiment. The blue column denotes "Yes", the red column represents "Maybe" and the green column signifies "No".

The scientific content of remote sensing is presented in a simple and an attractive way. Augmented reality helped access information easily and conveniently.

Achievement Test Results

Achievement test, which consists of (5) multiple questions and (5) true or false questions, was applied to the students before and after the experiment to measure the information they obtained during the experiment.

Figure (12) illustrates that the rates of children's answers before the experiment achieved less than half. This indicates lack of children's knowledge in the science of remote sensing and space, while their answers after the experiment achieved higher than half, suggesting that the children's knowledge rates increased after the experience. This manifests that children benefit from the experience in acquire skills and knowledge of remote sensing and space sciences.

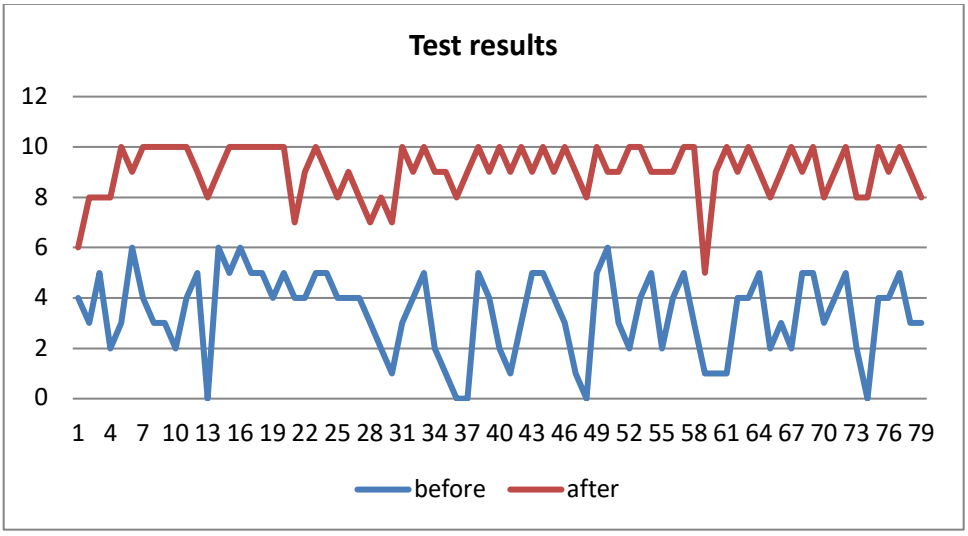

Fig.12: Results of achievement test before and after the experiment.

4 Discussions

The researchers created educational means to motivate children, develop their skills as well as mix science and imagination to develop the capabilities of creativity and imagination that stimulate and encourage innovation and global competition through three stages (designing an awareness cartoon movie, student interaction by participating in some manufactured games (puzzles) for a satellite image and using interactive learning based on augmented reality (AR) to search for minerals and rocks with satellite images). A digital elevation model with an accuracy of (30) meters was downloaded and contour lines were drawn for the locations of minerals using GIS programs, then it was drawn and converted into a three-dimensional model of the mountains. Thus, the educational system achieved complete knowledge of sensor and space sciences.

The results show that transforming teaching process into learning helped create excitement, suspense and attraction for the child and achieving effective and continuous education. Moreover, the augmented reality technology made the educational process enjoyable and stimulated the learner's enthusiasm and creativity using innovative and diverse patterns and methods in education. Furthermore, presenting scientific concepts in a familiar sensory broke the deadlock and abstraction that accompany many scientific concepts and made the educational process meaningful and enjoyable for the student. However, the diffusion level of augmented reality within the context of education systems remains a tough challenge.

Recommendations:

The present research recommends employing patterns of augmented reality in teaching to make learning interesting; encouraging teachers to use augmented reality at schools to teach different subjects and stimulate fun and imagination; delivering courses on the importance of using augmented reality in teaching and identifying its use and importance, adopting the idea of designing academic courses in the form of augmented reality, as one of the modern teaching methods as well as prioritizing creative thinking and visual culture due to their association with augmented reality patterns. Furthermore, universities and academic institutions can benefit from involving (AR) technologies in learning process because it presents several advantages at low cost. The significant influences of AR technology on education are likely to gradually become more considerable; for promoting children to interact and transferring the dominance of the AR book reading to children.

Acknowledgment

Words fail to express thanks and gratitude to the National Authority for Remote Sensing and Space Sciences for the place, devices, equipment, assistance, support and motivation provided to the researchers. Sincere thanks and appreciation also go to His Excellency Prof. Mohamed Bayoumi Zahran, Head of the National Authority for Remote Sensing and Space Sciences, for his support and motivation.

References

[1] Al-Dahasi, Al-Jawhara. (2017). Using augmented reality technology in developing mathematical thinking skills (Unpublished master's thesis). Cairo University, Egypt.

[2] Al-Ghamdi, Ibtisam Ahmed (2020). The effect of using augmented reality on the achievement of mathematics among middle school students in the Al-Baha region in the Kingdom of Saudi Arabia. Journal of the Islamic University of Educational and Psychological Studies., **28(2)**, 2020.

[3] Azuma, Ronald, YohanBaillot, Reinhold Behringer, Steven Feiner, Simon Julier, and Blair MacIntyre.(2001). Recent advances in augmented reality (Doctoral dissertation). Pepperdine University, California, United States.

[4] B. Joseph, D.G. (2016). The dark reality of augmented reality. Oxford medical case reports., **(10)**, 2016.

[5] D.P. Kaur, A. Mantri, B. Horan .(2020). Enhancing student motivation with the use of augmented reality for interactive learning in engineering education. Procedia Computer Science., **172**, 881-885, 2020.

[6] El-Sayed, Nevin. (2011). The application of expanded reality methods in the field of science education for the ninth grade student in Gaza (Unpublished master's thesis). The Islamic University, Gaza.

[7] El Sayed, N. (2011). Applying augmented reality techniques in the field of education and computer systems engineering (Master's thesis). Banha University, Egypt.

[8] Fares, Najla Rizk. (2017). Augmented reality and its applications in teaching and learning processes. Studies in university education.

[9] F. H. Goetz, Gregg Vane Jerry E. Solomon, Barrett N. Rock 7 (1985). Imaging spectrometry for earth remote sensing. Science., **228 (4704)**, 2017.

[10] Gibson, J. J. (2014). The ecological approach to visual perception: Classic edition. Psychology Press

[11] Hammad, Rowaida Fayek. (2019). The effect of using problem solving strategy on acquiring technology concepts for the ninth grade students. Journal of Educational and Psychological Sciences., **3(28)**, 131-147, 2019.

[12] Helsel, S. (1992). Virtual reality and education. Educational Technology., **32(5)**, 38–42, 1992.

[13] Khamis, Mohamed Attia. (2015). Virtual reality technology, augmented reality technology and blended reality technology. Technology Education, 25 (1). Cairo: Egyptian Association for Educational Technology. 3:1.

[14] Laffont, P.-Y., Martin, T., Gross, M., Tan, W. D., Lim, C., Au, A., and Wong, R. (2016). Rectifeye: A vision correcting system for virtual reality. In SIGGRAPH ASIA 2016 Posters, page 8. ACM.

[15] MacIsaac, D. et al. (2015). Google cardboard: A virtual reality headset for $10? The Physics Teache,r., **53(2)**, 125–125, 2015.

[16] M. Alkhattabi. ((2017). Augmented reality as E-learning tool in primary schools' education: Barriers to teachers' adoption. International Journal of Emerging Technologies in Learning (iJET)., **12(2)**, 91-100, 2017.

[17] Mashti, Rami. (2016). The effectiveness of employing augmented reality in developing creative thinking skills and the trend towards science among the ninth graders in Gaza.

[18] M.F.Sadek (2007). Geological and structural setting of Wadi Hodein area South Eastern Egypt with application of remote sensing. National Authority for Remote Sensing and Space Sciences, Cairo, Egypt. Commission VIII, WG VIII/12 KEY WORDS: Wadi Hodein, Pan-African, ETM Ratio Image.

[19] N. Elmqaddem. (2019). Augmented reality and virtual reality in education. Myth or reality? International Journal of Emerging Technologies in Learning (IJET), **14 (3)**, 234-242, 2019.

[20] P.A. Werner. (2019). Review of implementation of augmented reality into the georeferenced analog and digital maps and images Information., **10 (1)**, 12, 2019.

[21] Perez-Lopez, D.& Contero, M.(2013).Delivering educational multimedia contents through an augmented reality application: A case study on its impact on knowledge acquisition and retention. The Turkish Journal of Educational Technology., **1(24)**, 2013.

[22] Quality, Sublime. (2018). The use of augmented reality in developing arithmetic problem-solving skills and emotional intelligence among primary school students with mathematics learning difficulties in the Kingdom of Saudi Arabia (Unpublished master's thesis). Saudi Arabia.

[23] Shea, A. (2014). Student perceptions of a mobile augmented reality game and the role of remote sensing in finding hydrothermal mineral deposits on Earth. Dr Jonathan F. Huntington CSIRO Exploration and Mining, Mineral Mapping Technologies Group P.O.Box 136, North Ryde, NSW, 2113, Australia.

[24] Steuer, J. (1992). Defining virtual reality: Dimensions determining telepresence. Journal of communication, **42(4)**, 73–93, 2013.

[25] T. Aitamurto, J.B. Boin, K. Chen, A. Cherif, S. Shridhar. (2018). The impact of augmented reality on art engagement: Liking, impression of learning, and distraction. International Conference on Virtual, Augmented and Mixed Reality. Springer., 153-171, 2018.