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Determining Students' Attitudes Towards Augmented Reality Technology technology

Abstract

Introduction. The study examines the impact of augmented reality technology on students' attitudes in primary school science education. The research investigates whether integrating augmented reality applications into science lessons produces measurable differences in student attitudes compared with traditional instructional methods. *Methodology and Methods.* A pedagogical experiment was conducted with 91 primary school students (46 in the experimental group and 45 in the control group) who voluntarily participated in the study during the fall semester of 2023–2024. The experimental group received instruction in science using augmented reality technology for four weeks, whereas the control group received traditional instruction. The “Augmented Reality Applications Attitude Scale” was administered to both groups to measure student attitudes. *Results.* Analysis of the results demonstrated that students in the experimental group who learned with augmented reality technology in science class significantly outperformed the control group in terms of positive attitudes toward learning. The experimental group showed greater engagement, interest, and motivation compared to students receiving traditional instruction. *Scientific novelty.* The effectiveness of augmented reality technology as a tool for positively shaping student attitudes toward science education in primary school has been empirically demonstrated through a controlled pedagogical experiment. *Practical significance.* The findings suggest that augmented reality applications can be successfully integrated into primary school science instruction to enhance student attitudes and engagement, providing a practical framework for teachers seeking to improve the quality of the educational process through technology-enhanced learning.

Keywords: science lesson, augmented reality, primary school, distance learning.

Introduction. It is recognized and used that the changing and developing technologies in today's times create a more qualified environment in educational environments, as in all environments. It is also known that materials designed with new technological possibilities are preferred to be used in education (Çelik et al., 2023). As may be observed, there is a growth in research on the implementation of augmented reality technologies in the classroom, which are thought to be included in education in general and make a great contribution to education (Zhang et al., 2023). With augmented reality technology, it is also seen as a method that enables students and educators to present many objects, applications and experiments

in very different dimensions that they cannot reach or embody in the real world, along with various inadequacies in educational activities in education and dimension (Nasongkhla & Sujiva, 2023). In addition to these, it is seen that augmented reality technology applications play an important role in educational life as they allow interaction with virtual and real objects in education, provide learning by doing, and increase attention and motivation. (Abdul Hanid et al., 2022).

The inclusion of technology's augmented reality environments is defined as the simultaneous acquisition of images as a result of connecting real concepts and materials produced by smart devices to certain points of the image

with special software, while educational materials produced by various computers and their derivatives are displayed in front of the camera (Low et al., 2022). In other words, augmented reality is the visualization of objects or any shape displayed on computers or mobile devices and the reflection of the object on the screen as if it were real for the user (Assem et al., 2022). Along with these, thanks to the augmented reality technologies system and technology, an object or event that does not exist in real life can be seen in the palm of your hand on the smart device screen, and learning events can increase by feeling it (Rahma et al., 2021).

It is known that there are many studies and research within the literature on the importance of augmented reality applications and their applications in different fields (Fetaji, 2020). While some of these studies are experimentally designed, it can be said that some of them are designed according to the survey model (Chiang et al., 2022). Augmented Reality-based course material has been developed for the English preparatory class in the study that is always done by education with augmented reality (Ebadi & Ashrafabadi, 2022). It is seen that there are studies that reach the conclusion that students experience enriched learning experiences by structuring the knowledge in the teaching they carry out with these materials, and it is anticipated that this study will also benefit. In addition to these, he stated that the physics course conducted with the augmented reality environment in different fields provides an advantage for the students in understanding, explaining, and transforming the lesson from abstract to concrete (Demircioglu et al., 2022).

The fact that the concepts taught with this technology in the realm of education are combined to use what is learned in digital environments, together with the uses for augmented reality devices, attracts the attention of educators and the new generation of students who are studying in their fields (Kao et al., 2022). Applications using augmented reality enable students to be involved in a learning process suitable for a constructivist approach in education and enable students to use technology effectively (Drljević et al., 2022). Although the

quantity of scientific studies on the application of augmented reality technologies in the classroom is growing, it is a matter that requires further investigation in a multi-dimensional way (Lin et al., 2023).

Although the importance of the application with the augmented reality technologies mentioned and transferred is seen once again, it is among the expectations that it will be important in this study. This study will continue with augmented reality applications according to science lessons and will be designed for primary school students.

Related Research. In the investigation of McCord et al. (2022), augmented Reality education aimed to focus on the use of 3D models to assist pupils in understanding design, and in the results part of the research, it is aimed that educators make educated choices about utilizing comparable educational exercises to get their pupils ready to understand the 2D design documents used. They seem to have come to the conclusion that 2D documentation and augmented reality benefit them. As it is understood from the above research, it is seen that augmented reality technologies provide benefits by touching the lives of students.

Su et al. (2022) aimed to use augmented reality technology with the game in which the students are divided into duos, which encourages friendly rivalry between them and encourages them to find out more. As a result, in their research, augmented reality is widely beneficial for students. and also that our system is easy to use, and it achieves positive results, as actually competing with peers motivates them to do better.

In the study of Amores-Valencia et al. (2022), the purpose of this study was to explain the impact of augmented reality on secondary education pupils' academic performance and motivation, and as a result, in their study, AR's application in the classroom was reflected by elements like attention, interest, trust, and satisfaction. They found that it provides a higher level of motivation and reflects and shows improved test scores performed on the experimental groups compared to the control group.

Augmented reality's application in education has started to spread across numerous disciplines. Science education is among the best-suited industries for augmented reality. There is some research available when searching the ERIC (eric.ed.gov) index, but not enough. Four students with learning difficulties were to be taught "Solar Systems and Planets" using an augmented reality-based intervention; Yenioglu et al. (2024) were to investigate the efficacy of this approach. Kalemkus & Kalemkus (2023) examined the impact of augmented reality applications on scientific education students' academic progress. In Atalay's (2022) study, preservice teachers were asked to use an augmented reality application to generate lesson plans for science themes and goals in grades three and four. Chou et al. (2022) investigated whether learning strategies that incorporate augmented reality and multidimensional concept maps (ARMCMs) would improve learning more than those that only use MCMs and AR in terms of learning effectiveness, motivation, satisfaction, and cognitive load. Kul and Berbe (2022) investigated how students' academic progress on elements and compounds, as well as their motivation toward the science course and the augmented reality materials utilized, were affected by an augmented reality-enhanced seventh-grade science course.

Although primary school pupils are anticipated to benefit most from augmented reality technology, it is also anticipated that this technology will add to the body of knowledge and provide insight into the lives of future generations. It has to do with the fact that the studies included in the section on related research are mostly utilized in the instruction of science and literature in many subject areas. Nonetheless, a wide variety of disciplines are taught in the field of scientific education. Regarding the utilization of augmented reality applications in this subject, further research findings are required.

The research and literature are largely benefited by the studies included in the relevant research section. According to this study, augmented reality technology is anticipated to have significance mainly for elementary

school pupils, but it is also anticipated that it will add to the literature and illuminate future generations. This study's objective is to ascertain student attitudes towards augmented reality technology.

Materials and Methods. In this section of the research, it is observed that information will be given about the method used in the research, the tools, the participant groups, some demographic information, and the instrument used to collect data. All these values in the study were collected by the investigators and added in this section, and the research was advanced by making all the necessary detailed explanations.

Model of Research. The experimental design of the research and creation of the quantitative research model are clearly visible. When considering the quantitative study model, it is evident that this model is seen as the arrangement of the necessary conditions for gathering and evaluating data in accordance with the research purpose and economically. Comparison of more than one experimental group takes place in the literature, where it is predictable. The quantitative research approach is a research model that may be used to create graphs, charts, or tables with different numbers associated with such data and study themes (Oz et al., 2021). This research starts by using quantitative research techniques to compile the effects of augmented reality technology on primary school pupils' academic success.

Working Group/Students. In this part of the research, it is known as the section where the information on the students added to the study is included. 91 children who continued their education at Almaty, Kazakhstan's primary schools during the fall academic year of 2023–2024 were the subjects of this study. The study's instrument for gathering data was administered in person to 91 participant groups and was approved.

Gender. As may be observed, the numbers of male and female students are randomly chosen linearly while creating the gender section. In addition, the details of separating the gender data of the students are given in Table 1.

Table 1

The study's gender-valued distribution of primary school pupils

Gender	Boy		Girl	
	F	%	F	%
Variable	46	50.55	45	49.45

As can be seen, Table 1 incorporates the data that the participating groups contributed and supplied for the study. In this context, it is seen in Table 1 that 50.55% (46) are male students, while 49.45% (45) are female students. It is evident that every piece of information

provided in this section accurately depicts the distribution.

Internet Usage Situations During the Day. In this part of the study, the participants' daytime internet usage was investigated, and each value is presented in detail in Table 2.

Table 2

Daily internet usage status of students from primary schools taking part in the study

Internet usage situations during the day	1-2 times		3-4 times		5 or more hours	
	F	%	F	%	F	%
Variable	2	2.18	56	61.54	33	36.26

The internet usage status of both the experimental group students and the control group students in the study was examined according to the problem situation of the research, and it is seen that the results are given in Table 2. If Table 2 is interpreted on this scope, 2.18% of the students (2 people) use the internet during the day, and it is seen that they browse the internet between 1-2 hours, 61.54% (56 people) stated that they use the internet between

3-4 hours. 36.26% (36 people) stated that they spend 5 hours or more on the Internet.

Smart Device Preference Status of the Control and Experimental Groups Participating in the Study

In this part of the study, the smart device preference statuses of the control and experimental Groups included in the study were examined in accordance with the research's problem state, and Table 3 provides the pertinent data.

Table 3

Smart device preference status of the control and experimental groups participating in the study

Smart Device	Smart Phone		Tablet	
	F	%	F	%
Variable	85	93.41	6	6.60

When Table 3 is examined, the use of smart devices preferred by the students in the control and experimental groups included in the study was investigated, and 93.41% (85 people) stated that they use smartphones, while 6.60% (6 people) use tablets. Findings in smart device preference situations represent the real dissemination.

Data Collection Tools. The part that consists of the most important parts in the studies is

known as the instrument for gathering data, and the instrument for gathering data determines the course and direction of a study. In this research, it is seen that the "Augmented Reality Applications Attitude Scale" was developed and patterned by Küçük et al. (2014). If the data collection tool part of the study is handled carefully, if the "Augmented Reality Applications Attitude Scale", which was used and preferred by the researchers before, is explained, it is seen

that this scale includes 15 5-point Likert-type items. The items in the scale were evaluated with expressions such as “Strongly Disagree”, “Disagree”, “I am undecided”, “Agree”, and “Strongly Agree”. The Cronbach Alpha value of the original scale is .835 in the literature. On the other hand, the data collection instrument was obtained from the research participant groups via a face-to-face interview.

Procedure. The goal of this research is to examine how augmented reality technologies affect the academic performance of both experimental and control group students. Its objective is to give the students in the experimental group an education that differs from that of the students in the control group.

Experimental Group: Students in the experimental group taking part in the study received the course materials for the augmented reality technology science course from using web tools in a distance education environment. Science lessons were transferred as videos thanks to the Microsoft team’s tool. The duration of the science lesson videos was determined according to the augmented reality lesson dimensions, and the average video length was limited to 18-20 minutes. While watching science lesson videos, primary school students were given the ability to use all presentation files related to the subject or to download them to their smart devices. In addition, it was checked that the experimental group students followed the science lesson education system on a weekly basis, and the students who did not attend the lesson were ensured to participate. After the students watched the videos on the system, test questions were shared in order to reinforce them.

Control Group: For the control group of the research, only the presentation files for science lessons were transferred to the system using distance education. Both groups took an accomplishment test at the start of the study. The test of achievement was administered to both groups for the last time at the conclusion of the 4-week course. The two tests that were used were assessed on a scale of 100.

Compliance with Ethics. This study examines how augmented reality technology affects elementary school pupils’ performance was aimed at and it is seen that this study, which was compiled to teach these, was compiled by taking into account the rules in terms of some ethical committees. In addition, the concept dimensions of volunteerism were mainly applied for this research, and the information was explained to the people who participated in the study one by one. All participant groups in the study were included voluntarily, and those who did not want to take part in this study were excluded from this study. Demographic and identity information was kept secret to establish the integrity of the participant groups, and a code name was arranged for primary school students; their original information was kept. All the detailed information to be transferred to the study was explained to the students, and the people who participated voluntarily were expected to comply. Finally, all the questions asked by pupils in elementary school were answered in the field of application, and it was explained that the research was not specific to them but general. Finally, the ethics committee approval form was shown to the students and their families, and the whole scenario was designed according to this fact.

Data Analysis Technique. Frequency (f), percentage (%), mean (M), standard deviation (SD), and t-test (t) were used in the statistics program to examine the data collected from the primary school pupils who took part in the study. The program’s data are presented in the findings section along with tables and remarks.

Results. According to the research’s conclusions, the problem scenario questions were answered by forming an answer. Additionally, several interpretations were offered in accordance with each discovery.

How students in experimental and control groups view augmented reality technologies. Table 5 currently contains detailed data regarding the attitudes of students in the experimental and control groups toward augmented reality technology.

Table 5

Views of students regarding the augmented reality technology used in the control and experimental groups

Student Testimonials on Moodle App Effectiveness	Experiment Group		Control Group	
	M	SD	M	SD
I like lessons taught with augmented reality applications.	4.28	0.52	3.42	0.81
I get bored using augmented reality apps.*	4.31	0.52	3.41	0.84
Augmented reality apps are difficult to use.*	4.25	0.51	3.44	0.85
I can pay better attention to the lesson when augmented reality applications are used.	4.26	0.53	3.42	0.84
Thanks to the augmented reality applications, the lesson is more I work	4.29	0.51	3.46	0.79
Augmented reality apps confuse me, making learning more difficult. *	4.26	0.46	3.39	0.81
When augmented reality applications are used, I come to the lesson more willingly.	4.28	0.73	3.42	0.83
No use of augmented reality applications in lessons There is no need.*	4.33	0.65	3.37	0.74
3D objects in augmented reality applications gives a sense of reality.	4.32	0.63	3.35	0.85
Augmented reality applications do not interest me.*	4.34	0.41	3.32	0.81
Videos of 3D objects in the book in augmented reality applications. Displaying animations increases my curiosity about the subject	4.36	0.52	3.31	0.88
I would like to include augmented reality applications in textbooks in the future.	4.41	0.54	3.38	0.79
Applications for augmented reality are something I would like to incorporate into other classes.	4.42	0.58	3.46	0.78
It is a waste of time to employ augmented reality applications in the classroom.*	4.42	0.63	3.72	0.81
I like using augmented reality apps to learn at home.	4.41	0.55	3.62	0.88
Average for the Whole				

According to Table 5, the post-test findings comparing the opinions of students in the experimental group and those in the control group about augmented reality technology showed a significant difference ($p < 0.005$). In addition, the reverse process was applied in order to obtain the statistical values of the negative values stated on the scale.

Even though every statement differs significantly, the post-test results show that one of the most notable statements made by the experimental group's students is "I would like to include augmented reality applications in the textbooks in the future," with a $M = 4.41$ point average, whereas the control group's evaluation result is $M = 3.38$. Secondly, among the most notable manifestations of the students

in the experimental group, "I would like to use augmented reality applications in other lessons", was $M = 4.42$, while $M = 3.46$ in the control group. With the findings obtained, one may say that the pupils in the experimental group have a positive change in their sense of confidence thanks to augmented technology, and they have the opportunity to use augmented reality technology whenever and wherever they want to reinforce it, and it contributes positively to their understanding of the lessons of education.

Additionally, the experimental group's students said that "displaying 3D objects, videos, and animations in the book in augmented reality applications increases my interest in the subject", according to the post-test findings. In contrast, the control group's average score

was $M=3.31$, but the experimental group's was $M=4.36$. From the statements of the pupils in the test group, "I can pay better attention to the lesson when augmented reality applications are used," $M=4.26$, while the final result in the control group is $M=3.42$. Finally, one of the experimental group's students' most noticeable expressions, "I come to the lesson more willingly when augmented reality applications are used," was $M=4.28$, while the final result in the control group was $M=3.42$.

Given the aforementioned results, it can be concluded that the viewpoints of the research participant groups on augmented reality technologies have a positive value, and while they have the opportunity to learn the subjects, they learn more easily. More understandable course environments are created thanks to the resources and technology provided by augmented reality technologies.

Discussion. The purpose of this study was to compare and investigate the potential added value of an experimental study, a control group, and digital lecture notes, using a traditional teaching approach and an augmented reality application for education, with the experimental group. The study revealed differences in attitudes towards the augmented reality application between the two groups. A thorough analysis of these findings reveals that the experimental group members were preferred over the control group due to variations in attitude items between the two groups. Based on this result, it is concluded that augmented reality technology provides meaning and benefit to students in science education.

To improve learning outcomes, Benrahal et al. (2022) aimed to prioritize the use of Augmented Reality (AR), one of the most recent technical advancements, as a teaching aid. They also looked into how social influence affects behavioral intention to use augmented reality learning. When this value of the research is compared and evaluated with the results of this study, it is evident that the pupils in the experimental group expressed that they enjoyed the lessons given with augmented reality applications and wanted to spend more time with this technology. With these values,

augmented reality technology gives meaning to two separate studies, and the idea that this technology will support motivational types of education is always present in the literature.

Gao et al., (2023), in their research, aimed to present the effect of a mobile augmented reality application on students. Consequently, the pre- and post-test results of their investigation showed that the augmented reality software improved students' comprehension and communication of the material. They concluded that their experience with the application was favorable. The experimental group students' pre-test scores on the augmented reality application before training and their post-test scores on the augmented reality technology application after training differ significantly, according to the study's findings, when combined with this research.

Each study is expected to shed light on the literature while providing augmented reality and meaning for students in this field. In this study, the fact that primary school students benefit from augmented reality technology means that their use of technology in every sense in their future lives will create a more productive and learning society. The expectation of a repeat of this study elsewhere is increasing.

Conclusions. Looking at the results section, which adds a different meaning and integrity to the studies. The quantity of pupils is the most important factor. A thorough analysis of the student numbers reveals that a total of 91 people, 41 in the experimental group and 40 in the control group, voluntarily participated in this research. Another valuable aspect of the research is the examination of the internet usage patterns of both the experimental and control group students throughout the day, and the conclusion that 3–4 hours of internet use was the most desired. This implies that it would be advantageous to train the elementary school students who took part in the study. Examining how the experimental and control groups' pupils used smart gadgets and concluding that most of them preferred them is another important component of the study. This also serves as an educational tool among the opportunities offered to them. Another valuable

finding among the study's results is that the final test results regarding the opinions of the pupils in the augmented reality technology test group were higher than those in the control group, and a significant difference was detected. Furthermore, the study shows that the participating groups have positive views regarding augmented reality technologies, that they find easier learning opportunities, and that more understandable learning environments are created thanks to the resources and technology provided by augmented reality technologies.

Although the experimental group's students' attitudes toward the augmented reality technology environment were at the "strongly agree" level, the control group's average scores in this area were at the "agree" level. This is significant for the experimental group's students and has a higher value than the control group's students' knowledge level. It is evident from a careful examination of the study's findings that students in the test group use augmented reality technologies in scientific classes more successfully than those in the control group.

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