Applying Virtual Reality Experiments on Teaching kids from Teacher and Parent's perspective

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Abstract

In this research paper, we applied experiments using virtual reality technology to teach young students with the participation of their teachers and parents. This technology was applied to second-grade students, approximately 39 male and female students, and they were distributed into groups containing a certain number of students studying one common topic among them, using virtual reality glasses to watch a video explaining the required topic. All selected topics were mathematics only to achieve satisfactory results. After that, the teacher distributed activities to the students without any prior explanation of what was seen, and the parents also discussed with the students to determine the amount of comprehension and understanding of what was accomplished using this technology. The results showed correct and rapid responses for most students, up to 89.74%, compared to 10.25% of the students who did not complete their performance. We hope to apply some of the modern technologies to teach students and provide them with the desired experiences for the future of the country.

Keywords: virtual Reality; Experiments on Teaching; Teaching Kids; programming applications

1. Introduction

Education is generally defined as a permanent behavior change in the individual's behavior and the acquisition of sufficient experiences to meet life's challenges through his own experiences (Ertürk S., 1972). Learning is a cognitive procedure that requires active involvement by the individual (. Another approach that defines the term learning is a procedure of constructing the individual personality (VURAL & ARSLAN, 2019). On this basis, the process of teaching and learning requires active participation from the individual to acquire knowledge, perception, and systematic behaviors acquired based on the extent of knowledge acquisition. Existing technological changes in the field of computing bring many effective and appropriate applications to create broader opportunities for the individual to be permanently educated with high efficiency. Therefore, there will be no excuse accepted by individuals that prevent them from acquiring knowledge or restrict their performance in development and creativity (Smutny P., 2022).

The world is witnessing many rapid changes in the field of technology at all levels: educational, health, agricultural, economic, transportation, and others (Yousif J., 2020). Evidence for this is the presence of technologies all around us. Also, the emergence of new technologies from time to time is another evidence of the progress of these technologies. Among the innovative technologies is Virtual Reality (VR), which simulates the environment in which individuals live or a fictional reality similar in its characteristics and properties to the actual environment or not at all like the real environment. Suppose we simplify the definition of virtual reality. In that case, the individual can exist in another reality utterly different from his actual location regarding time and space. Thus, virtual reality is a reality that isolates users from their actual environment, which therefore causes lots of benefits and harms that we will mention later. For the individual to exist in virtual reality, the user must use a programmed helmet to transfer the individual to the required environment, in addition to some accompanying and not necessary accessories such as gloves. The words Virtual Reality are not new terms. Although they have been used recently, they were known before the 1980s. The history of virtual reality began with theatrical work and theaters before the 1990s (Dixon, S., 2006). Then, studies and research started to follow in this field, and it was considered a high-quality technical breakthrough that moved the world to a rapid and unprecedented development in all areas. Virtual reality is a participatory, interactive environment that can support the participation of many remote users in virtual places different from their actual location (Cho & Park, 2023). Virtual reality is also characterized by the possibility of creating the illusion of participating in a virtual environment more than external observation of such an environment (Gigante, M., 1993). Based on the time-based analysis, studies on virtual reality were presented after the 1950s (Başaran, F., 2010). Then, it was followed by studies

that led to its continuous development and emergence as a multi-use technology in all fields, and projects are still being built on it at high costs for the sake of science and knowledge.

The beginnings of the use of virtual reality in the field of education and learning began with a study conducted by Gürkan YILDIRIM, Mehmet ELBAN, and Serkan YILDIRIM on a group of students to find out students' opinions about using virtual reality glasses to teach history to students (Yildirim et al., 2018). While discussing the current developed technologies, it is seen that in the application of Virtual Reality (VR), most of the productions and releases were based on use in the field of education, which is one of the technologies that has been analyzed and discussed frequently in recent years. Therefore, virtual reality applications have already been discussed and researched for many years, and it is one of the most studied technologies to be developed for various purposes (Paolant et al., 2023; Rojas-Sánchez et al., 2023). In our current era, developments in virtual reality applications have continued their presence in multiple fields, from tourism to education. We can see some examples of it in the advertisement of a tourist destination, its appearance as historical elements of display for fun and learning, which need a high-resolution image enhancement system (Al-Hatmi M. & Yousif J.; Hasoon et al., 2011), or in the entertainment sector, for example, but not limited to. Of course, in addition to these widely used areas being developed and disseminated, current technology allows us to increase its use in educational environments such as using social Robot (Yousif J.,2021; Yousif et al, 2017). Mohammed (Yousif M., 2021a) Proposed an educational system based on a humanoid robot, which is used to improve the social and communication skills of children with autism.
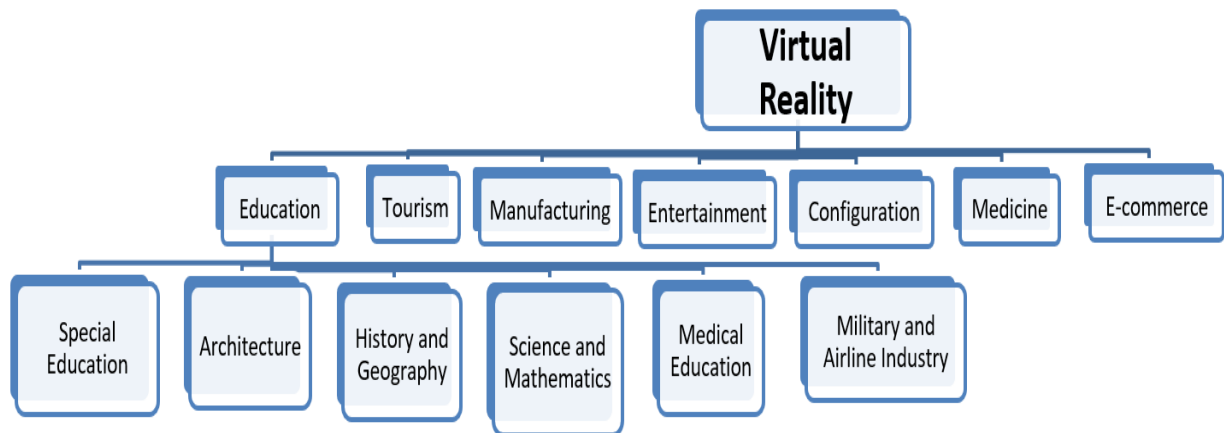

Figure 1: Virtual Reality Fields

Cavach classified the use of VR in education (ÇAVAS et al., 2004), while Başaran (Başaran, F., 2010) classified the usage of all application domains in VR, which is summarized in Figure 1. The existence of any technology always has two sides: a negative side and a positive side. Individuals must balance using any technology because of its short and long-term damages. They must also use it effectively for the benefit of the individual and society to move up the ladder of knowledge. According to previous studies, we will mention some of the advantages of using this technology. Individuals who use virtual reality applications consider themselves as part of that environment, so they increase their interest in it and in similar courses (Nooriafshar et al., 2004). In addition, virtual reality can facilitate the education process and simplify access to information. Effective learning results can be obtained using teaching materials prepared using the latest virtual reality technologies. These abstract concepts enable students to imagine and visualize them, track cosmic and astronomical events, conduct experiments and trips in different environments safely, and others. Therefore, the use of virtual reality technologies supports and simplifies education (Youngblut C., 1998).

2. Related Work

In as mentioned above, studies and research based on the use of virtual reality applications have evolved over the years to include various fields of life. And that indicates the great benefits of this technology, from facilitating the services used to acquiring knowledge and creativity. Let's consider the possibility of educating all segments of society that find it difficult for them to pay the cost of study or who need help with absorption and other purposes deemed standard in the regular learning system. This will make the education system more flexible and benefit everyone. Yildirim conducted an analysis survey on a group of history students using VR technology (Yildirim et al., 2018). The study aims to find out their opinions and suggestions on using VR glasses—the selected sample comprised 25 undergraduate students (13 females and 12 males). The methods used in collecting data were surveys and interviews. The result was interesting as the participants liked VR implementation, which was inferred through the active engagement of participants during the implementation. Furthermore, the participants would like to use it in new activities to gain more benefits and understand the topic (Başaran, F., 2010). Nooriafshar (Nooriafshar et al., 2004) conducted a similar study with different participants almost fourteen years from Yildirim (Yildirim et al., 2018). They applied it to two different environments to provide better perception, purpose, and results. The study involved students from business and nursing environments. The methods used were attending a tutorial session on a specific topic, and then, each participant was interviewed to collect their feedback on VR technology being used in the study. They concluded that VR multimedia efficiently provided visual understanding features, realistic views, and improved

learning as understanding the topic became faster and simpler due to engaging in the virtual environment and working as if it were real. Besides that, both students (in environment) agreed that this technology brings the real world to their places as it gives a close relationship with the whole world. Therefore, they concluded their study with the assumption documented by evidence that VR techniques are useful in teaching and learning. Maas & Hughes reviewed the literature studies on using VR in education, where both traditional and virtual studies were conducted. This study explores a mixture of traditional and virtual studies to detect the extent of student's comprehension of the academic axes and to conduct tests to determine the level of global understanding of what was exposed in both methods (Maas & Hughes, 2020).

A group of researchers studied the possibility of mixing education with augmented and virtual reality. Then, they discussed and analyzed the public's views and feelings about these technologies and their public stances on social media data such as Twitter. The study was conducted from 2010 to 2020 and received 17,000 tweets. Due to the vast responses, four databases were created and divided into two databases for educational use and two for general use. The researchers analyzed the data effectively through several methods and in three stages. The first stage is the stage of text mining, followed by sentiment analysis, and ends with topic modeling. Several techniques and Tools were used in these stages, such as Text-Blob, Word-Emotion-Association-Lexicon, Valence-Aware-Dictionary, and Latent-Dirichlet Al-location. The results showed that most of the audience supports the use of virtual reality and augmented reality in education in general, and most of their feelings centered on joy, confidence, and anticipation. The study concluded that virtual and augmented reality have precise educational results as an effective educational method for raising performance in general (Lampropoulos et al., 2022).

Andrzej Paszkiewicz presented methodologies related to Industry 4.0 on implementing VR in education. The research depended on comprehensive methods such as design, implementation, and testing of the courses implemented in the environment of VR. A VR technology training model was used to support the selected courses, which could provide reality. The results showed that the knowledge and skills of all participants were improved by using the training model based on VR. Furthermore, developing courses using VR could reduce the cost, improve safety, and increase performance efficiency (Paszkiewicz et al., 2021). Immersive VR Simulation was designed by Cho & Park to be used in environmental science education. The purpose of that is to spread awareness among students to be able to solve and recognize problems related to environmental science. The method used in this research was the virtual ecosystem model, which considered space, time, objects, organisms, and environmental factors. The evaluation of the virtual

ecosystem model showed average results due to the uncomfortable environment that students felt during the knowledge spreading of environmental science. In contrast, the others were interested (Cho & Park, 2023). Wei and Man studied education in the current and future with immersive VR. They built their research by exploring web science on educational technology and immersive virtual reality to write a complete analysis of Literature. Therefore, they used site space as a research tool. 1296 publications between 1916 and 2022 were studied. The result shows that the publication research is increasing in this field yearly. USA, England, China, Australia, Spain, Canada, Germany, and Taiwan were the top countries with many publications. Figure 2 shows the number of publications in those countries as evidence of the dramatic growth of immersive VR (Wei & Yuan, 2023).
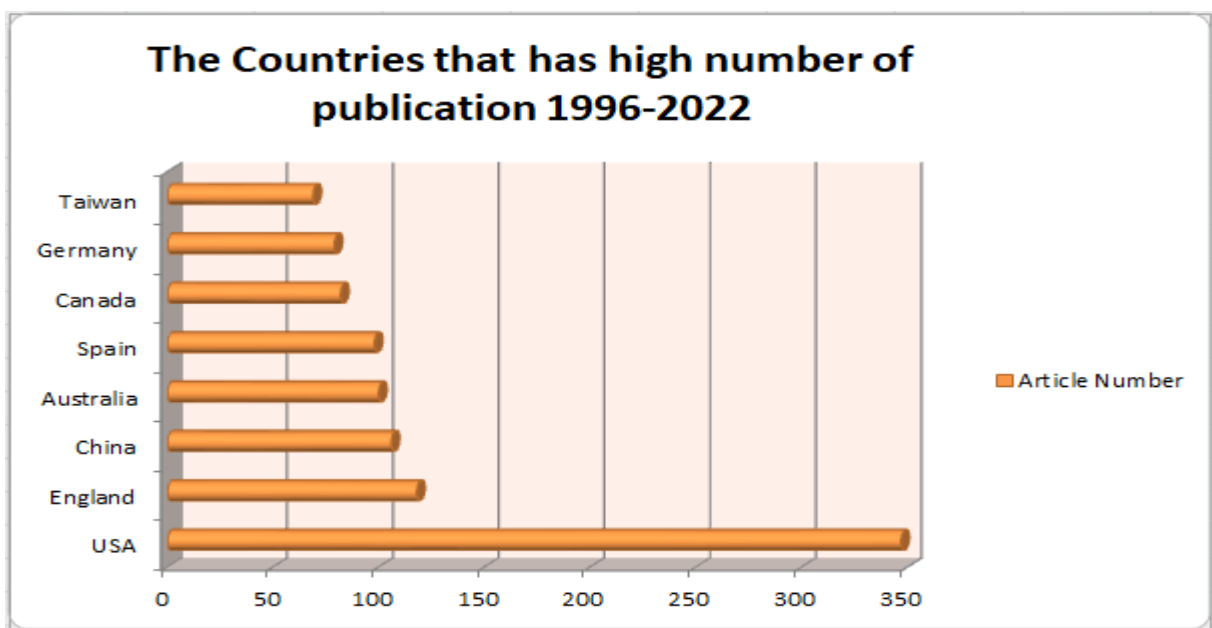

Figure 2: No. of VR publication in some countries

The University of Charleston offered VR Lab as a next generation of education. They implemented VR technology in their lab to study human anatomy in 3D in the fall of 2022 to enhance and improve students' learning mechanisms. Some features are provided in the lab, such as high-powered computers with high-resolution headsets. The total number of supported computers is 30 PCs. Prospectus VR is used in this experiment, which abstracts the translated data by making the images appear natural. This type of study can be used in many other fields, such as medicine, astronomy, physics, and nursing. The use of this laboratory is still in place for students, and the research is still in

progress. Still, the preliminary results of this mighty work are promising, as the students who use this laboratory have noticed an improvement in their performance in that study (Overman, D., 2022). Table 1 Summarizing VR Methods based on the related work studies.

Table 1: VR Summarization Methods

Authors	Year	Methods	Results
Cho & Park, 2023)	2023	Virtual ecosystem model	The evaluation showed average results due to uncomfortable environment that students felt during the knowledge spreading of the environmental science, while the others were interested.
(Wei & Yuan, 2023)	2023	Site-Space	The publication research are increasing in this filed year after a year.
(Overman, D., 2022)	Since 2022	Perspectus VR	The preliminary results of this mighty work are promising, as the students who use this laboratory have noticed an improvement in their performance in that study.
(Yousif, M., 2022)	2022	VR/AR	Implement a VR/AR environment for training students at the engineering Lab on the concepts of engineering tools. They liked the implementation, making the study more manageable and more understandable.
(Lampropoulos et al., 2022)	2010-2020	Text mining sentiment analysis topic modeling	Most of the audience supports the use of virtual reality and augmented reality in education in general, and most of their feelings centered on joy, confidence, and anticipation.
(Paszkiewicz et al., 2021)	2021	Comprehensive methodology such as design, implementation and testing of the courses implemented in the environment of VR	The knowledge and skills of all participants were improved by using the training model based on VR. Furthermore, the development of the courses using VR could reduce the cost, improve the safety and increase the efficiency the performance.
(Yousif, M., 2021b)	2021	Training and teaching applications used in VR	standalone applications for Autistic Children based on C# that can be executed in VR, which improve student academic performance.
(Maas & Hughes, 2020).	2020	Review mixture of traditional and virtual studies	Students' performances were improved in general.
(Başaran, F., 2010)	2018	Survey Interview	The participants liked VR implementation and inferred through active engagement of participants during the implementation.
(Nooriafshar et al., 2004)	2004	Tutorial session Interview	VR multimedia was efficient in terms of providing visual understanding features, realistic view and improve learning as understanding the topic become faster and simple due to the engaging in the virtual environment and working as if it were real.

3. Method and Implementation Process

In this study, virtual reality technology has been used on a group of kids by visualizing advanced learning programs, being active, and interacting with what they see as a case study method, which is considered qualitative. In the second stage, their parents are involved by explaining their roles in this study for the benefit of their kids, whether now or shortly. Therefore, the parents follow up with the kids at home by:

1) Ask them comprehension questions about the topic presented previously to check their level of comprehension.

2) Ask them memorization questions to find out how much they remember and memorize the material.

3) Write their comments on the extent of their kid's understanding and their satisfaction with this achievement, which got analyzed to find out the reasons behind their opinion.

The range of this study included 39 kids, with 19 males and 20 females, who were in second class in Primary School. Those participants must study the subject "Cambridge Math" as part of their total subjects. All participants were aware of the VR technology in playing games only, but not in learning methodologies.

In the implementation process, the participants were categorized into groups to measure various topics related to the same subject. They were organized into two categories. Each category consisted of three groups, each combined males and females of 6 to 7 students. This implementation process included a pilot study as a training experiment, which might enable them to adapt to various learning environments. The division of students into groups was not random. Still, it was based on several methodological foundations, including the student's mental abilities to understand and assimilate, trying to raise the general achievement level of students and pass the course successfully without difficulties. The learning contents included were:

1) Addition and Subtraction,

2) Appreciation and rounding,

3) Bigger and Smaller,

4) Matrices,

5) Contracts,

6) Even and Odd numbers. VR glasses were used in this experiment, which showed an interactive video for 5 minutes to each group of participants. Then, exercise questions were submitted to them to solve it without any further

explanation. Although their exercise's result was excellent and nearly all were correct, only some participants showed a few incorrect answers. But in general, the performance was fast and inspiring.

3.1. Data Collection and Analysis

Response as a data collection tool, an interview technique was used to collect all necessary data from the participant's teacher and parents. The technique used was a semi-structured interview prepared by another researcher and consisting of 6 similar questions with different topics. This interview was conducted at the end of the implementation stage directly after the experiments.

The content analysis method was used to analyze the collected data from the participant's teacher and parents, where an audio recording device was used to store their valuable data for all the questions asked. Their answers were structured and compared to determine the result of this experiment. The figure shows the implementation process in this experiment.
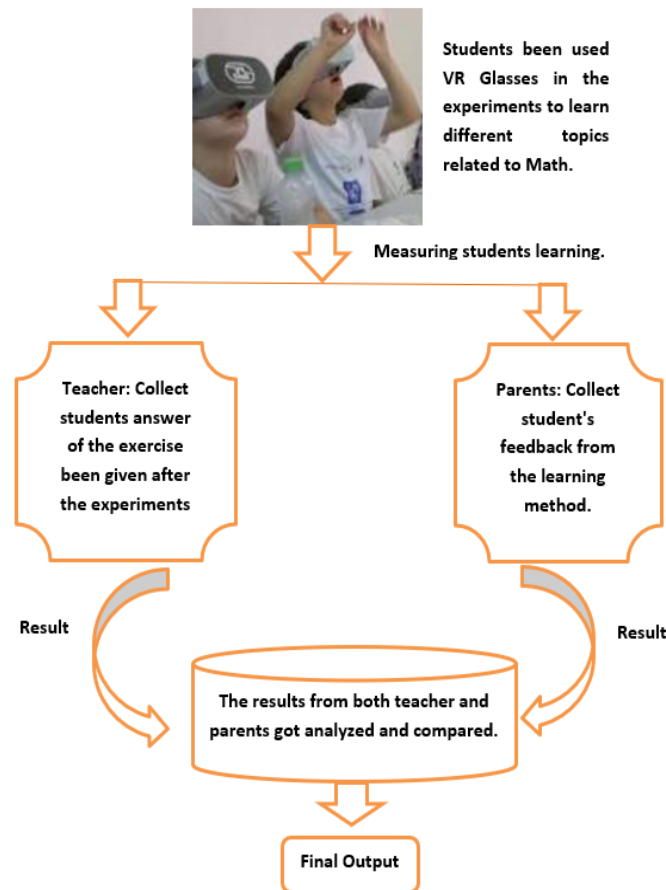

Figure 3: Schematic diagram of Implementation process

4. Discussion and Results

This research aimed to find out the opinions on adapting VR technology to teach young age students some topics related to Math subject and try to measure their understanding from the point of view of their teacher and parents. The interviews were done with the teacher and all participants' parents, a total of 40 people, where only 4 of the students out of 39 never used the VR glasses anywhere else.   But also, those students who used the VR glasses only used them in the video games in the funfair places. Furthermore, VR glasses have never been used as a learning and teaching tool for any subject. Therefore, adapting this technology was new for all the students, teachers, and parents.

4.1.   What is the teacher opinion on using VR technology on teaching some Math's topics?

Table present the teacher results that indicates that the students could answer any question theoretically and practically related to their topics 100%. Although some students need more exercises and practice to gain more knowledge in the given subject, they all solve the given exercise after adopting the technology. The only misleading was how fast they understood the exercise before starting to solve it, which led to low performance on 7 students from two topics, Matrices, and Contracts. For the rest of the topics, all students were able to perform well.

Table 2: Teacher's Results

Math's Topics	# of Students	# of Correct Result	# of Fast Responses	Teacher Remarks & Opinions
Addition and Subtraction	17.94%	15.38%	15.38%	Students' abilities to understand the topic and keep up with the video shown have improved significantly, which has led to:
Appreciation and Rounding	15.38%	15.38%	15.38%	1. Absorb and understand the topic well 2. Solve a model like what was presented correctly without the teacher's intervention
Bigger and Smaller	15.38%	15.38%	15.38%	3. Speed in completion with specific time setting
Matrices	17.94%	10.25%	7.69%	The students who made a mistake had an actual error in the result, but the solution method and steps were correct.
Contracts	17.94%	17.94%	17.94%	
Even and Odd numbers	15.38%	15.38%	15.38%	It is noted that the most difficult topic among the six topics is matrix, and this topic requires several models for optimal understanding and continuous training of matrix networks. As for the quick-understanding students, they were faster in achieving than the rest of the students.
Total	100%	89.74%	87.17%	

From Table 2 - the teacher was estimating the student's observation and understanding- we clearly indicate that using VR technology with the students at an early age was new for teaching and learning some topics related to their subjects was helpful and gave realistic results as a self-learner. Moreover, this technique can be used to raise the achievement level of students with a weak achievement level, which may result from increased knowledge and development of their mental abilities for correct actual achievement. Also, through the teacher's observations, some students increased their speed in solving the models accurately. Therefore, it can be applied and tested for another study whose goal is to determine the actual speed level of students and the possibility of increasing this speed or not because of using this technology.

4.2. What is the parent's opinion on using VR technology as a learning method?

During the interview with the parents, they were asked six similar questions to conclude the effectiveness and success of the technique used in this study. Accordingly, the general conclusion for this technique was built. Table 3 shows the questions asked to the parents with their opinions as a sample.

Table 3: Parent's Opinions

#	Questions	Responses		Opinions
		Yes	No	
1.	Did the parents notice any improvement on their kids regarding the topic that was exposed to the technique?	☐	☐	Most parents noticed their children's ability to remember the video shown as an explanation to understand a specific topic in mathematics, and most students were also able to explain what was presented. Most of the students also solved similar problems successfully. Therefore, from the perspective of parents, using this technology can raise the achievement level of students and reduce the possibility of failure, regardless of the subject.
2.	To examine the level of recall: Does the student remember the explanation presented?	☐	☐	
3.	Was the student able to solve similar problems on his own without prior explanation?	☐	☐	
4.	Was the activity completed successfully?	☐	☐	
5.	Can you use and apply this technique to raise the general level of the student?	☐	☐	
6.	Can the student repeat the same topic to their parents correctly?	☐	☐	
Total Number of Responses: 100%		89.74%	10.25%	

Based on the results reached through interviews with the student's parents as a complementary and confirmatory stage to the previous step, which consisted of open-ended discussions and dialogues with the subject's teacher to obtain accurate and more transparent information. Therefore, the results of this stage were identical to the previous results, as the students who made a mistake in answering the activity were the same ones who understood part of the video

shown or lost focus during the presentation. In this way, parents' solutions are presented to the questions raised and their suggestions for building a technologically aware generation.

Q_1: Most parents noticed a significant improvement in their children's performance in terms of understanding and comprehension, which enabled them to solve the activity efficiently and quickly. However, a few students found something that needed to be added in terms of concept and speed of performance for some of the topics presented in the video.

Q_2: The students were creative in re-explaining the topic presented in the video to their parents in an elaborate manner and with activity models, ensuring that their parents could distinguish the topic titles and deduce their children's mental abilities. However, a few students explained only a small part and expressed the rest by interacting with the video environment with movements.

Q_3: Based on the parents' conclusions about the extent of progress in the amount of knowledge of the video topic through the first and second questions, the parents examined their children mentally by handing them another activity identical to what was presented, with a difference in numbers, and another activity that is entirely different and requires concentration to solve. They reached an exciting and honorable conclusion that serves everyone: the children's ability to solve the exercises was excellent, with some students needing to rephrase the question for clarification.

Q_4: Parents did not need to think in-depth to answer this question, as the answer was clear and motivating for their children. So, all the parents answered yes with evident joy on their faces.

Q_5: All parents agreed on the importance of using modern technologies in learning and teaching because of their general benefit to children, facilitating the teacher's work faster, and motivating students to learn by being in an interactive environment different from the classroom and school environment.

Q_6: Parents expressed their surprise and joy at the same time at how their children explained the topic smoothly and understandably. However, some students briefly explained their topic while missing some essential points.

The number of students involved in this study was 39, and 35 (89.74%) could participate efficiently in the video. Exercises given by the teacher were solved perfectly, and they explained what they had viewed to their parents in deep detail. Only 4 of the students with (10.25) struggled with solving the exercise and explaining their points of view to their parents. But in general, this study with the used technology expressed how the growth of technology positively affects the learning methodology as it does not need to be in the classroom or in the school to learn the subjects at any age. Furthermore, this study proved that the use of modern technologies accelerates the delivery of information to

students, as changing the adopted system with a similar virtual system is capable of effective achievement and revolutionizing the field of science, learning, and teaching.

5. Conclusion

In this study, we apply experiments on school students using Virtual Reality Glasses to find out the capabilities of this study to provide the required knowledge to the students. To provide accuracy and credibility, we requested the participation of the mathematics teacher and parents to participate in giving the correct results and comparing them with each other, and this is what was achieved, such that the student's response to what was done was 89.74 percent.

The percentage of students who did not complete parts of their solutions was 10.25 percent. Thus, the result shows that the use of modern technologies for learning has become a demand in the revolution of the emergence of advanced technologies that support education and knowledge acquisition.

There are many challenges that we faced during the implementation of this study. Still, we mention only the two most important ones: Dealing with children requires a specialized person to gain their trust and monitor their behavior when dealing with the devices used. Also, using virtual reality glasses requires a budget for application at the school level and at all educational levels, which is currently unavailable. One of these challenges can be solved by searching for companies that adopt this idea and support this project financially, which is what we are seeking shortly.

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