

# A Review on Augmented Reality and Virtual Reality in Education

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**Abstract** - In a wide variety of instructional initiatives, VR and AR have been adapted, including astronomy, architecture, physics, geology, biology, chemistry, mathematics, geometry, the humanities, training and many other disciplines. A systematic analysis was undertaken on how the role of AR on the learning process was measured and the viability of incorporating virtual reality in the learning environment was understood. VR offers new visualization approaches and for Alternative approaches to the presentation of learning about materials. There are debates about whether VR and/or AR for separate learners will help address the existing education problems. These advances will push learning process into a new era and connect traditional schooling with the technology of the future.

**Key Words:** Augmented Reality, Virtual Reality, Education, Students, Teaching-Learning process, Visualization.

## 1. INTRODUCTION

Technology has been growing increasingly and dramatically affecting numerous facets of life in recent years; our thought, behaviors, social practices, and lifestyles have all evolved in various ways relative to a few years ago. One of the emerging technology that has undergone major importance is augmented reality (AR). As a result of its efficacy, particularly in education, growth has ceased in recent years. [9] Virtual reality (VR) and augmented reality (AR) technologies are explored in this study to optimize learning processes. New VR and AR technology and cell-phones can be paired with several other significant considerations, such as new age virtual course, responsive teachers and rules, efficient instructional resources, funding for hardware and apps, qualified and confident instructors, and ready learners to help enhance the experience, operation, and efficiency of learning. [6] A significant advantage brought on by such innovations from an instructional viewpoint is that they contribute to a classroom atmosphere that is mainly focused on learners. This promotes the use of novel instructional approaches and

incorporates new teaching modes into the learning experience. Students are highly inspired to introduce the new ICT technology into the practice of studying.

[17] The use of revolutionary VR educational environments for school, industry and creativity is made possible by technical developments. These emerging innovations are eager to be seen by students because ICT is now an important part of their society. The most prominent aim after the system is that the MR found by people has a central and primary role in practically rendering the using the entity. While a lot of research on AR has been carried out, but it has shown that few experiments have been performed in this field. However, AR in education is perceived to have effective function with broader consumer penetration than ever before due to the positive features and outcomes of progress in computing and information technology.

## 2. LITERATURE REVIEW

### 2.1 Summary

The main focus in [1], was to get an insight of the present level of understanding of AR concepts and how much it is adopted by schools. Two hypotheses were considered:

Hypothesis 1: School teachers and not aware of the concept of AR

Hypothesis 2: Acceptance of teachers in AR.

In relation to the questions, a further question was also asked by the respondents about their willingness to implement AR system in their modes of teaching. The query was: "Do you believe elementary school teachers are prepared in their learning styles to embrace AR applications".

As we continue teaching in a traditional way, which in turn has no scope in enhancement in ideas presented. The survey conducted from [7] shows how people are oblivious to augmented reality/virtual reality. Many studies show the advantages of AR/VR in education: visualization of abstract

objects, a better understanding of concepts, and a new technique in learning is accompanied by curiosity in the teaching-learning process. These techniques are useful for people with a certain disorder or people suffering from dyslexia (who find it arduous to learn from books). AR comes with its own specialty of immersing the Reality, providing new levels of interaction to magnify the user experience. In the matter of VR, it helps in simplifying complex problems, works with real-life scenarios, and allows the student to travel to a different environment virtually. Some scholars contend that the morale of teachers is central to educating; it is therefore very necessary to analyze the perceptions, expectations and aspirations of prospective teachers when it comes to the use of evolving field in the classroom [7].

In [14], they developed a prototype for a couple of concepts in the physics domain. This was developed on a survey conducted by the team where they interviewed a few teachers about their experience with AR/VR, lab environment, existing software for educational purposes in the physics domain, etc. The prototype was developed for Microsoft HoloLens. The prototype was presented to the teachers and later a survey was conducted to know their opinion on how AR/VR will be helpful in the physics domain. The survey resulted in a list of reasons like being able to visualize concepts like gravity, electricity, and magnetism which are invisible to the naked eye. Augmenting real-life objects along with before mentioned concepts will help students in the learning process.

The main aspect of AR/VR is to allow the students to perform the experiments that are not accessible in a real-world environment'. The problems as discussed in:

- Problem with Time: time-traveling allows the users to experience the historical tenure; in this VR acts as a medium for students to learn more about history.
- Physically not accessible: considering the subject of Science, we observe that there are specific scenarios that are untouched in learning from practical experience.

The fitness of complimenting AR technology to a subject was calculated on the basis of various factors relevant to the special affordances of AR technology that distinguish it from current classroom instruments: In fact, if students benefit from 1) three-dimensional representation of the mathematical context (e.g. volume visualization), 2) synchronized visualization of the content by separate representations (e.g. seeing spatial and numerical representations together), 3) physical interaction of

mathematical formulas, a curriculum subject has been rated as a great fit with AR, (ex: physically enacting decomposition of numbers), or 4) getting access to supplementary information in context (ex: accessing word meanings in a word problem).

[15] They created a marker-based 3D skeleton model to learn about the bones of the body using Unity and Vuforia. The 3D skeleton was designed using Autodesk 3ds Max. They conducted 2 quizzes one before using the model and one after using the model where it was found in the latter quiz indicated better retention about the topic among students. A survey was also conducted where high interest in teaching and learning with the aid of 3D models was to be found.

[3] The data suggest that while the majority of students have high hopes about these technological advancements, they still have a considerable number of misperceptions, especially about the health effects of AR/VR.

We intend to evaluate the elements that determine positive attitudes towards AR/VR in our future work, so that they can be used to boost enthusiasm to use new tech among future teachers.

The survey specified in [7] also focuses on the augmented learning experience with the incorporation of AR/VR.

Constructivist learning includes AR in a way that motivates students to interact with thorough level of subject.

Situated learning brings practical and real-life examples for better understanding.

Games-based learning can be used to encourage AR to Games-based immersive learning through the development of a digital narrative, putting in some positions of students, offering authentic tools and contextually appropriate incorporation about details.

Enquiry-based learning provided by VR means to Data is collected electronically for future review and given within a real-world context, synthetic, easily manipulated models.

According to the survey in [7], an online questionnaire was shared among the students of the ICT module (1st-5th year of the study program), as well as teachers to find out their opinions on the AR/VR learning process. The study found that while most students have favorable attitude for these innovative trends, there are still a great amount of misperceptions among them, especially about the health implications of AR/VR. This is mostly because VR/AR systems and how to use them in the classroom are still relevant to a tiny proportion of pupils.

## 2.2 Review Methodology

Based on the below questions/metric we have examined the research papers:

1. In these papers, what are the target groups used?
2. What are the various application domains where AR/VR is used?
3. Interest among students' and teachers' to use AR/VR "as a learning aid"?
4. What was the role of educators in the development process like?
5. What kind of effect the prototype examined?

## 2.3 Results and Statistics

Question 1 shows the target groups of the survey as seen in the Fig. 1

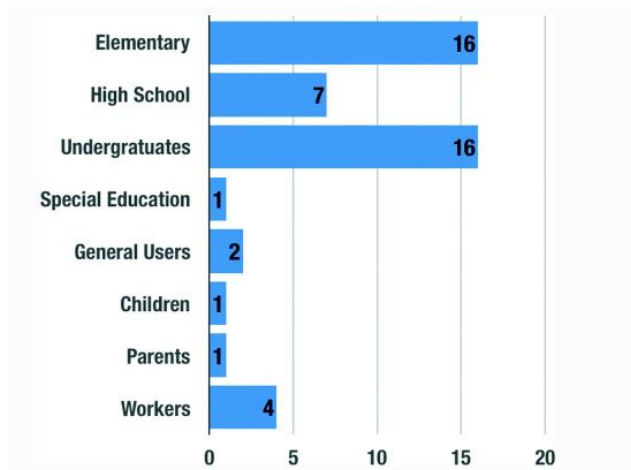


Fig-1. Target Population

Fig. 1, [18] indicates that undergraduate students and elementary school kids are the most common target group. In seven works, high school students emerged, thus becoming one of the most well-known group for AR instruments.

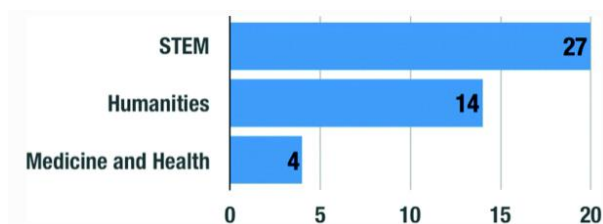


Fig-2: Application Domains

Fig. 2 demonstrates that STEM fields are related to most AR instruments. STEM is an abbreviation for areas of research, architecture, mathematics, and technology. Human sciences, followed by medicine and fitness, are the second most important field for applications.

For Ques 3 we refer the survey conducted in [15], where we see the impact of AR/VR on student's understanding.

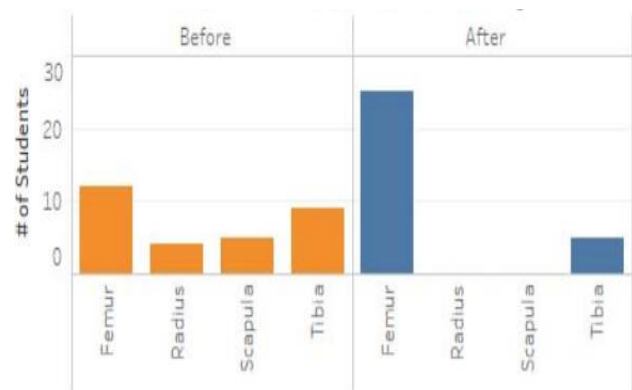


Fig-3: Question #3 in [15]

The survey showed that before using the application it was difficult for the students to interpret the certain concepts. And after the application there was increase of 43% in correct answers.

Table -1: Teachers' Survey

Questions	Response
Was the application easy and simple to use?	Agree
Was the survey completed quickly after using the application?	Strongly Agree
Was the 3D skeletal model effective in helping students complete the survey?	Agree
Was the 3D skeletal model presented clearly	Agree
Did the application have all the necessary information?	Neutral

[11] The AR application was simple to use and successful in encouraging students to learn the concepts, based on the findings of the instructor survey, as seen in Table 1. The instructor commented that in the classroom, all students used computers, including tablets, laptops, and projectors.

Question 4 underlines the significance of classroom faculty in the performance review as shown in Fig. 4.

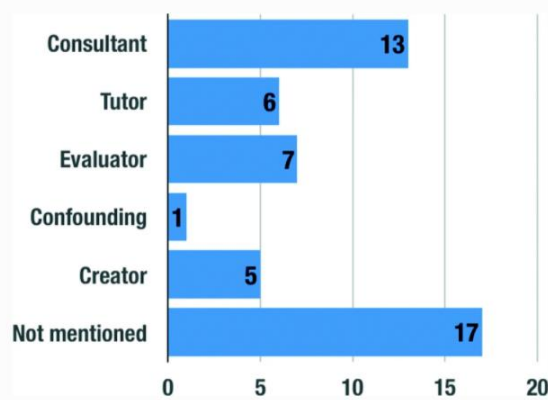


Fig-4: Teachers' Participation

Fig. 4 shows teacher participation in numerous forms and stages. Figure 12 indicates that the instructor can be interested in multiple ways in the creation and assessment process of AR instructional resources. Teachers were consulted for various reasons, such as questionable teaching material.

This question identifies the effect of the prototype / applications examine in the surveys.

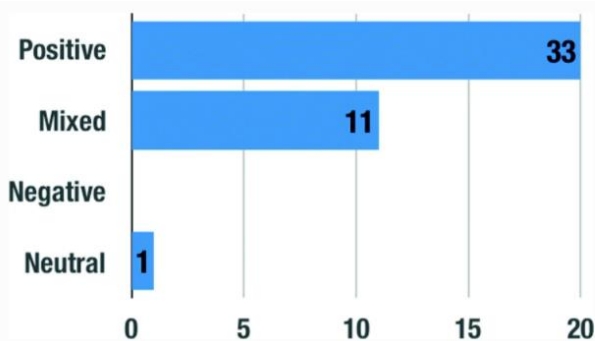


Fig-5: Impact of Prototypes

It found that the AR-based application was more successful in supporting student awareness than the web-based one.

Table -2: Teaching difficulty topics in Mathematics

Mathematics curriculum areas	Teaching difficulty	Match with AR technology
Notation, Vocabulary and Word Problems	High	High
Counting and Cardinality	Low	High
Measurement	Low	High
Fractions and Number Lines	High	Medium
Representing Numbers and Data	Medium	Medium
Place Value, Decomposition, and Operations	High	Unclear
Organization	Medium	Unclear
Automaticity	Medium	Unclear

[8] It is discussed only a few options through the prototyping exercise to resolve the curriculum topics found in the high-school math classroom as challenging to teach.

### 3. OPPORTUNITIES AND CHALLENGES

Research has demonstrated that augmented reality/virtual reality innovations are massively valuable for schooling and can help to productively develop students' capabilities and knowledge. In appealing ways, AR/VR programs can enhance instructional content and improve students' enthusiasm and participation. Students not only embrace AR/VR learning, but they also adopt teaching and AR/VR application allow them to gain a more thorough understanding. Some students, for example, do not understand virtual objects or abstract events, like the rotation of the world. AR/VR enables learners to visualize 3D models, digitally change models, find out unnoticeable event, and experience complex thoughts. VR technology can provide instantaneous messaging. Students may participate concurrently in a virtual classroom. They can talk, get direct comments from others, and feel like they are in the same location as their classmates.

[13] HDMs are very pricey and they cannot be used. Computers and display systems are often required in some situations to illustrate VR/AR items, which can be a difficulty for many schools. The second obstacle is to challenge the absence of practicality in VR or AR simulations. The standard of the graphics show excitement in the emotion of a consumer, it will boost the visual presentation. View and the delivery of a rich experience.

Health conditions and physical impact on students is the third challenge. HMDs are relatively heavy and, after some duration, can cause wearers to feel fatigued. The

vision can be obstructed by lenses in an HMD, but in modern models, they are adjacent to the eye. Simulator diseases are another reaction that is not limited to HMDs, and it occurs more in VR interactions.

[5] Hardware limitations are inherited from the fourth challenge. While current advancements in hardware have strengthened AR and VR demos, the shortcomings can preclude users from getting a better experience. Low practicality and location problems, latency between awareness of sensors, and the impact on the visual system are typical difficulties that can cause students irritation.

## 4. LITERATURE REVIEW

### 4.1 Our Perception

Through this analysis, we developed the capacity of AR to be implemented in learning contexts. AR technological advances also helped researchers to build and test further instruments in the field of education. Most of these articles used various metrics, but rather than only understanding, such as accessibility and performance, they assessed various aspects.

Therefore, an increasing curiosity in determining its effect on the learning process has been apparent. It is a well-known fact that AR will extend the limitations of learning. Any of the ideas reflect on interpreting learning mechanisms to provide students with a more successful environment that takes into account their personal interests and skills. We found in this analysis that strategies for various age groups and information domains are being created. Absence of appraisal of AR programs targeted at students has been noted.

### 4.2 Survey Conducted

According to the literature review and insights gained we designed our own survey for students' and teachers' of elementary school to understand their opinions about AR/VR technology and various domains related in the field of education.

The main goal of the survey was to know the topics which students and teachers find difficult in the teaching-learning process and where AR/VR would help as a learning aid.

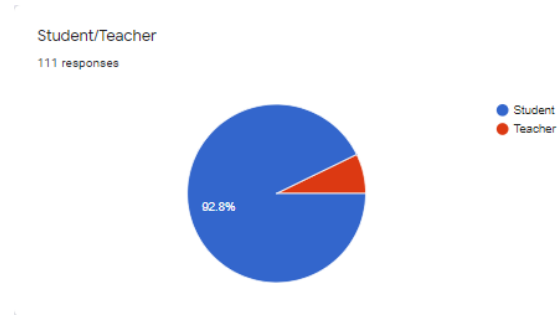


Fig-6: Number of Students and Teachers filled the form

The survey was conducted by circulating the Google form, as we see in Fig. 7 that 100 students and 11 teachers' responses were collected.

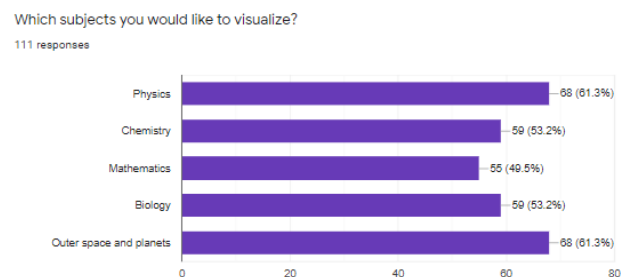


Fig-7: Q1 Subjects students would like to visualize in AR/VR

Students were asked about their preferences in subjects which they would wish to view in AR/VR. According to the statistics obtained, we interpret subjects like Physics and Chemistry are most preferred and Astronomy gains interests among students.

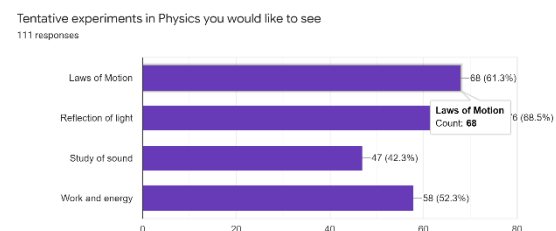


Fig-8.1: Q2 Experiments students wish to visualize in Physics.

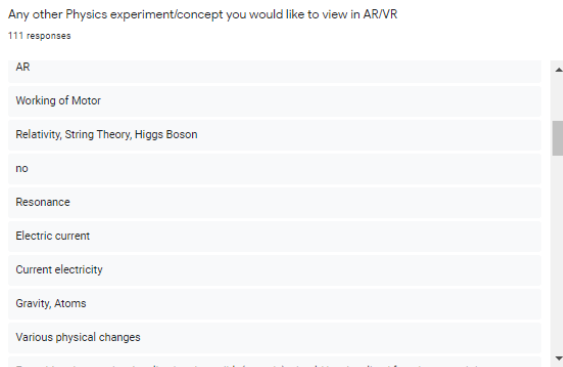


Fig-8.2: Q3 Students preferences in Physics.

Fig. 8.1 and 8.2, shows that the concepts like Laws of Motion, Reflection of Light and Work and Energy works on the processes like magnetism, gravity, electric current which are invisible to the naked eye, so here AR/VR will help in better understanding. And in addition to that, student were also asked for their preferences.

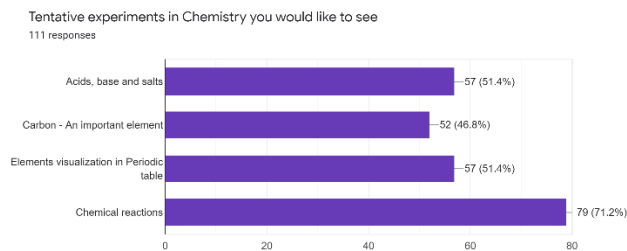


Fig-9.1: Q4 Experiments students wish to visualize in Chemistry.

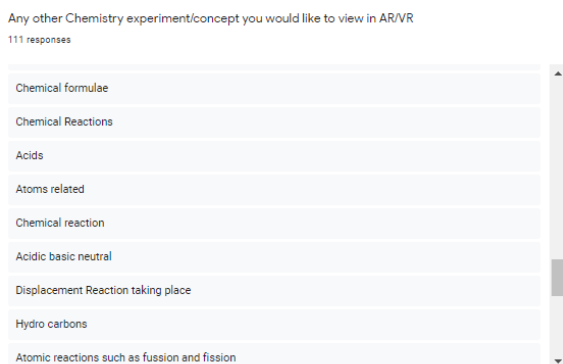


Fig-9.2: Q5 Students preferences in Chemistry.

Through Fig. 9.1 we see that 79% of the students find it hard to learn Chemical Reactions by the traditional

method, 57% find concepts like Acid- Bases and Periodic table difficult to learn. And with that in Fig. 9.2 students gave their options of experiments they would like to see visualized.

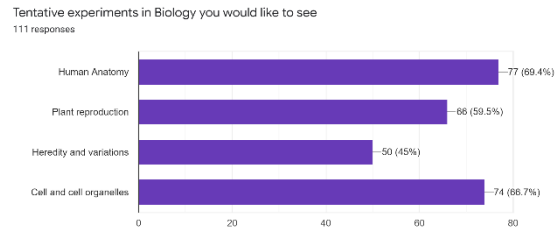


Fig-10.1: Q6 Experiments students wish to visualize in Biology.

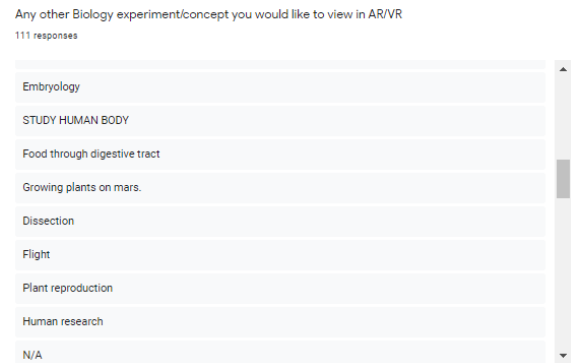


Fig-10.2: Q7 Students preferences in Biology.

Fig. 10.1 and 10.2 shows us responses related to Biology, here we see that 77 students and 74 students find difficult to comprehend concepts like Human Anatomy and Cell and Cell organelles.

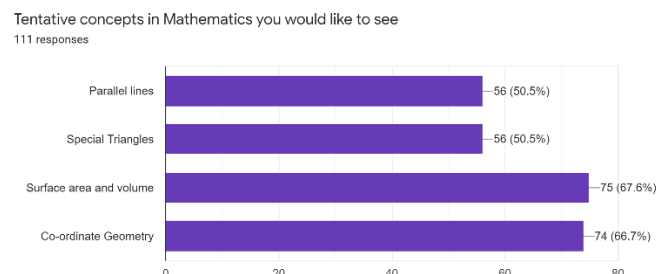


Fig-11.1: Q8 Experiments students wish to visualize in Mathematics.

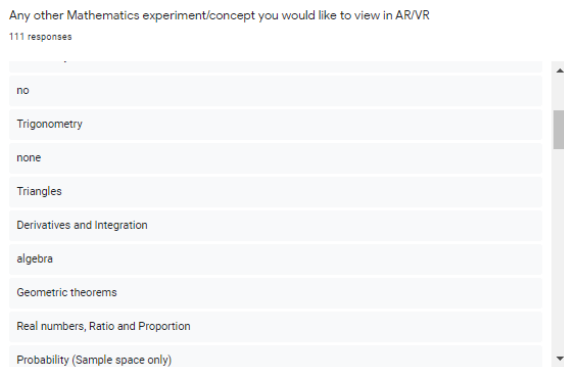


Fig-11.2: Q9 Students preferences in Mathematics.

The above figure, Fig. 11.1 and 11.2 focuses on Mathematics, as mathematics is a crucial subject student find it difficult to study topics like Surface area volume and Co-ordinate Geometry. The preference included advanced topics like Trigonometry, Venn Diagram and Probability.

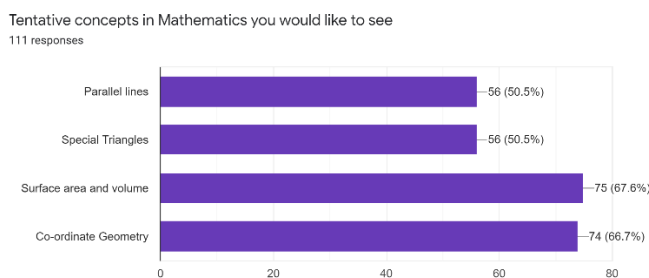


Fig-12.1: Q10 Experiments students wish to visualize in Astronomy.



Fig-12.2: Q11 Students preferences in Astronomy.

Topics like Solar System, Life of Star and Black Hole are amusing to view in AR/VR and also students can learn with fun.

## 5. CONCLUSION

We observed that students and teachers' are willing to accept the emerging technology, as it helps the students in knowledge retention, visualizing difficult concepts that will help them in the learning process. From Table 1 and Table 2, we interpret that few concepts are tough to teach via the traditional teaching-learning process. So, teaching the subject with the help of AR/VR will reduce its complexity and allow the students to master them.

Through the survey, we can conclude about the concepts and topics that students and teachers would like to explore more through visualization. The traditional format for teaching is no longer that useful, as it is still based on memorization of concepts and does not tackle the students' problem of knowledge overwhelm. The core principle is to propose a model in which students can carry out and imagine tests that in the real-world context are difficult to execute.

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