Exploring The Impact of Emerging Technologies in Instructional Design on Students' Learning; Comparison Between Middle-Fee Schools and High-Fee Schools

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Abstract

The use of developing technologies such as AR, VR, simulation, and gamification appears to become incumbent upon the learners of this era (21st century). The use of these technologies is increasing at an exponential rate in different walks of life, yet their effectiveness in school contexts is under exploration. This study investigated how students of private schools in Karachi, divided into middle-fee and high-fee schools, perceive the use of technology-enhanced learning in everyday learning. The study explored students' use of emerging technologies, their effect on students' engagement and students' preferences, the impact emerging technologies could possibly have on students' learning, the challenges students faced during the learning process and their interest in making these tools part of their class routines. A mixed-method research design was employed, surveying 210 students in grades 5-8 across 15 private schools, supplemented by 55 responses from students on an open-ended question. The study revealed that students advocated the use of emerging technologies in classrooms to turn learning into an engaging experience. Moreover, students expressed their preference for replacing lecture-based learning with tech-based learning. The study also reported a digital divide between the middle-fee and high-fee schools, providing evidence of limited use of emerging technology by the latter group. The findings revealed that the students of high-fee schools frequently use emerging technologies in the classroom and are more aware of their benefits than the middle-fee school students. Whereas, the middle-fee school students are more interested (than the high-fee school students) in exploring the exotic learning experiences of emerging technologies to aid their learning process.

***Keywords**: emerging technologies, technology-enhanced learning, digital divide*

Introduction

In the era where many children begin to have access to and use technology at the age of 2 years (Marta Tremolada, 2025), it is becoming formidable for educators to teach students using established teaching approaches. These methods fail to engage students in providing them with a lifelong learning experience. The gap between students' expectations and teachers' resourcefulness is widening as learners are becoming more demanding in the process of educational achievement. Educational institutions are adapting blended learning strategies where conceptual explanation is complemented by the use of emerging technologies. This study explores the use of augmented reality technology (AR), virtual reality technology (VR), simulation, gamification, and STEM education in the classroom pertaining to their frequency, impact, and limitations.

Furthermore, the report addresses the digital divide (the gap between schools that have access to the emerging technologies and those that do not have it) between middle-fee schools and high-fee schools and its possible implications.

Research Objectives

1. To examine how AR, VR, simulations, and gamification are being integrated into instructional design in private schools in Karachi.
2. To explore students' perceptions of how technology-enhanced learning affects their engagement, understanding, and motivation throughout their studies.
3. To compare technology adoption and student engagement across middle-fee and high-fee school groups.

Literature Review

Technologies like Virtual Reality, Augmented Reality, and Gamification significantly enhance the entire educational process, whether it is about the achievement of learning outcomes or the engagement and motivation of students. Simon Goorney (2023) claims the same by saying, "Tools such as artificial intelligence (AI), augmented reality (AR), adaptive learning, and gamification have begun to be integrated into classrooms, providing unprecedented opportunities to enrich teaching and learning"

Many researchers have contributed to the literature on using emerging technologies in instructional design, like Andres F. Mena-Guacas (2025), who states that "Educational transformation is increasingly influenced by emerging technologies, which offer unique opportunities to redefine learning". As a result, students' academic and professional achievements have been attained positively. The other one highlights that "VR and AR offer immersive and interactive learning experiences that were previously unimaginable, allowing students to practice complex procedures or explore historical and scientific subjects in a safe and engaging environment" (Hassan, 2023).

AI not only provides an opportunity to achieve learning aims and objectives but is also helpful in shaping educational materials to individual learning styles and abilities, providing immediate

feedback and identifying key areas for improvement. To understand how AI does all of the incredible work, we need to explore the concepts of the following technological terms:

Augmented Reality (AR): Augmented reality (AR) enriches the real environment with computer-generated virtual objects in order to provide an actual experience to the user. Augmented reality overlays digital information (text, images, 3D models, audio) onto the real world in real time, so users see and interact with both real and virtual elements at once. That is why studies have shown that AR applications for education have been steadily increasing since 2010 and have effectively taken root in educational settings (Juan Garzon, 2019)

Moreover, AR also contributes to improving the critical thinking abilities of students, enabling the transfer of learning from schoolrooms to lives. Matt Bower (2014) researched it and found out that "Learning augmented by AR is enhanced by overlaying digital information onto the physical world. It enables contextual exploration and visualization of abstract concepts, which can deepen critical engagement in teaching."

Virtual Reality (VR): Virtual reality (VR) is a computer-based simulation technology that enables users to interact while experiencing themselves in a virtual environment. According to Vivi Melinda (2022), "Virtual reality (VR) combines three-dimensional (3D) objects combined with hearing and vision to create effects for users as if they were in a virtual environment".

Students find it more lively to study Science, Engineering, even Languages, and sometimes Mathematics because VR creates an environment that allows students to practice procedures, explore variables, and visualize phenomena without full physical setups.

Gamification: Gamification means including games in your teaching process. Gamification can easily transform traditional education by incorporating game elements into its processes to create more absorbing, fun, motivating, and interesting learning environments and experiences that promote inclusion and student-centered learning (Sylvester, 2024).

Educators may use this technology to teach tough and drained concepts to students, as Sverre Raffnsoe (2017) suggests, that incorporating game elements into the educational environment can increase student motivation and engagement.

Learning Theories: Two educational theories completely align with the usage of such technologies in the teaching and learning process. They are Constructivist and Experiential learning theories.

Constructivism is a theory of learning or meaning-making that enables people to create their own new understanding based on an interplay between what they already know and believe and the concepts and knowledge with which they interact (R. Glaser, 2018).

Experiential learning theory is generated by the psychologist David Kolb (1984). According to him, learning is a process that involves our experiences, reflections, and ability to utilize what we've learned in new situations. His theory of experiential learning involves learning from experience. He defined this type of learning as "the process whereby knowledge is created through

the transformation of experience. Knowledge results from the combination of grasping and transforming the experience. Kolb's approach framed learning as an active and dynamic cycle. (Cherry, 2026)

However, where the literature is jam-packed discussing the benefits of using emerging technologies, there are few researchers who say that "The integration of these tools poses noteworthy challenges that must be addressed, especially in terms of their efficacy, their placement with pedagogical theories, as well as prepared educators in usage of them effectively" (Pranish A Kantak, 2024).

Efi Analyti (2024) researched the use of Virtual Reality in Education. She analyzed that despite having several benefits of VR in the educational field, a few barriers exist. That is the cost of buying VR headphones, controllers, and high-performance computers or other equipment needed for running VR software. Adding more, the fruitful incorporation of virtual reality (VR) into education requires teachers to be carefully trained in both the mechanical and instructional features of the technology. Deprived of appropriate training, even high-level schools may struggle to practice VR efficiently. Another barrier is Access and Equity in incorporating virtual reality (VR) into education. Wealthier schools, having more funds, are better positioned to afford the costly setup to support VR rather than middle-level schools. Here is a threat that the technology could expand the digital divide.

Health and ethical concerns are also cited by several authors. In a study conducted at the University of California at Los Angeles, the effects of using virtual reality could result in a term known as cyber sickness (Z.M. Aghajan, 2014). Cyber sickness causes a person to feel motion sickness due to a mismatch between the sensory input to the inner ear and the eyes (Owen, 2016). Southgate (2008) also points out that exposure to VR in young children raises questions about the ethics of creating false memories for children who are developmentally unable to distinguish between reality and VR.

The transformation of teaching styles, from traditional to contemporary, is essential because it advances access to information and enables the personalization of learning; likewise, it nurtures an environment in which pupils can relate more enthusiastically and collaboratively to educational content. This work provides a broad framework that summarizes how the emerging technologies transform instructional design and how students feel when they are being taught using them, while considering the differences between middle-fee schools and high-fee schools.

Main Body Content

Research Type

This research applied a mixed-method design using both quantitative and qualitative methods. Quantitative research aims to quantify the data and generalize findings from a sample of a study from varied perspectives. Quantitative research relies on data collection and data analysis, which is based on a logical method with the focus on testing theory, influenced by empiricist and positivist ideologies (Bryman, 2016)

On the other hand, qualitative research is seen as a style of inquiry that explores and provides a deeper, insightful understanding of real-world problems (Moser, 2017). The use of qualitative methods in this study enabled the researchers to gain deeper insights about the real-world practices and challenges pertaining to the use of emerging technologies.

Sampling Method

This report used a convenience research method, a type of nonprobability sampling which involves the sample being drawn from that part of the population that is close to hand (Ilker Etikan, 2015). This method is often used when easy data collection is required with a limited budget, such as in preliminary research or when working on new ideas or hypotheses. A total of 210 students participated in the research.

Data Collection

The data was collected using a questionnaire, one of the common devices for collecting information, and a form or instrument including a set of questions and secure answers that respondents (from a specific population) filled out to give the researcher information needed for the study. The data given from a questionnaire cannot be obtained from secondary sources (Dr. Prabhat Pandey, 2015).

The type of questions in the questionnaire was closed-ended questions, where participants were provided with four options to choose from. The reason for selecting close-ended questions in the study was to facilitate reticent respondents and to increase respondents' enthusiasm for submitting a completed questionnaire. (Michael R Hyman, 2016). For each close-ended question, the type of options used was ordinal-polytomous scales (strongly agree to strongly disagree).

In the interest of time and cost-effectiveness, the questionnaire was administered online using Google Forms. The link to the respective forms was shared with the research participants to fill out the form at their discretion, but within the given time.

The research proceeded with data collection from 15 private schools situated in Karachi. Two distinct groups, A (middle-fee school) and B (high-fee school) of students were made. The basis for categorizing schools into either of the two groups was the monthly fee of the schools. The classification was made using the arithmetic mean as the threshold. Specifically, the overall average school fee of the whole sample was computed; schools with a monthly fee below the overall mean (PKR 14,633) were classified as middle-fee schools, and those with a monthly fee above the mean as high-fee schools.

The arithmetic mean for each group was calculated using:

$$\overline{X} = \frac{\sum x}{n}$$

Where $\overline{X}$ = average monthly school fee
$\sum X$ = sum of individual school fees
n = total number of schools

$$X = \frac{11{,}000 + 11{,}200 + 11{,}500 + 12{,}000 + 13{,}000 + 13{,}000 + 14{,}000 + 14{,}000 + 14{,}800 + 15{,}000 + 15{,}000 + 16{,}000 + 16{,}000 + 18{,}000 + 25{,}000}{15}$$

$$X = \frac{219{,}500}{15}$$

$$X = 14{,}633$$

Table 1
Mean School Fees of Middle-fee and High-fee School Groups

School Group	Sum of School Fee (PKR)	Mean School Fee (PKR)	Number of Schools
Group A Middle-fee school	219,500	14,633	8
Group B High-fee school			7
Total			15

Ethical Consideration

The students were assured that their identities would remain confidential. Therefore, the questionnaire did not include students' names. The participants were asked to mention their grade level and their subject of interest in the questionnaire only. For anonymity, the school names were not disclosed at any point in the study. Instead, a list of codes was generated representing each school and shared with the respondents to be used when filling out the form (Ethical Guidelines for Educational Research, 2018)

DATA ANALYSIS & INTERPRETATION OF STUDENTS' RESPONSES:

Data Collection Tool

The survey form was divided into six segments. The first segment (section A) collected information about students' grade levels and their favorite subject(s). Segment two (section B) focused on students' experiences with the use of technology in the classroom. Establishing a link between the use and engagement, the third segment (section C) explored students' feelings about the use of games and simulations in the classroom. It further compared the difficulty level in comprehension and retention ability of the students when taught through textbooks and when taught using tech-led instructional design. The fourth segment (section D) aimed to achieve students' responses about the impact of using AR, VR, simulation, gamification and STEM on students' learning and motivation. The fifth segment (section E) was added to the questionnaire to learn about the challenges students face in tech-aided classrooms, while the last segment (section F) gauged students' interest in making the emerging technologies part of their routine learning.

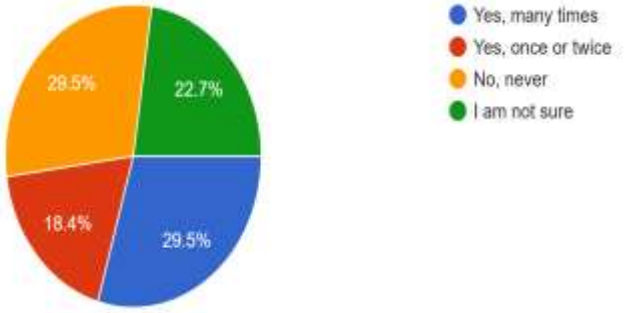
Piloting of the survey tool is an indispensable step before data collection to find out and resolve potential glitches before it is conducted on the entire sample. The tool was piloted on a small subsample of 10 students, thus permitting the investigators to ensure its reliability and validity. The results of the piloting did not indicate any discrepancies in terms of accessibility to the tool, phrasing of the questions, length of the tool, or content misalignment.

Section-Wise Data Analysis

Section B: Experiences with Technology in Class

Figure 1

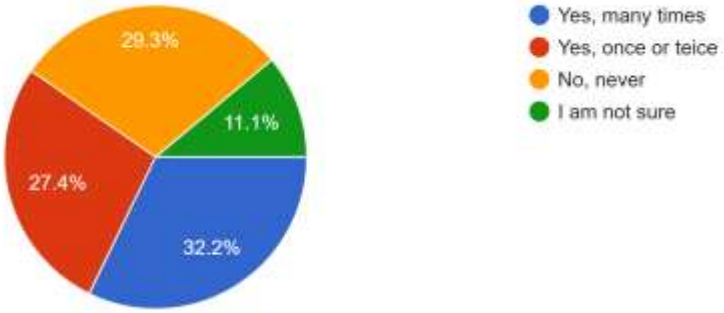
Use of an AR App That Shows 3D Models Pattern



An equal proportion of students (29.5%) reported using AR many times or never experiencing AR in the classroom. A smaller group reported that teachers have used AR multiple times.

Figure 2

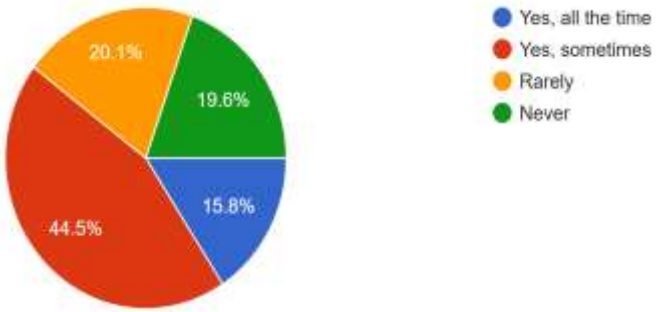
Use of Virtual Labs and Simulation Programs Pattern:



Most students (32.2%) reported using virtual labs or simulations many times. A smaller group reported being unsure or never using them.

Figure 3

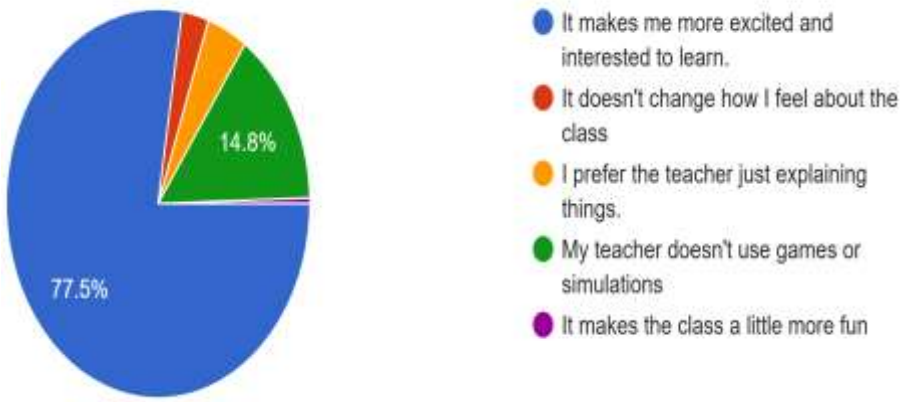
Use of Learning Games in the Classroom Pattern:



Most students (44.5%) reported that teachers sometimes use learning games in the classroom. A smaller group reported games being used all the time. In addition to that, 19.6% of the students mentioned that they never used learning games in the classroom.

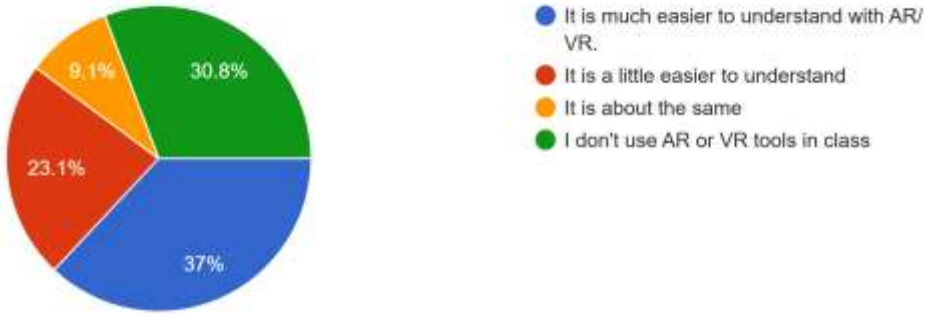
Section C: Engagement and Preferences

Figure 4
Student Feelings toward Games and Simulations Pattern



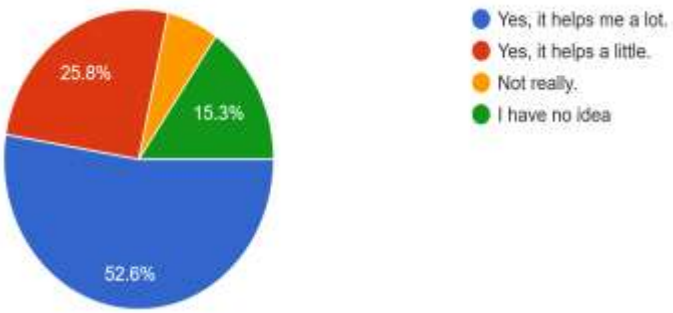
Most students (77.5%) reported that games and simulations make them more excited and interested in learning. A small minority preferred traditional teacher explanations without games. Only 0.5% of participants considered games and simulations as a source of fun only.

Figure 5
Ease of Understanding Topics Through AR/VR Pattern:



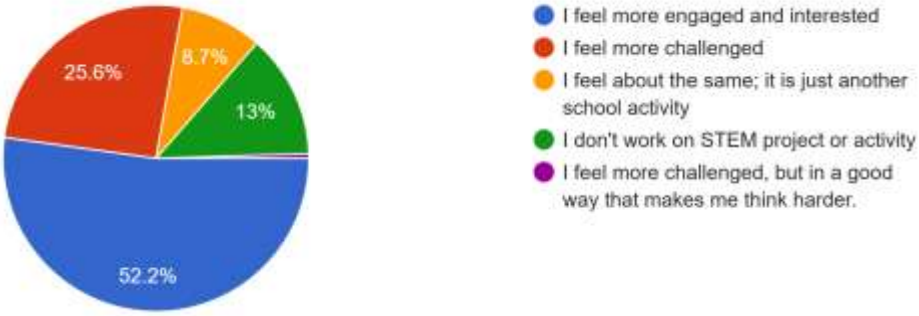
Most students (37%) said AR/VR makes topics much easier to understand. A minority reported that AR/VR makes no difference compared to textbooks. Moreover, a significant proportion highlighted that they do not use AR/VR tools in the classroom.

Figure 6
Gamification and Memory Retention Pattern



Most students (52.6%) believe gamification helps them remember the material better. Very few (6.2%) students believe gamification does not help learning.

Figure 7
Student Engagement in STEM Projects Pattern

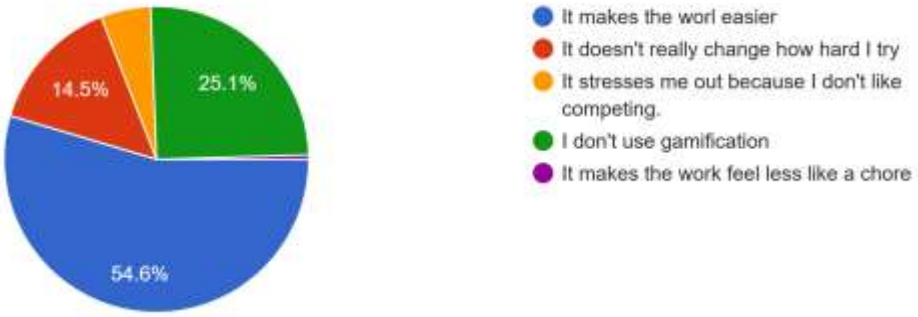


Most students (52.2%) feel more engaged and interested when working on STEM projects. A small number feel it is just another regular school activity. Only 0.5% of students considered STEM projects challenging, but a significant way to achieve higher-order thinking skills.

Section D: Perceived Benefits and Impact on Learning

Figure 8

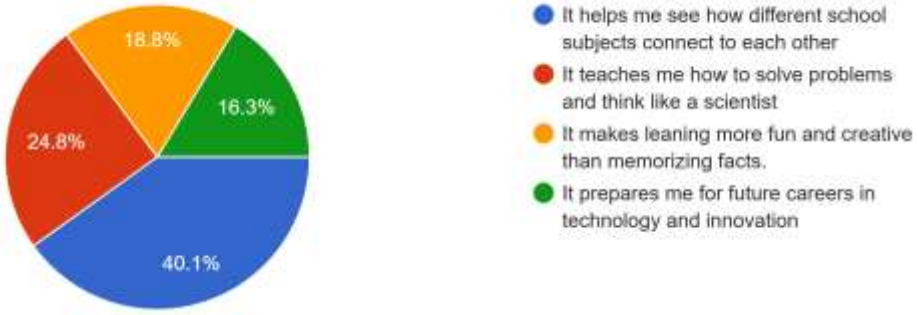
Gamification and Student Motivation Pattern



Most students (54.6%) said gamification makes learning easier and more motivating. A minority reported no change in motivation or feeling stressed by competition.

Figure 9

Benefits of STEM Activities Pattern



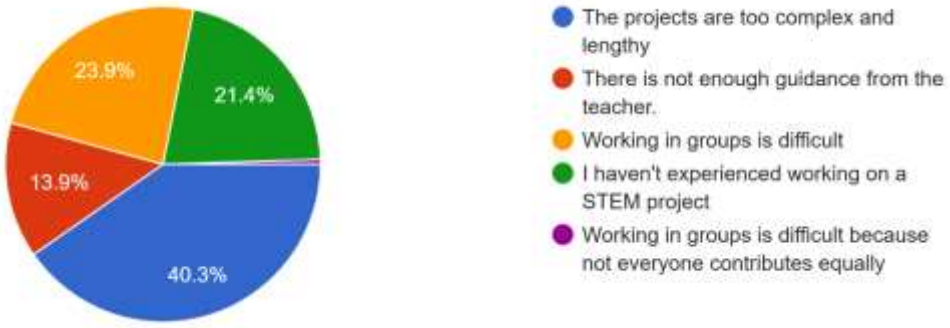
Most students (40.1%) believe STEM activities help them understand how different subjects connect to each other. Almost 25% of the respondents mentioned learning through STEM. Activities have transformed their random thinking into systematic reasoning. A smaller group believes the main benefit is preparing for future careers.

Section E: Challenges and Limitations

Figure 10
Frustrations with Gamified Learning Pattern

Most students (45%) reported that gamified learning sometimes feels too competitive. A small group felt that the games were fun but did not improve learning.

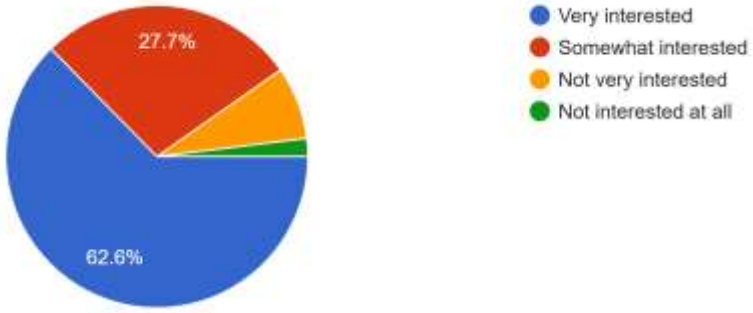
Figure 11
Challenges during STEM Projects Pattern



Most students (40.3%) believe STEM projects are too complex or lengthy. A small minority reported group work being the main challenge.

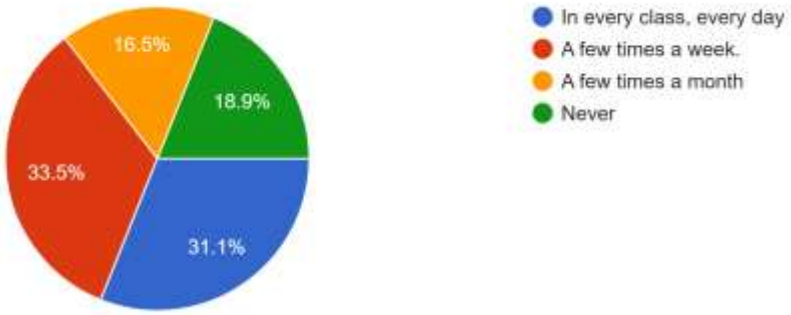
Section F: Interest in STEM and the Future

Figure 12
Student Interest in STEM Subjects Pattern



The majority of students (62.6%) reported being very interested in STEM subjects. Very few students reported no interest in STEM.

Figure 13
Preferred Frequency of Using Educational Technology in Class Pattern



Most students (33.5%) would like to use AR/VR and game-based learning a few times each week. A small number of students said they would prefer never to use them.

Students' Qualitative Comments

Looking at students' comments, thematic analysis has been done, and after going through the thematic analysis process, the following report has been generated by reviewing the initial codes in the data from which common patterns came up:

1) **Students want to escalate the use of technology in classrooms**
   Students want teachers to deploy technologies like tablets, multimedia, AR, VR, simulations, gamification, and other digital resources frequently. They feel this would make learning more interactive and less boring.
2) **Students want more engaging learning methods through technology**
   Some students shared that traditional teaching feels outdated. They prefer hands-on, visual, and game-based learning, and online quizzes instead of only lectures or textbooks.
3) **Students want more time for simulation and gamified activities**
   A few students mentioned they don't get enough time to explore simulations, experiments, or projects. They want more class time for practical work.
4) **Students suggested gaming classes**
   Some students suggested having special classes focused on educational games or tech-based learning.

Discussion and Conclusion

Discussion

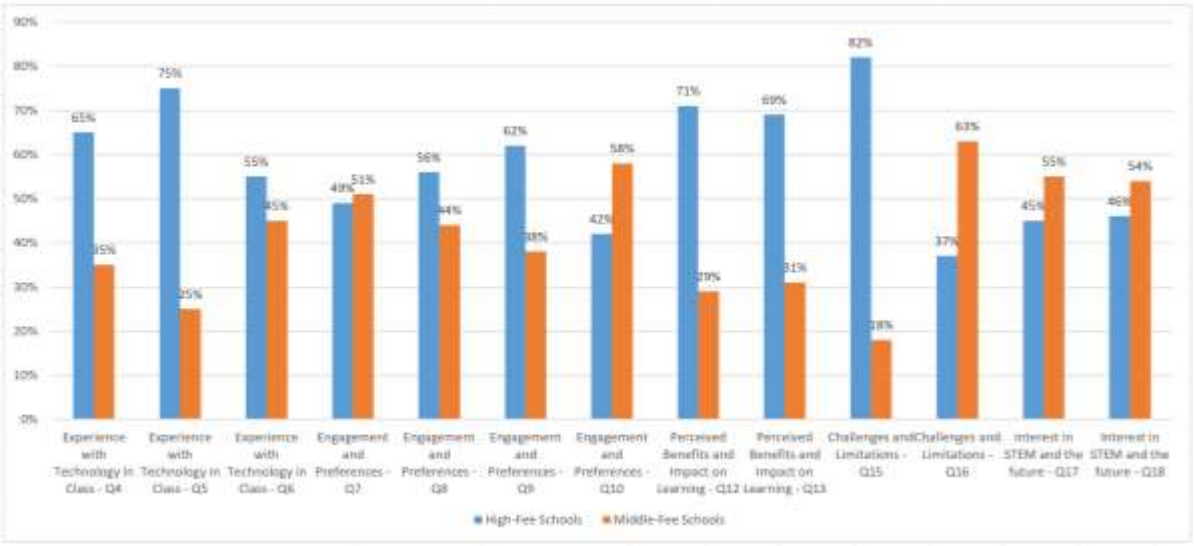
The primary purpose of the study was to explore students' experiences with the use of emerging technologies with respect to students' engagement, preferences and impact on their learning. Students are leaning towards a tech-based learning process. They expressed their experience with simulations, games, AR, and VR, reporting how these approaches are being incorporated and to what extent they have affected their engagement, understanding, and motivation (Krenare Pireva Nuci, 2026). This study also collected their written feedback. Many students favored lessons that were hands-on, visual, and interactive through technology over traditional approaches. However, when the use of AR, VR, simulation, and gamification was compared in middle-fee and high-fee schools, it was found that the latter group had better physical access to the required software and devices.

Therefore, our work entirely agrees with what Simon Goorney (2023) and Sverre Raffnsoe (2017) say: that incorporating technologies can enhance students' motivation and engagement extraordinarily. It also holds the theory of Constructivism true that children learn better when they interact. An extension of this paper's outcomes may be used to study the long-term impact on students.

Figure 14

Comparison Between The Middle-Fee and High-Fee Schools (Digital Divide)

The research findings revealed a significant difference in the use of emerging technologies by the middle-fee and high-fee schools.



1. *Experience with Technology:* The findings showed that high-fee school students are more frequently experiencing emerging technologies in the process of learning. The use of augmented reality and virtual labs seems to be an integral part of their classroom teaching. The availability of high-cost devices, such as AR smart glasses and laptops, provides students with more technology-aided learning opportunities. In contrast, middle school students rarely have exposure to the virtual world in the classroom. Students' responses revealed that the schools use desktops that may lack the processing power required to run virtual reality technology. In middle-fee schools, a general device-to-student ratio was 1:5, whereas in high-fee schools it was either 1:2 or 1:1.
2. *Engagement and Preferences:* The vigor of using emerging technologies in an educational setting was found to be the same among students of both groups. This shows that students want engaging learning experiences that keep them immersed. Moreover, students showed their trust in the emerging technologies that make understanding complex topics easier. The evident differences lie in the use of games and the comparison between teaching through STEM projects and textbooks. The proportion of students who advocated the use of games to enable them to remember the learning material was higher in the high-fee schools. When asked about the infrastructure of the labs, the high-fee schools were found to have dedicated labs with controlled lighting and soundproofing. This enhances the gaming effect. On the other hand, the middle-fee schools use the basic audio-visual rooms. Lastly, the high-fee school students are less interested in using STEM projects as compared to the middle-fee school students. Students of high-fee schools mentioned that the strategy is less engaging than gaming and virtual reality experiences.

3. *Perceived Benefits and Impact on Learning:* Because of more frequent exposure to the use of emerging technologies, high-fee school students, in greater proportion than the middle-fee school students, reported that the use of gamification makes their work easier and helps them witness the connection between different subjects.
4. *Challenges and Limitations:* On one hand, if the students of high-fee schools find gamification a potent experience, on the other hand, they feel like entering into a competition. The risk connected to 'competition' is that the outcomes could be highly productive or extremely counterproductive. Middle-fee school students highlighted the length and complexity of STEM projects as a challenge. The responses from students indicated that the teachers, in middle-fee schools, possess generic technology skills and are less confident in experimenting with new tools. In high-fee schools, teachers are experts in their subjects but lack mastery over the use of different digital tools.
5. *Interest in STEM and the Future*: Middle-fee school students showed more interest in learning through STEM and using AR, VR, and gamification in the classrooms. The reason for lower interest in the high-fee school students could be the unlimited access to technology at home. These students might be spending hours on social media and high-definition gaming devices as part of their daily routine.

The quantitative data were analyzed using descriptive statistics. Frequencies and percentages were calculated for each questionnaire item to summarize students' responses. The results were presented through tables and bar charts. In addition, responses from middle-fee and high-fee schools were compared descriptively to identify differences in students' access to and perceptions of emerging technologies in instructional design.

Challenges

Getting responses from both middle-fee and high-fee schools proved challenging for several reasons. Sometimes, it took extra time and effort just to reach participants on both ends. Some students were hesitant to answer the questionnaire, while others were busy due to exam schedules.

An additional task was the varied level of high-tech awareness. Some individuals were well aware of tools such as AR, VR, gamification websites, and simulations, while others had limited or ambiguous knowledge of these tools, so the researcher had to clarify them so they could answer.

Furthermore, inquirers also received partial surveys, which caused them trouble. Moreover, there were variations in how participants understood some questions.

Students from elite schools provided extensive responses because they were familiar with the tools, whereas those from middle-level institutes had limited experience with the equipment being studied.

Some students misunderstood a few items. To address this issue, the data was refined where possible to ensure it remained trustworthy and valid. Regardless of all this, the study still offers a clear picture of how schools are using new technology across different settings.

Recommendations

Studies have mostly examined how augmented and virtual reality, gamification, simulations, and STEM learning strongly boost motivation and enhance learning. Research basically revolves around the question "Does it work?" There is an enormous gap in the area of how to implement and sustain it. Deep research should be conducted on what the perspectives of teachers are and whether they are competent enough to integrate those technologies in their daily plans, across contexts and over time, as teachers from middle-fee schools have general knowledge of using new tools, while teachers from high-fee schools also lack mastery over the use of different digital tools.

Likewise, research gaps appear around long-term impact on students, whether the usage of such technologies makes students different from those who don't.

Conclusion

This study aims to compare the use of technologies in middle and high-level schools. It also studied how the inclusion of technologies has become a game-changer in achieving learning outcomes. Students agree that emerging technology can make instruction more interactive and student-centered. Tools like simulations, AR, VR, and gamification boost engagement and help students tackle tough content (Xiaoli Zhao, 2023).

By looking at what's happening in classrooms now and where teachers hit roadblocks, this study offers some direction for educators and instructional designers. With smart choices, technology can make learning richer and more effective for everyone (Crogman, 2025).

Technology is evidently ideal for engagement. Students told us that such technologies and hands-on activities made school more fascinating and assisted them in studying hard stuff. But some felt there was too much competition in games, and they lag just by not clicking the correct answer within seconds.

Students' feedback supported all this as they wanted more interactive and tech-infused lessons. They preferred hands-on and visual methods over passive sitting and listening to lectures. The bottom line schools are using it rarely, but there are clear gaps in access, incorporation, and prepared teachers. Students said that lessons using technology made learning more active and engaging. It's clear that digital tools are fast becoming a must-have in education (Mhlongo, 2023).

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