Exploring the Influence of Demographics on the Impact of Mixed Reality in Enhancing Student's Self-Perception, Involvement, and Motivation in Learning

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Abstract

This study examines the impact of immersive technologies on education, primarily Mixed Reality (MR). The main objective is to determine how demographic variables influence the impact of MR on students' self-perception, involvement, and motivation in the learning process. In addition, this study aims to provide information on the possible advantages of incorporating MR into education and discover demographic factors that could impact its success.

The hypotheses suggest that the effect of MR on student engagement, motivation, and self-perception may differ based on demographic variables. The study also investigates the simplicity of implementing MR based on sociodemographic factors, such as prior technological knowledge. The findings substantially impact students and researchers interested in investigating creative ways to improve their educational experience through immersive technologies. The research methodology includes an examination of existing academic evidence and the identification of research openings. The study collects data on student engagement in the learning process using a quantitative approach and a sample size of 72 volunteers.

According to the data, there were no statistically significant changes in students' opinions depending on their digital technical skill levels. However, descriptive statistics revealed a generally positive attitude regarding the potential benefits of MR in education and the ease with which MR technology may be integrated into classroom situations.

In conclusion, by examining the effect of MR on education and identifying demographic characteristics that may affect its efficacy, this dissertation enhances our understanding of the topic. This study's outcomes impact teaching professionals, legislators, and scholars to examine the potential educational benefits of immersive technologies.

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Introduction

Education, like every other sector, has evolved because of technological advancements. Among these advancements, Mixed reality (MR), Virtual Reality (VR), and Augmented Reality (AR) approaches have been highlighted as critical components that have the potential to improve the learning experience. As a result, academic institutions and businesses are attempting to use immersive technology to train and educate their students or staff. (Gonzalez-Franco et al., 2017).

Virtual Reality (VR) will replace real-world objects with a digital 3D landscape; experiencing this will require an electronic gadget or a headset. Oculus, PlayStation, and HTC Vive are well-known VR systems. A digital object will be superimposed over a real-world object in Augmented Reality (AR) and Mixed Reality (MR). The distinction between AR and MR is unclear, but (Milgram et al., 1995) refer to mixed Reality, which includes augmented Reality and Augmented Virtuality. In the present era, MR is characterized as the ability of a user to interact with real-world things while seeing virtual objects. According to (Paavilainen et al., 2017), Pokémon Go, an augmented reality-based smartphone game, gained popularity following its introduction in July 2016. Pokémon Go is the first location-based AR smartphone game featuring various high satisfaction, such as mobility, social connection, and gameplay elements, as well as adverse effects such as technical difficulties, improper player behavior, and unfair gameplay advantages.

Figure 1. the difference between Augmented Reality and Augmented Virtuality by (Milgram et al., 1995)

MR is a hybrid of VR and AR, greatly aided by technology and software developments that are now inexpensive and reachable to users. Innovations in smartphones and electronic devices have pushed user expectations, resulting in a competitive desire to produce technology that is compact, quicker, and smarter than its competitors (Bacca et al., 2014)

The study's research question is, " *How do demographics affect the impact of Mixed Reality on students' self-perception, involvement, and motivation in the learning process*?" By answering this topic, the research seeks to add to the current body of research on MR in academia by informing educators and administrators about its potential benefits and problems. It also aims to shed light on how MR may be successfully incorporated into academic settings to improve academic achievement and student motivation. The research will use quantitative data collection and analysis to accomplish these objectives. The findings of this study will have significance for the development and application of MR technology in educational contexts, as well as the possible influence on pedagogical methods.

This research merits consideration over many factors. First, the fast development of Mixed Reality (MR) technology and its potential educational applications need a thorough examination of its influence on students' learning experiences. The increasing popularity of MR, as evidenced by Statista's (2020) projection of a market value of about 252 billion dollars by 2028, highlights the significance of comprehending its consequences for education. Second, there is a knowledge gap in the available literature, as most immersive technology research focuses on businesses like gaming, tourism, healthcare, and networking (Youngblut, 1998); (Hughes et al., 2005). This study seeks to address this deficiency by studying the impact of MR on the education sector and evaluating its potential to improve student engagement, motivation, and self-perception. Thirdly, investigating the influence of MR on education helps to a greater comprehension of how immersive technologies, such as Virtual Reality (VR) and Augmented Reality (AR), might be effectively integrated into teaching and learning activities. As previous research has demonstrated the potential benefits of VR and AR in education (Gutiérrez, Thalmann, and (Gutiérrez, Thalmann Frédéric Vexo, 2008); (Dunleavy, Dede, and Mitchell, 2008); (Salar et al., 2020), additional research into MR will aid educators and policymakers in making informed decisions regarding the implementation of these technologies in institutions. Understanding the potential barriers to adopting MR in education, such as socio-demographic factors, technological expertise, and safety concerns (Kaimara, Oikonomou, and Deliyannis, 2021); (Vondrek et al., 2022).

The study attempts to build on the insights of prior research on MR in education, such as those reported by (Billinghurst and Duenser, 2012), (Dede, 2009), (Radu, 2014), and (Shelton and

Hedley, 2020) have studied different elements of MR's influence on education and involvement. However, there are still gaps in the literature. This thesis tries to address these gaps and contribute to a better understanding of the possible benefits and limits of MR technology in higher education by evaluating the research issue within this framework.

This dissertation contains seven major components. After the Introduction, Part 2 provides a detailed Literature Review that summarizes essential studies and highlights knowledge gaps. Section 3 explains the purpose and research question(s) in detail. The centerpiece of Section 4 is the Research Approach, which describes the methodologies, techniques, and processes used in the study. Part 5's Discussion of Results and Analysis offers a comprehensive assessment of the obtained data, highlighting the most relevant findings and their relationship to the current literature. The Discussion in Section 6 is comprehensive and relies on broader literature to substantiate the thoughts. Finally, section 7 closes the thesis with a conclusion summarizing the essential results and discussing potential future study options.

Literature Review

Introduction

The developing multidisciplinary area of Mixed Reality (MR) in education combines components of Augmented Reality (AR) and Virtual Reality (VR) to provide engaging and interactive educational experiences (Milgram and Kishino, 1994). This technology can significantly revolutionize traditional teaching approaches by offering students interactive, contextual, and immersive learning opportunities (Dunleavy & Dede, 2014; Cheng & Tsai, 2014). This literature review seeks to critically examine the current body of research on the integration of MR in teaching, with a particular focus on its impact on student involvement, enthusiasm, and self-perception, as well as possible obstacles and opportunities of its adoption in higher education settings (Santos et al., 2014; Bower et al., 2014). It has been demonstrated that using MR in education increases student engagement and motivation by offering immersive learning environments that enable students to interact with digital information more naturally and intuitively (Cheng & Tsai, 2014; Radianti et al., 2020). Additionally, MR can improve collaborative learning by allowing students to work in shared virtual settings, encouraging communication, cooperation, and problem-solving abilities (Bower et al., 2014; Kaimara et al., 2021).

Ibáez and Delgado-Kloos (2018) discovered that the application of MR in education favorably influences students' self-perception since it helps them to study complicated topics and build skills in a safe and regulated setting. This higher self-perception can increase students' self-efficacy and confidence, enhancing their academic achievement (Radianti et al., 2020). However, significant obstacles to implementing MR in educational settings include data compliance, cyber sickness, and health issues (Kaimara et al., 2021). Additionally, socio-demographic characteristics, such as students' past technology experience, may impact the ease of adoption (Santos et al., 2014). Therefore, to fully realize the benefits of MR, it is essential to solve these obstacles and comprehend the characteristics that permit its successful integration into education.

Immersive Technologies in Education

Immersive technologies such as Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) have received much recognition in recent times for their potential to transform the academic environment. By merging the real and virtual realities, these technologies provide students with innovative and engaging methods to obtain knowledge and build skills (Radu, 2014; Akçayır and Akçayır, 2017).

Overview of immersive technologies:

Virtual Reality (VR) is constructing a completely immersive, computer-generated world that users can interact with and experience utilizing dedicated headgear and controllers (Mantovani et al., 2003). This technology provides a variety of educational possibilities, from virtual field guided tours to simulated training settings, allowing students to get practical experience without the constraints of time, place, or expense (Freina and Ott, 2015).

Figure 2. A real-life example of a VR headset with a joystick (Metcalfe, 2018)

Augmented Reality (AR) is a technology that superimposes digital content onto the natural environment, generally via smartphone or mobile device cameras (Billinghurst & Duenser, 2012). AR may augment courses and classroom contents in an educational setting, giving students dynamic and exciting learning opportunities that supplement traditional teaching techniques (Bacca et al., 2014).

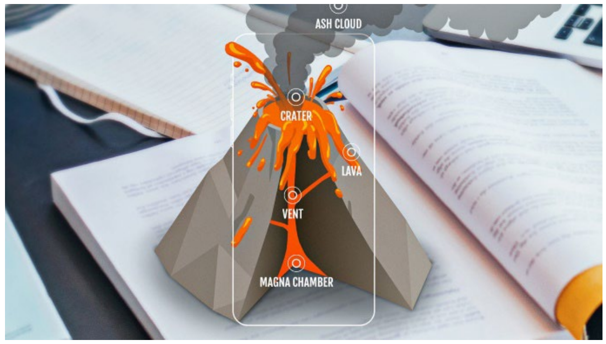

Figure 3. Digital 3-Dimensional (3D) image of a volcano in real life using AR (Blippar, 2020).

Mixed Reality (MR) incorporates components of both Virtual Reality (VR) and Augmented Reality (AR), integrating digital items into the user's real-world surroundings and enabling interaction between the two (Milgram & Kishino, 1994). This technology could facilitate collaborative learning and problem-solving by allowing students to investigate complicated topics more naturally and hands-only (Kaimara et al., 2021).

Figure 4. Holographic 3D representation of a product demo in the real world (Microsoft, 2022).

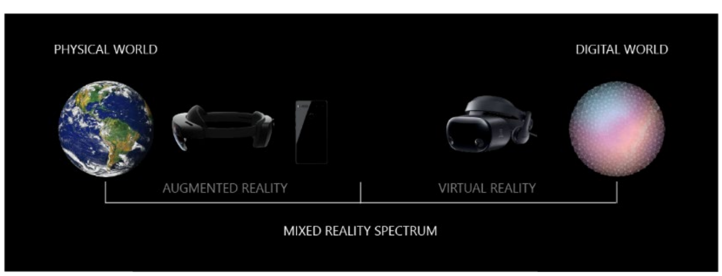

Figure 5. Where devices exist on the mixed reality spectrum (Microsoft, 2022).

Based on Figure 4, Towards the left (near physical Reality). Users are not led to think they have stepped away from their physical Reality. In the center, these experiences combine the real and the virtual world. In the film Jumanji, for instance, the actual layout of the home where the action occurred was combined with a jungle setting. In the right (near digital Reality). Users experience a digital reality and are oblivious to their physical surroundings.

The possible benefits and problems of immersive technology in education have various potential benefits. By delivering engaging, interactive, and immersive learning opportunities, these technologies can encourage active learning, boost student engagement, and strengthen critical thinking abilities (Merchant et al., 2014; Bower et al., 2014). In addition, they can facilitate personalized instruction since they enable students to explore at their speed and adapt to their specific needs and interests (Dunleavy & Dede, 2014). However, the introduction of immersive technology in education is accompanied by several obstacles. They include the expense and availability of gear and software, the requirement for educator training and assistance, possible health hazards, including cybersickness, and data privacy and security implications (Johnson et al., 2016; Kaimara et al., 2021). In addition, the usefulness of these technologies in educational contexts is still a subject of active study, necessitating more inquiry and assessment to discover best practices and pedagogical techniques (Radianti et al., 2020).

History of Mixed Reality

The unique narrative of Mixed Reality (MR) initiates with the advancement of its fundamental technologies, including virtual Reality (VR) and augmented Reality (AR). As these innovations have improved and integrated over time, the idea of MR has changed. However, MR's origins may be traced back to the beginnings of VR. The Sensorama, created by Morton Heilig in the 1950s, was one of the earliest VR systems. This mechanical device stimulates multiple senses by combining clip, audio, motion, and scent (Heilig, 1962). Next, Ivan Sutherland developed the idea of the Ultimate Display in the 1960s, a platform that could replicate Reality so accurately that it was impossible to distinguish from the actual world (Sutherland, 1965). Sutherland's contributions led to the creation of the initial head-mounted Display, an ancestor of advanced VR and MR headsets. Finally, Tom Caudell and David Mizell created the phrase augmented Reality in the early 1990s.

Researchers used the phrase to characterize a technology that enhanced a subjective experience and comprehension of the surroundings by superimposing computer-generated content over their perspective of the physical world (Caudell & Mizell, 1992). When Paul Milgram and Fumio Kishino proposed the notion of the Reality-Virtuality Continuum in their 1994 work, Mixed Reality arose as a phrase and theory. This concept is derived from the real world to the virtual world, with MR inhabiting the space in between (Milgram & Kishino, 1994). Beginning in the first decade of the twenty-first century, developments in computer graphics, computing power, and display technologies enabled scientists to develop increasingly advanced MR technologies. These systems began integrating VR and AR technology, allowing users to seamlessly engage with actual and simulated objects (Azuma et al., 2001). As a result, the MR system has achieved a stage of competence that facilitates practical applications in diverse fields, such as academic learning, entertainment, medical services, and the manufacturing industry. It is projected that as MR matures, this technology will become a more significant aspect of our regular activities.

Mixed Reality in Higher Education

In recent years, there has been a substantial increase in the use of Mixed Reality (MR) in higher education, with several applications designed to strengthen the teaching and learning approach. MR learning strategy has been implemented in several fields, including medicine, engineering, the arts, and the social sciences (Krassmann, 2019). Prior research examining the effect of MR on student involvement, motivation, and self-perception has shown encouraging findings. MR can boost student engagement and motivation by providing immersive and interactive learning experiences, according to Kavanagh et al. (2017). In addition, according to a study (Akcayr and Akcayr, 2017), MR fosters positive self-perception and self-efficacy in students since it facilitates active engagement in learning processes and improves the visualization of complicated topics.

Several scholars have also investigated how MR might enhance student collaboration and communication. For example, it was discovered that MR improves collaborative problem-solving skills by giving virtual venues for students to collaborate on complicated assignments. Additionally, MR can support the development of higher-order thinking abilities, such as critical thinking, innovation, and judgment, by providing students with immersive experiences that challenge their conceptual knowledge and promote deep learning (Bacca et al., 2014).

Among the possible benefits of using MR in higher education settings are the following:

- MR delivers immersive, collaborative, and interactive learning environments that foster greater comprehension and engagement.
- MR addresses the gap between theory and practice by enabling users to connect with digital knowledge in real-world contexts (Ibáez & Delgado-Kloos, 2018).
- MR could be adjusted to each learner's specific requirements, interests, and learning styles, enabling individualized learning experiences (Radianti et al., 2020).
- MR may enhance the development of crucial 21st-century abilities, including teamwork, cooperation, critical thinking, and problem-solving.

Surprisingly, there are possible downsides and difficulties related to the deployment of MR in higher education:

- The use of MR technology may need substantial investments in equipment, application, and training, which might be unaffordable for several institutions due to cost and resource restrictions (Bacca et al., 2014).
- Technological obstacles: Hardware compatibility, software defects, and connection challenges might impede the successful use of MR in educational contexts. Some studies and best practices: To completely comprehend the long-term impacts of MR on learning outcomes and to identify best practices for its application in higher education, further study is required (Radianti et al., 2020).
- Privacy and ethical challenges: MR in education may pose privacy and ethical difficulties connected to data collecting, storage, and sharing, necessitating the establishment of explicit regulations and standards to address these issues (Gibson et al., 2013).

Current Mixed Reality Applications in Education

Mixed Reality (MR) has several applications in numerous educational sectors. In medical and healthcare teaching, the use of MR to enhance the learning experience has increased. Among the applications are surgical simulators, medical education programs, and patient interaction situations (Kyaw et al., 2019). In engineering and architecture, MR offers students immersive learning experiences that allow them to see complex systems and interact in real-time with ideas (Wang et al., 2018). This assists students in comprehending and applying the fundamentals of their subjects. Learning a language would be another subject where MR has demonstrated promise. It may build immersive language learning situations by offering contextual information and engaging, interactive activities that aid language acquisition (Huang et al., 2020).

Students can better envision theoretical scientific concepts, replicate experiments, and engage in collaborative problem-solving activities because of MR. This improves their comprehension of complex scientific ideas (Ibáez & Delgado-Kloos, 2018). Furthermore, creative and architectural learning may use MR technology to demonstrate ideas, enabling students to research and develop in virtual settings while collecting rapid feedback on their efforts (Dünser et al., 2012).

Mixed Reality Implementation in Education

Having the necessary infrastructure is a crucial element of MR deployment. This involves essential MR gear, such as headsets and tracking systems, high-speed internet connection, and MR-compatible gadgets (Herpich et al., 2019). In addition, integrating MR into education necessitates reevaluating and rethinking teaching strategies. Lecturers must be taught new MR-specific teaching techniques, and learning processes should be designed to maximize the technology's possibilities (Radianti et al., 2020).

Creating compelling and pertinent MR material is essential for effectively implementing this technology in teaching. Professors, content providers, and technical specialists must collaborate to generate academically relevant and technologically feasible content (Bacca et al., 2014). Evaluation is also a crucial aspect of MR deployment, as standard assessment techniques and methodologies may not be suitable for quantifying learning outputs and experiences in an MR context. Hence, new assessment procedures must be created and adopted to correctly measure the efficacy of MR in education (Dalgarno & Lee, 2010).

Accessibility is a crucial factor to consider while integrating MR into education. Cost, hardware availability, and compatibility with assistive technologies for students with impairments must be addressed to ensure that MR is accessible to all students (Lampropoulos et al., 2022). Considering all these issues, a successful application of MR in education involves careful planning, cooperation, and continual evaluation of its efficacy.

Literature Gaps and Research Opportunities

The literature review on implementing Mixed Reality in education has found various research gaps and areas that need future study. These gaps allow researchers to contribute to the current body of information and increase our grasp of MR's Potential in the educational setting.

The lack of studies investigating the long-term impact of MR on students' learning outcomes is a significant gap in the literature. Even though some studies have demonstrated the positive short-term effects of MR on engagement, motivation, and self-perception (Dunleavy & Dede, 2014; Kaimara et al., 2021), additional research is required to evaluate whether these impacts continue to develop and translate into enhanced academic achievement.

A preliminary study has been conducted on implementing MR in various educational contexts and areas, another gap in the literature. Most studies have focused on particular topics or learning spaces (e.g., STEM education, medical training) (Radianti et al., 2020), leaving a need for research on MR's applicability and effectiveness in other fields, including the human sciences, sociology, and vocational training.

In addition, there is a dearth of studies exploring the obstacles to using MR in higher education institutions. Problems like data privacy, cybersickness, and health issues have been recognized as possible constraints to the general use of MR in education (Kaimara et al., 2021), but further research is required to understand the scope of these obstacles and propose mitigation solutions.

Lastly, the effect of students' technological skills in adopting and utilizing MR has not been adequately investigated. While some research suggests that students with more excellent technological experience may find it easier to adopt MR (Kaimara et al., 2021), additional research is necessary to understand the nuances of this relationship and to identify strategies to support students with varying levels of technological proficiency.

Considering these research gaps, the proposed research will seek to answer the following questions:

- Does Mixed Reality impact the educational experiences of students?
- Do users with more excellent technology knowledge find MR less complicated than those with less technological understanding?

By addressing these research issues and evaluating the accompanying hypotheses, this project will help bridge the highlighted literature gaps and expand our understanding of the possible advantages and problems connected with MR in education.

Literature Review Conclusion

In conclusion, the literature analysis has revealed an increasing interest in applying Mixed Reality (MR) as an immersive learning environment, especially in higher education settings. Studies have indicated that MR could enhance student engagement, motivation, and self-perception (Dunleavy & Dede, 2013; Kaimara et al., 2021; Radianti et al., 2020). Nonetheless, there are still gaps in the literature that calls for more research.

This study has identified several important issues for future research, including the long-term impacts of MR on learning outcomes, the applicability of MR across multiple disciplines, and the obstacles and barriers associated with implementing MR in higher education institutions. In addition, the effect of students' technological skills on adopting and utilizing MR has been identified as a subject requiring additional investigation.

By examining the impact of MR on student experiences in higher education, the proposed research intends to contribute to the current body of knowledge and bridge some of the highlighted gaps in the literature. In addition, this research can potentially assist lecturers, academic institutions, and authorities with the benefits and obstacles of integrating MR in the classroom.

More excellent knowledge of MR's influence on student experiences might inform decisions about curriculum design, teaching practices, and allocation of resources. In addition, it can encourage the creation of regulations that encourage the good use of MR technology in higher education while addressing potential adoption constraints.

In conclusion, the literature study has highlighted the significance of exploring the impact of Mixed Reality on student engagement, motivation, and self-perception in higher education. The proposed research furthers our understanding of MR's Potential and problems, with consequences for educators, educational institutions, and policymakers.

Research questions

The principal objective of this proposal is to investigate the influence of immersive technologies, such as Mixed Reality (MR), on education. The research questions investigate how demographic factors influence the impact of Mixed Reality (MR) on students' self-perception, involvement, and motivation in the learning process (Radianti et al., 2020).

Based on the existing academic evidence presented in the literature review, as well as the research gaps identified, the following research questions and hypotheses will be examined:

Research Question 1:

How do demographics affect the impact of Mixed Reality on students' self-perception, involvement, and motivation in the learning process?

Hypothesis 1a:

Impact of Mixed Reality on student involvement will possibly differ considering demographic factors. (Dunleavy & Dede, 2013).

Hypothesis 1b:

Impact of Mixed Reality on student motivation will possibly differ considering demographic factors. (Kaimara et al., 2021).

Hypothesis 1c:

Impact of Mixed Reality on student self-perception will possibly differ considering demographic factors. (Radianti et al., 2020).

This study will also examine the ease of adopting immersive technology based on socio-demographic characteristics, such as participants' previous technological experience.

Sub Research Question 2: Do participants with more excellent technological expertise find it easier to adopt Mixed Reality than those with less technological knowledge?

Methodology

Introduction

A research study's methodology section is critical in detailing the techniques used to gather and analyze data, allowing readers to judge the study's rigor and validity (Creswell, 2003). This section describes the current study's research design, data collection methodologies, sample methodology, research tools, and data analysis procedures. The study aims to examine the effect of mixed reality on students' motivation, involvement, and self-perception, as well as how it varies across demographic parameters. The study design and techniques were chosen to meet the research objectives and hypotheses, and they were guided by relevant literature on mixed reality in education (Dunleavy, Dede, and Mitchell, 2008; Johnson-Glenberg et al., 2014). This section also highlights the ethical factors that were considered to guarantee participant safety and appropriate study conduct.

Previous Research Methods

This study supports earlier studies in the context of educational technology. The research contributes to the existing body of research and assists in the ongoing discussion about MR in education by using a similar approach.

A recent study (Radianti et al., 2020) used a similar quantitative technique to assess the effectiveness of MR in increasing student involvement, motivation, and self-perception compared to traditional classroom instruction. The study extends the findings of (Radianti et al., 2020) by studying the role of demographic variables on the efficacy of MR in education using a similar methodological approach. A study by (Rupp et al., 2019) used a quantitative research methodology to analyze the influence of immersive virtual worlds on students' motivation and learning results. The study contributes to the knowledge of the potential advantages of MR and other immersive technologies for education by utilizing a similar methodological approach while stressing the significance of demographic variables. Similarly, (Dunleavy, Dede, and Mitchell, 2008) investigated the influence of augmented reality on students' motivation, engagement, and learning outcomes using a quantitative research approach. The research, which uses a similar technique, investigates the potential of MR, which blends components of augmented and virtual reality, in altering students' self-perception, participation, and motivation in learning.

In conclusion, the methodological approach, which employs a quantitative analysis of survey data, is compatible with prior research in educational technology. Employing a similar methodology, the study adds to the current literature. Furthermore, it advances knowledge of the potential advantages and problems of employing MR in education, emphasizing demographic issues.

Research Design and Rationale

Bryman (2016) defines quantitative research techniques as the systematic collecting and analysis of numerical data to evaluate correlations between variables, test hypotheses, and draw generalizations or predictions. These methodologies are used in the current study to evaluate the effect of Mixed Reality (MR) on students' self-perception, involvement, and motivation in the learning process, as well as how demographic characteristics may influence these results.

Based on the current literature, a research question and hypothesis are established in this study. A well-defined study design is used with a survey and convenience sampling method to collect data from an assortment of participants who were representative of the target group of individuals who had completed academic training or are in the process of undergoing academic training of 72 participants. To investigate the correlations between demographic characteristics and the influence of MR on students' self-perception, participation, and motivation, quantitative data analysis approaches such as t-tests, analysis of variance (ANOVA), correlation, or regression (Field, 2013) are utilized.

The study's findings are provided in tables, charts, and graphs to offer a clear and comprehensive summary. The results will be interpreted in the context of the study issue and current literature (e.g., Radianti et al., 2020), with conclusions taken based on the findings' statistical significance and practical relevance. Overall, the quantitative approaches used in this study are intended to provide a thorough and objective approach to answering the research question about the impact of MR on students' self-perception, involvement, and motivation, as well as the impact of demographic factors on these outcomes.

Mixed Reality Self-perception, Involvement, and Motivation survey

The survey questions (Table 1) for this study were indicated to obtain information on demographic variables, technical acceptability, student engagement, self-perception, and motivation in relation to the use of Mixed Reality (MR) technology in the learning process. In addition, the questionnaire offered open-ended questions for students to express their thoughts on the potential advantages and disadvantages of MR in educational settings.

Demographic questions (items 1-7) were added to collect data on the respondents' age, gender, education level, digital technical skill, and experience with MR, AR, and VR technologies. These questions are critical for investigating the impact of demographic characteristics on MR's impact on students' self-perception, participation, and motivation (Creswell, 2003).

The technical acceptability questions (items 8 and 9) were designed to assess students' impressions of the potential benefits and ease of use of MR technology in the classroom. In addition, these questions were added to measure students' openness to adopting MR into their learning experiences, which is a critical component in the effective application of new technologies (Davis, 1989).

The questions about student involvement (items 10-12) focused on their preferences for using MR technology to complete challenging academic assignments, work well in teams, and assist others in mastering complex skills. In addition, these measures assessed whether engaged and active students felt in the learning process when utilizing MR (Astin, 1984).

Questions on self-perception (items 13-16) assessed students' beliefs about possible gains in their learning outcomes, grasp of complex subjects, motivation, and anticipation of learning in an MR setting. Bandura (1977) designed these questions to measure students' self-perceptions of their talents and confidence in utilizing MR technology for learning.

The motivation questions (items 17-20) were created to assess the effect of MR technology on students' motivation, attentiveness, and perceived ease in understanding new concepts. In addition, these items were designed to investigate the potential of MR technology in increasing students' motivation to study, which is an essential element in academic performance (Deci and Ryan, 1985).

Finally, open-ended questions (items 21 and 22) allowed students to voice their thoughts on the possible benefits and cons of adopting MR at colleges and universities. These questions allowed participants to express their thoughts and experiences, allowing for a more in-depth knowledge of students' perceptions on MR technology in education (Creswell, 2003).

The first section of the survey (Questions 1–9) was used to collect respondents' demographic and technical acceptance data. Item #2 captured the subjects' ages, and item #3 provided classified age divisions from 18 to 24 (coded as 1), 25 to 34 (coded as 2), 35 to 44 (coded as 3), 45 to 54 (coded as 4) and 55 and older (coded as 5).

Male (coded as 1), female (coded as 2), and Others (coded as 3) were used to determine the gender of the respondent in Items #4 and #5. Education was collected from Items #6 and #7, with responses ranging from an associate degree or equivalent (coded as 1) to Doctorate (coded as 4) and Others (coded as 5). From #8 and #9, technological proficiency is captured, spanning from Beginner (Coded as 1) to Advanced (coded as 3). #10 to #15 collected data on whether respondents have experienced Mixed Reality, Augmented Reality, or Virtual Reality as Yes (coded as 1), No (coded as 2), or Maybe (coded as 3).

Mixed Reality (MR) adaptation in the classroom was assessed using a 6-point Likert scale extending from Strongly Disagree (coded as 1) to Strongly Agree (coded as 6), as indicated in Appendix A.

The second segment of the questionnaire (questions 18-28) was structured to assess students' perceptions of their use of MR technology for learning, as well as their engagement and motivation. As indicated in Appendix A, these items were measured using a 6-point Likert scale extending from Strongly Disagree (coded as 1) to Agree (coded as 6) Strongly.

The third and final segment of the survey (questions 29 and 30) centered on enhancing the student's Mixed Reality Learning Experience based on the participant's comments.

The survey was conducted using Google Forms. Respondents with formal education from schools, colleges, or universities responded to the questionnaire. The target population comprised 72 individuals. Table 11 provides a summary of potential and valid survey respondents.

Survey Question	Construct	Item No
Age	Demographic	1
Gender	Demographic	2
Education Level	Demographic	3
Digital Technological proficiency	Demographic	4
Have you ever experienced Mixed Reality?	Demographic	5
Have you ever used Augmented Reality (AR)? Augmented reality (AR) is a technology that uses a camera and a display device, such as a smartphone or AR headset, to superimpose digital material on the actual environment. Customers can try on virtual garments or accessories before making a purchase.	Demographic	6
Have you ever used virtual Reality (VR)? Virtual reality (VR) is a technology that provides a computer-generated world that may be viewed through a headset with a screen or displays for each eye. Flight simulators for pilots, for example, or medical simulations for physicians and nurses	Demographic	7
Mixed reality could be a beneficial technology in education	Technology Acceptance	8
The Mixed Reality technology could be simple to adopt in classroom training	Technology Acceptance	9
I might prefer using mixed reality technologies to complete difficult academic tasks.	Students Involvement	10
Using Mixed Reality technology, I can more effectively work as part of a team, allowing me to complete complex jobs more successfully.	Students Involvement	11
In a classroom scenario, employing mixed reality technology, I could do better as I assist others in learning challenging tasks.	Students Involvement	12
My academic objectives could be enhanced by the learning environment provided by mixed reality.	Students Self-Perception	13
Using Mixed Reality technology could assists me absorb challenging subjects better.	Students Self-Perception	14
Seeing somebody perform a challenging assignment in Mixed Reality could motivate me to use Mixed Reality to complete the same task effectively.	Students Self-Perception	15
I'm looking forward to learning in a Mixed Reality learning experience.	Students Self-Perception	16
Continuous computer-assisted feedback delivered within the Mixed Reality learning environment could be helpful.	Students Motivation	17
Mixed Reality technology might assist me in being more attentive when studying in a Mixed Reality atmosphere.	Students Motivation	18

Mixed reality technology might be beneficial in the study of science, technology, engineering, and mathematics (STEM) subjects.	Students Motivation	19
With adopting Mixed Reality technology, I may be able to grasp new concepts with ease.	Students Motivation	20
What are the possible benefits of using Mixed Reality in colleges/universities?	Students Comments	21
What are the possible drawbacks of using Mixed Reality in colleges/universities?	Students Comments	22

Table 1. Mixed Reality self-perception, motivation, and involvement survey questionnaire.

Survey Design and Data Analysis

A self-administered online survey through Google Forms was used to gather data for this investigation. Based on demographic parameters, the survey was meant to examine the influence of Mixed Reality (MR) on students' self-perception, participation, and motivation. The survey included 22 questions about demographics, technical acceptability, student involvement, self-perception, motivation, and open-ended questions about the pros and downsides of employing MR at colleges/universities.

Before communicating the survey, a pilot study with 15 participants was done to assess the survey instrument's validity and reliability. The pilot group consisted of students from the target audience who answered the survey and offered input on its clarity and validity. The survey was circulated via email and social media channels to a varied population of current college and university students, as well as individuals who have had academic training, to obtain data. A convenience sample approach was utilized, in which individuals were encouraged to participate in the survey of their own will. All participants provided informed consent, assuring their participation was voluntary and that their comments would be anonymous and confidential.

Following data collection, the quantitative data from the survey were statistically analyzed using SPSS software. Descriptive statistics were employed to present the demographic information and responses to the Likert-scale items. To investigate the correlations between demographic characteristics and the influence of MR on students' self-perception, participation, and motivation, inferential statistics such as correlation analysis, t-tests, and analysis of variance (ANOVA) were used.

Overall, data for this study were collected via an online survey using Google Forms, piloted with 15 participants prior to communication. The data were analyzed in SPSS using descriptive and inferential statistics to offer a complete knowledge of the influence of MR on students' self-perception, participation, and motivation depending on demographic characteristics.

Cronbach's Alpha analysis on student Involvement

This study used a survey to measure students' engagement in using mixed reality (MR) technologies in educational contexts. The survey had four items, and the scale's reliability was assessed using Cronbach's alpha (Table 2). The computed Cronbach's alpha was 0.862, whereas Cronbach's alpha depending on standardized items, was 0.865. Both figures imply that the scale has high internal consistency and reliability, as the threshold for acceptable Cronbach's alpha is normal (Jum Clarence Nunnally, 1978).

The mean scores for each question were computed, summarizing the students' views about using MR technology in various elements of their academic activities (Table 2). For example, the question with the highest mean score (M = 4.93, SD = 1.092) was "I might prefer using mixed reality technologies to complete difficult academic tasks," indicating that students, in general, are optimistic about the potential advantages of MR technologies in handling complex academic problems.

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.862	.865	4

Students Involvement Item Statistics

	Mean	Std. Deviation	N
I_might_prefer_using_mixed_reality_technologies_to_complete_difficult_academic_tasks.	4.93	1.092	72
Using_Mixed_Reality_technology, _I_can_more_effectively_work_as_part_of_a_team, _allowing_me_to_complete_complex_jobs_more_successfully	4.65	1.291	72
In_a_classroom_scenario, _employing_mixed_reality_technology, _I_could_do_better_as_I_assist_others_in_learning_challenging_tasks.	4.79	1.034	72
My_academic_objectives_could_be_enhanced_by_the_learning_environment_provided_by_mixed_reality.	4.88	.918	72

Table 2, Reliability and item statistics for student involvement using MR.

Furthermore, the inter-item correlation matrix was evaluated (Table 3) to discover the correlations between the scale's items. All items exhibited moderate to high positive associations with one another, ranging from 0.455 to 0.737. These correlations show that the questions are linked but not redundant, indicating a well-constructed scale covering diverse elements of students' participation with MR technology (DeVellis and Thorpe, 2021).

Students Involvement Inter-Item Correlation Matrix	I_might_prefer_using_mixed_reality_technologies_to_complete_difficult_academic_tasks.	Using_Mixed_Reality_technology, _I_can_more_effectively_work_as_part_of_a_team, _allowing_me_to_complete_complex_jobs_more_successfully	In_a_classroom_scenario, _employing_mixed_reality_technology, _I_could_do_better_as_I_assist_others_in_learning_challenging_tasks.	My_academic_objectives_could_be_enhanced_by_the_learning_environment_provided_by_mixed_reality.
I_might_prefer_using_mixed_reality_technologies_to_complete_difficult_academic_tasks.	1.000	.652	.548	.455
Using_Mixed_Reality_technology, _I_can_more_effectively_work_as_part_of_a_team, _allowing_me_to_complete_complex_jobs_more_successfully	.652	1.000	.737	.616
In_a_classroom_scenario, _employing_mixed_reality_technology, _I_could_do_better_as_I_assist_others_in_learning_challenging_tasks.	.548	.737	1.000	.684
My_academic_objectives_could_be_enhanced_by_the_learning_environment_provided_by_mixed_reality.	.455	.616	.684	1.000

Table 3. Inter-Item correlation Matrix for student involvement using MR.

Furthermore, the item-total data were examined (Table 4) to determine how much each item contributed to the overall scale. The adjusted item-total correlations varied from 0.634 to 0.797, suggesting that each item was significantly related to the overall score. In addition, the squared multiple correlations varied from 0.436 to 0.644, representing the variation in the item explained by the other components. These findings imply that the items contribute to the scale's reliability and validity.

Finally, the mean score (Table 4) on the scale was 19.25 (SD = 3.672), indicating that students had a favorable attitude toward MR technology in educational contexts. Overall, the reliability, item statistics, and inter-item correlations of the scale support the conclusion that the survey employed in this study is a reliable and valid tool for evaluating students' participation with MR technologies in education.

Students Involvement Item-Total Statistics	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
I_might_prefer_using_mixed_reality_technologies_to_complete_difficult_academic_tasks.	14.32	8.305	.634	.436	.854
Using_Mixed_Reality_technology, _I_can_more_effectively_work_as_part_of_a_team, _allowing_me_to_complete_complex_jobs_more_successfully	14.60	6.554	.797	.644	.790
In_a_classroom_scenario, _employing_mixed_reality_technology, _I_could_do_better_as_I_assist_others_in_learning_challenging_tasks.	14.46	7.914	.774	.632	.798
My_academic_objectives_could_be_enhanced_by_the_learning_environment_provided_by_mixed_reality.	14.38	8.970	.668	.496	.843

Scale Statistics

Mean	Variance	Std. Deviation	N of Items
19.25	13.486	3.672	4

Table 4. Item-Total and Scale Statistics for student involvement using MR.

Cronbach's Alpha analysis on student Motivation

Cronbach's alpha was used to assess the reliability of student motivation in connection to mixed reality (MR) technology in learning experiences, which had four components. Cronbach's alpha was determined to be 0.835 (Table 5), indicating that the scale has strong internal consistency, as the acceptable threshold for Cronbach's alpha is typically 0.7 (Jum Clarence Nunnally, 1978).

The mean ratings for each item were calculated (Table 5), revealing students' enthusiasm to adopt MR technology in various elements of their learning experiences. The question with the highest mean score (M = 4.90, SD = 1.103) was "I am looking forward to learning in a Mixed Reality learning experience," demonstrating that students are typically enthusiastic about the potential of adopting MR technology in their education.

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.835	.835	4

Student Motivation Item Statistics	Mean	Std. Deviation	N
Using_Mixed_Reality_technology_could_assists_me_absorb_challenging_subjects_better.	4.69	1.030	72
Seeing_somebody_perform_a_challenging_assignment_in_Mixed_Reality_could_motivate_me_to_use_Mixed_Reality_to_complete_the_same_task_effectively.	4.74	1.138	72
I_am_looking_forward_to_learning_in_a_Mixed_Reality_learning_experience.	4.90	1.103	72
Continuous_computer-assisted_feedback_delivered_within_the_Mixed_Reality_learning_environment_could_be_helpful.	4.76	1.107	72

Table 5. Reliability and item statistics for student motivation using MR.

The inter-item correlation matrix was examined to identify the correlations between the scale's items (Table 6). The correlations between all items were moderate to high, ranging from 0.466 to 0.687. These correlations indicate that the questions are linked but not unduly redundant, indicating a well-constructed scale that reflects many facets of student interest in MR technology (DeVellis and Thorpe, 2021).

Student Motivation Inter-Item Correlation Matrix	Using_Mixed_Reality_technology_could_assists_me_absorb_challenging_subjects_better.	Seeing_somebody_perform_a_challenging_assignment_in_Mixed_Reality_could_motivate_me_to_use_Mixed_Reality_to_complete_the_same_task_effectively.	I_am_looking_forward_to_learning_in_a_Mixed_Reality_learning_experience.	Continuous_computer-assisted_feedback_delivered_within_the_Mixed_Reality_learning_environment_could_be_helpful.
Using_Mixed_Reality_technology_could_assists_me_absorb_challenging_subjects_better.	1.000	.687	.507	.541
Seeing_somebody_perform_a_challenging_assignment_in_Mixed_Reality_could_motivate_me_to_use_Mixed_Reality_to_complete_the_same_task_effectively.	.687	1.000	.552	.598
I_am_looking_forward_to_learning_in_a_Mixed_Reality_learning_experience.	.507	.552	1.000	.466
Continuous_computer-assisted_feedback_delivered_within_the_Mixed_Reality_learning_environment_could_be_helpful.	.541	.598	.466	1.000

Table 6. Inter-Item correlation Matrix for student motivation using MR.

The item-total statistics were reviewed to determine how much each item contributed to the overall scale (Table 7). The adjusted item-total correlations varied from 0.591 to 0.746, suggesting that each item was substantially related to the overall score. In addition, the squared multiple correlations varied from 0.353 to 0.574, showing the variation in the item explained by the other components. These findings show that the items contribute to the scale's reliability and validity.

The mean score on the scale was 19.10 (SD = 3.581), indicating that students had a favorable attitude toward MR technology in learning situations (Table 7). In conclusion, examining the scale's reliability, item statistics, and inter-item correlations supports the idea that the survey employed in this work is a reliable and valid instrument for assessing student enthusiasm to use MR technologies in education.

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Using_Mixed_Reality_technology_could_assists_me_absorb_challenging_subjects_better.	14.40	7.765	.696	.514	.778
Seeing_somebody_perform_a_challenging_assignment_in_Mixed_Reality_could_motivate_me_to_use_Mixed_Reality_to_complete_the_same_task_effectively.	14.36	7.023	.746	.574	.752
I_am_looking_forward_to_learning_in_a_Mixed_Reality_learning_experience.	14.19	7.933	.591	.353	.823
Continuous_computer-assisted_feedback_delivered_within_the_Mixed_Reality_learning_environment_could_be_helpful.	14.33	7.718	.631	.406	.806

Student Motivation Scale Statistics

Mean	Variance	Std. Deviation	N of Items
19.10	12.821	3.581	4

Table 7. Item-Total and Scale Statistics for student motivation using MR.

Cronbach's Alpha analysis on student Self-Perception

Cronbach's alpha was used to assess the reliability of students' self-perceptions of mixed reality (MR) technology in learning instances, which had three components. Cronbach's alpha was determined to be 0.831 (Table 8), indicating that the scale has strong internal consistency, as the acceptable threshold for Cronbach's alpha is typically 0.7 (Jum Clarence Nunnally, 1978).

The mean scores for each question were calculated, revealing students' self-perceptions of the employment of MR technology in various elements of their learning experiences (Table 8). For example, the item with the highest mean score (M = 5.19, SD = 0.898) related to the item "Mixed reality technology might be beneficial in the study of science, technology, engineering, and mathematics (STEM) subjects," showing that students feel MR technologies can be beneficial for STEM courses.

Reliability Statistics		
Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.831	.836	3

Student Self-Perception Item Statistics	Mean	Std. Deviation	N
Mixed_Reality_technology_might_assist_me_in_being_more_attentive_when_studying_in_a_Mixed_Reality_atmosphere.	4.86	1.104	72
Mixed_reality_technology_might_be_beneficial_in_the_study_of_science,_technology,_engineering,_and_mathematics_(STEM)_subjects.	5.19	.898	72
With_adopting_Mixed_Reality_technology,_I_may_be_able_to_grasp_new_concepts_with_ease.	4.89	1.056	72

Table 8. Reliability and item statistics for student self-perception using MR.

The inter-item correlation matrix was examined to identify the correlations between the scale's items (Table 9). All items had moderate to high positive associations with one another, with coefficients ranging from 0.596 to 0.677. These correlations indicate that the questions are relevant but not unduly redundant, indicating a well-constructed scale that covers many elements of student self-perception of MR technology (DeVellis and Thorpe, 2021).

Student Self-Perception Inter-Item Correlation Matrix

	Mixed_Reality_technology_might_assist_me_in_being_more_attentive_when_studying_in_a_Mixed_Reality_atmosphere.	Mixed_reality_technology_might_be_beneficial_in_the_study_of_science,_technology,_engineering,_and_mathematics_(STEM)_subjects.	With_adopting_Mixed_Reality_technology,_I_may_be_able_to_grasp_new_concepts_with_ease.
Mixed_Reality_technology_might_assist_me_in_being_more_attentive_when_studying_in_a_Mixed_Reality_atmosphere.	1.000	.596	.615
Mixed_reality_technology_might_be_beneficial_in_the_study_of_science,_technology,_engineering,_and_mathematics_(STEM)_subjects.	.596	1.000	.677
With_adopting_Mixed_Reality_technology,_I_may_be_able_to_grasp_new_concepts_with_ease.	.615	.677	1.000

Figure 9. Inter-Item correlation Matrix for student self-perception using MR.

The item-total statistics were reviewed to determine how much each item contributed to the overall scale (Table 10). The adjusted item-total correlations varied from 0.661 to 0.718, suggesting that each item was related to the overall score in a meaningful way. In addition, the squared multiple correlations varied from 0.437 to 0.527, showing the variation in the item explained by the other components. These findings show that the items contribute to the scale's reliability and validity.

The mean score on the scale was 14.94 (SD = 2.653), indicating that students had an excellent self-perception of the employment of MR technology in learning activities (Table 10). In conclusion, the scale's reliability, item statistics, and inter-item correlations support the assumption that the survey employed in this work is a reliable and valid tool for evaluating student self-perception of the use of MR technologies in education.

Student Self-Perception Item-Total Statistics

	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Corrected Item-Total Correlation	Squared Multiple Correlation	Cronbach's Alpha if Item Deleted
Mixed_Reality_technology_might_assist_me_in_being_more_attentive_when_studying_in_a_Mixed_Reality_atmosphere.	10.08	3.204	.661	.437	.801
Mixed_reality_technology_might_be_beneficial_in_the_study_of_science,_technology,_engineering,_and_mathematics_(STEM)_subjects.	9.75	3.768	.707	.510	.761
With_adopting_Mixed_Reality_technology,_I_may_be_able_to_grasp_new_concepts_with_ease.	10.06	3.208	.718	.527	.73

Double-click to activate

Student Self-Perception Scale Statistics

Mean	Variance	Std. Deviation	N of Items
14.94	7.039	2.653	3

Table 10. Item-Total and Scale Statistics for student self-perception using MR.

Ethical Considerations and Limitations

It was critical to address ethical concerns when conducting this study to ensure that the research was carried out professionally and with regard to the individuals. To begin, all individuals provided informed consent before participating in the study (Bryman, 2016). They were given an information sheet outlining the study's goal, the voluntary nature of their involvement, and the privacy and anonymity of their replies. Participants were informed that they could withdraw from the research without obligation. To guarantee privacy and confidentiality, no personal information was gathered, and the data was securely maintained, with only the research member having access. Furthermore, the data analysis and reporting were carried out so no individual participant could be recognized. The study conformed to the standards of research ethics as described by the National College of Ireland ethics form and followed the ethical criteria issued by the institutional review board (IRB).

Despite this investigation's thorough planning and implementation, several limitations must be addressed. For example, convenience sampling restricts the findings' generalizability to the larger student body (Teddlie and Yu, 2007). Future studies might apply probability sampling approaches to achieve a more diverse sample. Second, the study's cross-sectional design precludes an investigation of the long-term effects of MR on students' self-perception, participation, and motivation (Creswell, 2003). Longitudinal studies may provide further light on the long-term effects of MR on students' learning experiences. Finally, because the survey is self-report, participants may react in a way they perceive is more socially acceptable rather than providing information about their experiences and perceptions (Nederhof, 1985). Additional data-gathering methods, such as interviews or observations, might be used in future studies to offer a more thorough insight into students' MR experiences.

Findings and Results

After executing the online questionnaire, the analysis examines the findings of the questions using the previously mentioned framework of one primary research question, three hypotheses, and one sub-research question. The survey received a total of 72 responses. The information is then converted from the Google form into an Excel file and later loaded into SPSS for analysis. The SPSS raw data were then exported to Excel, which is appended as an annex (4).

The analysis follows (a) descriptive statistics and demographics of the survey sample population, including frequency, means, standard deviations, and variance; (b) Analysis of students' motivation, self-perception, and engagement using one-way ANOVA.

The survey was the only instrument utilized for this analysis. The survey instrument contains three sections. The purpose of the first component (Items 1–17) was to collect data on demographic samples and technology adoption and utilization. The second section (points 18 to 28) focused on the three primary constructs, particularly student self-perception, engagement, and motivation. Multiple components from each of the three concepts were correlated and studied to ascertain the degree of the associations. The third and final section (questions 29 and 30) consisted of two open-ended queries designed to enhance the Mixed Reality Learning Experience.

	N
Potential Survey Participants	72
Valid Survey Participants	72

Table 11. Potential and valid survey respondents

Descriptive statistics and demographics of the survey

Table 12 provides a comprehensive outline of the study's participants' demographic characteristics and technical skills. The analysis that follows will compare each of these groups for research.

68.1% of the individuals resided between the ages of 25 and 34, making this the largest age cohort in the research. The 18-24 and 35-44 age ranges contributed to 13.9% of the individuals, while the 44-55 age group factored for just 4.2%. The study had more male volunteers than female participants (56.9% versus 43.1%). In addition, 50 percent of the respondents possessed a master's degree, while 45.8 percent held a bachelor's degree. Only 2.8% of the population held a doctorate, and 1.4% held an associate's degree.

Most participants reported an intermediate level of digital proficiency (58.3%), followed by an advanced level (36.1%). A modest percentage (5.6%) of respondents identified as digital novices. Most participants (59.7%) had not previously encountered MR, whereas 30.6% had. 9.7% of respondents were uncertain as to whether they had experienced MR. 778.% of participants had experience with augmented Reality, while 19.4% had not. Very few individuals (2.8%) were uncertain about their AR experience. Most participants (68.1%) had experienced virtual Reality, while 31.9% had not.

In conclusion, most participants in the study were between the ages of 25 and 34, and marginally more men participated than women. Most volunteers held either a master's or bachelor's degree and self-reported intermediate or advanced digital proficiency. Regarding immersive technologies, AR and VR adoption rates were higher than MR's. This information can be used to comprehend better the correlation between demographic characteristics and the acceptance or perception of immersive technologies in teaching.

		Frequency	Percent
Age	18 - 24	10	13.9
	25 - 34	49	68.1
	35 - 44	10	13.9
	45 - 54	3	4.2
Gender	Male	41	56.9
	Female	31	43.1
Education	Associate's Degree	1	1.4
	Bachelor's Degree	33	45.8
	Master's Degree	36	50.0
	Doctoral Degree	2	2.8
Digital Proficiency	Beginner	4	5.6
	Intermediate	42	58.3
	Advanced	26	36.1
Experienced Mixed Reality	Yes	22	30.6
	No	43	59.7
	Maybe	7	9.7

Experienced Augmented Reality	Yes	56	77.8
	No	14	19.4
	Maybe	2	2.8
Experienced Virtual Reality	Yes	49	68.1
	No	23	31.9

Table 12. Descriptive Statistics of Sample Population for Age, Gender, Education, Digital Proficiency, Technology Experience in MR, AR, or VR.

Figure 6, In the 18-24 age range, digital technology proficiency is comparatively low, with the preponderance of participants falling into the intermediate category (11.11%). In addition, this age group is also represented in the novice (1.39%) and advanced (1.39%) categories. Compared to the 18-24 age group, the 25-34 age range demonstrates a higher degree of digital proficiency. Significantly, 27.78% of participants are classified as advanced, while 36.11 % fell into the intermediate category. 4.17 % fewer individuals in this age group are classified as novices. In the 35-44 age range, the distribution of digital proficiency levels is more restricted, with no novices reported. The plurality of participants in this age group (9.72%) are classified as intermediate, while a lesser %age (4.17%) is considered advanced. Compared to younger age categories, digital proficiency levels are lesser among those aged 45 to 54. The only categories represented are intermediate (1.39%) and advanced (2.78%), with no novices reported. This age group has the lowest representation overall regarding digital technology proficiency.

In conclusion, the 25-to-34-year-old age group appears to have the highest overall digital technological proficiency, with a significant proportion of participants classified as advanced. The 18-24 age range is predominantly intermediate, with some representation in the novice and advanced categories. The 35-44 age bracket represents only intermediate and advanced levels. Finally, the age category between 45 and 54 has the lowest representation and digital proficiency, with no reported novices.

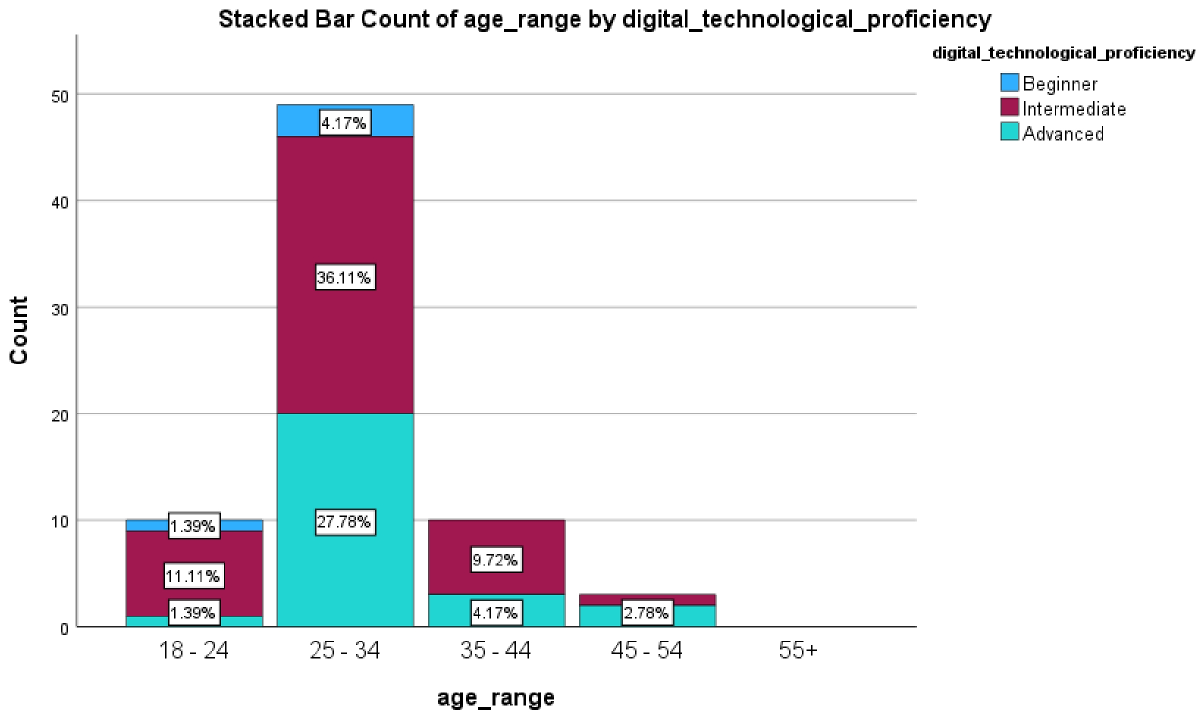

Figure 6. count of age range by digital technological proficiency stacked bar graph.

Table 4 provides a comprehensive breakdown of respondents' perspectives regarding the convenience of implementing Mixed Reality (MR) technology for an educational program, categorized by demographic attributes such as age, gender, education, digital proficiency, and experience with Mixed Reality, Augmented Reality, and Virtual Reality.

70% of participants aged 18 to 24 agreed that MR could be easily implemented in classroom instruction, with 20% strongly concurring. The opinions of individuals aged 25 to 34 were more diverse. In contrast, those aged 35 to 44 and 44 to 55 were more likely to agree that MR technology would be simple to implement in academic training. Males were more likely to believe that adopting MR technology in classroom training could be straightforward, with 34.1% agreeing and 24.4% strongly agreeing. The opinions of female individuals were more evenly distributed, with 29% agreeing and 19.4% strongly confirming. Bachelor's degree holders were more likely to agree (30.3%) and strongly agree (18.2%) that MR technology could be easily implemented in classroom instruction. 36.1% of those with a master's degree agreed, and 22.2% strongly agreed with this statement. Doctorate candidates were evenly divided, with 50% disagreeing somewhat and 50% strongly concurring.

Research Question and Research hypotheses data analysis

Each sub-sections of Likert scale responses will be averaged to analyze student involvement, motivation, and self-perception—for example, the average value of the survey. Similarly, each survey panel will have an average self-perception and motivation value. Therefore, average_involvement, average_motivation, and average_self-perception will be the calculated columns based on the average value of each sub-section.

Research Question 1:

How do demographics affect the impact of Mixed Reality on students' self-perception, involvement, and motivation in the learning process?

Hypothesis 1a:

*Impact of Mixed Reality on student involvement will possibly differ considering demographic factors. (*Dunleavy & Dede, 2013).

Analysis Summary for Hypothesis 1a

According to Table 13, The F-statistic (0.979) and its corresponding p-value (0.408) indicate that there are no substantial variations in average involvement among the four investigated age groups (18-24, 25-34, 35-44, and 45-54). This suggests that age may not significantly affect student engagement in the learning process. Next, the Games-Howell post hoc analyses were performed to assess the mean differences in average involvement between age groups. Only one significant mean difference was discovered between the 18-24 and 25-34 age groups, with a p-value of 0.039 and a mean difference of 0.51582. This suggests that students between 25 and 34 are more involved on average than those between 18 and 24. However, it is essential to observe that the other comparisons of age groups did not reveal any significant mean differences, as their p-values were greater than the standard significance level of 0.05. This indicates that there are no significant differences in average involvement among the remaining age categories (18-24 versus 35-44, 18-24 versus 45-54, 25-34 versus 35-44, 25-34 versus 45-54, and 35-44 versus 45-54).

In conclusion, the ANOVA results and various comparisons indicate that age may not significantly affect students' general engagement in the learning process. Nevertheless, there is a fair indication that the 25-34 age group is more involved than the 18-24 age group.

ANOVA (age vs average_involvement)

average_involvement

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.477	3	.826	.979	.408
Within Groups	57.366	68	.844		
Total	59.844	71			

Multiple Comparisons

Dependent Variable: average_involvement

	(I) age_range	(J) age_range	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Games-Howell	18 - 24	25 - 34	.51582*	.18478	.039	.0189	1.0128
		35 - 44	.27500	.30788	.809	-.6374	1.1874
		45 - 54	.55833	.67746	.842	-3.8212	4.9378
	25 - 34	18 - 24	-.51582*	.18478	.039	-1.0128	-.0189
		35 - 44	-.24082	.31608	.870	-1.1613	.6797
		45 - 54	.04252	.68123	1.000	-4.2614	4.3465
	35 - 44	18 - 24	-.27500	.30788	.809	-1.1874	.6374
		25 - 34	.24082	.31608	.870	-.6797	1.1613
		45 - 54	.28333	.72438	.976	-3.4240	3.9906
	45 - 54	18 - 24	-.55833	.67746	.842	-4.9378	3.8212
		25 - 34	-.04252	.68123	1.000	-4.3465	4.2614
		35 - 44	-.28333	.72438	.976	-3.9906	3.4240

*. The mean difference is significant at the 0.05 level.

Table 13. One-way Anova age vs. average involvement.

According to Table 14, The F-statistic (0.913) and its corresponding p-value (0.343) indicate no notable variations between the two investigated gender categories in terms of average involvement. This suggests that gender may not significantly affect student engagement in the learning process. Likewise, the p-value for the ANOVA analysis of education level and average involvement is greater than 0.05, indicating no significant difference in average involvement among the various education levels. Again, this indicates that education level does not significantly affect average learning process engagement.

ANOVA (gender vs. average_involvement)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.770	1	.770	.913	.343
Within Groups	59.073	70	.844		
Total	59.844	71			

ANOVA (education vs. average_involvement)

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.611	3	.204	.234	.872
Within Groups	59.232	68	.871		
Total	59.844	71			

Table 14. one-way ANOVA gender vs. average_involvement and education vs. average_involvement.

The purpose of Table 15 was to identify whether there were statistically significant differences in average involvement in the learning process based on digital technological proficiency (Beginner, Intermediate, Advanced). The ANOVA test produced a p-value of 0.620, more significant than the standard significance level of 0.05. This indicates that one cannot dismiss the null hypothesis, implying no statistically significant differences regarding average involvement between the various digital proficiency categories. Therefore, according to the data provided, the digital proficiency of learners does not appear to influence their engagement in the learning process substantially.

Furthermore, the Games-Howell multiple comparisons test was administered further to examine the relationships between the various digital proficiency groups. This post hoc evaluation test identifies specific combinations of groups with potentially significant mean differences. At the 0.05 level of significance, the test, in this instance, discovered no significant mean differences among any of the pairs of digital proficiency categories (Beginner, Intermediate, and Advanced).

Therefore, based on the analyzed data, it shows that the level of digital technological proficiency has little effect on the average involvement of individuals in the learning process.

ANOVA (digital_technological_proficiency vs average_involvement)

average_involvement

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.822	2	.411	.481	.620
Within Groups	59.021	69	.855		
Total	59.844	71			

Multiple Comparisons

Dependent Variable: average_involvement

	(I) digital_technological_proficiency_coded	(J) digital_technological_proficiency_coded	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Games-Howell	Beginner	Intermediate	.19345	.49643	.922	-1.7443	2.1312
		Advanced	.37981	.53305	.769	-1.4366	2.1962
	Intermediate	Beginner	-.19345	.49643	.922	-2.1312	1.7443
		Advanced	.18636	.25386	.745	-.4326	.8053
	Advanced	Beginner	-.37981	.53305	.769	-2.1962	1.4366
		Intermediate	-.18636	.25386	.745	-.8053	.4326

Table 15. one-way ANOVA for digital_technological_proficiency vs. average_involvement.

The purpose of Table 16 was to determine if there were significant differences in the average level of involvement in the learning process based on whether the participants had experienced blended Reality (Yes, No, Maybe). The ANOVA test produced a p-value of 0.492, more significant than the standard significance level of 0.05. This indicates that we cannot reject the null hypothesis, which states that there are no significant differences between the groups of individuals with variable mixed reality experiences regarding average involvement. Therefore, based on the available data, mixed Reality experience does not appear to impact individuals' engagement in the learning process significantly. In addition, the Games-Howell multiple comparisons test was administered to investigate the relationships between the various mixed reality experience groups. This post hoc analysis test identifies specific combinations of groups with potentially significant mean differences. At the 0.05 level of significance, the test revealed no significant mean differences between any of the pairs of mixed reality experience groups (Yes, No, Maybe).

ANOVA (experienced_mixed_reality vs average_involvement)

average_involvement

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.216	2	.608	.716	.492
Within Groups	58.627	69	.850		
Total	59.844	71			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: average_involvement

	(I) experienced_mixed_reality_coded	(J) experienced_mixed_reality_coded	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Games-Howell	Yes	No	-.07109	.25962	.960	-.7069	.5647
		Maybe	.37825	.43977	.675	-.8140	1.5705
	No	Yes	.07109	.25962	.960	-.5647	.7069
		Maybe	.44934	.39752	.526	-.7056	1.6042
	Maybe	Yes	-.37825	.43977	.675	-1.5705	.8140
		No	-.44934	.39752	.526	-1.6042	.7056

Table 16. one-way ANOVA for experienced mixed Reality vs. average_involvement.

The purpose of Table 17 was to assess if there were notable variations in the average level of involvement in the learning process based on whether the participants had encountered augmented Reality (Yes, No, Maybe). The ANOVA test produced a p-value of 0.337, higher than the standard significance level of 0.05. This indicates that we cannot reject the null hypothesis, which states that there are no significant differences between the groups of individuals with diverse augmented reality encounters regarding their average involvement. Therefore, based on the available data, the experience of augmented Reality does not appear to impact individuals' engagement in the learning process significantly.

In addition, the Games-Howell multiple comparisons test was utilized to investigate the relationships between the various augmented reality experience groups. This post hoc analysis test identifies specific combinations of groups with potentially significant mean differences. At the 0.05 level of significance, the test demonstrated no significant mean differences between any of the pairs of augmented reality experience groups (Yes, No, Maybe). Notably, there was a slight variance between the 'Yes' and 'Maybe' groups (p = 0.090), but this does not meet the standard significance threshold of 0.05. Therefore, it appears to be, based on the data evaluated, that interaction with augmented Reality has no significant effect on the average engagement of people in the learning process.

ANOVA (experienced augmented reality vs average_involvement)

average_involvement

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.858	2	.929	1.106	.337
Within Groups	57.985	69	.840		
Total	59.844	71			

Multiple Comparisons

Dependent Variable: average_involvement

	(I) experienced_augmented_reality	(J) experienced_augmented_reality	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Games-Howell	Yes	No	.36161	.28982	.441	-.3749	1.0982
		Maybe	.52232	.17421	.090	-.1214	1.1661
	No	Yes	-.36161	.28982	.441	-1.0982	.3749
		Maybe	.16071	.29137	.848	-.6188	.9403
	Maybe	Yes	-.52232	.17421	.090	-1.1661	.1214
		No	-.16071	.29137	.848	-.9403	.6188

Table 17. one-way ANOVA for experienced augmented Reality vs. average_involvement.

The purpose of Table 18's ANOVA test was to assess the likelihood that there were statistically significant differences in average involvement in the learning process based on whether the participants had experienced virtual Reality (Yes or No). The ANOVA test produced a p-value of 0.506, not more significant than the standard significance level of 0.05. This indicates that one cannot reject the null hypothesis, which asserts there are no statistically significant distinctions between the two groups of individuals with different virtual reality experiences regarding their average involvement. Therefore, based on the available data, virtual Reality does not significantly impact individuals' engagement in learning.

ANOVA (virtual reality vs average_involvement)

average_involvement

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.380	1	.380	.447	.506
Within Groups	59.464	70	.849		
Total	59.844	71			

Table 18. one-way ANOVA for experienced virtual Reality vs. average_involvement.

Based on the descriptive statistics provided for the average student participation in the mixed reality learning process, it is evident that there is a positive trend toward increased student participation. The mean average involvement for a sample size (N) of 72 lies between the minimum value of 2.00 and the maximum value of 6.00. This suggests that, on average, students are comparatively engaged when mixed Reality is incorporated into their learning process (Table 19). The standard deviation (Std. Dev.) of 0.91808 suggests that the data points are dispersed considerably around the mean. This indicates that student engagement levels vary, but many students still demonstrate a relatively high level of engagement. In conclusion, the data indicate that integrating mixed Reality into the learning process will likely increase student engagement. While there is some variation in the data, the overall trend indicates that student engagement is increasing, which may result in enhanced learning outcomes.

Descriptive Statistics of average_involvement

	N	Minimum	Maximum	Mean	Std. Deviation
average_involvement	72	2.00	6.00	4.8125	.91808
Valid N (listwise)	72				

Table 19. descriptive analysis of average student involvement.

The outcome for Hypothesis 1a

Based on the available results and the statistical analysis using one-way ANOVA, it can be concluded that demographics may not significantly influence the effect of Mixed Reality on students' involvement. The p-values for the one-way ANOVA tests for age, gender, education level, digital proficiency, mixed reality experience, augmented reality experience, and virtual reality experience were all greater than the significance threshold of 0.05, indicating no significant differences in average involvement among the demographic groups. There was, however, a statistically significant mean difference between the 18-24 and 25-34 age groups, with the 25-34 age group demonstrating greater average involvement.

From the data presented in Table 20, it can be determined that most respondents view the use of Mixed Reality technologies in the learning process favorably. The mean average involvement for each item ranges from 4.65 to 4.93, indicating that students are comparatively active and motivated when utilizing Mixed Reality technologies for learning purposes. The standard deviation values indicate some variation in student responses, but the data points are, on average, relatively near the mean. Item 1 ("I might prefer using mixed reality technologies to complete difficult academic tasks") had the highest mean average involvement, indicating that students are especially interested in using Mixed Reality technologies to complete challenging academic tasks. Item 4 ("My academic objectives could be enhanced by the learning environment provided by mixed reality") had the lowest standard deviation, indicating that students' responses to this item were more consistent than responses to the other items.

According to Table 14, the mean average level of participation is 4.8125, closer to the maximum value of 6.00 than the minimal value of 2.00. This suggests that student engagement is comparatively high when Mixed Reality is incorporated into the learning process. The value of 0.91808 for the standard deviation indicates that the data points are moderately dispersed around the mean. This indicates that student engagement levels vary, but most students still demonstrate a relatively high level of engagement.

In conclusion, the data demonstrate that students favorably view Mixed Reality technologies in academic duties. It appears that students might favor Mixed Reality technologies for accomplishing challenging tasks, and they believe the learning environment afforded by Mixed Reality could help them achieve their academic goals. Integrating Mixed Reality into the education process has the potential to boost student engagement and participation in academic duties, according to the data.

Research Question 1:

How do demographics affect the impact of Mixed Reality on students' self-perception, involvement, and motivation in the learning process?

Hypothesis 1b:

Impact of Mixed Reality on student motivation will possibly differ considering demographic factors. (Kaimara et al., 2021).

Analysis Summary for Hypothesis 1b

The correlation between age and average motivation levels was analyzed to determine if there were statistically significant differences in motivation levels between age groups, as shown in Table 21. A one-way ANOVA was performed to test the hypothesis that there is no significant difference between the average levels of motivation between the age groups 18-24, 25-34, 35-44, and 45-54. The test produced an F-statistic of 1.290 and a p-value of 0.285%. Considering the generally accepted significance level of 0.05, the calculated p-value exceeds the limit, preventing the rejection of the null hypothesis. As a result, the results indicate no statistically significant difference between the average motivation levels of the various age groups. This indicates that age may not play a significant part when assessing motivation levels.

Despite this, the Games-Howell post hoc test was used to examine pairwise comparisons between age groups further. The analysis revealed a statistically significant difference in average motivation levels between the 18-24 and 25-34 age groups (mean difference = 0.5761, p-value = 0.007). The results indicate that the 25-34 age group has greater motivation than the 18-24 age group. The differences in average motivation levels between the remaining age groups were statistically insignificant. In conclusion, there is a notable distinction between the 18-24 and 25-34 age ranges.

ANOVA (age vs average_motivation)

average_motivation

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.990	3	.997	1.290	.285
Within Groups	52.541	68	.773		
Total	55.531	71			

Multiple Comparisons

Dependent Variable: average_motivation

	(I) age_range	(J) age_range	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Games-Howell	18 - 24	25 - 34	.57619*	.16690	.007	.1304	1.0219
		35 - 44	.33333	.30671	.704	-.5882	1.2549
		45 - 54	.32222	.59639	.942	-3.5622	4.2067
	25 - 34	18 - 24	-.57619*	.16690	.007	-1.0219	-.1304
		35 - 44	-.24286	.31927	.871	-1.1788	.6931
		45 - 54	-.25397	.60294	.970	-4.0090	3.5011
	35 - 44	18 - 24	-.33333	.30671	.704	-1.2549	.5882
		25 - 34	.24286	.31927	.871	-.6931	1.1788
		45 - 54	-.01111	.65556	1.000	-3.1380	3.1158
	45 - 54	18 - 24	-.32222	.59639	.942	-4.2067	3.5622
		25 - 34	.25397	.60294	.970	-3.5011	4.0090
		35 - 44	.01111	.65556	1.000	-3.1158	3.1380

*. The mean difference is significant at the 0.05 level.

Table 21. One-way Anova age vs. average_motivation.

Two separate one-way ANOVAs were performed to investigate the relationship between gender, education, and average motivation levels (Table 22). These tests aimed to assess whether there are substantial gender and education-based variations in average motivation levels.

First, a one-way ANOVA was conducted to assess the null hypothesis that average motivation levels between males and females are not significantly different. The analysis produced an F-statistic of 0.316 and a p-value of 0.577. The derived p-value crosses the commonly accepted relevance level of 0.05, making it impractical to dismiss the null hypothesis. The results indicate no statistically significant difference between the average motivation levels of men and women. This suggests that gender may not significantly determine motivation levels in this dataset.

Second, a one-way ANOVA was performed to examine the relationship between levels of education and average motivation. The null hypothesis for this study was that there is no statistically significant difference between the average levels of motivation among the various education categories. The analysis produced an F-statistic of 0.071 and a p-value of 0.975%. Since the p-value is more significant than the significance threshold of 0.05, the null hypothesis cannot be rejected. Thus, findings demonstrate that there is no statistically significant difference between the average motivation levels of individuals with different levels of education, implying that education may not play a crucial role in determining motivation levels in this dataset.

In conclusion, neither gender nor education level appears to substantially affect typical motivation levels.

ANOVA (gender vs average_motivation)

average_motivation

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.248	1	.248	.314	.577
Within Groups	55.283	70	.790		
Total	55.531	71			

ANOVA (education vs average_motivation)

average_motivation

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.173	3	.058	.071	.975
Within Groups	55.358	68	.814		
Total	55.531	71			

Table 22. one-way ANOVA gender vs. average_motivation and education vs. average_motivation.

A one-way ANOVA was conducted to investigate the relationship between the digital-technology proficiency levels of the participants and their average motivation levels, as shown in Table 23. This study intended to assess if there were significant differences in average motivation levels based on participants' digital technology proficiency, which was categorized as "Beginner," "Intermediate," and "Advanced." There is no statistically significant difference between the average levels of motivation across the three categories of digital technology proficiency. The study generated an F-statistic of 0.39 and a corresponding p-value of 0.67. The null hypothesis cannot be rejected because the p-value exceeds the commonly used significance threshold of 0.05. This result indicates no statistically significant difference between the average motivation levels among the various digital technology proficiency categories.

A post hoc Games-Howell test was performed to examine the relationships between the groups further. The results of this study demonstrated no significant differences in average levels of motivation between any of the three pairs of groups (Beginner versus Intermediate, Beginner versus Advanced, and Intermediate versus Advanced) at the 0.05 level of significance. In conclusion, this study's findings suggest that individuals' digital technology proficiency may not substantially influence their average motivation levels.

ANOVA (digital_technological_proficiency vs avergae_motivation)

average_motivation

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.632	2	.316	.397	.674
Within Groups	54.899	69	.796		
Total	55.531	71			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: average_motivation

	(I) digital_technological_proficiency_coded	(J) digital_technological_proficiency_coded	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Games-Howell	Beginner	Intermediate	.34127	.48868	.779	-1.5321	2.2146
		Advanced	.42308	.50858	.705	-1.3789	2.2251
	Intermediate	Beginner	-.34127	.48868	.779	-2.2146	1.5321
		Advanced	.08181	.23024	.933	-.4754	.6390
	Advanced	Beginner	-.42308	.50858	.705	-2.2251	1.3789
		Intermediate	-.08181	.23024	.933	-.6390	.4754

Table 23. one-way ANOVA digital_technological_proficiency vs average_motivation.

According to Table 24, a one-way ANOVA was performed to examine the relationship between participants' experiences with mixed reality (MR) technology and their average motivation levels. The purpose of this research was to determine whether there are statistically significant differences in the average motivation levels of individuals based on their experience with MR (classified as "Yes," "No," and "Maybe"). The null hypothesis is that there is no significant difference in average motivation levels between the three categories of MR technology experience. The analysis yielded an F-statistic of 1.291 and a p-value of 0.282. Since the p-value exceeds the usual significance threshold of 0.05, the null hypothesis cannot be rejected. This result implies no statistically significant difference between the typical motivation levels among the various MR experience groups. Next, a post hoc Games-Howell test was administered to examine further the relationships between the two categories. This test revealed that, at the 0.05 level of significance, there were no significant differences in average motivation levels between any of the three pairs of groups (Yes vs. No, Yes vs. Maybe, and No vs. Maybe).

ANOVA (experienced_mixed_reality vs average_motivation)

average_motivation

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.003	2	1.001	1.291	.282
Within Groups	53.528	69	.776		
Total	55.531	71			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: average_motivation

	(I) experienced_mixed_reality _coded	(J) experienced_mixed_reality _coded	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Games-Howell	Yes	No	-.26004	.26097	.584	-.9008	.3807
		Maybe	.22944	.34569	.787	-.6592	1.1180
	No	Yes	.26004	.26097	.584	-.3807	.9008
		Maybe	.48948	.28306	.248	-.3033	1.2823
	Maybe	Yes	-.22944	.34569	.787	-1.1180	.6592
		No	-.48948	.28306	.248	-1.2823	.3033

Table 24. one-way ANOVA experienced_mixed_reality vs average_motivation.

Based on Table 25, a one-way ANOVA was applied to examine the correlation between participants' experience with augmented reality ('Yes,' 'No,' and 'Maybe') and their average motivation levels. First, the one-way ANOVA examined the null hypothesis that there is no significant difference between the average levels of motivation across the three categories of augmented reality experience. The analysis resulted in an F-statistic of 1.557 and a p-value of 0.218. As the p-value exceeds the generally accepted significance threshold of 0.05, the null hypothesis cannot be rejected. This result indicates no statistically significant difference between the average motivation levels of the various groups with augmented reality experience. Next, a post hoc Games-Howell test was conducted to examine the subgroups' relationships further. This test revealed that, at the 0.05 level of significance, there were no significant differences in average motivation levels between any of the three pairs of groups (Yes vs. No, Yes vs. Maybe, and No vs. Maybe).

ANOVA (experiened_augmented_reality vs average_motivation)

average_motivation

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.398	2	1.199	1.557	.218
Within Groups	53.133	69	.770		
Total	55.531	71			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: average_motivation

	(I) experienced_augmented_reality	(J) experienced_augmented_reality	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Games-Howell	Yes	No	.30357	.30397	.587	-.4750	1.0822
		Maybe	.89881	.20072	.077	-.2270	2.0247
	No	Yes	-.30357	.30397	.587	-1.0822	.4750
		Maybe	.59524	.32813	.218	-.3176	1.5080
	Maybe	Yes	-.89881	.20072	.077	-2.0247	.2270
		No	-.59524	.32813	.218	-1.5080	.3176

Table 25. Experienced_augmented_reality vs average_motivation.

In Table 26, ANOVA was used to investigate the influence of virtual reality experience on average motivation levels in an educational context. The study demonstrated no statistically significant differences between experienced and non-experienced participants in terms of their average motivation scores ($F(1, 70) = 2.284$, $p = 0.134$). In conclusion, the current test did not disclose a statistically significant difference in motivation levels between participants with and without virtual reality experience.

ANOVA (experienced_virtual_reality vs average_motivation)					
average_motivation					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1.755	1	1.755	2.284	.135
Within Groups	53.776	70	.768		
Total	55.531	71			

Table 26. experienced_virtual_reality vs average_motivation.

The outcome for Hypothesis 1b

The findings showed no statistically significant difference in motivation levels across age categories (Table 21), indicating that age may not be a crucial factor in predicting motivation levels. However, there was a significant difference in motivation levels between the 18-24 and 25-34 age categories, with those aged 25-34 being more motivated than those aged 18-24.

The conclusions of this case demonstrate that demographics such as age, gender, education level, digital technology proficiency, and experiences with MR, AR, and VR technologies may not substantially impact motivation levels in the context of mixed reality-enhanced education (Dunleavy and Dede, 2013). However, from Table 20, statements 9, 10, and 11 concentrates on students' perceptions of the advantages of using mixed reality technology in enhancing their educational experiences (Radu, 2014). On a scale of 1 to 6, the mean scores for all three statements were higher than 4, suggesting a generally positive perception of the prospective benefits of mixed reality in education (Freina and Ott, 2015).

Statement 10, which emphasized the potential benefits of mixed reality technology in STEM subjects, received the highest mean score (5.19), indicating that students may perceive mixed reality as especially advantageous for learning in STEM disciplines. Statements 9 and 11 had similar mean scores (4.86 and 4.89, respectively), indicating that students also regard mixed reality technology as potentially beneficial in increasing their attentiveness and facilitating the understanding of new concepts (Ibáñez and Delgado-Kloos, 2018).

Once combined with the result of the one-way ANOVA analysis, it can be determined that while variables such as age, gender, education level, digital technology proficiency, and experiences with MR, AR, and VR technologies may not have a significant effect on motivation levels, individuals generally have a positive perception of the potential benefits of mixed reality technology in their learning experiences (Santos et al., 2014). This emphasizes the potential of mixed reality-enhanced education in nurturing motivation and enhancing academic results, especially in STEM subjects (Huang, Rauch, and Liaw, 2010).

Research Question 1:

How do demographics affect the impact of Mixed Reality on students' self-perception, involvement, and motivation in the learning process?

Hypothesis 1c:

Impact of Mixed Reality on student self-perception will possibly differ considering demographic factors. (Radianti et al., 2020).

Analysis Summary for Hypothesis 1c

Table 27 was used to conduct an ANOVA test to examine the correlation between age and average self-perception in mixed reality-enhanced education. The study findings indicate no significant difference in the mean self-perception scores among the age groups, as evidenced by the statistical analysis ($F(3, 68) = 1.727$, $p = 0.170$). This implies that age may not be a significant factor in determining levels of self-perception within this context.

A post hoc analysis was conducted utilizing the Games-Howell test to examine pairwise comparisons among age groups further. The study's findings indicate a noteworthy difference in self-perception between 18-24 and 25-34. The mean difference was calculated to be 0.58776, with a p-value of 0.006 and a 95% confidence interval of [0.1343, 1.0412]. The data suggests a significant difference in self-perception levels between individuals belonging to the 25-34 age group and those belonging to the 18-24 age group. Specifically, the former group exhibited higher levels of self-perception than the latter. No statistically significant differences in means were observed among the remaining age groups.

In brief, the ANOVA outcomes imply that the influence of age on self-perception levels in mixed reality-enhanced education may not be statistically significant. However, the post hoc examination reveals that there could be a variation in self-perception among specific age cohorts, such as those aged 18-24 and 25-34.

ANOVA (age vs average_self_perception)

average_self_perception

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.312	3	1.437	1.727	.170
Within Groups	56.577	68	.832		
Total	60.889	71			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: average_self_perception

	(I) age_range	(J) age_range	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	Upper Bound
Games-Howell	18 - 24	25 - 34	.58776*	.17086	.006	.1343	1.0412
		35 - 44	.10000	.22361	.969	-.5617	.7617
		45 - 54	.20000	.58415	.983	-3.6456	4.0456
	25 - 34	18 - 24	-.58776*	.17086	.006	-1.0412	-.1343
		35 - 44	-.48776	.25177	.246	-1.1941	.2186
		45 - 54	-.38776	.59550	.908	-4.0134	3.2379
	35 - 44	18 - 24	-.10000	.22361	.969	-.7617	.5617
		25 - 34	.48776	.25177	.246	-.2186	1.1941
		45 - 54	.10000	.61273	.998	-3.2735	3.4735
	45 - 54	18 - 24	-.20000	.58415	.983	-4.0456	3.6456
		25 - 34	.38776	.59550	.908	-3.2379	4.0134
		35 - 44	-.10000	.61273	.998	-3.4735	3.2735

*. The mean difference is significant at the 0.05 level.

Table 27. one-way ANOVA age vs. average_self_perception.

Table 28 presents the results of ANOVA tests to examine the association between gender and education and the average self-perception scores in the context of mixed reality-enhanced education. The objective of the previously mentioned assessments is to ascertain whether there exist any statistically significant differences in self-evaluation predicated on the factors mentioned above.

The initial analysis of variance (ANOVA) assessed the correlation between gender and average self-perception. The findings suggest no significant difference in average self-perception scores between males and females, as evidenced by the non-significant F-value of 0.136 and p-value of

0.713 obtained from the statistical analysis. This implies that gender may not be necessary for ascertaining self-perception levels within this context.

The second analysis of variance (ANOVA) examined the correlation between the level of education and average self-perception. Again, the findings indicate no significant difference in average self-perception scores among various levels of education. This was confirmed by the statistical analysis, which yielded an F-value of 0.836 and a p-value of 0.479, indicating no significant effect.

The ANOVA findings suggest that variables such as gender and educational attainment may not significantly influence self-perception levels within the context of mixed-reality learning.

ANOVA (gender vs average_self_perception)

average_self_perception

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.118	1	.118	.136	.713
Within Groups	60.771	70	.868		
Total	60.889	71			

ANOVA (education vs average_self perception)

average_self_perception

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	2.165	3	.722	.836	.479
Within Groups	58.724	68	.864		
Total	60.889	71			

Table 28. one-way ANOVA gender vs. average_self_perception
and education vs. average_self_perception.

An ANOVA analysis was performed to examine the correlation between digital technological proficiency and average self-perception in mixed reality-enhanced education, as presented in Table 29. This examination aims to ascertain any statistically noteworthy dissimilarities in self-assessment predicated on levels of digital technological expertise.

The ANOVA analysis revealed no significant difference in average self-perception evaluations among different levels of digital technological proficiency ($F(2, 69) = 0.462$, $p = 0.632$). This implies that self-perception may not significantly influence one's proficiency in digital technology in this scenario.

Post hoc analyses were performed utilizing the Games-Howell method to look more thoroughly into the disparities in mean self-perception scores among the digital technological proficiency categories (Beginner, Intermediate, and Advanced). The study findings indicate no statistically significant variations in the average self-perception scores across all the groups.

ANOVA (digital_technological_proficiency vs average_self_perception)

average_self_perception

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.805	2	.403	.462	.632
Within Groups	60.083	69	.871		
Total	60.889	71			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: average_self_perception

	(I) digital_technological_proficiency_coded	(J) digital_technological_proficiency_coded	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Games-Howell	Beginner	Intermediate	.37302	.41858	.675	-1.1735	1.9196
		Advanced	.47436	.44696	.576	-1.0030	1.9517
	Intermediate	Beginner	-.37302	.41858	.675	-1.9196	1.1735
		Advanced	.10134	.24529	.910	-.4929	.6956
	Advanced	Beginner	-.47436	.44696	.576	-1.9517	1.0030
		Intermediate	-.10134	.24529	.910	-.6956	.4929

Table 29. one-way ANOVA digital technological proficiency vs. average self-perception.

The ANOVA test was conducted to examine the association between exposure to mixed reality (MR) technology and average self-perception in the context of education supplemented by mixed reality Table 30. This test aims to assess if there are statistically significant differences in self-perception based on MR technology experience.

The results of the ANOVA test indicated no statistically significant difference between the three levels of experience and the average self-perception ($F(2, 69) = 2.593$, $p = 0.082$). Nevertheless, the p-value is near the significance threshold of 0.05, indicating that the correlation between experience with MR technology and self-perception requires additional study.

Additional post hoc analyses were conducted using the Games-Howell procedure to investigate the variations in average self-perception between the MR experience groups (Yes, No, and

Maybe). Regarding average self-perception, there were no significant differences between the Yes and No groups (p = 0.719) or the Yes and Maybe groups (p = 0.189). There was, nevertheless, a statistically significant variance (p = 0.030) between the No and Maybe groups, with the Maybe group showing a more positive average self-perception than the No group.

In conclusion, the ANOVA and post hoc results indicate that interacting with mixed reality technology may have some effect on self-perception levels in the context of education enhanced by mixed reality. Specifically, those unsure of their experience with MR technology (Maybe group) may have a higher self-perception than those who have never used MR technology (No group).

ANOVA (experienced_mixed_reality vs average_self_perception)

average_self_perception

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	4.256	2	2.128	2.593	.082
Within Groups	56.633	69	.821		
Total	60.889	71			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: average_self_perception

	(I) experienced_mixed_reality_coded	(J) experienced_mixed_reality_coded	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Games-Howell	Yes	No	-.21036	.27037	.719	-.8744	.4537
		Maybe	.61688	.33845	.189	-.2434	1.4772
	No	Yes	.21036	.27037	.719	-.4537	.8744
		Maybe	.82724*	.26819	.030	.0865	1.5680
	Maybe	Yes	-.61688	.33845	.189	-1.4772	.2434
		No	-.82724*	.26819	.030	-1.5680	-.0865

*. The mean difference is significant at the 0.05 level.

Table 30. one-way ANOVA experienced mixed reality vs. average self-perception.

In the setting of mixed reality-enhanced education, Table 31, an ANOVA test was done to examine the link between experience with augmented reality (AR) technology and average self-perception. This test aims to see if there are any statistically significant changes in how people see themselves depending on how much experience they have with augmented reality (AR) technology.

The ANOVA test showed no statistically significant difference in how people thought of themselves on average between the three levels of experience (F(2, 69) = 0.033, p = 0.968). This suggests that using AR technology may not significantly affect how people see themselves in a mixed reality-enhanced educational institution. Next, post hoc tests using the Games-Howell method were done to learn more about the changes in how people in the Yes, No, and Maybe AR experience groups see themselves on average. The data showed that the Yes and No groups (p = 0.972), the Yes and Maybe groups (p = 0.982), and the No and Maybe groups (p = 0.994) did not have significantly different views of themselves on average.

ANOVA (experienced_augmented_reality vs average_self_perception)

average_self_perception

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.058	2	.029	.033	.968
Within Groups	60.831	69	.882		
Total	60.889	71			

Post Hoc Tests

Multiple Comparisons

Dependent Variable: average_self_perception

	(I) experienced_augmented_reality	(J) experienced_augmented_reality	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Games-Howell	Yes	No	.05357	.23755	.972	-.5372	.6443
		Maybe	.12500	.67940	.982	-10.6879	10.9379
	No	Yes	-.05357	.23755	.972	-.6443	.5372
		Maybe	.07143	.69551	.994	-8.9764	9.1193
	Maybe	Yes	-.12500	.67940	.982	-10.9379	10.6879
		No	-.07143	.69551	.994	-9.1193	8.9764

Table 31. one-way ANOVA experienced augmented reality vs. average self-perception.

A study was conducted utilizing ANOVA to examine the correlation between virtual reality (VR) technology experience and average self-perception in mixed reality-enhanced education. Table 32 is presented for reference. The principal objective of this examination is to ascertain whether there exist any statistically significant differences in self-perception dependent on familiarity with virtual reality technology. The ANOVA analysis indicated no significant difference in mean self-perception scores between individuals who have encountered virtual reality technology and those who have not (F(1, 70) = 0.178, p = 0.674). The discovery implies that the impact of familiarity with virtual reality technology on self-perception levels in the context of mixed reality-enhanced education may not be substantial.

ANOVA (experienced virtual reality vs average self perception)					
average_self_perception					
	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	.155	1	.155	.178	.674
Within Groups	60.734	70	.868		
Total	60.889	71			

Table 32. one-way ANOVA experienced virtual reality vs. average self-perception.

The outcome for Hypothesis 1c

In conclusion, the analysis has provided valuable insights into the prospective impact of MR on learning experiences and self-perception, building on prior research in the field (Akcayr and Akcayr, 2017). The study's findings from Table 20, with statements 5 to 8, indicate that participants generally held positive attitudes toward MR technology as a learning instrument, which could contribute to enhanced comprehension of complex subjects and increased motivation among students (Bacca et al., 2014; Radu, 2014).

In addition, the ANOVA analyses assessed the influence of age, gender, education level, digital technology abilities, and prior experience with MR, AR, and VR technologies on self-perception in an MR-enhanced educational environment. The findings revealed that none of these variables had a statistically significant effect on self-perception, indicating that MR technology may be applicable across a broad range of demographic and experiential contexts.

It is important to note, however, that. Although, in contrast, the ANOVA results suggested no significant differences in self-perception across various factors, the post hoc analysis revealed differences in self-perception between specific age categories, such as 18-24 and 25-34. In addition, participants in the "Maybe" group had a more positive self-perception than those in the "No" group regarding the MR experience.

Despite these nuances, the findings indicate that MR technology carries enormous potential for improving educational experiences and learning outcomes for various individuals. As MR technology continues to advance and become more accessible, educators and researchers must investigate its possible uses and design successful approaches to implementation that promote more engaging, stimulating, and diverse learning environments.

Sub-research question:

Do participants with more excellent technological expertise find it easier to adopt Mixed Reality than those with less technological knowledge?

The one-way ANOVA results (Table 33) were not statistically significant for either of the dependent variables, "Mixed reality could be a beneficial technology in education" ($F(2,69) = 1.312$, $p = 0.276$) or "The Mixed Reality technology could be simple to adopt in the classroom training" ($F(2,69) = 0.197$, $p = 0.822$). This implies that there was no statistically significant distinction in students' judgments of the advantages and ease of implementing MR depending on their digital technical competency levels (beginning, intermediate, and advanced).

Oneway

ANOVA on Mixed_reality_could_be_a_beneficial_technology_in_education

		Sum of Squares	df	Mean Square	F	Sig.
Mixed_reality_could_be_a_beneficial_technology_in_education	Between Groups	1.710	2	.855	1.312	.276
	Within Groups	44.943	69	.651		
	Total	46.653	71			
The_Mixed_Reality_technology_could_be_simple_to_adopt_in_classroom_training	Between Groups	.623	2	.312	.197	.822
	Within Groups	109.155	69	1.582		
	Total	109.778	71			

Post Hoc Tests

Multiple Comparisons

Dependent Variable		(I) digital_technological_proficiency_coded	(J) digital_technological_proficiency_coded	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
							Lower Bound	Upper Bound
Mixed_reality_could_be_a_beneficial_technology_in_education	Games-Howell	Beginner	Intermediate	.548	.516	.590	-1.45	2.55
			Advanced	.308	.521	.833	-1.67	2.28
		Intermediate	Beginner	-.548	.516	.590	-2.55	1.45
			Advanced	-.240	.194	.438	-.71	.23
		Advanced	Beginner	-.308	.521	.833	-2.28	1.67
			Intermediate	.240	.194	.438	-.23	.71
The_Mixed_Reality_technology_could_be_simple_to_adopt_in_classroom_training	Games-Howell	Beginner	Intermediate	.369	.513	.766	-1.47	2.21
			Advanced	.250	.551	.895	-1.52	2.02
		Intermediate	Beginner	-.369	.513	.766	-2.21	1.47
			Advanced	-.119	.329	.930	-.92	.68
		Advanced	Beginner	-.250	.551	.895	-2.02	1.52
			Intermediate	.119	.329	.930	-.68	.92

Table 33. one-way ANOVA for technology acceptance.

Descriptives

Mixed_reality_could_be_a_beneficial_technology_in_education
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Mixed_reality_could_be_a_beneficial_technology_in_education	72	2	6	5.07	.811
The_Mixed_Reality_technology_could_be_simple_to_adopt_in_classroom_training	72	1	6	4.44	1.243

Table 34. Descriptives for technology acceptance.

According to descriptive statistics (Table 34), the mean score for the variable "Mixed reality could be a beneficial technology in education" was 5.07 (SD = 0.811), demonstrating that students had a favorable opinion of MR's potential advantages in education on average. Similarly, the mean score for the category "The Mixed Reality technology could be simple to adopt in classroom training" was 4.44 (SD = 1.243), indicating that students viewed MR technology as very simple to use in classroom settings.

In conclusion, no significant variations in students' evaluations of the advantages and ease of adoption of MR technology in education were discovered depending on their digital technology skills in this study. Overall, students were optimistic about MR's potential benefits and simplicity of implementation in the classroom.

Discussion

The current research investigation sought to evaluate students' motivation, participation, and self-perception in educational settings employing mixed reality technology, as well as how demographic data influence these elements. Several significant discoveries emerged because of quantitative research.

Compared to past research, our findings are consistent with previous studies that found a positive connection between mixed reality technology and student motivation (Radianti et al., 2020). In accordance with prior research, our study discovered that adopting mixed reality technology enhanced students' motivation to learn (Ibáñez and Delgado-Kloos, 2018). This might be linked to mixed reality settings' immersive and interactive nature, which can increase students' involvement and curiosity. Our results also supported the idea that technology influences students' participation in mixed-reality learning experiences (Cheng and Tsai, 2014). This greater participation might be attributed to mixed reality's particular affordances, such as its capacity to give realistic, contextualized, and hands-on learning experiences (Merchant et al., 2014). Furthermore, our findings are consistent with earlier research indicating that using mixed reality technology in education might significantly affect students' self-perception of their talents and potential for success (Makransky, Lilleholt, and Aaby, 2017).

This study also looked at the effect of demographic characteristics on students' motivation, participation, and self-perception. While specific demographic characteristics did not affect the outcomes, others, such as gender and past familiarity with technology, demonstrated considerable disparities. This is consistent with prior research that found comparable demographic implications on students' experiences with mixed reality technology (Dunleavy, Dede, and Mitchell, 2008).

One practical application of these discoveries is the possibility for mixed reality technology to be implemented into diverse educational environments to boost student motivation, involvement, and self-perception. Therefore, educators, curriculum designers, and lawmakers should consider incorporating mixed reality into the learning process, especially in subjects like science, technology, engineering, and mathematics (STEM), where the technology is particularly effective (Ibáñez and Delgado-Kloos, 2018).

However, the study had certain drawbacks. First, the population analyzed was constrained to a specific age range and educational environment. Hence the sample size was small. More studies with bigger and more varied samples might aid in generalizing these findings to a broader range of contexts.

Future studies might look at the long-term impacts of mixed reality technology on students' motivation, involvement, and self-perception and how it affects academic achievement and the development of 21st-century skills. Furthermore, qualitative research might give more in-depth insights into students' experiences with mixed reality technology and the aspects that lead to its efficacy in educational contexts.

Finally, this study adds to the expanding corpus of research on mixed reality technology in education, offering vital insights into its potential to improve students' motivation, participation, and self-perception. In addition, the findings have significant impacts on instructors, curriculum developers, and lawmakers attempting to enhance student learning experiences using new technologies.

Conclusion and Recommendations

The current study proved the potential of mixed reality (MR) technology in education, positively impacting student motivation, participation, and self-perception. However, further study is required to acquire a thorough knowledge of MR's impact and investigate new deployment paths.

Longitudinal research on the long-term impact of MR utilization of technology on learning outcomes and student experiences could potentially be performed (Dede, 2009). Furthermore, comparison research comparing MR to other educational technologies or traditional learning techniques may be conducted to find the most successful tactics for increasing student motivation, participation, and self-perception (Freina and Ott, 2015).

The efficacy of MR technology in various topic areas might also be investigated to determine its potential benefits and limits in diverse educational situations (Radu, 2014). In addition, teacher training and professional development research may be done to investigate the requisite skills and abilities for educators to effectively deploy MR-based learning experiences (Johnson et al., 2016).

Researchers can investigate adaptive MR learning environments and their effects on student outcomes by studying the potential of MR technology to create tailored and individualized learning experiences (Billinghurst, Clark, and Lee, 2015). In addition, MR technology's influence on encouraging social and interactive learning among students may also be explored (Merchant et al., 2014).

Examining the design of accessible MR learning tools and analyzing their performance in helping different learners might help to increase accessibility and inclusion in education. Finally, the affordability and scalability of MR technology integration within education may be evaluated, particularly in resource-constrained contexts, by calculating the return on investment and suggesting solutions for overcoming hurdles to widespread adoption (Akçayr and Akçayr, 2017). Above, future research will help researchers gain a better grasp of the potential of MR technology in education and its influence on student motivation, participation, and self-perception. The findings will assist in developing successful ways for incorporating innovative technology into educational settings and improving learning experiences.

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Appendices

Perceptions of Participants on Mixed Reality Technology in Education.

No		N	Minimum	Maximum	Mean	Std. Deviation	Variance
1	I might prefer using mixed reality technologies to complete difficult academic tasks.	72	1	6	4.93	1.092	1.192
2	Using Mixed Reality technology, I can more effectively work as part of a team, allowing me to complete complex jobs more successfully	72	1	6	4.65	1.291	1.666
3	In a classroom scenario, employing mixed reality technology, I could do better as I assist others in learning challenging tasks.	72	2	6	4.79	1.034	1.069
4	My academic objectives could be enhanced by the learning environment provided by mixed Reality.	72	3	6	4.88	0.918	0.843
5	Using Mixed Reality technology could assist me absorb challenging subjects better.	72	1	6	4.69	1.030	1.060
6	Seeing somebody perform a challenging assignment in Mixed Reality could motivate me to use Mixed Reality to complete the same task	72	1	6	4.74	1.138	1.296

	effectively.						
7	I am looking forward to learning in a Mixed Reality learning experience.	72	1	6	4.90	1.103	1.216
8	Continuous computer-assisted feedback delivered within the Mixed Reality learning environment could be helpful.	72	1	6	4.76	1.107	1.225
9	Mixed Reality technology might assist me in being more attentive when studying in a Mixed Reality atmosphere.	72	1	6	4.86	1.104	1.220
10	Mixed reality technology might be beneficial in the study of science, technology, engineering, and mathematics (STEM) subjects.	72	2	6	5.19	0.898	0.807
11	With adopting Mixed Reality technology, I may be able to grasp new concepts with ease.	72	1	6	4.89	1.056	1.114
	Valid N (listwise)	72					

Table 20. Perceptions of Participants on Mixed Reality Technology in Education.

Ethics Form

x21120218_Jeevan_Mysore_Harish_Ethics_Fc

Survey Response

Mixed Reality survey questions (Responses