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ADOPTING VIRTUAL REALITY FOR EDUCATION: EXPLORING TEACHERS' PERSPECTIVES ON READINESS, OPPORTUNITIES, AND CHALLENGES

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ABSTRACT

Virtual reality (VR) can be adapted to teach many topics and may be particularly effective for complex concepts. However, little is known about teacher readiness on adopting VR in the classroom. Accordingly, 189 higher education teachers were surveyed to explore perceptions on adopting VR. Findings revealed the adoption of VR vectored on teachers perceived readiness confidence in technology skill and belief that VR has potential to benefit student learning. Moreover, understanding students cognitive experience in the immersive VR environment remains underdeveloped and may influence teacher's perception of readiness to adopt VR for teaching. However, there is an opportunity to influence educational models by providing a VR approach to knowledge creation centred around cognitive processes students use to make sense of the real world. But there remain perceived challenges centered around costs, technical issues, content availability, and pedagogical integration. This study concludes any successful adoption of VR for teaching will require careful planning for teacher readiness with primary focus on technology competence and pedagogical matters. Although more research is needed to understand teachers' readiness, VR is likely forthcoming and has potential to be an important resource in the educator's toolkit.

KEYWORDS

Extended Reality, Virtual Reality, Teacher Readiness, Self-Regulation, Classroom Technology

1. INTRODUCTION

Problems of developing teacher readiness—teachers' perception of their capabilities and skills to integrate classroom technology [1] derives significance from the theme of professional training. Professional training becomes more evident in a setting where technological advancements involve complex knowledge, focused experience, and electronic prose for successful teaching [2]. Also, it must be admitted the problem of teacher readiness can be framed around theories of self-regulation, where low levels of self-regulation belong to a group of factors that restrain teacher readiness and high levels of teacher readiness improve self-regulation [3]. Regardless, teacher readiness to adopt technology requires adaptation to complex pedagogical environments [4], which, in the classroom, is the basic premise and normative ideal of professional training [5]. In fact, technology is likely the most considered factor for shaping current education and teacher readiness [6].

A new technology starting to make its way into education is extended reality (XR). Although the virtual continuum of XR includes the domains of augmented reality (AR) and mixed reality (MR), the more well-known domain of virtual reality (VR) is the focus of much of the educational momentum [7]. Whereas AR includes digital elements intersecting the real world and

MR includes interacting digital elements overlapping onto the real world, VR provides an immersive and object engaging environment where the 'real world' is entirely blocked out. And the completely virtual environments of VR can be designed to simulate any setting relevant to education, helping learners interact and connect with information in a way that would be otherwise challenging in the classroom. In VR, learners can interact with objects from molecules to human organs, they can travel though time to learn about different eras, and they can journey through space to learn about the universe.

It serves to reason this VR learning may have fruitful benefits for students and educators. The purpose of this study is to evaluate teacher readiness along with opportunities and challenges for adopting VR into the university classroom based upon historical information, relevant literature, and teacher perspectives. Next, is a review of extant literature on the potential benefits of VR for education and the adoption of VR for education.

1.1. Potential Benefits of VR for Education

Today's students are accustomed to, and in some cases are even dependent on the use of technology for information, learning, and problem solving. And educators are adopting more multimedia instructional design as a means of teaching, suggesting teacher readiness is a timely topic. Although multimedia teaching includes a broad sector of technologies, much of its delivery is centered around the constructivist theoretical model for knowledge acquisition—and this includes VR [8]. Likely because constructivism suggests that to learn, a learner must actively construct their own understanding of new information and build upon prior knowledge, and that learning is enhanced by connecting authentic tasks and social interaction. Moreover, authentic and social virtual environments can be adapted to provide highly connected learning experiences built upon these constructivist principles of active learning [9]. Another important consideration is collaborative learning experiences where students can work together on group projects or engage in role-playing activities. Virtual reality enhances social interaction and communication, promoting teamwork and collaboration skills that fosters cognitive learning [10].

Virtual reality also shows benefit from multisensory learning by engaging multiple senses, such as visual, auditory, and haptic feedback, which can enhance learning experiences. Students can visually explore and interact with virtual objects, hear sounds that mimic real-world situations, and even feel tactile feedback through haptic devices. This multisensory stimulation has potential to improve information processing and memory retention [11]. And the contextualized VR environment promotes meaningful learning to transfer knowledge and skills to real-world situations. It is also accepted that VR provides a safe and controlled environment for students to learn and practice skills that may be risky or ethically challenging in the real world [12]. For example, medical students can practice surgical procedures or emergency response scenarios in a virtual setting without the risk of harm to patients. Virtual reality allows students to learn from their mistakes. Making mistakes allows students to look at a situation from different perspectives, identify flaws in thinking, and to uncover assumptions.

For topics that are difficult to conceptualize, VR activities can be designed to allow students to interact and experiment in ways that may not have been otherwise possible [13] and be used to improve interest in topics that are tedious or boring for students through interactivity or even gamification [14]. Additionally, VR provides a means to mimic face-to face classes [15] by providing opportunities for team and social interaction in the classroom that are challenging through video conferencing software. By leveraging these opportunities VR can significantly enhance student learning experiences in the classroom.

1.2. Adoption of VR for Teaching

There remains the question: How will VR be adopted into the classroom? Virtual mediums bring new design challenges, and early adoption confronts educators with personal, professional, and pedagogical considerations [13]. Integrating technology engenders teachers to considerer pedagogical strategies, content integration, cognitive load management, and ongoing professional development [16]. Teachers need a basic understanding of VR technology, its capabilities, and its educational application. Curricular approaches to VR must be recognized and would likely include innovative designs that incorporate teaching digital skills and design thinking. Although teachers may be wary of using new technology, Jaschik and Lederman [17] found that teachers are willing to adopt new technology if they believe students learn better when they are engaged with technology. And other inquiries have shown that if teachers believe an instructional method is beneficial, they are more apt to engage positive self-regulation to adopt use of that method in the classroom [3], [18], [19].

While barriers to early adoption of technology into the classroom often include poor professional development or training deficiencies, teachers who acquire comfort with technology have a better understanding of its education application and often champion its usage. For example, in 2006 the National Education Association-American Federation of Teachers (NEA-AFT) acknowledged survey results that indicated up to 65% of teachers felt inadequately trained for using the internet for research, using technology equipment, and using administrative software [20]. A condition that has noticeably changed over time because teachers today rely on these very tools to facilitate classroom lessons and learning. By extending this view to VR, the argument becomes plausible that more educators will engage VR as a teaching technology as it becomes more widely used and available. However, there are challenges at the pragmatic level of VR adoption that my benefit from teacher readiness. No doubt, a better understanding of teacher readiness to adopt VR into the university classroom justifies inquiry.

2. METHODS

An 18-item survey was developed by the authors using Qualtrics® (Qualtrics.com). Items soliciting information regarding interest and understanding of VR were collected using multiple-response items and a 5-point Likert scale, ranging from strongly disagree to strongly agree. To ensure that there were no misleading or confusing questions, and that the survey addressed the questions that the investigators intended, the survey was initially administered to a focus group of teachers at the researchers' institution. No major alterations were made to the survey instrument based on these initial survey assessments.

Any teacher at an institute of higher education was eligible to participate in the study. To ensure a diverse sample, survey links were distributed to randomly selected teachers at randomly selected institutions. The survey was active for 4 months, from September to December of 2018. Reminders to complete the survey were sent once per month while the survey was open. A total of 4101 invitations were sent via email. Survey data was quantified and displayed using Microsoft® Office Excel® (Microsoft.com). This study was approved by the Institutional Review Board at the researchers' university and informed consent was obtained from participants prior to their completion of the survey.

3. RESULTS

A total of 189 teachers participated in the study from various disciplines, including Health and Medical Professions, Education, and Business, from a broad range of Carnegie Institutional Classifications® [21], including R1 (24%), R2 and R3 (25%), and Other (50%). Participant age varied, with 25% of participants between 18 and 39 years old, 24% between the ages of 40 and 59, and 31% aged 60 or older.

Less than half of participants indicated any previous experience with VR (45%), although 50% of participants know what VR is, but have never tried it. Most participants indicated that they are interested in using VR for teaching (59%). However, health and medical science teachers were more interested in using VR for teaching compared to teachers from other disciplines (45% and 24%). Most participants indicated that they think VR should be used for teaching in some capacity, with most indicating that VR should be used "regularly for classes where it augments learning" or "for occasional special events, such as simulations". Regardless of discipline, most participants specified that they would be comfortable and willing to use VR for teaching if they received sufficient training (57%), and most participants indicated they would be willing to use VR for teaching with established software (58%) rather than developing their own content (22%). A majority of participants (82%) agreed or strongly agreed that VR could improve student interest in learning and that VR could improve teaching effectiveness (66%). However, only around half of the participants (54%) agreed or strongly agreed that they planned to learn more about using VR in the classroom and only 38% agreed or strongly agreed that they are likely to use VR in their classroom.

Not surprisingly, participants with more VR experience more strongly agreed that VR could improve student interest in learning and that VR could improve teaching effectiveness (85% and 81%) than those who have less VR experience (73% and 52%). They are also more likely to use VR in their own classroom than less experienced participants (74% and 28%). More participants with above average computer proficiency than participants with average or below average computer proficiency agreed or strongly agreed that VR could improve teaching effectiveness (63% and 49%), plan to learn more about using VR in the classroom (56% and 42%) and are likely to use VR in their classroom (39% and 30%). Additionally, participants with more than 20 years of teaching experience more strongly agreed that VR could improve student interest in learning and that VR could improve teaching effectiveness (79% and 61%) than participants with 1-5 years of teaching experience (60% and 35%).

Forty participants provided qualitative feedback when asked to provide any other information about using VR for education that they thought may be important to the researchers. Most comments involved concerns over professional training, support for VR implementation, cost of using VR for education, and comments that VR should only be used where it can benefit teaching objectives and improve student learning.

4. DISCUSSION

By exploring teachers' perspectives this study claims evidence on teacher readiness to adopt VR in the classroom as an educational tool. The basic premises and normative idea of technology in the classroom is well researched over the last several decades. Importantly, much of this work implies teachers must have readiness confidence before adoption of technology for teaching. Important because despite general research on adopting technology in the classroom, VR has novelty it its context and cognitive experiences due to its immersive and interactive nature. It engages multiple senses and engenders active learning and situated cognition. The novelty of VR

as a learning context posits a need to better understand how students experience VR and how students' cognition plays in the VR experience [16]. In other words, understanding the students cognitive experience in VR remains underdeveloped and may influence teachers' readiness perception and may impact self-regulation behaviors. Moreover, teachers must consider how to optimize their own cognitive experience when using VR to teach. These considerations may include their familiarity with VR technology, pedagogical strategies, content integration, cognitive load management, and ongoing professional development. The forthcoming sections incorporate participant perspectives, and along with extant literature, broadens the current understanding of these considerations.

4.1. Readiness

In this study teacher readiness is considered teachers' perception of their capabilities and skills required to integrated classroom technology. And that teacher readiness is a prerequisite for self-regulation behaviors towards effective teacher activity. Wherefore, most teachers in this study voiced their concern about being ready to teach VR. There is no single universally accepted approach to teacher readiness [22]. However, teacher readiness to adopt technology has potential to be understood within the framework of Zimmerman's [23] self-regulation theory [24]. Teacher self-regulation refers to the ability of teachers to set goals, monitor their progress, and thus adjust their instructional strategies. The general psychological tone of teacher self-regulation on readiness can be centered around behavioral processes underlying teachers' adoption and integration of technology. Integrating the teacher self-regulation literature with technology adoption sheds light on the cognitive processes underlying teachers' self-regulatory behaviors related to technology implementation [25].

Petko et al. [6] exhibited "…that the use of educational technology in classrooms is dependent on teacher readiness, which, in turn, is strongly influenced by school readiness." Much of education research suggests that professional development programs can support teacher readiness for technology adoption. A teacher's capacity for learning and adaptation can be harnessed through training. Cardoso-Leite et al. [26] demonstrated professional development programs focusing on technology integration can modulate attention and cognitive control. Universities can take several steps to prepare teachers for adopting VR in the classroom like offering comprehensive professional development programs focused on VR technology and its effective integration into teaching and learning. These programs should address both technical aspects (e.g., VR equipment, software, troubleshooting) and pedagogical strategies for utilizing VR to enhance student learning. Providing ongoing training and support is essential to build teachers' knowledge, skills, and confidence in using VR along with improving self-regulatory behaviors [24]. University systems should ensure that teachers have access to VR resources, including hardware, software, and a variety of educational VR content. This may involve allocating budgetary resources to purchase VR equipment and licenses, as well as collaborating with technology providers or educational institutions to access VR resources. Adequate access to VR technology allows teachers to explore, experiment, and familiarize themselves with its potential applications and prompt readiness confidence.

There should also be established platforms or networks for teachers to collaborate and share best practices regarding VR integration. This can include virtual communities, online forums, or regular meetings where teachers can exchange ideas, lesson plans, and experiences related to VR in the classroom. Peer-to-peer support and knowledge sharing can enhance teachers' readiness [27] and facilitate the adoption of VR technology. University systems can identify teachers who are interested piloting VR. These pilot programs should be accompanied by rigorous research and evaluation to gather evidence on the effectiveness of VR integration and identify best practices that can inform future implementation efforts. Of course, integrating VR into the classroom

should align with the curriculum and learning goals of the university. They should provide guidelines or frameworks that help teachers connect VR experiences to specific learning objectives and subject areas. The alignment with curriculum ensures that VR is integrated purposefully and enhances the overall educational experience. Finally, universities need to ensure that the necessary infrastructure and technical support are in place to facilitate VR adoption. This includes reliable internet connectivity, sufficient storage capacity for VR content, and IT personnel who can provide technical assistance and maintenance. Having a dedicated support system can help address technical issues promptly and minimize disruptions during classroom activities and help assure teacher readiness.

4.2. Opportunities

The adoption of VR for education is forthcoming and should be expected, especially for students who learn best using multimedia approaches. This study, like others, provides support that teachers are willing to adopt new technology for teaching if they deem it to be beneficial for student learning—and there are a growing number of studies demonstrating the benefits of VR for student learning [28]. Our survey similarly found that most teachers believed virtual technology should be used in the university classroom in some capacity, but most teachers were only interested in using VR if they had adequate professional training. Indeed, other research referencing adoption of technology models in education regard training a core factor that mediates perceived ease of use and perceived usefulness.

Another overreaching finding was that most teachers surveyed agreed VR for education is imminent and could improve both student interest in learning and would benefit their teaching; aligning with several studies that have demonstrated the positive impact of VR on student learning outcomes [29]. Moreover, there is growing literature to suggests VR can enhance student motivation and engagement, leading to improved academic achievement and constructive learning [30]. But participants espoused broader conditions for any successful VR implementation were complicit at both the individual teacher level and in the wider school context. And that the interplay of these conditions is not amply clear [31].

Additionally, VR has the potential to influence educational models by providing an approach to constructivist knowledge creation that, despite the physical world being blocked out, remains centred around cognitive processes students use to make sense of the real world. The VR platform can deliver a countless variety of immersive learning activities that appeal to 21st century learners and that associates with well-established constructivist learning principles [32]. For example, Parong and Mayer [30] examined the instructional effectiveness of immersive VR in a classroom and found that students who experienced VR-based lessons outperformed their peers in knowledge retention and transfer. The immersive nature of VR allowed students to explore scientific phenomena, conduct virtual experiments, and gain a deeper understanding of complex concepts. Correspondingly, a central benefit of VR—the teachers' role shifts from a knowledge provider to a knowledge facilitator, helping students to independently learn using VR by empowering students to engage control over their learning process. Consider VR helping students interact and connect with discrete content in subjects like English, History, and Science. For example, students could virtually encounter the Adventures of Huckleberry Finn, contribute to the Consulate that ended the French Revolution, or navigate a mission to colonize the planet Mars. Successful adoption experiences highlight the benefits of VR in enhancing student engagement, improving learning outcomes, and providing immersive educational experiences. Virtual reality holds promise to connect students to cognitive learning in a way that could never be done in the physical world—and its advantages are only limited by teacher readiness, adoption beliefs, and creative experiences.

4.3. Challenges

Previous teacher experiences when adopting classroom technology shed light on the challenges faced in terms of technical issues, content availability, and pedagogical integration. Content availability is another adoption challenge. Freina and Ott [33] discussed the limited availability of high-quality VR content that aligns with specific educational objectives. Against that background there is a co-dependant relationship in that teachers are reluctant to use VR for teaching without meaningful educational content and developers are reluctant to create educational software without wide-spread teacher adoption and the promise of return on investment. Comments from survey respondents such as, “VR in and of itself would not improve outcomes, like all technology it must be used mindfully and have a specific purpose” and “when done well VR can be a boom and offer a new world of learning possibilities when done poorly VR will be a novelty at best”, highlight the need for meaningful learning activities for VR to be useful.

Pedagogy poses another challenge for educators. Akçayır and Akçayır [29] highlighted the need for teachers to develop new instructional strategies that effectively integrate VR into the curriculum. Requiring careful alignment between learning objectives, VR activities, and assessment methods. However, educational instances of meaningful VR experiences for sourcing are limited. And our findings reckoned few teachers willing to create VR learning experiences without adequate training. Developing or acquiring suitable VR experiences that align with specific learning objectives and subject areas may require significant effort and resources. For example, one respondent commented, “I would be more likely to use VR for teaching neuroanatomy if I were aware of existing technology for teaching neuroanatomy. I do not think I could develop my own.” Without appropriate instructional design, VR is likely to be unsuccessful. Kizilcec et al. [34] found that simply adding VR to an existing instructional module yielded insignificant learning benefits. They emphasized the importance of thoughtful instructional design that leverages the unique affordances of VR to promote active learning and engagement. Cook et al. [35] discussed the challenge of finding or developing VR experiences that align with specific learning objectives and cater to diverse subject areas. The limited availability of high-quality and curriculum-aligned VR content can restrict the range of topics and activities that can be explored through VR, potentially limiting its effectiveness as a learning tool. Nevertheless, there is a small group of early adopters who have begun using VR for teaching using their own developed software. And although some interesting non-higher educational examples of VR are being used for training in areas like underground coal mining [36], army artillery protocols [37] and health monitoring decision making [38], early adopters in education must be motivated to deliberately redesign and rethink their approach to teaching [18] a potential pedagogical barrier where teacher resistance to change has been a contention for as long as there have been classrooms.

Less than half of the participants in this study had experience using VR, highlighting another potential challenge. Teachers that are not familiar or comfortable with technology may find it more difficult to visualize how to use it for teaching [6]. Despite most teachers indicating they would be willing to adopt VR if they received sufficient training, alas, such training may not be readily available or feasible for many teachers willing to adopt the technology for teaching [1]. Further aiding to what Borko et al. [31] called a “wicked problem” on the issues of technology and teacher learning. Likely accounting for why only about half of the surveyed teachers planned to learn more about VR for teaching and less than half expressed the likelihood of using VR in their own classroom.

5. CONCLUSIONS

This study provides a perspective from higher education teachers on their readiness to adopt VR for teaching. Impressions were that VR affords many potential prospects like providing exhilarating simulations, immersive learning conditions, and conceivably sets the stage for more a meaningful learning experience. However, most participants in this study voiced their concern about their readiness to teach with VR because they felt the need for ample training and development and better understanding of student implications. Accordingly, teachers believe the current educational potential of VR has a long way to go before becoming a widespread adopted technology in the classroom.

While researchers are starting to discover how VR learning environments foster knowledge, a better grasp of the theoretical groundwork that supports and activates students in the direction of deeper cognitive learning warrants more work. The converging fields of technology and education has a history of technophobia. Future research ought to focus on identifying concerns of administrators, teachers, and students, and correlating rejections of VR with strategies and policies that can be implemented to reduce resistance and encourage adoption of useful teacher and student VR experiences.

An argument can be made that educators need to be involved in actively designing and developing VR technologies for the classroom. Future research is needed to establish a wider context of learning theories that support the design of VR learning systems and the expected learning outcomes of VR methods.

Finally, it becomes clear that VR is anticipated to be more broadly integrated into education in the coming years as more studies are published that demonstrate its usefulness. Given the challenges that many educators still face in using VR for teaching, such as limited exposure to VR, lack of meaningful training, learning experiences, and limited budgets, the expectation of adoption will initially be more prominent in disciplines that require hands-on learning and specialized equipment, where the benefits of VR are more feasible. Although more research is needed to understand the how's and why's of VR in the classroom, as hardware improves, consumer adoption increases, and meaningful educational software is developed, teachers are likely to have more readiness confidence to adopt VR as an important resource in their education toolkit.

REFERENCES

[1] S. K. Howard, A. Chan, and P. Caputi, (2015) "More than beliefs: Subject areas and teachers' integration of laptops in secondary teaching," *British Journal of Educational Technology*, Vol. 46, No. 2, pp360-369. [Online]. Available: https://doi.org/10.1111/bjet.12139.

[2] M. D. DeSchryver and A. Yadav, (2015) "Creative and computational thinking in the context of new literacies: Working with teachers to scaffold complex technology-mediated approaches to teaching and learning," *Journal of Technology and Teacher Education*, Vol. 23, No. 3, pp411-431. [Online]. Available: https://www.learntechlib.org/primary/p/151572/.

[3] N. Senovska and O. Pryshliak, (2020) "Developing Professional Self-Regulation of Students during Pedagogical Practice," *International Journal of Research in Education and Science*, Vol. 6, No. 4, pp679-691.

[4] S. Järvelä and H. Järvenoja, (2011) "Socially constructed self-regulated learning and motivation regulation in collaborative learning groups," *Teachers College Record*, Vol. 113, No. 2, pp350-374.

[5] D. L. Butler, H. N. Lauscher, S. Jarvis-Selinger, and B. Beckingham, (2004) "Collaboration and self-regulation in teachers' professional development," *Teaching and Teacher Education*, Vol. 20, No. 5, pp435-455. [Online]. Available: https://doi.org/10.1016/j.tate.2004.04.003.

[6] D. Petko, D. Prasse, and A. Cantieni, (2018) “The interplay of school readiness and teacher readiness for educational technology integration: A structural equation model," *Computers in the Schools*, Vol. 35, No. 1, pp1-18. [Online]. Available: https://doi.org/10.1080/07380569.2018.1428007

[7] H. Lee and Y. Hwang, (2022) “Technology-enhanced education through VR-making and metaverse-linking to foster teacher readiness and sustainable learning," *Sustainability*, Vol. 14, No. 8, pp4786. [Online]. Available: https://doi.org/10.3390/su14084786

[8] W. Jiawei and N. A. M. Mokmin, (2023) “Virtual reality technology in art education with visual communication design in higher education: a systematic literature review," *Education and Information Technologies*. [Online]. Available: https://doi.org/10.1007/s10639-023-11845-y.

[9] Y. Arima, (2018) “Social Cognition," in *Psychology of Group and Collective Intelligence*, Springer International Publishing, 2022, pp1-36.

[10] R. E. Carpenter, (2021) “Learning as cognition: A developmental process for organizational learning," *Development and Learning in Organizations: An International Journal*, Vol. 35, No. 6, pp18-21. [Online]. Available: http://dx.doi.org/10.1108/DLO-08-2020-0183

[11] S. T. Jallad and B. Işık, (2021) “The effectiveness of virtual reality simulation as a learning strategy in the acquisition of medical skills in nursing education: A systematic review," *Irish Journal of Medical Science* (1971-), Vol. 1-20. [Online]. Available: https://doi.org/10.1007/s11845-021-02695-z

[12] G. Riva, R.M. Baños, C. Botella, F. Mantovani, & A. Gaggioli, (2016) “Transforming experience: The potential of augmented reality and virtual reality for enhancing personal and clinical change," *Frontiers in Psychiatry*, Vol. 7, No. 164, pp1-14. [Online]. Available: https://doi.org/10.3389/fpsyt.2016.00164

[13] L. Coyne, T. Merritt, B. L. Parmentier, R. A. Sharpton, & J. K. Takemoto, (2019) “The past, present, and future of virtual reality in pharmacy education," *American Journal of Pharmaceutical Education*, Vol. 83, No. 3, 7456. [Online]. Available: https://doi.org/10.5688/ajpe7456

[14] S. Khazaie and S. Ebadi, (2023) “Exploring the feasibility of augmented reality game-supported flipped classrooms in reading comprehension of English for Medical Purposes," *Computer Assisted Language Learning*, pp1-34. [Online]. Available: https://doi.org/10.1080/09588221.2023.2173612

[15] L. Coyne, J. K. Takemoto, B.L. Parmentier, T. Merritt, & R. A. Sharpton, (2018) “Exploring virtual reality as a platform for distance team-based learning," *Currents in Pharmacy Teaching and Learning*, Vol. 10, No. 10, pp1384-1390. [Online]. Available: https://doi.org/10.1016/j.cptl.2018.07.005

[16] H. M. Huang, S. S. Liaw, and C. M. Lai, (2016) “Exploring learner acceptance of the use of virtual reality in medical education: A case study of desktop and projection-based display systems," *Interactive Learning Environments*, Vol. 24, No. 1, pp3-19. [Online]. Available: https://doi.org/10.1080/10494820.2013.817436.

[17] S. Jaschik and D. Lederman, (2014) “The 2014 inside higher ed survey of faculty attitudes on technology: A study by Gallup," *Inside Higher Ed*. [Online]. Available: http://www.insidehighered.com/download/form.php?width=500&height=550&iframe=true&title=Survey%20of%20Faculty%20Attitudes%20on%20Technology&file=IHEFacTechSurvey2014%20final.pdf

[18] I. Backfisch, A. Lachner, K. Stürmer, and K. Scheiter, (2021) “Variability of teachers’ technology integration in the classroom: A matter of utility!" *Computers & Education*, Vol. 166. [Online]. Available: https://doi.org/10.1016/j.compedu.2021.104159

[19] D. C. Dwyer, C. Ringstaff, and J. H. Sandholtz, (1991) “Teacher beliefs and practices part I: Patterns of change. The evolution of teachers’ instructional beliefs and practices in high-access-to-technology classrooms first–fourth year findings," [Online]. Available: https://pdfs.semanticscholar.org/a7bc/027d8afc2fa044414563fe8dba9b0f70ccdd.pdf

[20] National Education Association- American Federation of Teachers (NEA-AFT), (2008) “Access, adequacy, and equity in education technology: Results of a survey of America’s teachers and support professionals on technology in public schools and classrooms," Washington, D. C.

[21] Carnegie Classification of Institutions of Higher Education. [Online]. Available: https://carnegieclassifications.acenet.edu/

[22] M. L. Hung, (2016) “Teacher readiness for online learning: Scale development and teacher perceptions," *Computers & Education*, Vol. 94, pp120-133. [Online]. Available: https://doi.org/10.1016/j.compedu.2015.11.012

[23] B. J. Zimmerman and D. H. Schunk, (2001) “Self-Regulated Learning and Academic Achievement: Theoretical Perspectives," New York, NY: Routledge.

[24] K. Davison, L. E. Malmberg, and K. Sylva, (2023) “Academic help-seeking interactions in the classroom: A microlongitudinal study," *British Journal of Educational Psychology*, Vol. 93, No. 1, pp33-55. [Online]. Available: https://doi.org/10.1111/bjep.12538

[25] R. P. Bagozzi, (2007) “The legacy of the technology acceptance model and a proposal for a paradigm shift," *Journal of the Association for Information Systems*, Vol. 8, No. 4, p. 3. [Online]. Available: https://aisel.aisnet.org/jais/vol8/iss4/12

[26] P. Cardoso-Leite, R. Kludt, G. Vignola, W. J. Ma, C. S. Green, & D. Bavelier, (2016) “Technology consumption and cognitive control: Contrasting action video game experience with media multitasking," *Attention, Perception, & Psychophysics*, Vol. 78, pp218-241. [Online]. Available: https://doi.org/10.3758/s13414-015-0988-0

[27] S. Haidusek-Niazy, D. Huyler, and R. E. Carpenter, (2023) “Mentorship reconsidered: A case study of K-12 teachers’ mentor-mentee relationships during the COVID-19 pandemic," *Social Psychology of Education*. [Online]. Available: https://doi.org/10.1007/s11218-023-09788-w

[28] D. Hamilton, J. McKechnie, E. Edgerton, and C. Wilson, (2021) “Implementing immersive virtual reality in higher education: A qualitative study of instructor attitudes and perspectives," *Innovative Practice in Higher Education*, Vol. 4, No. 2, pp207-238. [Online]. Available: http://journals.staffs.ac.uk/index.php/ipihe/article/view/210

[29] M. Akçayır and G. Akçayır, (2017) “Advantages and challenges associated with augmented reality for education: A systematic review of the literature," *Educational Research Review*, Vol. 20, pp1-11. [Online]. Available: https://doi.org/10.1016/j.edurev.2016.11.002

[30] J. Parong and R. E. Mayer, (2018) “Learning science in immersive virtual reality," *Journal of Educational Psychology*, Vol. 110, No. 6, pp785-797. [Online]. Available: https://psycnet.apa.org/doi/10.1037/edu0000241

[31] H. Borko, J. Whitcomb, and D. Liston, (2009) “Wicked problems and other thoughts on issues of technology and teacher learning," *Journal of Teacher Education*, Vol. 60, pp3-7. [Online]. Available: https://doi.org/10.1177/0022487108328488

[32] J. Pottle, (2019) “Virtual reality and the transformation of medical education," *Future Healthcare Journal*, Vol. 6, No. 3, pp181-185. [Online]. Available: https://doi.org/10.7861%2Ffhj.2019-0036

[33] L. Freina and M. Ott, (2015) “A literature review on immersive virtual reality in education: State of the art and perspectives," in *The International Scientific Conference eLearning and Software for Education 3*, 2015, pp133-141. doi: 10.12753/2066-026X-15-124

[34] R. F. Kizilcec, J. N. Bailenson, and C. J. Gomez, (2017) “The instructor's face in video instruction: Evidence from two large-scale field studies," *Journal of Educational Psychology*, Vol. 109, No. 6, pp814-834. [Online]. Available: https://psycnet.apa.org/doi/10.1037/edu0000013

[35] M. Cook, Z. Lischer-Katz, N. Hall, J. Hardesty, J. Johnson, R. McDonald, T. Carlisle, (2019) “Challenges and strategies for educational virtual reality," *Information Technology and Libraries*, Vol. 38, No. 4, pp25-48. [Online]. Available: https://doi.org/10.6017/ital.v38i4.11075

[36] A. Grabowski and J. Jankowski, (2015) “Virtual reality-based pilot training for underground coal miners," *Safety Science*, Vol. 72, pp310-314. [Online]. Available: https://doi.org/10.1016/j.ssci.2014.09.017

[37] R. Girardi and J. C. de Oliveira, (2019) “Virtual reality in army artillery observer training," in *2019 21st Symposium on Virtual and Augmented Reality (SVR)*, IEEE, pp25-33.

[38] Y. Li, L. Zheng, and X. Wang, (2019) “Flexible and wearable healthcare sensors for visual reality health-monitoring," *Virtual Reality & Intelligent Hardware*, Vol. 1, No. 4, pp411-427. [Online]. Available: https://doi.org/10.1016/j.vrih.2019.08.001