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Future-Ready Construction and Facility Management:
Driving Research and Innovation for a Smart Built Environment

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BUILT ENVIRONMENT STUDENTS' PERCEPTIONS ON AUGMENTED REALITY (AR) TEACHING AND LEARNING TOOLS FOR CONSTRUCTION TECHNOLOGY COURSES

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Abstract
The antiquated and uninspiring characteristics of conventional teaching approaches have hindered student development. Consequently, augmented reality (AR) technology has gained prominence in educational settings, particularly within construction technology courses. It facilitates the presentation of digital visuals and information within a physical setting during teaching and learning. Hence, the study aims to investigate built environment students' perceptions of Augmented Reality (AR) Teaching and Learning Tools for Construction Technology Courses. The objectives are threefold: to identify the concept of Augmented Reality (AR) technology as a teaching and learning tool for construction technology courses; to determine the benefits of implementing Augmented Reality (AR) technology; and to investigate the challenges for AR implementation for construction technology courses. Focus group discussions were conducted among thirty-seven (37) built environment students (i.e., architecture, quantity surveying, and building) at Universiti Teknologi MARA Sarawak Branch, Samarahan Campus. The data analysis was carried out qualitatively via thematic content analysis. The results indicated the concepts of AR technology through familiarity, experience, and applications, six (6) utmost benefits, and six (6) key challenges in implementing AR teaching and learning tools for construction technology courses. The results could serve as guidelines for the integration of AR as a teaching and learning tool in construction technology courses.

Keywords: Augmented Reality (AR), Construction Technology Courses, Built Environment

1. INTRODUCTION

Traditional teaching methods have become outdated and limit students' engagement and understanding in construction technology education. Educators often rely on conventional approaches in which learners passively receive information, making it difficult for them to implement theoretical knowledge into practice. Therefore, it is imperative to incorporate technology into education to resolve this issue, particularly under the Industrial Revolution 4.0 (IR 4.0) agenda (Pertama, 2018). According to Kucuk et al. (2016), one of the emerging technologies is Augmented Reality (AR), as it enables the overlay of digital images and information in the real world, thereby providing an interactive and immersive learning experience. Ahmad Fauzi et al. (2019) emphasize that AR has the potential to enhance students' creativity and comprehension by enabling them to access information at any time through smart devices and visualize intricate construction processes. Nevertheless, the effectiveness of AR could be impeded by significant obstacles, including the complexity of developing AR teaching materials, students' unfamiliarity with AR, and technical issues such as hardware malfunctions and user interface problems (Sırakaya & Alsancak Sırakaya, 2022). Therefore, this paper's objectives are threefold: to identify the concept of AR in

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education, determine its benefits, and investigate the implementation challenges.

2. LITERATURE REVIEW

Augmented Reality (AR) is a technology that aims to enhance and enrich the user's perception and interaction with the real world by integrating virtual objects or information into the same environment (Ghosh, 2023). Additionally, it is anticipated that AR could improve academic performance, interaction, and learning motivation (Kairu, 2021). At present, AR is extensively utilized in a variety of higher education disciplines, such as biology and mathematics, and in construction technology courses that are associated with architecture, building, and construction (Urban et al., 2022). Nevertheless, the development of AR teaching materials is intricate, and resource constraints may pose challenges to the teaching and learning process (Mundy et al., 2019). In addition, to effectively incorporate technology into the lessons, educators must undergo additional training and support (Neil Sahota, 2023). Technical obstacles such as hardware-related problems, gadget malfunctions, or connectivity issues with local servers can significantly impact the learning process's efficacy (Sırakaya & Alsancak Sırakaya, 2022). Hence, addressing and resolving these issues is imperative to improve the educational experience and render it more user-friendly and effective.

3. METHODOLOGY

This study utilized focus group discussions (FGD) via Google Meet, involving thirty-seven (37) students from architecture, quantity surveying, and building programs. A total of seven (7) sessions were conducted to gather built environment students' perceptions of Augmented Reality (AR) as a teaching and learning tool for construction technology courses. Data was analyzed using thematic analysis, which involved transcribing discussions, coding key themes, reviewing patterns, and interpreting findings.

4. FINDINGS AND DISCUSSION

Table 1 presents the findings of the focus group discussion on the *concept* of Augmented Reality (AR) technology as a teaching and learning tool for construction technology courses, as well as *the benefits* and *challenges* of implementing Augmented Reality (AR) technology as a teaching and learning tool for construction technology courses.

Table 1: Results of Focus Group Discussion

Objectives	Findings (Thematic Analysis)	Elaboration (Respondents Code)
Concept of Augmented Reality (AR) Technology	*Familiarity with AR* ● **75.68% (28/37)** of students were familiar with AR as a technology that overlays digital content in the real world	1. *Overlays digital information onto the real world* (P1, P12, P8, P24, P31) 2. *Adding digital materials, content, or elements to the physical environment* (P2, P3, P6, P7, P11, P13, P14, P15, P16, P16, P20, P21, P25, P28, P30) 3. *Technology that visualizes things that are not present in the real world* (P29, P32, P33, P34, P35, P36, P37)

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	Experience with AR ● **16.22% (6/37)** of students used it in education**,** while **40.54% (15/37)** of students used AR in entertainment (games, social media filters), and **10.81% (4/37)** experience with AR in business and internship	1. *Used AR technology in high school to scan QR codes in textbooks, which displayed 3D models* (P30, P33, P34) 2. *Used AR apps to measure dimensions* (P14, P36, P37) 3. *Use in gaming and social media filter* (P6, P7, P9, P10, P21, P23, P24, P25, P26, P27, P28, P29, P31, P35) 4. *AR used during internships to measure areas, fit furniture, and visualize spaces* (P8, P11, P13) 5. *Applications for trying on products such as shoes virtually*, like the Nike app (P32)
	AR Applications or Tools for Teaching and Learning ● **24.32% (9/37)** of students had encountered AR learning tools (e.g., Google Expeditions AR)**,** but **75.68% (28/37)** of students never used AR for learning, indicating a lack of exposure	1. *AR tools such as Google Expeditions AR, Google AR, the 3D Planner app, measuring apps, and QR codes in textbooks that trigger 3D model visualizations* (P23, P29, P30, P32, P33, P34, P35, P36, P37)
***Benefits* of implementing Augmented Reality (AR)**	● **62.16% (23/37)** AR enhances students' comprehension, understanding, and engagement by making learning more interactive and providing accurate visualizations.	1. *Students could enhance their understanding of construction elements, designs, and processes* (P3, P21) 2. *Help students understand complex contexts* (P6, P8, P9, P10, P11, P13, P14, P20, P21, P23, P25, P31, P28, P29, P34, P33) 3. *Easier to understand the measurement of dimensions in a drawing* (P15, P17, P29, P31, P36)
	● **51.35% (19/37)** AR allows students to enhance their visualization of complex concepts, including 3D models and provides a clear understanding of design and structure.	1. *Enhance the visualization of complex construction concepts* (P1, P5, P2, P6, P12, P14, P18, P23, P24, P30, P32, P37) 2. *View the design and structure clearly* (P7, P28, P33) 3. *Enhance student's vision and imagination* (P13, P16, P19, P25)
	● **5.41% (2/37)** AR technology makes learning more enjoyable and engaging.	1. The utilization of AR in education can *enhance the excitement, interest, and enjoyment* of the learning experience for students (P20, P24)
	● **5.41% (2/37)** AR technology makes learning more accessible and convenient, providing students with interactive materials that are easy to access and use	1. AR has the potential to *enhance the accessibility and convenience of education in the future* (P26, P35)
	● **2.70% (1/37)** AR could save costs, making learning processes more efficient and reducing the need for physical materials.	1. AR is *cost-efficient, as it reduces the need for physical materials and tools for training* (P22)
	● **10.81% (4/37)** AR enables hands-on learning without physical materials, providing a safe environment for skill practice	1. *Students can experience hands-on learning and training in a safe virtual environment without the need for physical materials or visiting a high-risk construction site* (P4, P19, P23, P27)

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***Challenges* of implementing Augmented Reality (AR)**	● **51.35% (19/37) Technical issues**, including hardware limitations, high-speed internet requirements, and maintenance needs.	1. Setting up AR technology can be *complicated and challenging* (P1) 2. AR technology involves *complex technical elements* (P10, P19) 3. AR technology needs a *fast and reliable internet connection* (P21, P22, P23, P24) 4. AR technology requires *high-performance* computers and devices to function properly (P14, P22, P28) 5. Ongoing *maintenance* (P8, P12) 6. Outdated hardware unable to support AR (P17, P18, P23, P24, P25, P29, P30) 7. Requires *specific technical skills and knowledge* (P3, P5)
	● **27.03% (10/37**) **High cost** of AR devices and software, making adoption difficult for institutions.	1. The *high implementation costs* of AR (P12, P15, P26, P31, P32). 2. Involves significant expenses in both *hardware and software investments* (P4, P14, P21, P25) 3. High cost, especially for educational institutions with *limited budgets* (P23)
	● **19.92% (7/37) Limited familiarity** with AR, highlighting a lack of exposure and training.	1. Not everyone is *aware/ unfamiliar/ knows* AR due to lack of exposure (P2, P6, P9, P11, P13, P16, P20)
	● **16.22% (6/37) Poorly designed AR content** can negatively impact learning, while	1. *Poorly designed or low-quality AR content* can affect the overall effectiveness and credibility of the AR application (P14, P27) 2. *Potential inaccuracies* in placing objects or models in real-world scenarios and measuring dimensions (P32, P34, P35, P37)
	● **16.22% (6/37) Limited content and specialized skills** may be required to develop effective AR learning materials for construction education.	1. Require *additional training* for students and educators (P1, P2, P5, P30, P36) 2. Limited content might restrict the high quality of AR due to *specific design requirements in construction education* (P5)
	● **5.41% (2/37)** Educators and students may **prefer traditional teaching methods** and are reluctant to adopt AR	1. Students and lecturers may prefer the *traditional teaching method because of its familiarity and ease of use* (P1, P7) 2. Some students may find it *challenging to adapt to AR* due to the transition to the digital era, with a preference for traditional learning methods (P33)

According to Table 1, built environment students understood the ***concept*** of augmented reality (AR) as the overlaying and visualization of digital information, materials, content, or elements onto the physical world. Nevertheless, few utilized augmented reality in high school education to scan QR codes in textbooks that presented 3D models, and employed it during internships to measure areas, arrange furniture, and view rooms, indicating a deficiency in augmented reality exposure for teaching and learning. As for the ***benefits***, the respondents indicated that the implementation of AR improves their comprehension of construction elements, designs, procedures, intricate situations, and

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facilitates the interpretation of dimensional measurements in drawings. Next, the prominent ***challenge*** involves technical issues associated with the implementation of AR technology, which encompasses intricate technical components, necessitates a swift and dependable internet connection, demands high-performance computers and devices for optimal functionality, entails continuous maintenance, is hindered by outdated hardware incapable of supporting AR, and requires specialized technical skills and expertise.

5. CONCLUSION

To recapitulate, this paper examines the concept, benefits, and challenges of Augmented Reality (AR) technology as a teaching and learning tool in construction technology courses among built environment students. It is emphasized that there remains insufficient exposure to students' experiences and the deployment of augmented reality as a pedagogical tool for building technology courses. Moreover, it underscores the advantages of augmented reality, such as improved visualization, engagement, understanding, and experiential learning within a secure setting. However, technological challenges, elevated costs, resource limitations, and opposition to change impede its acceptance. Overall, Augmented Reality possesses the capacity to revolutionize construction education; nevertheless, its deployment necessitates investment, awareness, and refinement.

6. REFERENCES

Ahmad Fauzi, A. F. A., Ali, K. N., & Amirudin, R. (2019). Evaluating students readiness, expectancy, acceptance and effectiveness of augmented reality based construction technology education. *International Journal of Built Environment and Sustainability, 6*(1), 7–13. https://doi.org/10.11113/ijbes.v6.n1.309

Ghosh. (2023). Augmented Reality. In International Research Journal of Modernization in Engineering Technology and Science www.irjmets.com @*International Research Journal of Modernization in Engineering*, 3376. www.irjmets.com

Kairu, C. (2021). Augmented Reality and Its Influence on Cognitive Thinking in Learning. *American Journal of Educational Research, 9*(8), 504–512. https://doi.org/10.12691/education-9-8-6

Kucuk, S., Kapakin, S., & Goktaş, Y. (2016). Learning anatomy via mobile augmented reality: Effects on achievement and cognitive load. *Anatomical Sciences Education, 9*(5), 411–421. https://doi.org/10.1002/ase.1603

Mundy, M.-A., Hernandez, J., & Green, M. (2019). Perceptions of the Effects of Augmented Reality in the Classroom. In *Journal of Instructional Pedagogies*, 22. http://www.aabri.com/copyright.Augmented

Neil Sahota. (2023). Augmented Reality in Education: The Future of Learning is Here https://www.neilsahota.com/augmented-reality-in-education-the-future-of-learning-is-here/

Pertama, C. (2018). Proceedings Of New Academia Learning Innovation (Nali) Symposium 2018 UTM Academic Leadership (UTMLead) Universiti Teknologi Malaysia.

Sırakaya, M., & Alsancak Sırakaya, D. (2022). Augmented reality in STEM education: a systematic review. In *Interactive Learning Environments, 30* (8), 1556–1569. Routledge. https://doi.org/10.1080/10494820.2020.1722713

e-ISBN : 978-967-2776-60-4

Urban, H., Pelikan, G., & Schranz, C. (2022). Augmented Reality in AEC Education: A Case Study. *Buildings, 12*(4), Article 391. https://doi.org/10.3390/buildings12040391

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