UNIVERSITI TEKNOLOGI MARA

Public Interest Centre of Excellence

International Teaching Aid Competition 2023

Reconnoitering Innovative Ideas in Postnormal Times

iTAC 2023

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INTERNATIONAL TEACHING AID COMPETITION
E-PROCEEDINGS

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PREFACE

iTAC or International Teaching Aid Competition 2023 was a venue for academicians, researchers, industries, junior and young inventors to showcase their innovative ideas not only in the teaching and learning sphere but also in other numerous disciplines of study. This competition was organised by the Special Interest Group, Public Interest Centre of Excellence (SIG PICE) UiTM Kedah Branch, Malaysia. Its main aim was to promote the production of innovative ideas among academicians, students and also the public at large.

In accordance with the theme "Reconnoitering Innovative Ideas in Post-normal Times", the development of novel ideas from the perspectives of interdisciplinary innovations is more compelling today, especially in the post-covid 19 times. Post-pandemic initiatives are the most relevant in the current world to adapt to new ways of doing things and all these surely require networking and collaboration. Rising to the occasion, iTAC 2023 has managed to attract more than 267 participations for all categories. The staggering number of submissions has proven the relevance of this competition to the academic world and beyond in urging the culture of innovating ideas.

iTAC 2023 committee would like to thank all creative participants for showcasing their innovative ideas with us. As expected in any competition, there will be those who win and those who lose. Congratulations to all the award recipients (Diamond, Gold, Silver and Bronze) for their winning entries. Those who did not make the cut this year can always improve and join us again later.

It is hoped that iTAC 2023 has been a worthy platform for all participating innovators who have shown ingenious efforts in their products and ideas. This compilation of extended abstracts published as iTAC 2023 E-Proceedings contains insights into what current researchers, both experienced and novice, find important and relevant in the post-normal times.

Best regards,

iTAC 2023 Committee
Special Interest Group, Public Interest Centre of Excellence (SIG PICE)
UiTM Kedah Branch
Malaysia

THREE-DIMENSIONAL AUGMENTED REALITY: A TRANSFORMATIVE TOOL FOR ENHANCING MACHINERY TEACHING AND LEARNING

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ABSTRACT
The subject of Mechanization of Estate Operation requires students to have a grasp of the structure of plantation machineries. Traditionally, teaching involves using 2D diagrams along with hands-on experience. However, some learning institutes lack access to real machinery. Given the complexity of these machineries, it becomes extremely difficult for students to fully understand the subject without a clear visual representation of the actual machines. Augmented reality (AR) technology offers a solution by overlaying virtual objects onto the physical environment, creating a mixed reality experience. This project aims to incorporate AR into teaching plantation machineries by developing an enhanced 3D AR teaching aid called ARyMM2.0 version 2.0. The goal is to provide students with a comprehensive learning experience. ARyMM2.0 is an upgraded version that integrates Solidworks for customizing the 3D design of machinery and UNITY application for AR implementation. While the use of AR in education is not new, its application specifically for teaching plantation machinery subject is limited. This project stands out with its integration of two digital platforms and its specific focus on AR for plantation machineries. ARyMM2.0 enhances students' learning by increasing their sense of presence, immersion, and by placing learning in an authentic environment. Being a digital tool, ARyMM2.0 can be easily shared, benefiting students who lack access to actual machinery. The project contributes to the improvement of education quality in line with SDG 4, aligns with the concept of Education 4.0, and

helps students prepare for and adapt to the demands of the fourth industrial revolution (IR4.0). Although ARyMM2.0 can be commercialized as a standalone digital application, the current model that utilizes open-source platforms allows for the free sharing of knowledge with anyone in need.

Keywords: augmented reality, machinery, teaching aid, jigspace, mechanization

INTRODUCTION

Learning technology is continually changing, and the COVID-19 epidemic has highlighted its worldwide significance. During the height of the pandemic, several countries used remote learning methods. Hands-on experiments are difficult to provide in remote learning, especially in STEM (Science, Technology, Engineering, and Mathematics) courses. However, advances in interaction methods and intelligence have paved the way for virtual learning in STEM courses. The usage of eXtended Reality (XR), which includes Augmented Reality (AR), Mixed Reality (MR), and Virtual Reality (VR), is one viable technique. Because it can merge both real and virtual lab activity, XR is especially well-suited for displaying information during experimentation (Altmeyer et. al, 2020)

AR provides new teaching opportunities by merging virtual items with the actual environment, as shown by studies in a variety of educational situations (Iqbal et. al, 2022; Wu et. al, 2013). AR has been shown to significantly improve student engagement in the learning process, inspiring students to become more active (Radu et. al, 2019). Instructors have several obstacles in STEM topics because to students' lack of fundamental proficiency, motivation, background knowledge, encouragement, attention, confidence, and other issues (Bacca et. al, 2015). Incorporating kinesthetic learning, which incorporates physical involvement and hands-on experiences, may help students absorb technical topics by creating an immersive learning environment. When paired with kinesthetic learning, AR is useful in overcoming these obstacles. Hand-tracking technology, particularly in virtual settings, is gaining popularity in the post-COVID age as a way to avoid touching equipment and reduce disease transmission (Iqbal et. al, 2021). In addition, in AR settings, several interaction approaches such as touch, marker tracking, gestures, and hand recognition are being investigated (Ghazwani et. al, 2020).

Using cellphones to allow real-time hand engagement with virtual objects is a powerful method for developing kinesthetic apps and promoting interactive learning experiences. Furthermore, smartphone affordability is especially helpful in resource-constrained contexts, such as impoverished areas in both less developed and developed nations (Iqbal et. al, 2021; Pimmer et. al, 2020). In these circumstances, learning tools are often lacking in classrooms or personal learning spaces, restricting hands-on practise for comprehending scientific topics. As a result, the case study application discussed in this article focuses on chemistry within a resource-constrained learning environment, providing a virtual hands-on learning method appropriate for middle/high school level pupils.

The purpose of this research is to create an educational mobile AR application for teaching agricultural equipment, especially engines, to non-engineering students. It also aims to uncover essential design issues for mobile AR apps in the context of learning. The study's results will be useful to educators, researchers, and practitioners who are striving to solve teaching problems for students with limited relevant backgrounds in a university context. Given the potential of Covid-19 transmission, AR may also be used as a self-directed learning tool to enhance online teaching and learning. Finally, the purpose of this research is to give insights regarding the usage of augmented reality learning technologies during the epidemic.

PRODUCT INVENTION

ARyMM is an initial idea that indicates handling a grasp of the structure of plantation machinery using 3D design to boost the quality and quantity of products though enhancing the skills essential by production. Through smart farming, crucial agricultural challenges can be eliminated, such as by encouraging more people to participate in these sectors, increasing farmers' income, and most importantly, transforming the agriculture sector to different standards towards developed countries. ARyMM2.0 is an upgraded version that integrates Solidworks for customizing the 3D design of machinery and UNITY application for AR implementation.

METHODOLOGY

The 3D AR teaching aid ARyMM2.0 was designed and developed using the Solidworks 3D software integrated with the Unity Real-Time Development Platform and Jigspace. ARyMM2.0 is an improvement from the previous version, making it easier for students to interact virtually. It was developed to assist in the teaching and learning methods for the subject of farm machinery. Students only need to use their smartphones and project it in a suitable area to interact with ARyMM.

1. Design phase

The selection of the 3D model to be designed will be based on the curriculum within the farm machinery subject. The process of designing this 3D model is done using Solidworks software. This process is carried out in detail to ensure that all engine components can be clearly seen. Furthermore, the engine components need to be properly connected to facilitate the learning process.

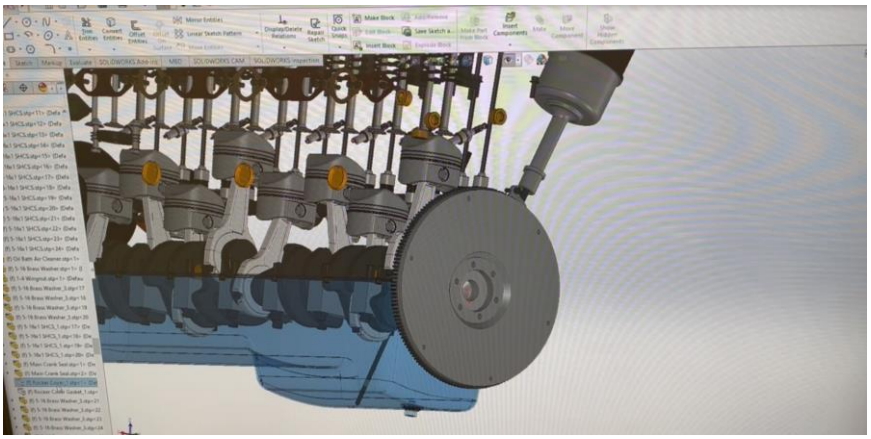


Figure 1. 3D model design using Solidworks software

2. Development phase

The model that has been completed in Solidworks software is then transferred to Unity software for the touch-up process to make the used model look realistic. Afterward, it is uploaded into the Jigspace system.

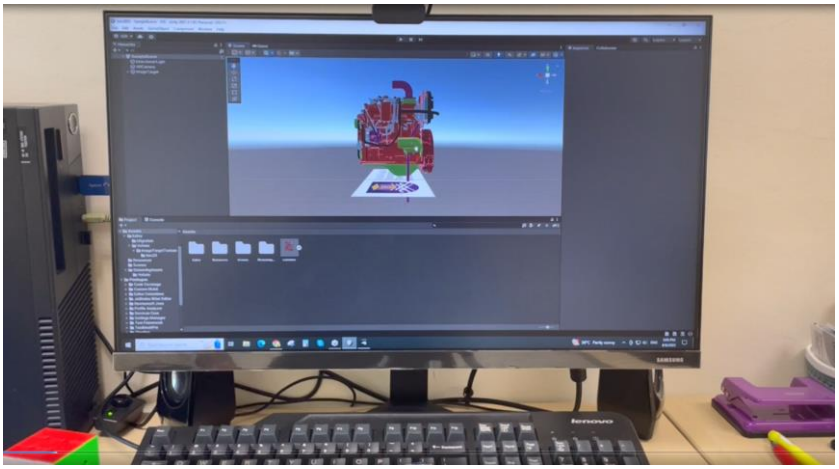


Figure 2. 3D model design transferred to Unity software

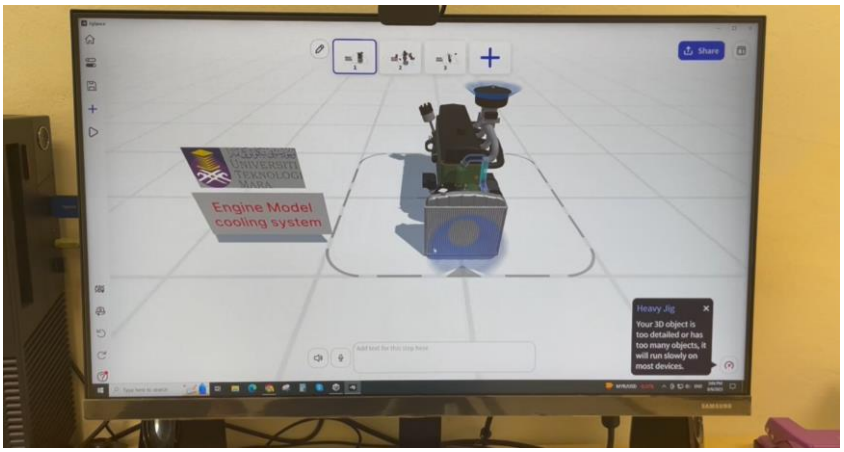


Figure 3. 3D model design uploaded and labeled using Jigspace.

3. Implementation and evaluation phase

The ARyMM2.0 was tested to evaluate the effectiveness on student psychomotor. The Diploma of Plantation and Industrial Management student utilized Augmented Reality with the guidance from lecturer.

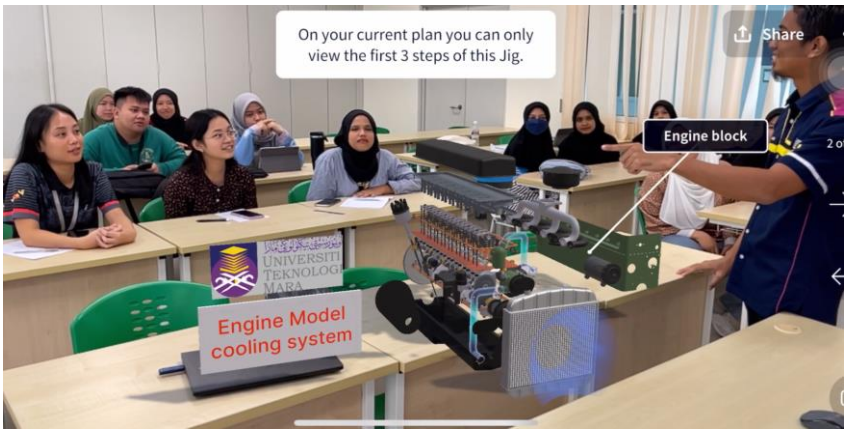


Figure 4. ARyMM2.0 product testing at classroom

RESULTS AND DISCUSSION

Since ARyMM2.0 is targeting potential to lecturer, student and institution, the utilization of this method may benefit all parties well.

Impact of Invention to Lecturer

The invention and implementation of three-dimensional augmented reality (3D AR) as a transformative tool for enhancing machinery teaching and learning can have a significant impact on lecturers. Here are some of the ways in which lecturers can benefit from using 3D AR in their teaching practices:

1. **Improved engagement:** 3D AR can greatly enhance student engagement in the classroom. By incorporating interactive and immersive learning experiences, lecturers can capture students' attention and make the learning process more exciting and enjoyable. Engaged students are more likely to participate actively, ask questions, and contribute to discussions, creating a dynamic and stimulating learning environment.
2. **Enhanced teaching effectiveness:** With 3D AR, lecturers can present complex machinery concepts in a more intuitive and visual manner. They can use virtual models to demonstrate the inner workings of machinery, showcase different components, and illustrate how they interact with each other. This visual representation can aid lecturers in conveying information effectively, making abstract concepts more tangible and easier to understand.
3. **Personalized instruction:** 3D AR technology allows for personalized instruction based on individual student needs. Lecturers can design interactive experiences that cater to different learning styles and skill levels. They can provide real-time feedback and guidance tailored to each student's progress, addressing their specific challenges and reinforcing their strengths. This personalized approach promotes a deeper understanding of the subject matter and helps students overcome learning barriers.
4. **Facilitation of practical training:** Lecturers can utilize 3D AR to facilitate practical training sessions in a controlled and safe environment. They can create virtual simulations of machinery maintenance or repair procedures, allowing students to practice hands-on skills without the risk of damaging real equipment. Lecturers can monitor and assess students' performance, provide guidance, and evaluate their competency, ensuring they are well-prepared for real-world scenarios.

Overall, the adoption of three-dimensional augmented reality (3D AR) in machinery teaching and learning can positively impact lecturers by enhancing engagement, improving teaching effectiveness, facilitating practical training, providing access to a wider range of resources, and promoting professional development. By leveraging the transformative capabilities of 3D AR, lecturers can create more immersive, interactive, and effective learning experiences for their students, preparing them for the challenges of the machinery industry.

Impact of Invention to Student

The invention and implementation of three-dimensional augmented reality (3D AR) as a transformative tool for enhancing machinery teaching and learning can have a profound impact

on students. Here are some of the ways in which students can benefit from using 3D AR in their machinery education:

1. **Enhanced understanding and retention:** 3D AR technology offers a highly immersive and interactive learning experience. Students can visualize complex machinery concepts in three dimensions, allowing them to better understand how different components fit together and function. The interactive nature of 3D AR enables students to manipulate virtual models, disassemble and assemble parts, and observe machinery from multiple angles. This hands-on approach promotes a deeper understanding of the subject matter and enhances long-term retention.

2. **Increased engagement and motivation:** 3D AR experiences captivate students' attention and make learning more engaging and enjoyable. The ability to interact with virtual machinery models in real-time stimulates curiosity and encourages active participation. The visual and interactive nature of 3D AR fosters a sense of excitement and motivation, making students more eager to learn and explore machinery concepts.

3. **Practical skills development:** 3D AR provides students with a platform to practice and develop practical skills related to machinery. They can engage in virtual simulations of maintenance and repair procedures, troubleshoot problems, and perform hands-on tasks without the risk of damaging real equipment. This practical training in a controlled environment enables students to gain valuable experience and build the skills necessary for real-world machinery scenarios.

4. **Real-world application:** 3D AR bridges the gap between theoretical knowledge and real-world application. Students can apply their understanding of machinery concepts to virtual scenarios, observing how different components interact and affect the machinery's operation. This application-based learning cultivates critical thinking, problem-solving abilities, and the ability to analyse and troubleshoot machinery issues.

CONCLUSION

In conclusion, the utilization of augmented reality (AR) technology provides solution as it superimposes virtual objects onto the real-world environment, resulting in a blended reality encounter. The objective of this project is to integrate AR into the education of plantation machinery through the development of an improved 3D AR teaching called ARyMM2.0 version 2.0. The aim is to offer students a thorough and all-encompassing learning experience. The usage of Three-Dimensional Augmented Reality (3D AR) in the teaching and learning activities of plantation machineries has significantly impact lecturers, students and educational institution.

Lecturers benefits from the use of 3D as it improves their ability to engage students and enhance

the effectives of their teaching through interactive and visually immersive learning experiences. It enables personalized instruction, facilitates practical training in a control setting, and expands access to a broader selection of educational resources. Moreover, lecturers have the opportunity to participate in professional development programs to enhance their proficiency in utilizing 3D AR, thereby further improving their teaching abilities. Students benefits from 3D AR through enhanced understanding and retention of complex machinery concepts. It increases their engagement and motivation, facilitates the development of practical skills, bridges the gap between the theory and real-world application, provides access to diverse learning resources, promote collaboration and teamwork, and improves their career readiness.

REFERENCES

Pimmer, C., Linxen, S., Gröhbiel, U., Jha, A. K., Burg, G. (2013). Mobile Learning in Resource Constrained Environments: A Case Study of Medical Education, *Med. Teach. 35*(5) e1157–e1165.

H. K. Wu, S.W.-Y. Lee, H.-Y. Chang, J.-C. Liang, (2013). Current Status, Opportunities and Challenges of Augmented Reality in Education, *Comput. Educ. 62*,41–49.

I. Radu, B, Schneider. (2019). What Can We Learn from Augmented Reality (AR) in: CHI '19: Proceedings of the 2019 CHI *Conference on Human Factors in Computing Systems, Association for Computing Machinery.*

J. Bacca, S. Baldiris, R. Fabregat, S. Graf, et al. (2015). Mobile Augmented Reality in Vocational Education and Training, *Procedia Comput. Sci. 75*:49–58.

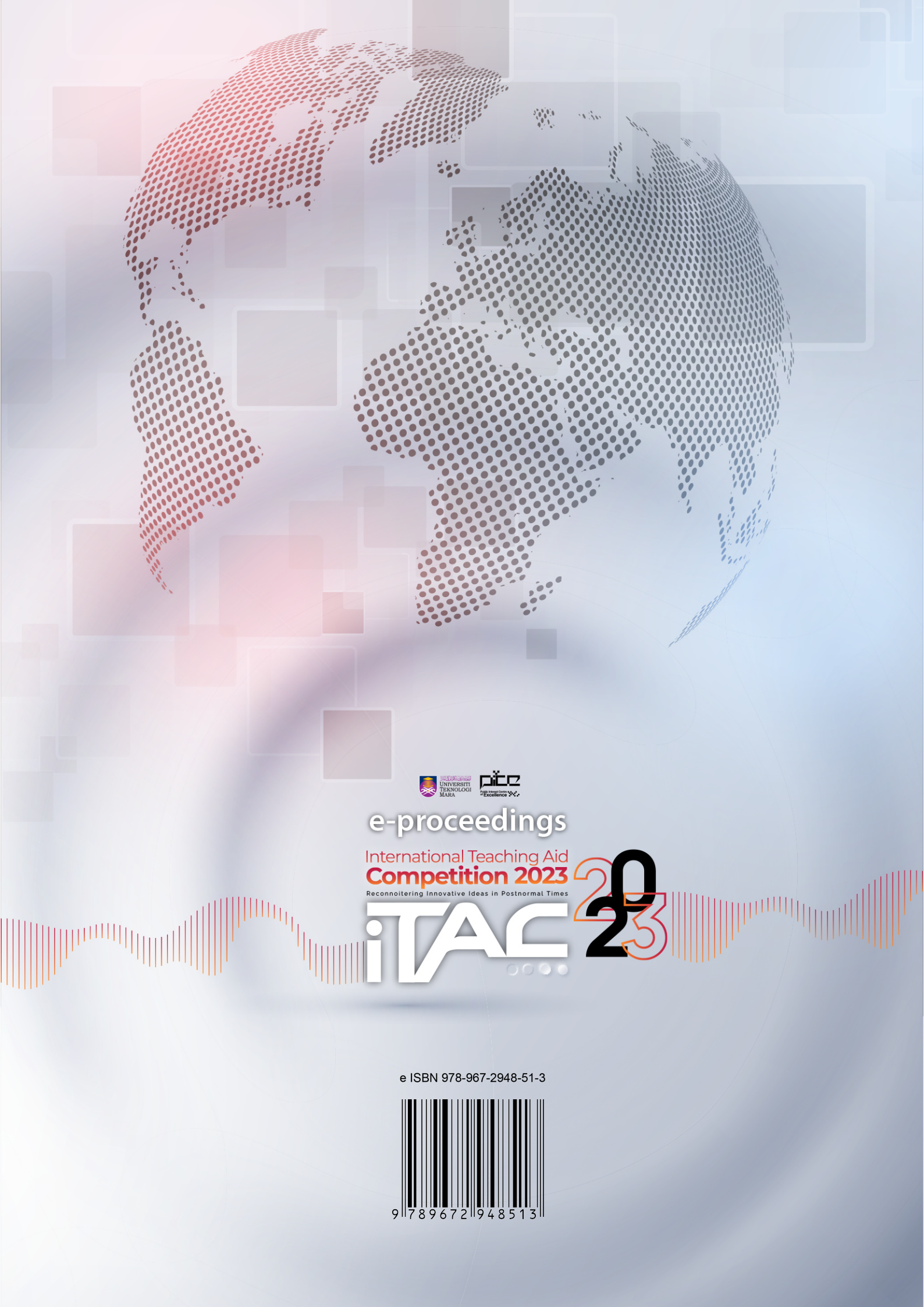
K. Altmeyer, S. Kapp, M. Thees, S. Malone, J. Kuhn, R, Brünken. (2020). The Use of Augmented Reality to Foster Conceptual Knowledge Acquisition in Stem Laboratory Courses Theoretical Background and Empirical Results, *Br. J. Educ. Technol. 51*(3): 611–628.

M. Z. Iqbal, E. Mangina, A., G. Campbell. (2022). Current Challenges and Future Research Directions in Augmented Reality for Education, *Multimodal Technol. Interact. 6*(9):75.

M. Z. Iqbal, A.G. Campbell. (2020). The Emerging Need for Touchless Interaction Technologies, *Interactions 27*(4):51–52.

M. Z. Iqbal, A., G. Campbell. (2021). Covid-19, Education, and Challenges for Learning-Technology Adoption in Pakistan, *Interactions,* 29.

Y. Ghazwani, S., Smith. (2020). Interaction in Augmented Reality: Challenges to Enhance User Experience, in: *Proceedings of the 2020 4th International Conference on Virtual and Augmented Reality Simulations*, 2020, pp. 39–44.



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