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## Mirror..mirror on the Wall Are We Real in Reality? Virtual reality learning application in malaysian education

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### Abstract

Virtual reality has a lot of promise, and its use in education and industry has recently piqued the interest of many in academia. In Malaysian educational environments, there are presently just a few thorough studies on how academics and educationists use immersive virtual reality. Until far, Virtual Reality-based education in Malaysia has received little attention in the literature. This is a systematic literature review paper that follows closely the methodology of PRISMA that consists of rigid and vigorous literature search. Findings showed in virtual reality's use, including not taking into account the best practices for teaching and lack of evaluations.

Keywords:: Virtual Reality; Learning Environment; Systematic Literature Review

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### 1.0 Introduction

The covid -19 pandemic has changed the stigma of teaching among educators in Malaysia when the optimal use of technology is significant. High reliance on education technology skills increased educators' awareness when all schools were closed due to this covid 19, and teachers had no choice in ensuring that teaching took place except online learning. In Malaysia's early stages of implementing the Movement Control Order (MCO), some educators still gave reasons. However, when the pandemic is protracted, online learning and teaching is the only way to ensure the continuity of teaching in schools. This is to ensure that student dropouts are avoided. (Na et al., 2020)

The use of technology is becoming increasingly popular, and there are numerous methods and options available that can be used and integrated into this online teaching. One of them is VR technology, which some educators are concerned about when the impact of technology is high, particularly when it involves some learning scenarios that cannot be carried out as usual. Fundamentally, starting education in Malaysia is shifting towards more efficiency with less dependence on examination performance as the main measurement.

Examination-based has been so engraining in Malaysian society which learning happen through good results and excellent performance in major national examination. This also continued with higher education levels. Students enter university and colleges because good results in their exam transcript matter more than another achievement. Hence teachers, lecturers, instructors, and Malaysian education focus the majority of the teaching and learning process on the traditional verbal educational approach, which is not always

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feasible. The previous study has shown that students who are taught using a verbal approach have a significantly more difficult time understanding and solving issues than those taught using a combination of verbal and visual techniques. (Rosli & Kamarudin, 2020)

The educational institutions in Malaysia remain focused on lecturing and teaching, which causes students to lose interest. These components are retention (the capacity to keep what you have learned) and transfer (the ability to apply what you have learned to a problem). Because of this, educators must identify the best way to provide teaching and offer new methods to improve student achievement. The other way of saying this is that primary school education is where children grow and play, get experience, and hone their social skills. In Malaysia, children start attending primary school at the age of seven and remain in it for six years, known as Standard 1 to 6. There are just two levels for children from 1 to 3 years old: Level One is for one year to three years, while Level Two would be for four to six years. While secondary continued with Form 1 until Form 5, this level ended with one national exam called SPM (Sijil Pelajaran Malaysia). Students will continue with their tertiary education with a variety of choices offered by the public and private universities and colleges. Due to changes in the education paradigm, Malaysian educators shift towards more engaging, easy, and effective teaching and learning approaches. Virtual Reality (VR) technology has become one of the "sophisticated technology, and it has been the main highlights for the past ten years in education practices. (Adnan et al., 2019)

VR technology, advances in image processing, tracking technologies, and natural human-computer interaction come together to provide a hands-on experience. Classrooms that use this approach should consider domain-specific, pedagogical, and psychological aspects while designing instructional applications that utilize this method. Children's education is succeeding by using video games to adapt to collaborative activities between instructors and students. When two or more parties work together to accomplish a shared objective, it begins a collaborative endeavor. In education, collaborative activities provide instructors and students with opportunities to collaborate and exchange information via play and exploration. To provide a better experience for youngsters, different input devices are used. VR technology enables users to experience objects in the real world via a computer-generated system. Playing games is a new method for a kid to apply for education. Research has shown that preschoolers learn programming skills while playing games. Integrating computers, multimedia resources, the internet, simulation games, and immersive technologies like the 3D virtual world is essential in helping educators aid and improve student learning. When using creative techniques, activities should be organized to teach and meet educational objectives.

Since it is essential to hold, keep, and apply information to help students progress in today's learning environment, new technologies should be used in educational settings to provide instructional material compatible with human cognition. Advances in audio and visual technology have recently become a new approach to education, influencing the learning process and classroom environment. While VR has more of a future than other technologies, such as multimedia, gaming, and online learning, it has to be seen if it will have a larger impact than these other technologies.

Despite the potential for VR to make learning more enjoyable, educators must discover new ways to make education better. The subjects tested in primary school are Malay Comprehension, Malay Writing, English Comprehension, English Writing, Science, and Mathematics. While this concept applies mostly to Malaysia, the current state of affairs in Malaysia applies to the idea that learning and instruction begin in elementary school and continue through high school, where teachers have control over their students. In most Malaysian education contexts, teaching and learning occur sequentially from one end to the other. A fifth sense approach, such as sight, hearing, or touch, will be used for teaching and learning. A classroom environment that motivates and engages children makes it easier to adjust to the school setting. The criteria for each technique, people, and the facility must be established to achieve a quality teaching and learning experience and student accomplishment and social well-being. Modules vary from basic to advanced, with escalating degrees of difficulty. As a result, the use of VR in Malaysian education instruction will be essential in the future.

Education systems need to adapt quickly to new methods and teaching techniques, which needs a short developmental cycle. The system uses a wide range of interactive teaching and learning techniques. Virtual reality has made it possible to keep critical priorities such as adopting new technology and fostering cooperation front of mind VR. Virtual reality's educational potential is elusive; there is no silver bullet(VR. While technology advances, individuals are aware of the need to have practical skills acquired in practical methods. Research has indicated that VR may help students develop a deeper interest in the subject matter they are learning about, provide them a diverse set of views to consider, and encourage them to become involved in class discussions. The program offers instructional benefits to teachers, including improving student comprehension and promoting class debate.

### **Aim of the study**

This is a systematic literature review paper that follows closely the methodology of PRISMA that consists of rigid and vigorous literature search. The findings of the study are expected to give guidelines, trends and findings on the implementation of virtual reality in Malaysia education landscape.

Objectives of this study formulated as below;

1. To identify types of immersive VR technologies are used in Malaysian education practices?To describe research designs, data collection methods, and data analysis methods are applied to examine the use of immersive VR in Malaysian Education practices?
2. To explain types of research methods and techniques are applied to evaluate the learning outcomes of immersive VR learning based on Malaysian Education practices?
3. To explore types of learning content in Malaysian education are immersive VR applications used?

## 2.0 Literature Review

### 2.1 Virtual Reality and It's Implementation in Education

It has been a long time since virtual reality technology has been accessible to assist the teaching-learning process in publications with an educational focus (Na et al., 2020). With the introduction of new technologies that are more affordable and more efficient, their usage has grown increasingly prevalent across all educational levels. Although there are many benefits to using this technology, several challenges are associated with its use. According to Petrakou( 2019), students should get more familiar with virtual world settings and improve their technical skills to benefit from these environments. Identifying and resolving the technical problems associated with these computer-generated configurations would also be helpful in this situation. Similar to this, the value of augmented reality and virtual reality settings in engineering has been translated to university education, where a variety of virtual reality-related projects are being conducted. To encourage innovation while creating virtual reality applications (Omar et al., 2018)recommends the creation of multidisciplinary groups. It is important to promote divergent thinking since it is one of the most important phases.

Other more recent studies(Edwards et al., 2018)have specifically addressed the creative aspect of the process. Virtual learning environments have the potential to improve quality in autonomous learning and the capabilities of future engineers and designers, but the benefits of doing so have not been well compared. The vast majority of studies are concerned with evaluating the quality of immersion and engagement with the environment, as well as the ease with which it may be used (Azar et al., 2020)

The findings of the students who utilized the VR module were substantially better, indicating that they had a greater understanding of the assessed competencies. The majority of technology was also translated to motivation, as these students said that the VR tool had improved their learning. Several thorough overviews and systems analyses have previously been done on virtual reality (VR) technology (Jensen & Konradsen, 2018; Merchant, Goetz, Cifuentes, Keeney-Kennicutt, & Davis, 2014). However, there are still fewer discussions on VR application in various disciplines within Malaysian education settings.

### 3.0 Methodology

A method on Systematic Literature Review (SLR) is based on Kitchenham (2004), who describes it as "a process that involves finding, assessing, and interpreting all relevant papers to stated research questions or a particular subject of interest." This technique is suggested in conjunction with a set of 10 research questions specified in conjunction with the method's justification.

To perform a search of published, peer-reviewed literature on the use of mobile and wearable technologies in the Malaysian education context. Search terms, criteria, and resources were initially selected and defined in the first step. The main resources for this research are Google Scholar, SCOPUS, IEEE Xplore, Scopus, Science Direct, and. This screening method utilized the following inclusion and exclusion criteria:

- Articles published after 2010
- Studies published in English
- Research from peer-reviewed journals or conferences, books, and lecture notes
- Articles are focused on mobile or wearable solutions
- Papers must be in a full or short version (not abstracts) Rankings Portal - Computing Research and Education n.d.), and Journal Citation Reports (JCR) 2018 (la science-help.-thomsonreuters. com, 2019) were used accordingly.

### 3.1 Data Sources and Search Strategies

To perform this comprehensive literature evaluation, we looked for articles on five databases: Google Scholar, IEEE Xplore Digital Library, Science Direct, Scopus, and Web of Science. These were only sources relevant to technology, engineering, and computer science, so we excluded references to chemistry and medicine. We also returned to the years between January 2010 and June 2021, choosing items published during the past 10 years.

#### 3.1.1 Article Selection

Once we selected the databases for searching, we figured out which search terms to look for to locate relevant research studies to answer our queries, and then we established exclusion and inclusion criteria to hone and refine the results.

#### Search Strings

The formulated the search strings based on the relevant topics to our systematic literature review and determined a set of specific keywords to use in our queries, i.e., "Virtual Reality," "Malaysia Education," "Immersive Technology," "Virtual Reality Malaysia," "Virtual Reality Wearables," and "Immersive Learning" that would be useful to answer our research questions. These strings were focused on finding studies that analyzed or experimented with the use of virtual reality in any teaching and learning programs that took place specifically in Malaysia and by local researchers. In Table 2, we present the specific search strings used in the selected databases.

Table 1. Search strings.

ID	Search Strings
<b>SS1</b>	("Virtual Reality" OR VR ) AND ( "Malaysia") AND ("learning" OR education OR "teaching" OR "Immersive learning")
<b>SS2</b>	("Virtual Reality" OR VR OR Virtual) AND (Malaysian education OR " learning")

<b>SS3</b>	AND ("virtual environment" OR virtual learning OR "VR based learning" OR "immersive learning") ("Virtual Reality" OR VR OR Virtual) AND ("wearables technology" OR HMD OR "Immersive learning" OR "VR classroom")
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### Study Selection Criteria

We created a basic understanding of the ideas by answering the research questions by referencing the circumstances found in Table 3.

Table 2. Inclusion criteria.

ID	Inclusion Criteria
IN1	Studies published over the last 10 years, between January 2010 and June 2021.
IN2	Journal articles and conference papers.
IN3	Studies with a focus on Virtual Reality.
IN4	Studies related to the usage of Virtual Reality in Malaysian settings.
IN5	Studies performed in an educative context in various disciplines and conducted by Malaysian academics, researchers, and local organizations.

The types of papers presented in Table 3 were excluded.

Table 3 Exclusion criteria.

ID	Exclusion Criteria
EX1	Studies with an exclusively medical focus on the technical VR explanation of science computers and programming.
EX2	Studies related to Augmented Reality (AR) or wrongly used terms of virtual referring to the use of video.
EX3	Studies that consider virtual learning in contexts that do not specifically involve VR use.
EX4	Studies that conducted outside of Malaysian education settings

Table 2 indicates that a study's highest possible score is 8 points. The extraction procedure was made possible using Tables 1 and 3.

### Research Questions

ID	Research Questions
RQ1	What types of VR technologies are used in Malaysian education settings?
RQ2	What types of research designs are ployed for Malaysian education?
RQ3	What types of VR evaluation are applied to the effectiveness of learning interventions.
RQ4	What are the design elements of VR learning applied to Malaysian education?
RQ5	What is the purpose that has been applied to the proposed
RQ6	What is the target population?
RQ7	What are the outcomes obtained by applying VR intervention in Malaysian education settings?

In the following section, the research design, which consists of the method, review process, and classification framework, is discussed in detail.

## 4.0 Results and Analysis

Firstly, all publications were retrieved based on searched keywords. All study with related title and abstract is thoroughly examined. However, sources with duplication are excluded while the remaining articles are selected for the next process step. The process of selection is followed closely by the PRISMA guidelines.

There were n= 23485 numbers of articles retrieved. Only 220 were selected for a full review. The last step involved 158number of the study were discarded from this 62 selected after applying all detail of criteria aligned with the study. The following tables conclude all lists of papers and results of the review.

Of the 66 articles included in our analysis, 68% originated from conferences, whereas 32% were published in journals. The search window was from 2010–to 2021. The number of journal publications since 2015 was remarkable, indicating an increasing scholarly interest in VR for Malaysian education.

## 4.1 VR technologies

### **RQ1: What types of immersive VR technologies are used in Malaysian education practices?**

Review shows that 76% of the studies used high-end HMDs, such as Oculus Rift or HTC Vive. These high-end VR systems use various supporting tools, such as controllers, touchpads, and haptic feedback. Out of 41 VR technology counts, eight used low-budget mobile VR. However, interactive manipulation was performed through a desktop monitor connected to the mobile app. Only a few of the articles used enhanced VR. Overall, high-end HMDs were the most commonly used immersive VR technology. This results show a trend to the implementation of Virtual Reality among the researcher and practitioner in education relying on so called "high-end technology" for more convincing study. This is to justify the implementation of high end technology in classroom as most of this type of study still known as "high cost" study. Most of the study is developed upon a research grant funded for researchers.

### **RQ2: Which research designs, data collection methods, and data analysis methods are applied to examine the use of immersive VR in Malaysian Education practices?**

Concerning the research method, development research was popular, and a survey (16 articles both qualitative and quantitative data analysis methods were applied. The structural equation modeling study was the most commonly applied quantitative data analysis method. Conversely, in only one to three articles on average, other methods were rarely used, except for the correlation method (5 articles). Most of the design-oriented works had combined their studies with development (22 articles), experimental design, usability, and user testing (35 articles), or had used interviews and focus group discussions on collecting data (5 articles). This pattern is similar to other empirical qualitative and empirical quantitative studies. Many of the local studies were designed as conceptual, and researchers are still reviewing the advantages and disadvantages of the study since this study involves virtual reality is costly, especially for social science studies. One of the difficulties found from some of the studies designed and developed by researchers with non technical background such as programming and computing knowledge, Researchers are from various social studies try to adapt and embrace the benefit of Virtual Reality. However, the study is stuck at development and experimental study since researchers need to rely upon their prototype from the vendor or selected programmer appointed for their study. Researchers have to bear with delays and additional cost

### **RQ3: Which research methods and techniques are applied to evaluate the learning outcomes of immersive VR learning based on Malaysian Education practices?**

Almost half of the reviewed articles did not specify a learning outcome evaluation method (). A few articles used questionnaires (22%) or user activities while logged into the VR application (12%). Exams, expert judgments, or focus group discussions accounted for a mere 5%, respectively, while the remaining articles used observations or sensor data. This fact is intriguing because many articles described evaluations of developed VR applications. However, the focus was mainly placed on usability or user experience. Nevertheless, several articles measured or evaluated how much the students' knowledge or skills progressed after using immersive VR, for example. Most popular paper published for this technology among the researchers are still at looking at literature rather than stepping forward to the development and implementation. Majority of the study is trying to customade their virtual reality prototype whereas there are various platform now made virtual reality more accessible. This is include platform like youtube and google already promoted their virtual reality version to be used and implemented for various learning activity, research and pilot study.

### **RQ4: Which learning contents in Malaysian education are immersive VR applications used?**

The analysis shows that VR applications for Malaysian education practices were most frequently used to teach content topic related to science and technology. The rest of the learning content categories found in the literature were communication, collaboration, and soft skills (10%), behavioral impact (6%), and learning a language (2%). It is found that virtual reality serve it's purpose for science and technology topic since the ability of virtual reality provide non-accessible learning environment because it' s too hazardous or too costly like learning in construction site, activity at active volcanoes or even experience real space shuttle. It is impossible for traditional classroom to provide this type of learning experience. Therefore, virtual reality could bring the real experience to the classroom.

## 5.0 Discussions

The word immersion has been interpreted to mean a different thing when talking about virtual reality (VR) technology. Many articles were eliminated from consideration due to their usage of this word, which was often used to describe non-immersive technology. To get a wide variety of related terms, such as Oculus, Vive, Samsung Gear, Google Cardboard, and Samsung Odyssey, and to exclude as many unrelated terms, such as 360-degree videos, Desktop VR, CAVE, and panoramic videos, we utilized a high number of inclusion terms that focus on immersive technologies, like Oculus, Vive, Samsung Gear, Google Cardboard, and Samsung Odyssey, and excluded as many exclusion terms as possible, like 360-degree videos, Desktop VR, CAVE, and panoramic videos. There is still confusion over whether equipment that offers virtual reality and augmented reality and "immersive technology" is virtual reality and augmented reality. Many different learning theories were discovered in the literature, all of which had already been addressed in other publications. For the most part, the papers describing VR applications for Malaysian education provided an in-depth analysis of VR's uses in education but failed to provide a clear theoretical basis for the applications.

In these papers, a detailed description of VR application development was provided. However, evaluations were restricted to assess usability. In contrast to the things mentioned, these works had an experimental nature and were only partially repeatable, if at all. Finally, several of the in-depth papers on VR development were unconnected to the discussion of learning theories. To take another example, the

researchers only examined the features and usability of the applications and not the educational results. Lastly, news stories spoke about educational VR design and ideas behind it but did not go into technical depth about how it was built. Many design aspects were, however, difficult to extract from these documents.

While certain aspects of VR appeared sophisticated enough to be utilized for procedural, practical knowledge, and declarative knowledge, others were immature and could not be used. Fire safety, surgery, nursing, and astronomy were all examples. More advanced VR apps were utilized in these instances, and they are adequate for higher-level studies. However, of the papers examined, the majority suggests that VR for education is still in the experimental phases, with tests and experiments being performed on a prototype.

Although not many publications have examined the learning outcomes that result from using VR in a particular area, the majority of the assessments that have been conducted tend to be usability-oriented. In addition, this is another demonstration of the degree of VR's maturity, which is an obstacle to wider use in normal educational activities.

In VR learning material, simple interactions are used as the exclusive design feature. Although this seems to be the case, on a closer examination, writers discuss two degrees of user interactions: The terms within the virtual environment (i.e., inside a VR environment) and interactions with the hardware (i.e., interacting with the hardware) are examples of different types of interactions. A majority of the publications claim to have developed virtual reality (VR) applications in the context of realistic surroundings, and the "realistic surroundings" aspect was present in nearly all instructional material. There are still disagreements about what it means to use the term "realism." However, for some, "realistic enough" refers to a high-fidelity VR environment that features complex, high-quality graphics, while for others, it can mean "realism," in that the environment can be identified without the use of special effects.

## 6.0 Conclusion and Future Research

VR (virtual reality) is still experimental in Malaysian education and has not been used systematically or based on best practices. This paper identifies key weaknesses that can lead to future growth, especially for VR application developers and teachers in the education context of the students in Malaysia. Teachers, lecturers, and researchers at the nation's universities, technical colleges, and community colleges may also be affected. It is planned to advance Malaysian.

## References

- Aziz, K. A., & Siang, T. G. (2014). Virtual Reality and Augmented Reality combination as a holistic application for heritage preservation in the Unesco World Heritage Site of Melaka. *International Journal of Social Science and Humanity*, 4(5), 333-338.
- Bakar, N. A. A., Zulkifli, A. N., & Mohamed, N. F. F. (2011, September). The use of multimedia, Augmented Reality (AR), and Virtual Environment (VE) in enhancing children's understanding of road safety. In *2011 IEEE conference on open systems* (pp. 149-154). IEEE.
- Chimeremeze, O. H., Sulaiman, S., & Foong, O. M. (2013, December). An exploratory study on the prospect of virtual reality's key multi-sensory elements in traditional foot reflexology. In *2013 1st International Conference on Artificial Intelligence, Modelling and Simulation* (pp. 137-142). IEEE.
- Che Mat, R., Zulkifli, A. N., Nordin, N., & Mohd Yusof, S. A. (2015). Online 3D oil palm plantation management based on game engine: A conceptual idea. *Jurnal Teknologi*, 78(2-2), 109-113.
- Chen, C. J., Lau, S. Y., Chuah, K. M., & Teh, C. S. (2013). Group usability testing of virtual reality-based learning environments: A modified approach. *Procedia-Social and Behavioral Sciences*, 97, 691-699
- Chuah, K. M., Chen, C. J., & Teh, C. S. (2011). Designing a desktop virtual reality-based learning environment with emotional consideration. *Research & Practice in Technology Enhanced Learning*, 6(1).
- Damio, S. M., & Ibrahim, Q. (2019). Virtual reality speaking application utilization in combatting presentation apprehension. *Asian Journal of University Education*, 15(3), 235-244.
- Edwards, B. I., Bielawski, K. S., Prada, R., & Cheok, A. D. (2019). Haptic virtual reality and immersive learning for enhanced organic chemistry instruction. *Virtual Reality*, 23(4), 363-373.
- Juhari, A. S., Mohamed, S. F. S., & Mohamed, R. (2012). Enriching Learners' Learning Experiences through Virtual Learning Environments in Open University Malaysia.
- Hamid, N. S. S., Aziz, F. A., & Azizi, A. (2014, August). Virtual reality applications in the manufacturing system. In *2014 Science and Information Conference* (pp. 1034-1037). IEEE.
- Hashim, A. F. M., Hussin, H., Othman, M. H., & Ahmad, S. A. S. (2016). Usability evaluation of a desktop virtual reality prototype (DVRP) courseware to enhance knowledge on drug abuse. *Journal of Techno Social*, 8(1).
- Hashim, A. F., Taib, M. Z. M., & Alias, A. (2014). The integration of interactive display method and heritage exhibition at the museum. *Procedia-*
- Huda, M., Siregar, M., Teh, K. S. M., Said, H. A. M. D. A. N., Jamsari, E. A., Rahman, S. K. A., ... & Ninsiana, W. I. D. H. I. Y. A. (2017). From live interaction to virtual interaction: addressing moral engagement in the digital era. *Journal of Theoretical and Applied Information Technology*, 95(19), 4964-4972.
- Jumaat, N. F., & Tasir, Z. (2013). Integrating project-based learning environment into the design and development of mobile apps for learning 2D animation. *Procedia-Social and Behavioral Sciences*, 103, 526-533.
- Kiat, L. B., Ali, M. B., Abd Halim, N. D., & Ibrahim, H. B. (2016, October). Augmented reality, virtual learning environment and mobile learning in education: A comparison. In *2016 IEEE Conference on e-Learning, e-Management, and e-Services (IC3e)* (pp. 23-28). IEEE.

- Khairudin, M., Triatmaja, A. K., Istanto, W. J., & Azman, M. N. A. (2019). Mobile virtual reality to develop a virtual laboratory for the subject of digital engineering.
- Lam, C. K., Sundaraj, K., & Sulaiman, M. N. (2013). Virtual reality simulator for phacoemulsification cataract surgery education and training. *Procedia Computer Science*, 18, 742-748.
- Lee, E. A. L., Wong, K. W., & Fung, C. C. (2010). How does desktop virtual reality enhance learning outcomes? A structural equation modeling approach. *Computers & Education*, 55(4), 1424-1442.
- Mamat, I., Yusoff, A. S. M., Abdullah, W. S. W., & Razak, F. Z. A. (2015). Factors Contributing Pre-School Trainees Teachers Adoption of Virtual Learning Environment: Malaysian Evidence. *Turkish Online Journal of Educational Technology-TOJET*, 14(2), 73-79.
- Masmuzidin, M. Z., Jiang, J., & Wan, T. (2011). A pilot study: The evaluation of Malaysian virtual folktales in second life. *Procedia-Social and Behavioral Sciences*, 15, 1993-1997.
- Muhamad, M., Zaman, H. B., & Ahmad, A. (2010, June). Developing a virtual laboratory for biology (VLab-Bio): A preliminary study. In *2010 International Symposium on Information Technology* (Vol. 1, pp. 1-6). IEEE.
- Mustafa Kamal, N. N., Mohd Adnan, A. H., Yusof, A. A., Ahmad, M. K., & Mohd Kamal, M. A. (2019, January). Immersive Interactive Educational Experiences—Adopting Education 5.0, Industry 4.0 Learning Technologies for Malaysian Universities. In *Proceedings of the International Invention, Innovative & Creative (InIIC) Conference, Series* (pp. 190-196).
- Mohd Adnan, A. H., Ya Shak, M. S., Abd Karim, R., Mohd Tahir, M. H., & Mohamad Shah, D. S. (2020). 360-degree videos, VR experiences, and the application of Education 4.0 technologies in Malaysia for exposure and immersion. *Advances in Science, Technology and Engineering Systems Journal*, 5(1), 373-381
- Na, K. S., Mohamed, F., Isham, M. I. M., Siang, C. V., Tasir, Z., & Abas, M. A. (2020, November). Virtual Reality Application Integrated with Learning Analytics for Enhancing English Pronunciation: A Conceptual Framework. In *2020 IEEE Conference on e-Learning, e-Management, and e-Services (IC3e)* (pp. 82-87). IEEE.
- Normala, R., Norkhairani, A. R., Roslinda, M., Tengku Siti Meriam, T. W., & Nor Azan, M. Z. (2016). Usability Evaluation of Virtual Museum Environment: A Case Study in Terengganu State Museum, Malaysia.
- Petrak, A. Interacting through avatars: Virtual worlds as a context for online education. *Comput. Educ.* **2010**, 54, 1020–1027.