

Design and Build Virtual Reality-Based Smart Tourism and Hospitality as an Immersive Learning Media in the Pre-Practicum Stage of the Tourism Diploma Program

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Abstract

The development of digital technology encourages changes in learning methods in vocational education, especially in the field of tourism and hospitality which focuses on practical competencies. However, pre-practicum learning is still dominated by conventional methods so that it is not able to provide a learning experience that resembles real working conditions. This research aims to design and develop a Virtual Reality (VR)-based *Smart Tourism and Hospitality* learning system as an immersive learning medium to increase student readiness before participating in practicum activities. The research uses a *Research and Development (R&D)* approach through the *Software Development Life Cycle (SDLC)* model with the *Waterfall method* which includes the stages of needs analysis, system design, implementation, testing, and implementation. Needs analysis was carried out through the dissemination of Questioners, interviews, and discussions with lecturers and laboratories of the Hospitality and Travel Study Program. The results of the study show that students need learning media that is able to realistically simulate the work environment of the *Front Office Hotel* and tour guide activities. The prototype developed integrates *scenario-based simulation* and *decision-based learning* approaches so that students gain learning experience before carrying out the practicum directly. The development of this system supports the implementation of the *Smart Laboratory* concept while strengthening digital transformation in tourism vocational education through increasing learning effectiveness, practicum efficiency, and student competency readiness.

Keywords: Immersive learning; Hospitality; Tourist trips; Smart Tourism and Hospitality; Virtual Reality

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INTRODUCTION

Digital transformation has transformed various sectors of life, including the vocational higher education sector. Technological developments ([Asad, Naz, Churi, & Tahanzadeh, 2021](#)) such as *Artificial Intelligence (AI)*, *Internet of Things (IoT)*, *Big Data*, *Augmented Reality (AR)*, and *Virtual Reality (VR)* open up new opportunities in creating a learning environment that is more interactive, adaptive, and centered on student learning experiences ([Buhalis, Lin, & Leung, 2023](#)). In the field of tourism and hospitality education, this transformation is an urgent need considering the characteristics of learning which are dominated by practicum activities and service simulations to tourists and hotel guests.

The Diploma in Tourism Program at the University of Merdeka Malang implements competency-based learning that integrates theory and practice as a provision for students to enter the industrial

world. However, the implementation of pre-practicum learning still faces various obstacles. Students generally do not have a clear picture of the work environment, service flow, operational standards, and forms of interaction that occur in the tourism and hospitality industry. This condition causes students to have difficulties in understanding work procedures when entering laboratories and field practices. These problems are also affected by the limited laboratory facilities, practicum operational costs, limited laboratory use time, and the risk of errors when students practice directly.

The use of Virtual Reality (VR) technology is one of the alternative solutions to bridge the gap between theoretical and practical learning. Virtual Reality is able to present a three-dimensional virtual environment that allows users to interact directly to create an immersive learning experience ([Buhalis, Leung, & Lin, 2023](#)). Various studies show that VR-based learning is able to increase learning motivation, conceptual understanding, decision-making skills, and learning retention compared to conventional methods ([Freina & Ott, 2015](#); [Radianti et al., 2020](#); [Makransky & Petersen, 2021](#)).

On the other hand, the development of the concept of *Smart Tourism* is not only applied to the management of tourist destinations, but also begins to be implemented in the education system through the development of *Smart Laboratories* that integrate digital technology to increase the effectiveness of the learning process. The laboratory no longer functions as a mere place of practice, but has developed into an innovation center capable of providing work simulations based on technology, data, and user experience.

The results of the need identification carried out in the Hospitality Study Program and the Travel Study Program show that lecturers and laboratory staff expect learning media that is able to simulate Hotel Front Office activities and tour guide activities realistically. In addition to presenting visualizations of the work environment, the system is also expected to provide service scenarios, simulations of communication with guests or tourists, decision-making exercises, and evaluation of student performance during the learning process. These findings show that there is a real need for the development of Virtual Reality-based learning media that is in accordance with the characteristics of vocational education.

Although various studies have discussed the use of Virtual Reality in the tourism sector, most of the research still focuses on the promotion of tourist destinations (virtual tourism), digital marketing, and virtual tourism experiences ([Guttentag, 2010](#); [Omran, 2024](#); [Bhakta et al., 2022](#)). Research that integrates the concepts of Smart Tourism, Smart Hospitality, and Virtual Reality as pre-practicum learning media in vocational education is still relatively limited. Furthermore, few studies have specifically addressed the development of VR-based systems for pre-practicum preparation in tourism diploma programs, where students require hands-on experience before entering real laboratory or industry settings ([van der Meulen & de Vries, 2023](#); [Vaishnavi & Ajit, 2024](#)). This gap is significant because vocational education demands immersive learning experiences that conventional methods cannot provide, particularly in developing practical competencies in hospitality and tour guiding. Therefore, this research offers a novelty in the form of the development of a Virtual Reality-based learning system specifically designed to support pre-practicum activities in the Tourism Diploma Program through a scenario-based simulation and decision-based learning approach.

Based on this description, the purpose of this research is to design and develop a prototype of a *Virtual Reality-based Smart Tourism and Hospitality* system as an immersive learning medium to increase student readiness before participating in practicum activities in the Hospitality Study Program and the Travel Study Program. In addition to producing a prototype of the system, this study also aims to identify user needs and analyze the contribution of *Virtual Reality* to increasing the effectiveness of vocational learning in the tourism and hospitality sectors.

METHOD, DATA, AND ANALYSIS

Research Design

This research uses a *Research and Development (R&D)* approach that aims to produce innovative products in the form of *Virtual Reality (VR)*-based learning systems as a pre-practicum learning medium in the Tourism Diploma Program of Merdeka University of Malang. The *R&D* approach was chosen

because the research not only identifies learning problems, but also designs, develops, tests, and evaluates prototype systems that can be implemented in the learning process (Weyant, 2022).

Software development is carried out using *the Software Development Life Cycle (SDLC)* with *the Waterfall* model (Sugiyono, 2018). This model was chosen because it has systematic, documented stages, and is in accordance with the characteristics of the research that already has clearly identified system needs through user needs analysis. In addition, *the Waterfall* approach allows each stage to be validated before entering the next stage, minimizing errors in the system development process (Galvão, Abreu, & de Melo, 2025).

Research Location

The research was carried out at the *Smart Tourism and Hospitality* Laboratory of the Diploma Program in Tourism at the University of Merdeka Malang by involving two study programs, namely the Diploma III Hospitality Study Program and the Diploma III Tourism Travel Study Program.

The laboratory was chosen as the location of the research because it is the center of practicum activities that will utilize *the Virtual Reality* system as a learning medium before students carry out practice directly (Gao, Bozkir, Hasenbein, & Hahn, 2021).

Research Subjects

The research subjects consisted of several user groups that acted as data sources for system needs, namely:

1. Lecturer in Front Office Hotel courses.
2. Lecturer in National and International Guiding courses.
3. Laboratory of the Tourism Diploma Program.
4. Students as prospective users of the system.

The involvement of various user groups aims to obtain the needs of the system from the perspective of academic, laboratory technical, and end users so that the prototype developed is in accordance with the learning needs.

Data Collection Techniques

Data collection is carried out using several techniques to obtain comprehensive information about the needs of Virtual Reality-based learning systems.

1. Observation

Observations were made on the practicum learning process in the Hospitality Study Program and the Travel Study Program. The observation aims to identify laboratory conditions, learning flows, available facilities, and obstacles faced by students before participating in the practicum.

2. Questionnaire

Questioners are used to identify user needs for *Virtual Reality* learning media, carried out in two stages. The first stage aims to determine the level of need for VR-based learning media development in the Tourism Diploma Program. The second stage is carried out using *open-ended questionnaires* to obtain more specific needs regarding the features, scenarios, appearances, and interactions expected in the *Virtual Reality* system.

The analysis of the Questioner's results showed that most of the respondents stated the need for Virtual Reality-based learning media as a means of pre-practicum learning.

3. Interview

Interviews were conducted with lecturers from each Study Program. The interview aims to obtain information about: competencies that must be achieved by students; practicum materials that require simulation; expected learning scenarios; the need for features in the *Virtual Reality* system; evaluation of the *developed prototype*.

4. Documentation

Documentation is carried out on learning documents, Semester Learning Plans (RPS), practicum modules, Standard Operating Procedures (SOP), observation results, and prototype development results to support the analysis process.

Requirement Analysis

The needs analysis stage is carried out based on the results of observations, questioners, interviews, and documentation. The analysis yields two groups of needs, namely functional needs and non-functional needs ([Jagatheesaperumal, Ahmad, Al-Fuqaha, & Qadir, 2024](#)):

1. Functional Requirements

The system must be able to: provide the main menu of the application; display application usage information; provide a simulation of the Front Office Hotel; provide a simulation of Tour Guiding; display VR usage instructions; run a scenario-based simulation; provide an immersive learning experience; enable user interaction with virtual objects; provide communication simulations with tourists and hotel guests; support the evaluation of the learning process.

2. Non-Functional Requirements

The system was developed by paying attention to the following aspects.

- 2.1. *Usability*, the system must be easy to understand by students who have never used Virtual Reality devices.
- 2.2. *Performance*, the application must run stably on the Meta Quest 3 device without experiencing a decrease in performance during the simulation.
- 2.3. *Compatibility*, the system was developed using Unity so that it can be implemented on Android-based VR devices.
- 2.4. *User Interface*, an interface designed to be simple, intuitive, and easy to understand according to the characteristics of users in vocational education.

Software Development Method

The development of the system was carried out using the Waterfall model which consists of five main stages ([Lodhi, Del Gesso, Asif, & Cobanoglu, 2024](#)).

1. Requirement Analysis

The first stage is carried out to identify user needs through observation, interviews, and the dissemination of Questioners. The results of the analysis are used as the basis for the preparation of system requirements specifications.

2. System Design

The design stage includes: system architecture design; application flowchart; Virtual Reality storyboards; interface design; preparation of learning scenarios; simple database design; User navigation. At this stage, learning flows were also prepared for two main simulations, namely Front Office Hotel and Tour Guiding.

3. Coding

The implementation is carried out using Game Engine Unity. This stage includes the construction of a virtual environment, the integration of three-dimensional objects, the programming of user interactions, navigation, and the implementation of learning scenarios.

4. Testing

Testing is carried out through several stages. White Box Testing is used to test program logic and the internal functions of the application. Black Box Testing is used to ensure that each menu and feature runs according to the specifications of the needs. The test was conducted with lecturers, laboratory workers, and students to obtain feedback on the ease of use, interface comfort, and suitability of learning materials.

5. Implementation

The implementation stage is carried out at the *Smart Tourism and Hospitality Laboratory* as a pre-practicum learning medium. Students use *Virtual Reality devices* before entering the practical laboratory so that they have an initial understanding of the practicum operational procedures.

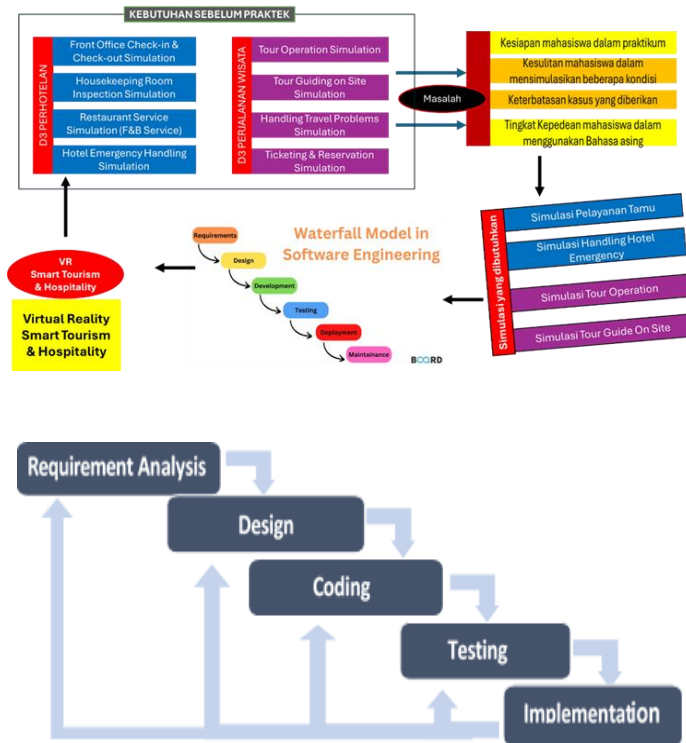


Figure 1: Waterfall Method

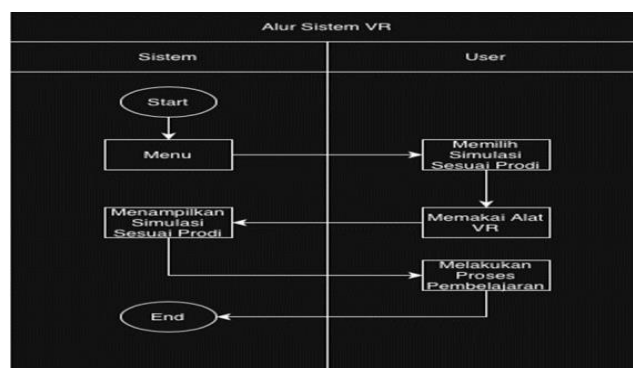


Figure 2: System Flow

RESULTS

Results of Analysis of the Development Needs of Virtual Reality Learning Media

The initial stage of the research is focused on identifying user needs for the development of *Virtual Reality (VR)*-based learning media in the Tourism Diploma Program, Merdeka University of Malang. Needs analysis is carried out through the distribution of Questioners to lecturers involved in the practicum learning process in the Hospitality Study Program and the Travel Study Program.

The results of the analysis showed that the majority of respondents gave a positive assessment of the development of VR-based learning media as a means of pre-practicum learning. Respondents

assessed that VR technology was able to bridge the gap between pre-practicum learning and practicum operations so that students had an overview of the conditions before entering the laboratory.

These findings show that there is a need for learning media that is able to present realistic, interactive, and safe simulations of the work environment without causing practical operational risks.

The analysis of the results of the first stage of the Questioner showed that most of the respondents were in the category of **Agree** and **Strongly Agree** with the implementation of *Virtual Reality* as a learning medium.

Table 1: Recapitulation of Stage I Questioner Results

Category	Quantity
Strongly Disagree	0
Disagree	0
Neutral	0
Agree	44
Strongly agree	16

Based on these results, it can be seen that **100%** of respondents gave a positive response to the development of Virtual Reality-based learning media. There were no respondents who gave neutral answers or rejections of the implementation of the system.

These results show that users have a high level of acceptance of the use of *Virtual Reality* technology in supporting pre-practicum learning.

User Needs Identification Results

After it was known that users accepted the use of VR as a learning medium, the research continued with the deployment of the second stage of Questioner with an *open-ended questionnaire* model to obtain the system needs of each study program involved more specifically. From the second stage of the Questioner, it was obtained:

1. Hospitality Study Program Needs

In the Hospitality Study Program, the main focus is on VR learning media that is able to simulate the operations of *the Front Office Hotel* realistically.

Some of the key needs that were successfully identified include:

Table 2: Identification of VR Needs in Hospitality Study Programs

Aspects	Requirements
User Interface	Simple, easy to understand, attractive
Visualization	Displaying <i>the Front Office Hotel</i> in real condition
Material	Display <i>Front Office equipment</i> and its functions
Simulation	Guest service, <i>check-in</i> , <i>check-out</i> , <i>reservation</i> , evacuation route,
Interaction	Students can interact with virtual guests
Evaluation	Exercises based on case studies
Navigation	More flexible user movement
Information	An explanation is available before the simulation begins

In addition, respondents proposed that the system be able to present service scenarios (*study cases*) based on real conditions that are often encountered in the hotel industry.

2. Needs of the Travel Study Program

In the Travel Study Program, the main need focuses on the system's ability to present a simulation of tour *guide activities* in a tour bus.

Table 3: Identification of VR Needs for the Travel Study Program

Aspects	Requirements
Visualization	Realistic interior of a tourist bus
Environment	The atmosphere of a sightseeing trip on the bus
Simulation	National and International Guides
Interaction	Communication with virtual tourists
Skenario	Questions and answers from tourists
Navigation	Students can move around on the bus
Language	Support communication exercises
User Interface	Simple and easy to use

Respondents also expect the system to provide experiences such as being a real *tour guide* through simulated communication with tourists so that students can practice their speaking skills, conveying information, and making decisions during the guiding process.

Prototype Design Results

Based on the results of identifying user needs, a prototype of a Virtual *Reality-based Smart Tourism and Hospitality* learning system was developed ([Leung, Zulkernine, & Isah, 2018](#)). The prototype consists of eight main menus that are integrated with each other.

Tabel 4: Fitur Prototype *Smart Tourism and Hospitality*

Menu	Function
Loading Screen	Loading system
Main Menu	Main navigation
Information	Application information
Select Simulation	Choose a learning scenario
VR Front Office	Hotel Front Office Simulation
VR Tour Guiding	Tour Guide Simulation
How to Use	VR usage guide
Exit	Exit the app

Prototype development using *the Unity Game Engine*.

Prototype Implementation Results

The prototype developed successfully integrated two main learning scenarios, namely *the Front Office Hotel* simulation and *the Tour Guiding* simulation.

In the *Front Office simulation*, students can get to know the work environment, equipment, guest service procedures, and interact with virtual objects before carrying out the practicum.

Meanwhile, in the *Tour Guiding* simulation, students gained experience in guiding tourists in the tour bus through the delivery of tourist information, *opening & closing*, and getting to know the interior of the tour bus.

The implementation of these two scenarios shows that the system is able to provide a learning experience that ([Bennett, Borg, & Gall, 1984](#)) resembles the actual practicum conditions so that students gain an initial understanding before entering practicum activities.

System Test Results

Testing is carried out through two stages, namely *White Box Testing* and *Black Box Testing*

Table 5: Summary of Test Results

Types of Testing	Results
<i>White Box Testing</i>	All program functions run according to system logic
<i>Black Box Testing</i>	All menus and features work well

In general, the test results show that the system has met the needs of the users both from the functional and the interface aspects. Users consider the application to be easy to understand, simple navigation, and able to provide a more interesting learning experience.

Summary of Research Results

Based on the overall results of the study, it can be concluded that the development of *Smart Tourism and Hospitality Design and Construction Through Virtual Reality as an Immersive Learning Experience* has succeeded in producing a prototype of immersive learning media that is in accordance with the needs of the Hospitality Study Program and the Travel Study Program. Needs analysis shows that users want systems that are realistic, easy to use, and support scenario-based learning. The prototype developed has accommodated these needs through an interactive *Front Office Hotel* simulation and *Tour Guiding* so that it has the potential to increase student readiness before participating in practicum activities.

DISCUSSION

The results of the study show that the development of *Virtual Reality (VR)*-based learning media in the Tourism Diploma Program obtained a very high acceptance rate from users. All respondents expressed their agreement or strongly agree with the implementation of VR as a pre-practicum learning medium. These findings indicate that the need for immersive technology-based learning in tourism and hospitality vocational education is already at a real and urgent stage ([Talwar, Kaur, Nunkoo, & Dhir, 2023](#)).

The high level of user acceptance can be explained through the characteristics of vocational learning that emphasizes hands-on experience (*learning by doing*). In conventional learning methods, students often only gain practical experience when entering laboratories or industries so that their understanding of work procedures and service standards is still limited. The use of VR allows students to gain initial experience in a safe and controlled environment before undertaking real practice. This finding is in line with the research of [Guttentag \(2010\)](#) who stated that VR is able to create realistic environmental simulations thus improving users' understanding and practical skills.

The analysis of user needs shows that there is a difference in focus between the Hospitality Study Program and the Travel Study Program. The Hospitality Study Program emphasizes the need to simulate the operational procedures of the *Front Office Hotel* such as *check-in*, *check-out*, reservation, and guest handling, while the Travel Study Program emphasizes more on simulating communication and tour guidance in the tourism bus. These differences show that the development of VR systems in vocational education needs to consider the characteristics of the competencies of each study program so that the simulations produced are relevant to learning outcomes.

The developed prototype integrates *scenario-based simulation* and *decision-based learning* approaches. This approach allows students not only to follow predetermined procedures, but also to be faced with service situations that require decision-making. The integration of these two approaches is one of the main contributions of this research because most VR applications in the tourism sector still focus on destination promotion or virtual tourism experiences, rather than on competency-based pre-practicum learning ([Maryanto, Buchori, Zhannisa, & Wibisana, 2024](#)).

From the perspective of *Smart Tourism* and *Smart Hospitality*, the system developed supports the transformation of laboratories towards the Smart Laboratory concept ([Ngelambong, A. Kibat, Wong, & Abdullah, 2024](#)). Laboratories no longer function only as a place of physical practice, but also as a digital learning ecosystem integrated with simulation, data, and learning evaluation technologies. This concept is in line with the thinking of [Gretzel et al. \(2015\)](#) and [Koo et al. \(2017\)](#) who emphasize the importance of integrating digital technology to improve the quality of user experience and operational efficiency.

In addition to improving the quality of learning, the use of VR also has the potential to provide operational benefits (["Software engineering: A practitioner's approach," 1983](#)). Virtual simulations can reduce the need for repeated use of laboratory facilities at the orientation stage, reduce the risk of equipment damage due to beginner errors, and allow students to practice independently before entering the practicum session ([Parong & Mayer, 2018](#)). Thus, the implementation of VR not only has an impact on improving student competence, but also on the efficiency of laboratory management.

However, this study still has some limitations. First, testing of new systems is carried out at the prototype stage and does not yet include long-term implementation in the regular learning process ([Shen, Xu, Sotiriadis, & Wang, 2022](#)). Second, the research has not conducted quantitative measurements on improving student learning outcomes through experimental design. Third, the number of respondents at the needs analysis stage is still limited to the Tourism Diploma Program of the Merdeka University of Malang. Therefore, further research needs to be carried out by involving more institutions, applying *pretest-posttest experimental designs*, and measuring the impact of VR on the cognitive, psychomotor, and affective aspects of students more comprehensively ([Zhao, Ren, & Cheah, 2023](#)).

CONCLUSION

This research successfully designed and developed a prototype of a *Virtual Reality-based Smart Tourism and Hospitality* system as an immersive learning medium at the pre-practicum stage of the Diploma Program in Tourism at the University of Malang ([Pezzè et al., 2025](#)). The needs analysis shows that users need learning media that is able to simulate the work environment of *the Front Office Hotel* and tour guide activities in a realistic, interactive, and easy-to-use manner.

The prototype developed integrates scenario-based simulation and decision-making learning so that students can gain a learning experience that is close to real working conditions before carrying out the practicum. The test results show that all system functions are running well and users rate the application according to learning needs ([Zhao et al., 2023](#)).

Theoretically, this research contributes to the development of VR-based immersive learning concepts in the context of tourism and hospitality vocational education. Practically, the system developed has the potential to increase learning effectiveness, efficiency of laboratory use, improve practicum operational safety and student readiness before entering the practicum. Further research is suggested to test the effectiveness of the system through experimental design and implementation on a wider scale ([Alsharif, Isa, & Alqudah, 2024](#)).

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REFERENCES

- Alsharif, A., Isa, S. M., & Alqudah, M. N. (2024). Smart Tourism, Hospitality, and Destination: A Systematic Review and Future Directions. *Journal of Tourism and Services*. <http://doi.org/10.29036/jots.v15i29.746>
- Asad, M. M., Naz, A., Churi, P., & Tahanzadeh, M. M. (2021). Virtual Reality as Pedagogical Tool to Enhance Experiential Learning: A Systematic Literature Review. *Education Research International*. <http://doi.org/10.1155/2021/7061623>
- Bennett, N., Borg, W. R., & Gall, M. D. (1984). Educational Research: An Introduction. *British Journal of Educational Studies*. <http://doi.org/10.2307/3121583>
- Buhalis, D., Leung, D., & Lin, M. (2023). Metaverse as a disruptive technology revolutionising tourism management and marketing. *Tourism Management*. <http://doi.org/10.1016/j.tourman.2023.104724>
- Buhalis, D., Lin, M. S., & Leung, D. (2023). Metaverse as a driver for customer experience and value co-creation: implications for hospitality and tourism management and marketing. *International Journal of Contemporary Hospitality Management*. <http://doi.org/10.1108/IJCHM-05-2022-0631>
- Galvão, A., Abreu, F. B., & de Melo, J. J. (2025). Toward a Consensual Definition for Smart Tourism and Smart Tourism Tools. In *Smart Life and Smart Life Engineering: Current State and Future Vision*. http://doi.org/10.1007/978-3-031-75887-4_8
- Gao, H., Bozkir, E., Hasenbein, L., & Hahn, J. U. (2021). Digital transformations of classrooms in virtual reality. In *Conference on Human Factors in Computing Systems - Proceedings*. <http://doi.org/10.1145/3411764.3445596>
- Jagatheesaperumal, S. K., Ahmad, K., Al-Fuqaha, A., & Qadir, J. (2024). Advancing Education Through Extended Reality and Internet of Everything Enabled Metaverses: Applications, Challenges, and Open Issues. *IEEE Transactions on Learning Technologies*. <http://doi.org/10.1109/TLT.2024.3358859>
- Leung, T., Zulkernine, F., & Isah, H. (2018). The use of virtual reality in enhancing interdisciplinary research and education. In *IMSCI 2018 - 12th International Multi-Conference on Society, Cybernetics and Informatics, Proceedings*.
- Lodhi, R. N., Del Gesso, C., Asif, M., & Cobanoglu, C. (2024). EXPLORING VIRTUAL AND AUGMENTED REALITY IN THE HOSPITALITY INDUSTRY: A BIBLIOMETRIC ANALYSIS. *Tourism and Hospitality Management*. <http://doi.org/10.20867/thm.30.1.6>
- Maryanto, Buchori, A., Zhannisa, U. H., & Wibisana, M. I. N. (2024). Design Virtual Tour Technology Application to Improve Digital Literacy of Teachers and Students About Edu-tourism. *JST (Jurnal Sains Dan Teknologi)*. <http://doi.org/10.23887/jstundiksha.v13i2.83962>
- Ngelambong, A., A. Kibat, S., Wong, S. F., & Abdullah, D. (2024). Conceptualizing Extended Reality Metaverse-based Pedagogy Model: A Hospitality and Tourism Education Perspective. *Information Management and Business Review*. [http://doi.org/10.22610/imbr.v16i3\(i\)s.3957](http://doi.org/10.22610/imbr.v16i3(i)s.3957)
- Parong, J., & Mayer, R. E. (2018). Learning science in immersive virtual reality. *Journal of Educational Psychology*. <http://doi.org/10.1037/edu0000241>
- Pezzè, M., Abrahão, S., Penzenstadler, B., Poshyanyk, D., Roychoudhury, A., & Yue, T. (2025). A 2030 Roadmap for Software Engineering. *ACM Transactions on Software Engineering and Methodology*. <http://doi.org/10.1145/3731559>
- Shen, S., Xu, K., Sotiriadis, M., & Wang, Y. (2022). Exploring the factors influencing the adoption and usage of Augmented Reality and Virtual Reality applications in tourism education within the context of COVID-19 pandemic. *Journal of Hospitality, Leisure, Sport and Tourism Education*.

<http://doi.org/10.1016/j.jhlste.2022.100373>

Software engineering: A practitioner's approach. (1983). *Advances in Engineering Software* (1978).
[http://doi.org/10.1016/0141-1195\(83\)90118-3](http://doi.org/10.1016/0141-1195(83)90118-3)

Sugiyono. (2018). Educational Research Methods Quantitative, Qualitative, and R&D Approaches. *Alfa Beta*.

Talwar, S., Kaur, P., Nunkoo, R., & Dhir, A. (2023). Digitalization and sustainability: virtual reality tourism in a post pandemic world. *Journal of Sustainable Tourism*.
<http://doi.org/10.1080/09669582.2022.2029870>

Weyant, E. (2022). Research Design: Qualitative, Quantitative, and Mixed Methods Approaches, 5th Edition. *Journal of Electronic Resources in Medical Libraries*.
<http://doi.org/10.1080/15424065.2022.2046231>

Zhao, X., Ren, Y., & Cheah, K. S. L. (2023). Leading Virtual Reality (VR) and Augmented Reality (AR) in Education: Bibliometric and Content Analysis From the Web of Science (2018–2022). *SAGE Open*. <http://doi.org/10.1177/21582440231190821>