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Enhancing Distance Learning through Immersive Technologies: Integration of Augmented and Virtual Reality in Higher Education

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Abstract: *This study investigates the integration of Augmented Reality (AR) and Virtual Reality (VR) in distance learning to enhance student engagement and comprehension in higher education. Employing a Research and Development (R&D) design guided by the ADDIE model, the research was conducted at four Indonesian universities. In the analysis stage, data were gathered from students and lecturers to identify learning challenges. Based on this, AR/VR-based modules were designed and implemented, particularly in zakat-related subjects. The results showed significant improvements in student motivation and understanding, with post-intervention test scores rising notably. Students experienced a more immersive and interactive environment, enabling flexible and context-rich learning. The study also highlights the importance of faculty training, infrastructure readiness, and continuous evaluation to ensure successful implementation. Findings support theories such as Dual Coding, Experiential Learning, and Constructivism, indicating that AR and VR can transform distance learning into more effective, inclusive, and student-centered experiences.*

Abstrak: Penelitian ini mengkaji integrasi teknologi Augmented Reality (AR) dan Virtual Reality (VR) dalam pembelajaran jarak jauh untuk meningkatkan keterlibatan dan pemahaman mahasiswa di pendidikan tinggi. Menggunakan pendekatan Research and Development (R&D) dengan model ADDIE, studi ini dilakukan di empat perguruan tinggi Indonesia. Pada tahap analisis, data dikumpulkan dari mahasiswa dan dosen untuk mengidentifikasi tantangan belajar. Modul berbasis AR/VR dikembangkan dan diterapkan, khususnya pada materi zakat. Hasilnya menunjukkan peningkatan signifikan dalam motivasi dan pemahaman siswa, dengan skor tes pasca-intervensi yang meningkat. Teknologi ini menciptakan lingkungan belajar yang imersif dan interaktif, memungkinkan pembelajaran yang lebih fleksibel dan kontekstual. Studi ini juga menekankan pentingnya pelatihan dosen, kesiapan infrastruktur, dan evaluasi berkelanjutan untuk keberhasilan implementasi. Temuan mendukung teori Dual Coding, Pembelajaran Pengalaman, dan Konstruktivisme, menunjukkan bahwa AR dan VR dapat mentransformasi pembelajaran jarak jauh menjadi lebih efektif, inklusif, dan berpusat pada siswa.

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INTRODUCTION

The rapid advancement of educational technology has led to the integration of immersive tools such as Augmented Reality (AR) and Virtual Reality (VR) in distance learning. These technologies have gained attention due to their ability to enhance learning experiences by providing interactive and engaging environments. As digital learning environments evolve, AR and VR offer new possibilities for simulating real-world scenarios, making education more dynamic and accessible for students in remote settings.

Incorporating AR and VR into distance learning has become increasingly relevant due to their potential to improve student engagement, motivation, and knowledge retention. These technologies create experiential learning opportunities, allowing students to interact with digital content in a more meaningful way. Given the growing demand for effective digital learning methods, the use of AR and VR presents a promising approach to addressing some of the challenges in remote education.

Recent studies have highlighted the effectiveness of AR and VR in enhancing learning experiences. Research suggests that AR supplements traditional learning materials by providing interactive digital overlays, while VR enables simulated experiences that mimic real-world interactions (Tene et al., 2024). Additionally, the combination of these technologies has been found to improve knowledge acquisition and skill development, making them valuable tools for educational settings (Familoni & Onyebuchi, 2024). Scholars have also emphasized the need for structured implementation strategies to ensure that these technologies align with pedagogical objectives (Shevchuk et al., 2023; Schwaiger et al., 2024).

Despite the growing body of research on AR and VR in education, there remains a lack of comprehensive studies focusing on their application in distance learning at higher education institutions in Indonesia. While previous research has explored the general benefits of immersive learning technologies, specific investigations into their implementation strategies in remote learning environments remain limited. Additionally, the perspectives of educators regarding the adoption of AR and VR in university-level distance education require further examination.

This study distinguishes itself from prior research by focusing specifically on the integration of AR and VR in distance learning at at 4 colleges, East Java. Unlike previous studies that primarily discuss the benefits of these technologies, this research investigates practical strategies for implementing AR and VR to create immersive learning experiences in a university setting. The study aims to explore how these technologies can be effectively integrated into the learning process to maximize their potential for student engagement and educational outcomes.

By examining the practical application of AR and VR in distance learning, this research extends existing discussions on immersive education. The findings provide insights into how these technologies can be integrated into university curricula to enhance student engagement and learning outcomes. Moreover, understanding the

implementation strategies offers educators a framework for incorporating AR and VR in remote teaching environments.

The outcomes of this research contribute to the broader field of educational technology by providing empirical evidence on the role of AR and VR in distance learning. The study's findings inform educators, instructional designers, and policymakers about effective ways to leverage immersive learning tools in higher education. Additionally, the research contributes to ongoing discussions on digital pedagogy and the future of technology-enhanced learning in remote settings. Thus, the research questions in this study are as follows: (1) How can the use of Augmented Reality (AR) technology combined with Virtual Reality (VR) create an immersive learning experience in distance learning at Trunojoyo University, East Java? (2) What are the strategies for implementing immersive learning using Augmented Reality (AR) combined with Virtual Reality (VR) in a distance learning at Trunojoyo University, East Java?

METHOD

Research Design

This research uses the Research and Development (R&D) model with the ADDIE approach which consists of five stages: Analysis, Design, Development, Implementation and Evaluation. At the Analysis stage, researchers identified the needs and challenges faced by students and lecturers in distance learning (Shakeel et al., 2023). Each stage plays a crucial role in the overall project development process. The subsequent phases of this development are outlined clearly in Figure 1 and Table 1.

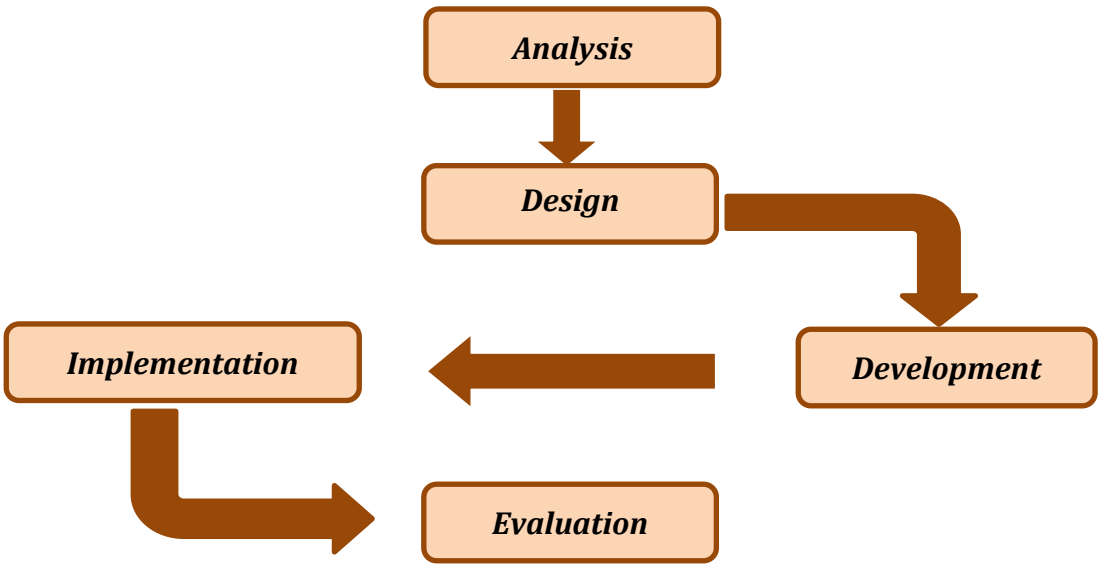

Figure 1. Research Stages

Table 1. The Steps of Research Process

STEPS	ACTIVITIES		RESULTS	INDICATORS
	Process	Details		
Pre-research	Analysis	Needs analysis (curriculum)	Learning outcomes to be researched	Measurable and specific learning outcomes
		Needs analysis (students)	Student profile, learning styles and abilities	Target students according to stages in the curriculum
		Needs analysis (materials)	Technology integrated into learning materials	Learning materials can be integrated with AR & VR
Research process	Design	Syntax	Lesson plan	Success of the learning process
		Prototype	Outline learning module	Organized module structure
	Development	Development of teaching material content	Material content in the form of text, images, video, audio and sources Other Learning Resources	AR & VR integration in modules
	Implementation	Planning	implementation of Identification time, location, and source Required power	Definition teachers, students to that module will be used
		Validation	Revision	Revised
	Evaluation	The effectiveness of evaluation	Product (module)	Final product

Participants

Participants in this research consisted of 200 students from four universities in Indonesia, namely Trunojoyo University, Nahdlatul Ulama Sunan Giri University, Nahdlatul Ulama University Surabaya, and Al Khoziny Islamic Institute. They were chosen randomly from various study programs and levels of education at each

university. All participants have experience in distance learning and will be involved in experiments testing the use of Augmented Reality (AR) and Virtual Reality (VR) technologies to evaluate their impact on their learning experience.

Data Collection

Data collection techniques in this research were carried out through several methods, namely interviews, expert and teacher questionnaires, and field trials (Toni & Sudin, 2024). During the interview, an interview guide with deep interview techniques was used to explore more in-depth information regarding the experiences and opinions of the respondents. Expert and teacher questionnaires were used to assess the feasibility of module products based on AR technology, with a focus on aspects of content, language, audio and visualization of the material. The expert test questionnaire contains questions related to the quality of content and technical elements, while the practitioner test questionnaire focuses on the suitability of the module in supporting the achievement of learning objectives. After receiving input from experts and practitioners, the product was then revised and tested at four campuses in Indonesia, namely Tunojoyo University, to see the effectiveness and user response to the learning.

Data Analysis

The analysis stage in this research is a crucial first step, where researchers identify and understand students' needs and the challenges they face in learning zakat fitrah and the profession. In this phase, researchers collect data through various methods, such as surveys, interviews and observations, to get a comprehensive picture of existing learning conditions (Taqwa & Raupu, 2022). Through this analysis, researchers can evaluate how zakat material is currently delivered and identify aspects that need to be improved, such as the level of student engagement and understanding of concepts. Apart from that, the analysis stage also involves literature studies to understand the latest developments in educational technology, especially in the use of AR and VR. This helps researchers to formulate clear and specific goals in developing the learning media that will be created. By understanding student needs and learning contexts, researchers can design more targeted solutions.

RESULT AND DISCUSSION

RESULT

Immersive Learning Experiences in Distance Learning

The research findings show the positive influence of using Augmented Reality (AR) and Virtual Reality (VR) technology in creating immersive learning experiences in the context of distance learning at Trunojoyo University, Indonesia. Evaluations on AR modules combined with VR in teaching Zakat Fitrah and Profession material confirm their effectiveness. Material experts rated them 83.7%, while media experts gave 81%, indicating high educational quality and media effectiveness. These results highlight how AR and VR can enrich learning in an interactive and engaging way.

Student feedback also demonstrated significant improvements in engagement and understanding. The trial class provided an 86% rating, and a larger student group rated it 81.6%, averaging 83.1%. This suggests AR and VR technology has great potential for distance learning, especially for contextual and practical subjects like Zakat Fitrah and Profession. Interactive elements in learning materials enable students to participate actively rather than passively receiving information. For instance, in studying Zakat Fitrah, students can engage in zakat calculations through AR and VR simulations, improving their comprehension of real-world applications.

Additionally, AR and VR enhance engagement by offering immersive experiences. Students become emotionally and cognitively involved, moving beyond theoretical learning to directly experiencing concepts. This heightened interactivity increases motivation, focus, and overall comprehension. AR and VR create a dynamic learning environment, positively impacting student learning outcomes.

Besides fostering interactivity, AR and VR reduce common distance learning limitations, particularly those related to geography and time constraints. Students in remote areas gain equal access to learning experiences comparable to their on-campus peers. This technology enables students in different locations to access the same virtual materials, ensuring equitable education regardless of physical distance.

AR and VR also address time constraints in distance learning. Students can access materials anytime, providing flexibility in learning. Simulations allow learners to study at their own pace, making it easier for busy students to keep up with coursework. By offering a flexible and inclusive learning environment, AR and VR help overcome barriers of distance and time.

Test results after using AR and VR modules showed a significant improvement in student comprehension, with scores rising to an average of 86. These modules not only present content interactively but also integrate simulations that make zakat-related processes more tangible. At Trunojoyo Madura University, Nahdlatul Ulama University Surabaya, Nahdlatul Ulama Sunan Giri University, and Al Khoziny Islamic Religious Institute, students displayed greater enthusiasm and involvement.

Figure 2 below shows a comparison of the average test score between conventional modules and AR and VR-based modules. The average score before the use of AR and VR modules (72) was compared to the average score after implementation (86). This figure illustrates a significant improvement in student test results, confirming the effectiveness of AR and VR technology in enhancing understanding and learning outcomes.

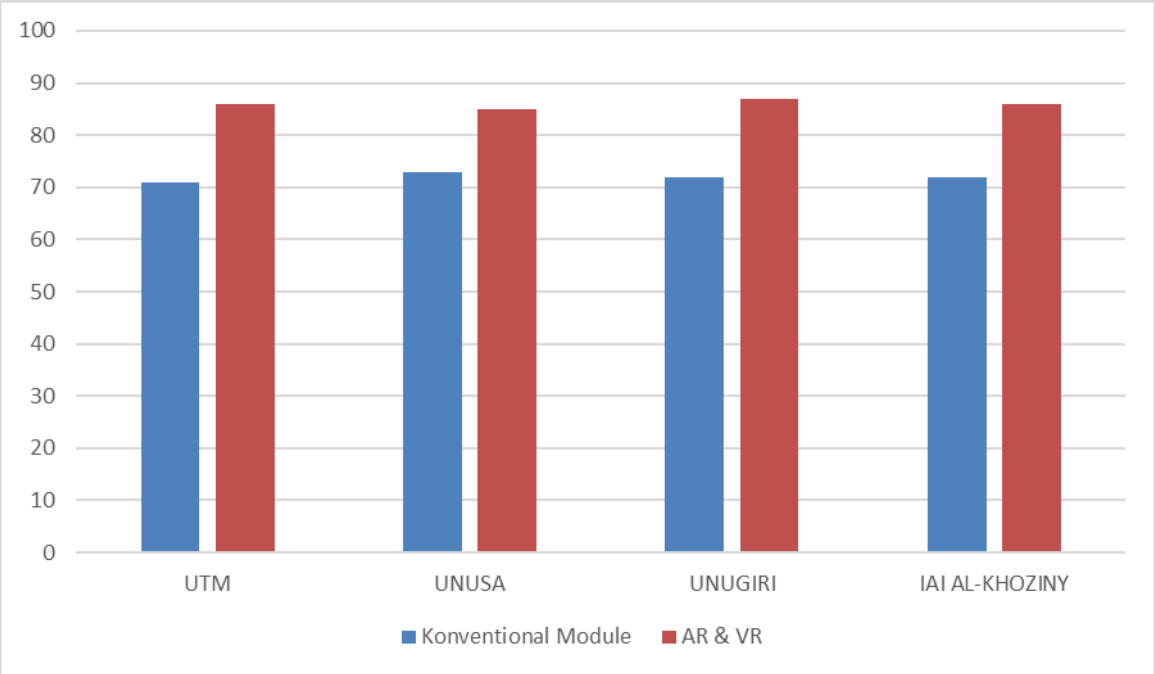

Figure 2. Student Learning Test Results

Strategies for Implementing Immersive Learning in Distance Learning

This research found that curriculum design that is integrated with Augmented Reality (AR) and Virtual Reality (VR) technology can increase learning effectiveness by creating a more immersive and interactive experience. In developing an AR and VR-based curriculum, each learning material needs to be adapted to the needs of the technology, so that learning becomes more focused and easier to understand. This technology allows students to interact with educational content directly, enriching learning experiences that were previously limited by time and space constraints. For example, in subjects such as zakat fitrah and zakat mal, students can use VR to conduct simulation experiments, allowing them to understand these concepts in more depth without having to rely on limited physical resources.

Apart from that, this research also shows that the use of AR and VR in learning can reduce practical obstacles that are usually encountered in conventional education. For example, experiments or simulations that require high costs or are difficult to access in the real world, can be easily carried out using this technology. This provides opportunities for students to develop practical skills in a safer and more controlled context. Thus, integrating AR and VR in curriculum design not only enriches the learning experience, but also opens up new opportunities to improve the quality of learning, especially in material that requires complex understanding or hands-on experience.

Furthermore, the success of integrating AR and VR technology in the learning process is very dependent on the lecturer's readiness to operate and utilize the technology. Lecturers need to be intensively trained to understand how to design immersive and effective learning experiences, as well as manage AR/VR devices well. This training includes not only technical skills, but also the ability to create an interactive learning environment and support maximum student engagement. Apart

from that, lecturer training must also focus on developing teaching strategies that utilize this technology, so that it can improve learning outcomes significantly.

This research shows the importance of organizing special training programs for lecturers in order to facilitate the development of their competence in the use of AR and VR, especially in the distance learning context. With the right training, lecturers will be better prepared to optimally integrate this technology into their curriculum. This training program needs to be tailored to the specific needs of lecturers and the material being taught, so that the resulting learning experience is more relevant and effective. With developed competencies, lecturers can provide more interesting and useful learning experiences for students, which will ultimately improve the quality of education in the digital era.

The use of AR and VR technology in education requires supporting facilities and infrastructure so that its implementation can run effectively and optimally. One of the main components is appropriate hardware, such as a VR headset (e.g. VR Box or Oculus), as well as a mobile device or computer that supports AR, such as a smartphone or tablet with high graphics processing capabilities. In addition to hardware, compatible software is also very important, including applications or platforms that can support AR and VR-based learning, such as Unity, Unreal Engine, or learning-specific applications that integrate these technologies. Without these facilities, the desired immersive learning experience cannot be achieved, and teaching will be limited by technological limitations.

This research also found that ongoing evaluation of AR and VR-based learning is essential to ensure the effectiveness of its implementation. After implementing this technology in the teaching and learning process, collecting feedback from students and lecturers becomes key in assessing the extent to which this technology contributes to students' understanding and skills. This feedback provides valuable insight into aspects that need improvement, both from a technical (e.g., device and application compatibility) and pedagogical (such as teaching methods and interactions in simulations) perspective. By conducting continuous evaluations, teachers can identify obstacles or shortcomings in the learning experience and make necessary adjustments so that AR and VR-based learning can be more optimal in the future.

In addition, the findings of this research also show that the evaluation and feedback collected are not only useful for improving technical aspects, but also for developing better implementation strategies in distance and conventional learning. This process allows faculty to understand students' perceptions of the new technology, whether they feel more engaged and benefit significantly from this immersive experience. Regular evaluations help create a learning environment that is more responsive to student needs, which can ultimately improve the overall quality of learning. Thus, evaluation and feedback play an important role in optimizing the use of AR and VR as innovative learning aids.

DISCUSSION

AR & VR Create Immersive Learning Experiences in Distance Learning

The implementation of Augmented Reality (AR) and Virtual Reality (VR) in distance learning, as revealed in this study, has shown a significant impact on enhancing the quality and depth of students' learning experiences. One of the key enabling factors is the availability of adequate supporting infrastructure, particularly fast and stable internet connections (Asio et al., 2021), which are indispensable for the seamless delivery of AR/VR content that requires high data transmission in real time. The physical environment also plays a crucial role, especially for VR-based activities, which demand spacious and distraction-free areas to ensure safe and effective interaction.

Moreover, the successful integration of AR and VR is closely tied to users' readiness, both lecturers and students must receive targeted technical training. This training enables effective device utilization, minimizes technological barriers, and maximizes pedagogical impact. When the infrastructure and user competence are aligned, immersive learning becomes a reality that supports a more holistic educational experience, thereby contributing to overall education quality improvement.

These findings resonate with Dual Coding Theory (Mir et al., 2023), which underscores the cognitive advantage of delivering information through both visual and verbal channels. Through AR and VR, students not only read or hear theoretical concepts but also interact directly with virtual simulations. In the context of zakat learning, for example, students are able to visualize and practice zakat calculations in real-life-like scenarios (Radianti et al., 2020), increasing comprehension and long-term memory retention (Huang & Musah, 2024).

In alignment with Experiential Learning Theory (Healey & Jenkins, 2000; Kolb, 1984), this study affirms that AR/VR fosters learning through direct and meaningful experiences. By "doing" rather than merely observing, students develop deeper conceptual understandings and apply their learning to real-life contexts, especially in complex topics like *Zakat Fitrah* and *Zakat Profesi*. The simulation-based nature of VR supports experiential cycles of concrete experience, reflective observation, abstract conceptualization, and active experimentation.

Further, this immersive learning experience is deeply grounded in Constructivist Theory (Chand, 2023), which emphasizes active, contextual knowledge construction. Through AR and VR, students are no longer passive recipients but become participants in dynamic learning environments. When zakat is taught through AR-enabled interfaces, students engage in simulations that replicate real-world donation scenarios, thereby enabling the internalization of abstract concepts through authentic application (Guerra-Tamez, 2023).

The study also finds that these technologies significantly influence intrinsic student motivation, as elaborated by Self-Determination Theory (Dunn & Zimmer, 2020). Learners experience autonomy in navigating simulations, competence from mastering challenges, and relatedness when interacting collaboratively, fulfilling the

three essential psychological needs that drive motivation. This emotional engagement translates into more sustained and meaningful learning behaviors.

From a sociocultural perspective, rooted in Vygotsky's Zone of Proximal Development (ZPD) (Hakkarainen & Bredikyte, 2008), AR and VR mitigate geographical disparities by offering remote learners access to experiences equal to those in physical classrooms. This democratizes education and supports equitable learning opportunities, as students from underserved areas can engage with the same interactive modules as their urban counterparts. Such findings support broader policy directions toward inclusive, technology-based education (Yu et al., 2013).

Complementarily, the study's results align with Self-Directed Learning Theory (Loeng, 2020). AR and VR enable learners to explore content asynchronously and independently, adjusting pace and depth according to personal needs. This flexibility not only accommodates diverse learning styles but also empowers learners to take ownership of their educational journeys, which in turn enhances academic performance and lifelong learning attitudes.

Strategies for Implementing Immersive Learning Using AR Combined with VR in Distance Learning

The integration of AR and VR in distance education must be guided by structured pedagogical strategies. In line with Constructivism and Experiential Learning Theory (Sharma & Shukla, 2023; Kolb, 1984), educators must design simulations and experiences that reflect real-world relevance and facilitate active knowledge construction. This approach transforms passive content delivery into active, inquiry-driven exploration, equipping students with both conceptual understanding and practical skills.

A salient aspect of this research is the emphasis on overcoming economic and physical barriers (Haleem et al., 2022). Through immersive technologies, high-cost or location-dependent experiences, such as religious or vocational simulations, can be replicated virtually. This not only reduces inequities but also broadens the educational horizons of students across diverse socioeconomic backgrounds.

Crucially, the Technology Readiness in Education framework, particularly the TPACK model (Schmidt et al., 2014), is foundational for successful implementation. Lecturers must balance their mastery of content, pedagogy, and technology to effectively facilitate AR/VR-based instruction. Therefore, ongoing professional development and training are essential. Such training should cover technical operations, scenario design, and methods to foster engagement through interactive media.

The findings also support Active Learning Theory (Li et al., 2023; Bonwell & Eison), reinforcing the need for student-centered activities in which learners are cognitively and emotionally engaged. AR and VR can serve as mediums for case-based learning, problem-solving, and collaborative projects, which promote higher-order thinking and knowledge retention.

However, the technical feasibility of immersive learning also depends on the availability of adequate infrastructure. As highlighted by Buabeng-Andoh (2012), a proper match between educational technology and context is essential. Hardware such as VR headsets, high-performance mobile devices, and compatible software like Unity or Unreal Engine, along with reliable internet connections and suitable spatial environments (Talbert & Mor-Avi, 2019), must be ensured.

Furthermore, the study underlines the importance of continuous evaluation and formative assessment (Scriven; Dede et al., 2017). These evaluations ensure instructional effectiveness, identify barriers, and guide adaptive improvements. Feedback loops also align with Kirkpatrick's Four-Level Evaluation Model, addressing user satisfaction (reaction), learning gains, behavioral application, and long-term results. Regular assessment thus ensures that immersive tools truly serve pedagogical goals and enhance learning outcomes.

In conclusion, the results affirm that AR and VR, when supported by pedagogically sound strategies, adequate infrastructure, trained educators, and responsive evaluation mechanisms, can transform distance learning into a dynamic, inclusive, and impactful educational experience.

This study presents a significant novelty by integrating Augmented Reality (AR) and Virtual Reality (VR) technologies into Islamic education, specifically in teaching *Zakat Fitrah* and *Professional Zakat* within higher education institutions in Indonesia. Unlike prior studies that predominantly focused on science and engineering disciplines, this research explores immersive technologies in religious and contextual learning domains. It further contributes by comprehensively applying and validating a combination of educational theories (Dual Coding, Experiential Learning, Constructivism, Self-Determination Theory, and Self-Directed Learning) in the context of distance learning. The systematic application of the ADDIE model throughout all research phases (analysis, design, development, implementation, and evaluation) also offers a robust methodological contribution to the field of educational technology research.

In terms of contribution, this study advances theoretical discourse by extending the applicability of classical learning theories to immersive and digital contexts that are both local and contextual. Practically, the findings provide a strategic framework for higher education institutions to implement AR/VR-based learning, covering critical components such as infrastructure readiness, faculty training, and pedagogically aligned content development. Furthermore, the study offers empirical evidence for policymakers to consider immersive technologies as part of transformative strategies in distance education, emphasizing the importance of equitable access, learning flexibility, and the effectiveness of experiential, student-centered learning.

CONCLUSION

The results of this research show that the use of AR and VR technology in education can increase learning effectiveness by creating a more immersive and interactive experience. Based on Dual Coding theory, the use of AR and VR allows

students to process information visually and verbally simultaneously, which deepens their understanding of the material. This technology also supports Experiential Learning theory, which emphasizes the importance of direct involvement in learning experiences to increase contextual understanding. In Zakat material case studies, AR and VR have been proven to help students understand complex concepts in a more practical and realistic way, creating a more meaningful and in-depth learning experience.

The use of AR and VR in learning is in line with Constructivism theory, which emphasizes the importance of direct experience in building knowledge. This technology gives students the opportunity to be actively involved in learning by simulating real situations that are relevant to the material being studied. For example, the use of AR in Zakat learning not only teaches theory, but allows students to directly experience situations that illustrate the application of zakat. This increases student engagement and helps them link theory to practice, supporting deeper and more contextual learning.

Implementing AR and VR technology in learning requires lecturers' readiness to operate this technology effectively. Based on the Technological Pedagogical Content Knowledge (TPACK) theory, lecturers need to master a balance between technological knowledge, pedagogy and content to ensure that technology can be used optimally in educational contexts. Therefore, training lecturers in technical skills and developing immersive learning experiences is essential to maximize the potential of AR and VR in improving the quality of education. In addition, Active Learning theory underlines the importance of student involvement in active learning, which can be obtained through the use of AR and VR as tools that enable students to be more active in the learning process.

Apart from lecturer training, the implementation of AR and VR also requires support from adequate facilities and infrastructure, such as appropriate hardware and software. The availability of Learning Infrastructure shows that the success of technology integration in education is very dependent on the suitability of devices to learning needs. AR and VR require hardware such as VR headsets and mobile devices with high graphics capabilities, as well as compatible software to support the learning experience. The infrastructure must also include a fast and stable internet connection and sufficient space to support an optimal VR experience. Without the right facilities, this technology will not provide maximum benefits and can limit the effectiveness of AR and VR-based learning.

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