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TRANSFORMING MICROTEACHING WITH VIRTUAL REALITY: IMPACTS ON PRE SERVICE ELEMENTARY SCHOOL TEACHER EDUCATION STUDENTS PEDAGOGICAL SKILLS

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Abstract (Garamond 13)

This study explores the integration of Virtual Reality (VR) in microteaching to enhance the pedagogical competence of pre-service teachers. Grounded in the Technology Acceptance Model (TAM), the research examines the influence of perceived ease of use (PEOU) and perceived usefulness (PU) on pedagogical development during immersive teaching simulations. A quantitative explanatory approach was employed, involving 60 undergraduate students from the Elementary Teacher Education Program at the University of West Sulawesi, Indonesia. Data were collected through structured questionnaires and analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS 4.0. The findings revealed that both PEOU and PU significantly and positively influence pedagogical competence, with PEOU demonstrating the strongest effect. Additionally, PEOU strongly predicted PU, reinforcing the central relationships outlined in TAM. The model accounted for 82.8% of the variance in pedagogical competence, indicating substantial predictive power. These results support the application of VR as an effective tool in teacher preparation, particularly in bridging the gap between theoretical knowledge and real classroom practice. It concludes that microteaching supported by virtual reality not only fosters instructional skill development but also promotes technology acceptance among pre-service teachers. Implications for curriculum design and teacher training in rural contexts are discussed.

Abstrak (Garamond 13

Penelitian ini mengkaji integrasi teknologi Virtual Reality (VR) dalam kegiatan microteaching untuk meningkatkan kompetensi pedagogis calon guru. Berlandaskan pada kerangka Technology Acceptance Model (TAM), studi ini menganalisis pengaruh perceived ease of use (PEOU) dan perceived usefulness (PU) terhadap pengembangan kompetensi melalui simulasi pengajaran berbasis teknologi imersif. Pendekatan kuantitatif eksplanatori digunakan dengan melibatkan 60 mahasiswa program studi Pendidikan Guru Sekolah Dasar di Universitas Sulawesi Barat, Indonesia. Data dikumpulkan melalui kuesioner terstruktur dan dianalisis menggunakan Partial Least Squares Structural Equation Modeling (PLS-SEM) melalui perangkat lunak SmartPLS versi 4.0. Hasil analisis menunjukkan bahwa baik PEOU maupun PU berpengaruh signifikan dan positif terhadap kompetensi pedagogis, dengan PEOU memberikan pengaruh paling kuat. Selain itu, PEOU secara signifikan memprediksi PU, menguatkan hubungan utama dalam kerangka TAM. Model ini menjelaskan 82,8% variansi dalam kompetensi pedagogis, menunjukkan daya prediksi yang

substansial. Temuan ini mendukung pemanfaatan VR sebagai alat yang efektif dalam pendidikan calon guru, khususnya dalam menjembatani kesenjangan antara teori dan praktik lapangan. Penelitian ini menyimpulkan bahwa microteaching berbasis VR tidak hanya mendorong pengembangan keterampilan instruksional, tetapi juga meningkatkan penerimaan teknologi di kalangan calon guru. Implikasi bagi desain kurikulum dan pelatihan guru di daerah terpencil turut dibahas.

INTRODUCTION

The swift advancement of immersive technologies has reshaped educational methodologies, especially within teacher training programs. Virtual Reality (VR), in particular, has emerged as a game-changing tool that enhances the microteaching experience, which is a core element in preparing future educators. Traditionally conducted in simulated classroom settings, microteaching is now evolving through VR platforms that offer interactive, realistic, and context-rich teaching environments. This shift presents a valuable opportunity to narrow the gap between theoretical instruction and hands-on teaching practice (Ferdig et al., 2020; Allsopp et al., 2006).

Developing teaching proficiency is a multifaceted endeavor that encompasses cognitive, technical, emotional, and situational dimensions (Shulman, 1987). While conventional microteaching enables pre-service teachers to rehearse lesson planning, classroom control, and student interaction, it often falls short in replicating the spontaneity and complexity of actual classroom dynamics. VR helps overcome these shortcomings by immersing learners in lifelike scenarios where they can make instructional decisions, receive immediate feedback, and engage in reflective practice using recorded sessions (Radianti et al., 2020).

This research explores how VR-based microteaching influences the pedagogical development of pre-service teachers, with particular attention to how their perceptions of usefulness and ease of use affect engagement and learning outcomes. The study employs the Technology Acceptance Model (TAM) as its analytical framework, while also drawing on broader theories such as experiential learning, situated cognition, and social constructivism.

The Technology Acceptance Model (TAM), originally proposed by Davis (1989). provides a conceptual basis for evaluating how users come to accept and utilize technological innovations. In the context of VR integration within teacher training, TAM emphasizes two primary constructs: perceived usefulness (PU) and perceived ease of use (PEOU). PU reflects the extent to which individuals believe that using a particular technology will improve their performance, while PEOU refers to the degree to which they perceive the technology as user-friendly and effortless to operate.

Further refinements to the model by Venkatesh & Davis (2000) introduced additional variables such as subjective norms, job relevance, and output quality, which enrich the explanatory

power of TAM in educational environments. These factors help capture the social and contextual influences that shape technology adoption among pre-service teachers.

In the context of VR-based microteaching, pre-service teachers' acceptance of the technology is often predicated on their belief that it will help them better prepare for real classroom challenges. When the simulations are intuitive, contextually relevant, and supportive of pedagogical goals, teachers are more likely to engage meaningfully and transfer the acquired skills to real-life teaching scenarios (Venkatesh & Bala, 2008). Studies by Huang et al. (2023) and Lee & Wu (2024) confirm that TAM remains a robust model in predicting pre-service teachers' intention to use VR tools in their practice.

Experiential Learning Theory

Kolb's (2014) conceptualizes learning as a dynamic progression in which individuals construct understanding by engaging with and transforming their experiences. This experiential process unfolds through four interconnected phases: engaging directly in an experience, observing and reflecting on it, forming abstract ideas based on those reflections, and applying the new concepts through active trial and practice. VR provides an ideal platform for this cycle to unfold. In a VR microteaching environment, pre-service teachers experience classroom situations (concrete experience), review their performance (reflective observation), connect experiences to educational theory (abstract conceptualization), and revise strategies in subsequent simulations (active experimentation).

Virtual reality (VR) strongly reflects the principles of experiential learning by providing real-time feedback, authentic situational contexts, and emotionally engaging experiences, all of which are essential for deep learning (Lindgren & Johnson-Glenberg, 2013). Through VR, pre-service teachers can repeatedly navigate challenging teaching situations, evaluate their choices, and refine their instructional practices within a risk-free, simulated environment.

Situated Cognition and Authentic Learning

Situated cognition theory asserts that learning is most effective when it occurs in contexts that reflect how knowledge will be used in real-life situations (Brown et al., 1989). In microteaching, this means simulating classroom interactions as realistically as possible. VR environments allow for such situated learning by immersing learners in scenarios.

Authentic learning environments, as described by Herrington et al. (2009), are characterized by complex tasks, ill-defined problems, and social collaboration. VR-based microteaching systems can simulate these characteristics by enabling user interaction with virtual students, integrating real-

time classroom data, and supporting peer review and reflection. This immersive context supports the transfer of skills from the simulated to the real classroom.

Social Constructivism

Social constructivist theory emphasizes that knowledge is co-constructed through social interaction and cultural tools (Vygotsky, 1978). In VR-enhanced microteaching, social interaction can take place through collaborative simulations, instructor feedback, and peer discussion. Some VR platforms allow for multi-user teaching simulations where candidates can co-teach, observe others, or role-play student behaviors. It is enabling the co-construction of pedagogical knowledge and reflection-on-action. Moreover, VR tools often incorporate built-in analytics and AI-driven feedback, which serve as "more capable others" (Vygotsky & Cole, 1978), guiding learners through scaffolded development of teaching skills. In this way, the learning process becomes both individualized and socially grounded.

Empirical Support and Challenges

Several empirical studies have demonstrated the pedagogical benefits of VR-based microteaching. Zhang et al. (2024) found that pre-service teachers who used VR simulations showed significant improvements in lesson planning, time management, and student engagement strategies. Lee and Wu (2024) further demonstrated that participants using VR reported higher teaching confidence, reflective abilities, and motivation compared to those in traditional microteaching setups.

A meta-analysis by Merchant et al. (2014) revealed that immersive environments are particularly effective for procedural and affective learning outcomes. Similarly, studies by (Bower et al., 2020) highlight that VR encourages risk-taking and experimentation in teaching techniques, something often missing in conventional training.

Despite these advantages, the implementation of VR in teacher education faces several practical challenges. High setup costs, equipment maintenance, and the need for training among faculty are barriers to widespread adoption (Radianti et al., 2020). There are also pedagogical concerns, such as the risk of overemphasizing technology at the expense of content mastery and critical pedagogy.

Designing effective VR-based learning scenarios requires interdisciplinary collaboration among educators, technologists, and instructional designers to ensure the alignment of technological affordances with pedagogical objectives (Slater, 2021). Issues of accessibility and equity must also be considered to avoid exacerbating digital divides in teacher education programs.

Drawing from the earlier discussion, this research seeks to investigate the potential of Virtual Reality (VR) in enhancing pedagogical competence within pre-service teacher education. The study specifically focuses on exploring how future educators perceive the practicality and user-friendliness of VR when applied in microteaching contexts. In line with these aims, the principal research question posed is: in what ways does implementing VR in microteaching contribute to the development of pedagogical abilities among pre-service teachers?

METHOD

This research adopted a quantitative explanatory design to examine how perceived ease of use and perceived usefulness influence the pedagogical competence of pre-service teachers within VR-based microteaching environments. The study was anchored in the Technology Acceptance Model (TAM) proposed by Davis (1989) and later refined by Venkatesh & Davis (2000), which posits that individuals' willingness to embrace technology is largely shaped by their perceptions of its utility and user-friendliness. TAM continues to serve as a foundational framework in educational technology studies, offering valuable insights into how innovative tools impact instructional practices (Alasmari & Zhang, 2019; Scherer et al., 2021).

Data were collected through a structured questionnaire distributed to respondents after their participation in VR-based microteaching sessions. There are 15 indicators in the questionnaire, but only 12 indicators are valid. The instrument consisted of three latent variables: *Perceived Ease of Use (PEOU)*, *Perceived Usefulness (PU)*, and *Pedagogical Competence (PC)*. Each variable was measured using four items adapted from validated scales (Davis, 1989; Shulman, 1987; Zhang et al., 2024), and all items were rated on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree). Construct validity and reliability were assessed through outer model analysis using SmartPLS.

The participants in this study were 60 undergraduate students from the Elementary Teacher Education Program (PGSD) at the University of West Sulawesi (Unsulbar), Indonesia. These students were aged between 20 and 22 years. They come from rural and coastal areas with limited technology. None of the participants had prior experience with virtual reality technology. Before engaging in the study, participants attended a brief orientation session to familiarize themselves with the use of VR headsets and the learning simulation environment.

Data collection was conducted between May and June 2025, immediately following participants' completion of the VR-based microteaching sessions. These sessions were designed to replicate realistic classroom scenarios in a three-dimensional virtual environment where

participants practiced teaching in immersive, interactive settings. The virtual teaching environment was accessed through FrameVR.io, a web-based platform that enables users to create and join customizable 3D virtual spaces directly from a browser without requiring complex installations. FrameVR.io provides features such as spatial audio, screen sharing, interactive objects, and avatar-based communication, which made it possible to simulate classroom dynamics in a more engaging and realistic manner. The aim of this design was to assess how VR-supported simulation could enhance pedagogical skills, such as instructional planning, classroom communication, and reflective teaching practices.

Figure 1. Virtual Reality from Framevr.io

In each VR session, one student acted as the teacher while eight other students joined the virtual classroom as guest avatars representing pupils. Through this arrangement, the designated student-teacher was able to practice delivering lessons, managing classroom interaction, and applying pedagogical strategies, while the guest students participated as learners. This setup allowed the teaching process to closely resemble real classroom dynamics, providing an authentic microteaching experience in a virtual environment.

To analyze the data, the study utilized Structural Equation Modeling with Partial Least Squares (SEM-PLS) using SmartPLS version 4.0. This method is suitable for small-to-medium sample sizes and is particularly effective for evaluating latent constructs and their structural relationships (Hair et al., 2021; Ramayah et al., 2018).

RESULTS AND DISCUSSION

Average Variance Extracted (AVE)

Based on the results of the Average Variance Extracted (AVE) analysis, all three constructs in the model demonstrate strong convergent validity, as indicated by AVE values that significantly

exceed the minimum threshold of 0.50. The construct of Perceived Ease of Use (PEOU) achieved an AVE of 0.938, indicating that 93.8% of the variance in its indicators is explained by the construct, thereby reflecting a high degree of indicator representation.

Similarly, Perceived Usefulness (PU) recorded an AVE of 0.891, suggesting that 89.1% of its indicator variance is accounted for by the construct. Pedagogical Competence (PC) also exhibited strong convergent validity, with an AVE value of 0.876. These results confirm that each construct is measured consistently and accurately through its respective indicators. The AVE output is visually represented by the blue circle in Figure 1.

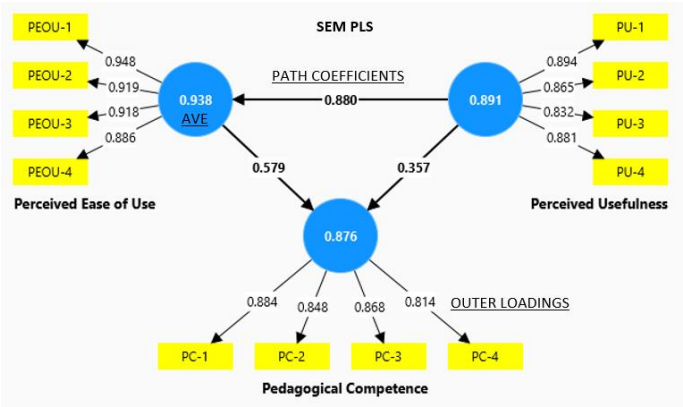

Figure 2. SEM PLS Output

Outer Loadings

The outer loadings output can be observed in the numerical values displayed on each path between the latent constructs and their respective indicators, as shown in Figure 1. The analysis of outer loadings indicates that all indicators demonstrate very strong contributions to their corresponding latent constructs, with values exceeding the recommended threshold of 0.70. For the Perceived Ease of Use (PEOU) construct, all indicators (PEOU-1 to PEOU-4) yielded loading values ranging from 0.886 to 0.948, reflecting a very high level of indicator validity.

Similarly, for the Perceived Usefulness (PU) construct, the loading values ranged from 0.832 to 0.894, confirming that all items are valid and significantly contribute to the construct. The Pedagogical Competence (PC) construct showed comparable results, with outer loadings ranging from 0.814 to 0.884. These results indicate that all items in the model meet the statistical requirements for indicator validity, and therefore, no items need to be eliminated from the measurement model.

Path Coefficients

The analysis of path coefficients reveals that all hypothesized relationships between the latent constructs are statistically significant, with meaningful direction and strength. The relationship from Perceived Ease of Use (PEOU) to Perceived Usefulness (PU) yielded a path coefficient of 0.880**,** indicating a strong and positive effect. This finding supports the Technology Acceptance Model (TAM) proposed by Davis (1989), which posits that users' perceptions of a technology's usefulness are significantly influenced by how easy it is to use.

Furthermore, the relationship between PEOU and Pedagogical Competence (PC) was found to be positive and substantial, with a coefficient of 0.579, suggesting that pre-service teachers' perceptions of the ease of using VR technology directly contribute to the enhancement of their pedagogical competencies. Meanwhile, the path from PU to PC recorded a coefficient of 0.357. It though relatively weaker, it remains a statistically significant and positive influence on pedagogical development.

These results collectively imply that both perceived usefulness and perceived ease of use play pivotal roles in shaping the pedagogical competence of pre-service teachers. Among these relationships, the PEOU → PU pathway emerges as the most dominant in the model.

Hyphothesis testing

Hypothesis testing was conducted using the bootstrapping procedure in SmartPLS. The results, illustrated in Figure 2, confirm that all hypotheses proposed in the structural model are statistically significant**.**

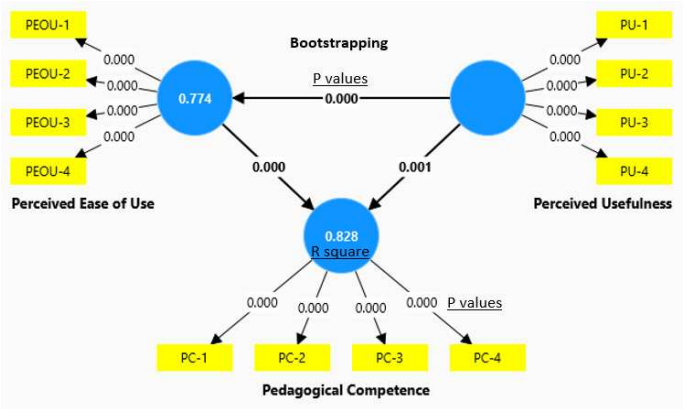

Figure 3. Bootstrapping output

The relationship between Perceived Ease of Use (PEOU) and Perceived Usefulness (PU) shows a path coefficient of 0.880 with a p-value < 0.001, indicating a strong and positive influence.

This finding aligns with the Technology Acceptance Model (TAM), which asserts that users' perceptions of usefulness are shaped by their experience of ease of use (Davis, 1989; Venkatesh & Davis, 2000).

Additionally, the relationship between PEOU and Pedagogical Competence (PC) is also significant, with a coefficient of 0.579 ($p < 0.001$). This suggests that the easier pre-service teachers find VR technology to use, the more it contributes to their confidence and ability in designing and delivering instructional content. The effect of PU on PC, while comparatively weaker, remains statistically significant, with a coefficient of 0.357 ($p = 0.001$). This highlights that the perceived benefits of using VR also enhance pedagogical development.

The R-square values further confirm the model's substantial predictive power: 82.8% of the variance in pedagogical competence is explained by PU and PEOU, while 77.4% of the variance in PU is explained by PEOU. These findings underscore the effectiveness of VR integration in microteaching and affirm that perceived ease of use and usefulness are key factors in shaping pre-service teachers' professional growth.

Confidence Intervals

The bootstrapping analysis revealed that all hypothesized paths in the structural model are statistically significant at the 95% confidence level.

Path coefficients - Confidence intervals

	Original sample (O)	Sample mean (M)	2.5%	97.5%
PEOU -> PC	0.579	0.580	0.342	0.771
PU -> PC	0.357	0.356	0.146	0.571
PU -> PEOU	0.880	0.884	0.832	0.927

Figure 4. Output of Confidence Intervals

The confidence intervals for each path coefficient that PEOU to PC (CI: 0.342 to 0.771), PU to PC (CI: 0.146 to 0.571), and PU to PEOU (CI: 0.832 to 0.927). It does not include zero, indicating robust and reliable relationships among the constructs (Hair, 2021). These findings confirm that perceived ease of use and perceived usefulness significantly contribute to the development of pedagogical competence and validate the directional strength of the proposed model.

The findings of this study confirm that the integration of Virtual Reality (VR) into microteaching significantly enhances pre-service teachers' pedagogical competence. The statistical analysis using SEM-PLS demonstrated that both *Perceived Ease of Use (PEOU)* and *Perceived Usefulness (PU)* significantly influenced *Pedagogical Competence (PC)*. These results support the assumptions of the Technology Acceptance Model (TAM), where user attitudes toward technology adoption are strongly shaped by their perceptions of its usability and benefits (Davis, 1989; Venkatesh & Davis, 2000).

The strong influence of PEOU on PU ($\beta = 0.880$, $p < 0.001$) aligns with previous studies indicating that when pre-service teachers find VR technology intuitive and accessible, they are more likely to perceive it as an effective tool for teaching practice (Scherer et al., 2021; Huang et al., 2022). This reflects the importance of interface design, user training, and technical support in educational VR applications. It also validates TAM's assertion that ease of use indirectly promotes user satisfaction and long-term engagement.

Furthermore, the direct effect of PEOU on pedagogical competence ($\beta = 0.579$, $p < 0.001$) reveals that user-friendly VR systems not only enhance perceptions but also contribute concretely to skill development. This is consistent with Kolb's Experiential Learning Theory, which emphasizes the transformation of experience into knowledge through repeated cycles of action and reflection (Kolb, 1984; Lindgren & Johnson-Glenberg, 2013). In this study, participants who engaged with VR-based teaching scenarios had the opportunity to reflect on their instructional strategies, recognize areas of weakness, and adjust their approaches accordingly. These reflective practices contributed directly to the enhancement of their pedagogical awareness.

Although the path from PU to PC was slightly weaker ($\beta = 0.357$, $p = 0.001$), it remains statistically significant. This suggests that when teacher candidates perceive the use of VR as beneficial to their instructional growth, they are more likely to exhibit increased confidence, planning ability, and classroom management skills. Prior research supports this notion, showing that perceived usefulness of VR is associated with heightened motivation, reflection, and professional identity among pre-service teachers (Lee & Wu, 2024; Rahmawati et al., 2024; Want & Visscher, 2024).

This finding is further echoed by Meivawati et al. (2025), who emphasized that "the perception of tangible benefits appears to be the more influential factor in teachers' decisions to embrace AI technology," a conclusion that aligns with how perceived usefulness of immersive tools like VR can drive intention and engagement among teacher candidates.

The explanatory power of the model is also noteworthy. The R^2 value for Pedagogical Competence was 0.828, indicating that PEOU and PU together explain more than 82% of the variance in teaching competence. This is considered substantial (Hair et al., 2021), suggesting that immersive technology acceptance is a critical factor in shaping teacher quality within training programs. This finding echoes the conclusions of Cárdenas and Alvarez (2022), who highlighted the transformative potential of immersive simulations in developing communicative and instructional skills in future teachers.

Despite the promising results, certain contextual considerations must be acknowledged. Participants in this study were novice users of VR technology and came from rural backgrounds with limited exposure to advanced educational tools. Their positive engagement may have been amplified by the novelty of the experience. Nonetheless, this also highlights the inclusive potential of VR as a medium that can provide equitable access to high-quality teaching simulations, regardless of geographical or socioeconomic background (Chen, 2022).

This study offers a novel contribution by applying the Technology Acceptance Model (TAM) to examine how VR-based microteaching shapes pedagogical competence among pre-service teachers in a rural Indonesian context. Unlike previous research, it quantitatively demonstrates the strong predictive power of ease of use and perceived usefulness in fostering instructional skills through immersive simulation.

Finally, the findings support calls for more deliberate design and integration of VR in teacher education curricula. As VR technologies become more accessible and affordable, institutions should consider embedding immersive microteaching modules into practicum or instructional methods courses. Moreover, interdisciplinary collaboration is essential to ensure that VR content not only engages learners but also aligns with pedagogical standards and curriculum goals (Docter et al., 2024; Zhang et al., 2024).

CONCLUSION

This study reinforces the value of Virtual Reality (VR) as a transformative tool in teacher education, particularly through its integration into microteaching practices. The findings affirm that pre-service teachers' acceptance of VR, shaped by their perceptions of its ease of use and usefulness, plays a significant role in enhancing their pedagogical competence. These results align with the Technology Acceptance Model (Davis, 1989; Venkatesh & Davis, 2000), emphasizing that

intuitive and accessible technologies foster more meaningful engagement and instructional confidence.

Furthermore, the experiential and immersive nature of VR supports deeper learning through reflection and contextualized practice (Kolb, 1984; Lindgren & Johnson-Glenberg, 2013), making it a pedagogically powerful medium for novice educators. By grounding the research in a rural Indonesian context, this study also highlights VR's inclusive potential to bridge educational disparities. These insights contribute to the growing body of evidence advocating for the deliberate integration of immersive technologies in teacher preparation programs, supported by interdisciplinary collaboration and curriculum alignment (Zhang et al., 2024; Docter et al., 2024).

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