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Teaching Anxiety, Efficacy, and Immersive Experience in VR-Based Microteaching among Elementary Pre-Service Teachers in Rural Context

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Abstract

Teacher education in rural contexts faces challenges related to limited teaching practice opportunities, technological access, and pedagogical support, which may affect pre-service teachers' instructional readiness. This study examines the roles of teaching anxiety, teaching efficacy, immersive learning experience, and interest in virtual reality in shaping basic teaching skills through virtual reality–based microteaching among elementary pre-service teachers in rural contexts. A quantitative explanatory design was employed involving 205 pre-service teachers from the Primary School Teacher Education program at Universitas Sulawesi Barat. Data were collected using a structured questionnaire and analyzed using Partial Least Squares Structural Equation Modeling. The findings indicate that immersive learning experience has a strong positive effect on basic teaching skills (β=0.501, $p<0.001$), followed by teaching efficacy (β=0.372, $p<0.001$). In contrast, teaching anxiety shows a negative but non-significant effect ($\beta = -0.043$, $p > 0.05$). Additionally, interest in virtual reality positively influences immersive learning experience (β=0.330, $p<0.001$) and indirectly contributes to basic teaching skills through immersion (β =0.165, $p<0.01$). The model explains 61.3% of the variance in basic teaching skills (R^2=0.613). These results highlight the potential of virtual reality–based microteaching as an effective approach for developing pedagogical skills among elementary pre-service teachers in rural educational settings.

Keywords: virtual reality; microteaching; immersive learning experience; teaching anxiety; teaching efficacy

INTRODUCTION

Teacher education in rural contexts faces challenges that differ markedly from those in urban and well-resourced areas. Pre-service elementary teachers in rural settings often experience limited access to instructional resources, fewer opportunities for varied teaching practice, and minimal exposure to innovative learning technologies. These conditions may affect not only pedagogical competence but also emotional readiness to teach (Ajani & Ngema, 2024; Mazzuki, 2025).

In many rural institutions, teaching practice occurs in constrained and relatively homogeneous environments. Limited school infrastructure, large class sizes, and insufficient technological support restrict opportunities for meaningful teaching simulations. As a result, pre-service teachers frequently feel unprepared when encountering real classroom situations, particularly during early teaching experiences such as microteaching (Arslan, 2021).

A prominent issue emerging in this context is teaching anxiety. Pre-service teachers commonly report nervousness, fear of making mistakes, and lack of confidence when performing teaching tasks in front of peers, lecturers, or students. These reactions tend to be more pronounced among elementary pre-service teachers, who must manage young learners with diverse needs while maintaining instructional clarity (Ramirez, 2020). In rural contexts, teaching anxiety is often intensified by limited pedagogical support, fewer mentoring opportunities, and restricted exposure to diverse classroom settings. Consequently, there is a growing need for instructional approaches that provide safe, supportive, and realistic teaching experiences.

Teaching anxiety refers to emotional responses characterized by tension, worry, and apprehension related to teaching tasks and classroom performance, arising during lesson preparation, instructional delivery, classroom interaction, and evaluation processes (Aydin, 2021). One major contributor is limited teaching experience, particularly when pre-service teachers feel unprepared to manage classroom dynamics or respond effectively to students' questions (Brown et al., 2015). In rural teacher education, this challenge is compounded by fewer opportunities for repeated practice and observation of experienced teachers. Additional factors include constraints in teaching materials, learning technologies, and supportive learning environments, which may increase uncertainty and self-doubt. Social pressure, such as fear of negative evaluation by peers or instructors, can further heighten anxiety during microteaching sessions (Darling-Hammond et al., 2020). High levels of teaching anxiety have been shown to negatively affect instructional clarity, classroom management, and decision-making, thereby reducing readiness for professional teaching roles (Bantilan et al., 2024).

Closely related to teaching anxiety is teaching efficacy, defined as teachers' beliefs in their capability to plan, implement, and manage instructional activities effectively. Grounded in social cognitive theory, teaching efficacy is a key psychological factor influencing teaching behavior, motivation, and persistence when facing challenges (E. Richter et al., 2021). Empirical evidence consistently shows that pre-service teachers with higher teaching efficacy demonstrate stronger instructional performance, better classroom management, and greater willingness to experiment with innovative teaching strategies. Teaching efficacy also functions as a buffer against anxiety, enabling teachers to remain confident and adaptive during instructional challenges (Li, 2023). In rural teacher education contexts, strengthening teaching efficacy is particularly important, as confident pre-service teachers are more likely to overcome contextual limitations and engage proactively with students despite constrained resources (Harris et al., 2025).

In recent years, virtual reality (VR) has gained increasing attention in education due to its ability to create immersive, interactive, and realistic learning environments. In teacher education, VR enables pre-service teachers to engage in simulated classroom experiences that closely resemble real teaching situations, allowing them to practice instructional skills without the risks associated with actual classrooms (Radianti et al., 2020). Immersive learning experience refers to learners' perceptions of presence, engagement, and realism within a learning environment. Higher levels of immersion are associated with deeper cognitive processing, improved skill acquisition,

and better learning transfer (Ragan et al., 2010). In VR-based microteaching, immersive experiences may help pre-service teachers concentrate on instructional tasks rather than performance-related anxiety. Previous studies suggest that VR can reduce teaching anxiety by providing a low-stakes environment where mistakes are viewed as part of the learning process, while repeated immersive practice can strengthen teaching efficacy through successful teaching experiences and reflection (Zhong et al., 2024).

Compared to conventional microteaching, VR-based immersive learning offers advantages such as realistic classroom dynamics, consistent practice conditions, and opportunities for repeated reflection. These features make VR particularly suitable for teacher education in contexts where access to real classrooms and mentoring is limited. Although microteaching is a well-established approach for developing basic teaching skills through structured practice and feedback (Lozgka, 2024; Sezaki et al., 2023), its implementation in rural contexts often faces limitations related to technology access and mentor availability (Mazzuki, 2025). VR-based microteaching offers a potential solution by enabling scalable and technology-supported teaching simulations that enhance realism and reflective practice. Prior research has demonstrated the effectiveness of VR-based microteaching in improving pre-service teachers' pedagogical skills (Meivawati & Meiliza, 2025).

Despite growing interest in VR applications for teacher education, empirical studies integrating teaching anxiety, teaching efficacy, and immersive learning experience within VR-based microteaching remain limited, particularly in rural contexts (Mazzuki, 2025; Radianti et al., 2020). Understanding how psychological and experiential factors interact in VR-based microteaching is therefore essential for developing effective teacher preparation programs in rural areas. This study addresses this gap by examining the roles of teaching anxiety, teaching efficacy, and immersive learning experience in shaping the teaching readiness of elementary pre-service teachers in rural contexts. The findings are expected to contribute to the theoretical development of technology-enhanced teacher education and provide practical insights for improving microteaching practices. Prior research has also highlighted the role of technological skills and motivation in shaping pre-service teachers' pedagogical creativity and performance (Meiliza et al., 2025).

METHODS

This study employed a quantitative explanatory research design to examine the relationships among teaching anxiety, teaching efficacy, immersive learning experience, and basic teaching skills in virtual reality–based microteaching. A quantitative approach was selected because it allows for systematic examination of relationships among latent variables and provides empirical evidence to support theoretical assumptions in teacher education research (Creswell & Creswell, 2017). To analyze the proposed research model, Partial Least Squares Structural Equation Modeling (PLS-SEM) was applied. PLS-SEM is particularly suitable for exploratory and predictive research, complex models with multiple latent constructs, and studies conducted with relatively small sample sizes (Hair et al., 2022). This approach is widely used in educational research involving technology-enhanced learning and psychological constructs.

Research Subjects

The participants of this study were 205 elementary pre-service teachers enrolled in the Primary School Teacher Education (PGSD) program at Universitas Sulawesi Barat, a public university located in a rural context in Indonesia. The rural setting was characterized by limited access to advanced educational technologies and restricted opportunities for diverse and authentic teaching practice. The participants consisted of fifth-semester students, representing intermediate stages of teacher preparation. This composition allowed the study to capture variations in teaching experience and pedagogical readiness among pre-service teachers. A total sampling technique was employed, as all students who had participated in virtual reality–based microteaching activities during the semester were invited to take part in the study. This approach ensured that the collected data reflected authentic learning experiences within the actual instructional context (Etikan et al., 2016). All participants had prior experience with conventional microteaching and were subsequently introduced to VR-based microteaching as part of their coursework. Participation was voluntary, and informed consent was obtained from all participants prior to data collection.

Research Instruments

Data were collected using a structured questionnaire consisting of 25 items measured on a four-point Likert scale, ranging from 1 (strongly disagree) to 4 (strongly agree)The instrument was developed by adapting constructs and indicators from multiple established theoretical frameworks, including immersive learning and virtual reality research, self-determination theory, and teacher self-efficacy literature (Petersen et al., 2022a; Ryan & Deci, 2000; Tschannen-Moran & Hoy, 2001). The questionnaire was designed to capture pre-service teachers' psychological and pedagogical experiences in virtual reality–based microteaching.

Teaching anxiety was measured using indicators reflecting emotional responses during teaching activities, such as nervousness, fear of making mistakes, and perceived teaching pressure. Teaching efficacy was assessed through items representing confidence in lesson planning, classroom management, and instructional delivery, consistent with established measures of teacher self-efficacy (Tschannen-Moran & Hoy, 2001). Immersive learning experience was measured using indicators related to perceived realism, engagement, and interaction within the virtual learning environment, adapted from prior research on immersive learning (Makransky & Petersen, 2021a). Basic teaching skills were assessed through indicators representing core instructional competencies in elementary education, including lesson opening and closure, questioning techniques, classroom management, and instructional clarity. Prior to data analysis, the instrument underwent expert review to ensure content validity, clarity, and contextual relevance. Based on the measurement model evaluation, one item was excluded due to insufficient validity, resulting in 24 items being retained for further analysis.

Research Procedure and Data Collection

The research was conducted from August to December 2025 and followed a series of systematic stages to ensure methodological rigor and consistency in data collection. During the preparation stage, participants were informed about the research objectives and introduced to virtual reality–based microteaching using the FrameVR platform, as illustrated in Figure 1. In this stage, the pre-service teacher acting as the instructor used a virtual reality headset to conduct the teaching session, while the students joined the virtual classroom by accessing a FrameVR link,

similar to participating in an online meeting platform. This configuration allowed interaction between the instructor and students within a shared virtual learning space. Participants received orientation on navigating the virtual classroom environment and utilizing basic interaction features to support effective engagement and reduce cognitive overload (Radianti et al., 2020).

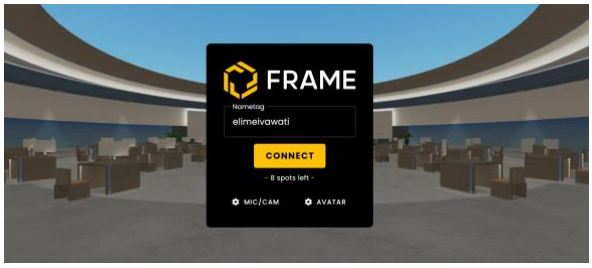

Figure 1. FrameVR

In the implementation stage, pre-service teachers conducted simulated teaching sessions in virtual classroom environments designed to represent elementary school settings, as illustrated in Figure 2. During these sessions, participants practiced basic teaching skills such as lesson opening and closure, questioning techniques, classroom management, and instructional explanation. The immersive and low-risk nature of the virtual environment enabled participants to focus on instructional practice while minimizing performance pressure (Makransky et al., 2021).

Figure 2. VR-Based Microteaching

Data collection was conducted after participants completed the VR-based microteaching sessions. Participants were asked to complete a structured questionnaire electronically to reflect on their teaching experiences immediately following the simulations, which has been shown to enhance the accuracy of self-reported learning perceptions (Makransky & Petersen, 2021a). All responses were anonymized to ensure confidentiality, and the collected data were stored securely for research purposes and subsequent analysis using structural equation modeling.

Data Analysis

Data analysis was executed via SmartPLS version 4, utilizing the Partial Least Squares Structural Equation Modeling (PLS-SEM) approach. Adhering to the dual-stage framework established by Hair et al. (2022), the study first examined the measurement model before evaluating the structural model. The former involved verifying convergent validity through factor loadings and Average Variance Extracted (AVE), alongside reliability assessments using Cronbach's alpha and composite reliability. Discriminant validity was established via the Heterotrait–Monotrait ratio (HTMT).

Subsequently, the structural model's integrity was gauged by analyzing path coefficients, coefficients of determination (R^2) and effect sizes (f^2). Predictive relevance (Q^2) was derived from blindfolding techniques, while the Standardized Root Mean Square Residual (SRMR) served as the primary model fit index. To determine the statistical significance of the proposed hypotheses, a bootstrapping procedure with five thousand subsamples was implemented, ensuring a robust evaluation of the model's explanatory and predictive capabilities.

RESULTS AND DISCUSSION

Results

This segment details the systematic assessment of the measurement model to verify the reliability and validity of all underlying constructs. The primary focus of this evaluation involves a rigorous analysis of indicator reliability through the examination of individual item outer loadings.

Table 1. Outer Loadings

Item	Basic Teaching Skills	Immersive Learning Experience	Interest in VR	Teaching Anxiety	Teaching Efficacy
BTS1	0.784				
BTS2	0.901				
BTS3	0.902				
BTS4	0.885				
BTS5	0.859				
BTS6	0.910				
BTS7	0.913				
ILE1		0.853			
ILE2		0.922			
ILE3		0.936			
ILE4		0.868			
IVR1			0.878		
IVR2			0.936		
TA1				0.846	
TA2				0.869	
TA3				0.907	
TA4				0.868	
TA5				0.862	
TE1					0.821
TE2					0.871
TE3					0.848
TE4					0.843
TE5					0.827

The empirical results displayed in Table 1 indicate that all indicators possess sufficient convergent validity, as every loading exceeds the established threshold of 0.70. Detailed analysis reveals that the metrics for basic teaching skills, immersive learning environments, interest in virtual reality, teaching anxiety, and teaching efficacy exhibit robust correlations with their assigned latent variables. Consequently, these results verify that each item effectively captures the theoretical essence of its corresponding construct. Consistent with the methodological guidelines established by Hair et al. (2022), loadings surpassing the 0.70 benchmark signify that the latent variables account for a significant portion of the indicator variance, which reinforces the structural integrity of the measurement model.

Furthermore, the data summarized in Table 2 provides evidence for the reliability and validity of the constructs. All latent variables exhibit high levels of internal consistency and meet the requirements for convergent validity, ensuring the stability of the measurement instruments used in this study.

Table 2. Construct Reliability and Validity

Variables	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Basic Teaching Skills	0.951	0.954	0.960	0.775
Immersive Learning Experience	0.917	0.921	0.942	0.801
Interest in VR	0.790	0.841	0.903	0.823
Teaching Anxiety	0.922	0.966	0.940	0.758
Teaching Efficacy	0.897	0.898	0.924	0.709

The statistical outcomes for construct reliability and validity reveal that every latent variable in this study achieves a high level of internal consistency and convergent validity. All constructs reported Cronbach's alpha scores exceeding the 0.70 benchmark, which signifies a reliable measurement scale. Furthermore, both the reliability coefficients ρ_a and composite reliability values ρ_c surpass the 0.70 limit, further validating the strong internal consistency of the indicators.Regarding convergent validity, the Average Variance Extracted (AVE) for all latent variables is consistently above 0.50. This demonstrates that the constructs account for a majority of the variance in their respective indicators. Following the methodological framework of Hair et al. (2022), these indices collectively confirm that the measurement model adheres to the necessary standards for reliability and validity. Finally, Table 3 details the discriminant validity through the heterotrait–monotrait (HTMT) ratio, illustrating the distinctiveness of the latent constructs within the model.

Table 3. Discriminant Validity (HTMT)

Latent Constructs	Original sample (O)	Sample mean (M)	2.5%	97.5%
Immersive Learning Experience & Basic Teaching Skills	0.780	0.779	0.670	0.873
Interest in VR & Basic Teaching Skills	0.443	0.445	0.267	0.608
Interest in VR & Immersive Learning Experience	0.376	0.379	0.194	0.561
Teaching Anxiety & Basic Teaching Skills	0.211	0.216	0.089	0.374
Teaching Anxiety & Immersive Learning Experience	0.346	0.346	0.203	0.489
Teaching Anxiety & Interest in VR	0.141	0.160	0.064	0.306
Teaching Efficacy & Basic Teaching Skills	0.746	0.743	0.642	0.833
Teaching Efficacy & Immersive Learning Experience	0.721	0.719	0.599	0.823
Teaching Efficacy & Interest in VR	0.463	0.463	0.291	0.628
Teaching Efficacy & Teaching Anxiety	0.252	0.253	0.105	0.413

Discriminant validity was assessed using the heterotrait–monotrait ratio (HTMT), as recommended by Henseler et al. (2015). The results indicate that all HTMT values are below the conservative threshold of 0.85 and the 95% confidence intervals do not include the value of 1.00. These findings confirm that each construct is empirically distinct from the others, demonstrating

adequate discriminant validity. The measurement model satisfies the criteria for discriminant validity and supports the appropriateness of the proposed construct structure.

Structural Model Evaluation

This section evaluates the structural model to examine the relationships among the latent constructs proposed in the research model. The evaluation focuses on path coefficients, explanatory power (R^2), predictive relevance (Q^2), and overall model fit to assess the robustness of the hypothesized relationships. Table 4 presents the results of the collinearity assessment using the Variance Inflation Factor (VIF) to examine potential multicollinearity among the constructs.

Table 4. Collinearity (VIF)

ITEM	VIF	ITEM	VIF
BTS1	2.174	TA1	2.615
BTS2	4.960	TA2	2.235
BTS3	4.925	TA3	3.844
BTS4	3.452	TA4	3.120
BTS5	3.063	TA5	3.112
BTS6	4.852	TE1	2.093
BTS7	4.820	TE2	2.700
ILE1	2.307	TE3	2.330
ILE2	4.017	TE4	2.380
ILE3	4.488	TE5	2.196
ILE4	2.673		
IVR1	1.743		
IVR2	1.743		

Collinearity was assessed using the Variance Inflation Factor (VIF) to examine potential multicollinearity among indicators. The results show that all VIF values are below the recommended threshold of 5.00, indicating that multicollinearity is not a concern in the measurement model. According to the guidelines proposed by Hair et al. (2022), VIF values below 5 suggest that the indicators do not exhibit problematic collinearity and that each indicator contributes unique information to its respective construct. Therefore, the measurement model is free from multicollinearity issues and suitable for further structural model analysis.

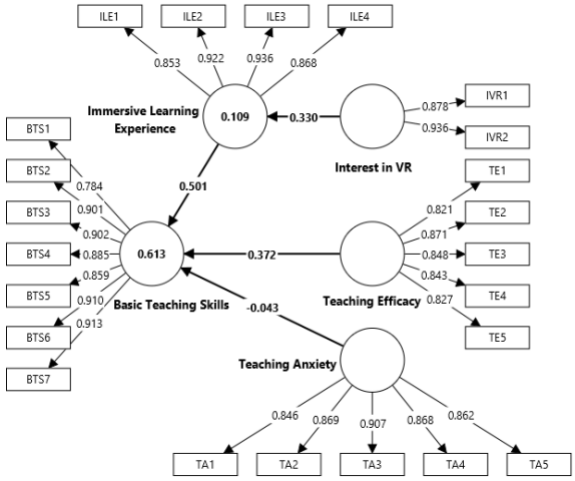

Figure 3. PLS-SEM Model

Figure 3 illustrates the PLS-SEM model, which delineates the factors influencing the pedagogical competencies of pre-service teachers. The structural equation model reveals that Interest in VR significantly predicts Immersive Learning Experience with a path coefficient of 0.330. Subsequently, Immersive Learning Experience exerts a robust positive effect on Basic Teaching Skills (0.501), suggesting that engagement within digital environments significantly enhances pedagogical readiness.

Furthermore, Teaching Efficacy demonstrates a positive and significant influence on Basic Teaching Skills (0.372), indicating that instructional self-confidence contributes directly to the mastery of teaching skills. Conversely, the impact of Teaching Anxiety on Basic Teaching Skills is found to be minimal and negative (-0.043), reflecting a negligible buffering effect within this specific framework.The explanatory power of the model, represented by R^2 values, indicates a moderate effect for Basic Teaching Skills (0.613), signifying that the model accounts for 61.3% of the variance in this construct. The R^2 for Immersive Learning Experience is reported at 0.109. Table 5 presents the results of the predictive relevance assessment (Q^2) obtained through the blindfolding procedure for the endogenous constructs.

Table 5. Predictive Relevance (Q^2)

Variables	SSO	SSE	Q^2 (=1-SSE/SSO)
Basic Teaching Skills	1435.000	772.336	0.462
Immersive Learning Experience	820.000	755.779	0.078
Interest in VR	410.000	410.000	0.000
Teaching Anxiety	1025.000	1025.000	0.000
Teaching Efficacy	1025.000	1025.000	0.000

Predictive relevance of the model was assessed using the blindfolding procedure by examining the Q^2 values. The results show that Basic Teaching Skills has a Q^2 value of 0.462, indicating strong predictive relevance, while Immersive Learning Experience shows a positive Q^2 value of 0.078, suggesting acceptable predictive capability. According to the criteria proposed by Hair et al. (2022), Q^2 values greater than zero indicate that the model has predictive relevance for the endogenous constructs. The Q^2 values for Interest in VR, Teaching Anxiety, and Teaching Efficacy are reported as zero because these constructs are specified as exogenous variables and are not predicted by other constructs in the model. Overall, these results confirm that the structural model demonstrates adequate predictive relevance. Table 6 presents the model fit indices used to evaluate the overall adequacy of the proposed structural model.

Table 6. Model Fit

Model Fit	Saturated model	Estimated model
SRMR	0.053	0.162
d_ULS	0.786	7.287
d_G	0.559	0.858
Chi-square	665.403	832.272
NFI	0.844	0.805

The evaluation of global model fit was conducted through the analysis of several established indices. The saturated model yielded a Standardized Root Mean Square Residual (SRMR) of 0.053, which remains safely under the conventional 0.08 limit, thus signifying a satisfactory fit between the model and the empirical data. Additionally, the Normed Fit Index (NFI) reached 0.844, a value that denotes an acceptable level of fit within the context of PLS-SEM. While metrics such as d_{ULS}, d_G, and Chi-square are included in the results, they serve as

descriptive supplements rather than primary fit indicators in variance-based modeling. As noted by Hair et al. (2022), SRMR remains the primary metric for reporting model fit in PLS-SEM. Therefore, the observed SRMR in this study confirms that the proposed theoretical framework provides an adequate representation of the collected data.

Hypothesis Testing

Building upon the conceptual framework and theoretical foundations previously established, this study developed a series of hypotheses to investigate the complex interconnections between immersive learning experiences, teaching anxiety, instructional self-efficacy, interest in virtual reality technologies, and fundamental pedagogical skills. These proposed relationships were empirically scrutinized through a SEM approach. This methodology was employed to rigorously evaluate the statistical significance and the specific direction of the hypothesized paths within the structural model.

1) H1: Immersive learning experience has a positive effect on basic teaching skills among elementary pre-service teachers.
2) H2: Teaching efficacy has a positive effect on basic teaching skills among elementary pre-service teachers.
3) H3: Teaching anxiety has a negative effect on basic teaching skills among elementary pre-service teachers.
4) H4: Interest in virtual reality has a positive effect on immersive learning experience.
5) H5: Interest in virtual reality has an indirect effect on basic teaching skills through immersive learning experience.

The empirical findings regarding the hypothesized direct effects are summarized in Table 7, which details the path coefficients, *t*-statistics, and corresponding significance levels for each path. These metrics provide a comprehensive overview of the strength and statistical relevance of the relationships proposed within the structural model.

Table 7. Direct Effects

Analysis	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Immersive Learning Experience to BasicTeaching Skills	0.501	0.499	0.079	6.334	0.000
Interest in VR to Immersive Learning Experience	0.330	0.336	0.080	4.122	0.000
Teaching Anxiety to Basic Teaching Skills	-0.043	-0.036	0.041	1.041	0.298
Teaching Efficacy to Basic Teaching Skills	0.372	0.372	0.072	5.194	0.000

The results of the direct effects analysis indicate that immersive learning experience has a positive and significant effect on basic teaching skills ($\beta = 0.501$, $t = 6.334$, $p < 0.001$). In addition, teaching efficacy shows a positive and significant relationship with basic teaching skills ($\beta = 0.372$, $t = 5.194$, $p < 0.001$). Interest in virtual reality also has a positive and significant effect on immersive learning experience ($\beta = 0.330$, $t = 4.122$, $p < 0.001$). In contrast, teaching anxiety

demonstrates a negative but non-significant effect on basic teaching skills (β = −0.043, t = 1.041, p = 0.298).

Based on these results, H1 is supported, as immersive learning experience has a positive and significant effect on basic teaching skills. H2 is also supported, indicating that teaching efficacy positively and significantly influences basic teaching skills among elementary pre-service teachers. H3 is not supported, since teaching anxiety shows a negative but non-significant effect on basic teaching skills. Furthermore, H4 is supported, as interest in virtual reality has a positive and significant effect on immersive learning experience. Finally, the mediation analysis confirms that H5 is supported, demonstrating that interest in virtual reality has a significant indirect effect on basic teaching skills through immersive learning experience. Table 8 presents the results of the indirect effect analysis to examine the mediating relationships among the constructs in the proposed model.

Table 8. Indirect Effect

Analysis	Original sample (O)	Sample mean (M)	Standard deviation (STDEV)	T statistics (|O/STDEV|)	P values
Interest in VR to Basic Teaching Skills	0.165	0.169	0.053	3.125	0.002

The indirect effect analysis shows that interest in virtual reality has a positive and significant indirect effect on basic teaching skills through immersive learning experience (β = 0.165, t = 3.125, p = 0.002). This result indicates that interest in VR does not directly influence basic teaching skills but contributes to skill development by enhancing the quality of immersive learning experiences. The significance of this indirect effect confirms the mediating role of immersive learning experience in the relationship between interest in VR and basic teaching skills, supporting the appropriateness of the proposed structural model.

Discussion

Immersive Learning Experience and the Development of Basic Teaching Skills

The findings indicate that immersive learning experience plays a central role in enhancing basic teaching skills among elementary pre-service teachers in rural contexts. This result aligns with previous studies emphasizing that immersive virtual environments support deeper engagement, realism, and effective skill transfer in teacher education (Radianti et al., 2020; Ragan et al., 2010). In rural settings, where teaching practice often occurs in constrained and homogeneous environments, VR-based microteaching offers opportunities to simulate realistic classroom situations that are otherwise difficult to access (Arslan, 2021; Mazzuki, 2025).

The depth of this immersive experience is critical because it fosters a sense of "presence," allowing pre-service teachers to perceive the virtual classroom as a real pedagogical space. Recent evidence suggests that such high fidelity simulations bridge the gap between theoretical pedagogical knowledge and the complexities of actual classroom interactions (Park, 2024). Furthermore, the high level of sensory immersion in VR minimizes external distractions, thereby maximizing cognitive engagement and the retention of instructional techniques (Poupard et al., 2025). The strong effect of immersive learning experience highlights the importance of

experiential and technology-supported learning designs in preparing elementary pre-service teachers for real classroom challenges.

Teaching Efficacy as a Key Psychological Resource

Teaching efficacy was found to have a positive and significant effect on basic teaching skills, supporting the view that teachers' beliefs in their instructional capabilities strongly influence teaching performance. This finding is consistent with social cognitive perspectives, which emphasize teaching efficacy as a key determinant of instructional behavior, motivation, and persistence in challenging contexts (S. M. Richter, 2023). In line with previous research, pre-service teachers with higher teaching efficacy demonstrate greater instructional confidence and classroom management skills (Li, 2023).

This confirms that higher teaching efficacy serves as a significant predictor for better basic teaching skills, especially in virtual environments where pre-service teachers can undergo multiple mastery experiences. Modern research indicates that digital simulations provide a safe yet challenging platform for novices to build professional confidence before entering real school settings (Ledger et al., 2022). In rural teacher education contexts, where access to mentoring and diverse teaching experiences is limited, VR-based microteaching may function as a mastery-oriented learning environment that strengthens teaching efficacy and supports professional readiness (Harris et al., 2025). From a theoretical standpoint, these findings can be explained through Bandura's concept of mastery experience as the most influential source of self-efficacy, where repeated successful performance enhances individuals' confidence in their abilities (Bandura, 1997). In immersive environments, such repeated practice opportunities are more accessible and structured, allowing pre-service teachers to progressively refine their teaching skills.

This suggests that efficacy does not just drive skill performance but also shapes the teacher's professional identity in technology-rich educational landscapes (Green, 2025). Furthermore, recent studies highlight that self-efficacy plays a mediating role between technological integration and pedagogical effectiveness, meaning that teachers who feel confident in using digital tools are more likely to implement innovative teaching strategies effectively (Bi et al., 2025; Makransky & Petersen, 2021). Strengthening teaching efficacy through VR-based microteaching not only enhances immediate instructional performance but also supports long-term professional growth and adaptability within dynamic educational contexts.

Teaching Anxiety in Virtual Reality–Based Microteaching

Although teaching anxiety showed a negative relationship with basic teaching skills, the relationship did not reach statistical significance. This finding suggests that VR-based microteaching may mitigate the negative influence of anxiety on teaching performance. Prior studies indicate that teaching anxiety commonly arises from fear of mistakes, evaluation pressure, and limited teaching experience, particularly during early teaching practice (Aydin, 2021; Ramirez, 2020). In rural contexts, these challenges are often intensified by limited pedagogical support and restricted exposure to varied classroom settings (Darling-Hammond et al., 2020). This aligns with broader literature indicating that anxiety can impair instructional clarity, decision-making, and classroom interaction, especially among novice teachers who lack sufficient teaching experience (Edwards, 2012; MacIntyre, 2017).

The non-significant impact of anxiety in this study implies that the "low stakes" nature of virtual reality reduces the social evaluative threat typically found in traditional peer-to-peer microteaching. By providing a controlled environment, VR allows pre-service teachers to manage their emotional responses while focusing on pedagogical tasks (Bi et al., 2025). This finding can be explained through the concept of reduced evaluative anxiety, where simulated environments minimize fear of negative judgment, thereby lowering emotional barriers to performance (Makransky & Petersen, 2021). In immersive settings, users often experience a sense of presence without real social consequences, which helps shift attention from self-consciousness to task engagement.

The immersive and low-risk nature of VR-based microteaching appears to reduce performance pressure, allowing pre-service teachers to focus on instructional tasks rather than anxiety-related concerns, thereby buffering the adverse effects of teaching anxiety (Bantilan et al., 2024). Additionally, recent research suggests that repeated exposure to simulated teaching scenarios can support emotional regulation and desensitization to anxiety-provoking situations, ultimately improving teaching confidence over time (Bi et al., 2025a; Zhong et al., 2024). Although teaching anxiety remains a relevant psychological factor, its impact can be substantially reduced in immersive learning environments that prioritize safety, allow repeated practice, and foster reflective engagement.

Interest in Virtual Reality and Immersive Learning Experience

The results demonstrate that interest in virtual reality has a positive and significant effect on immersive learning experience, as well as an indirect effect on basic teaching skills. This finding supports the view that learner interest and motivation enhance engagement and perceived presence in immersive learning environments (Zhong et al., 2024). However, it is essential to note that interest acts as a catalyst rather than a direct driver of skill acquisition. High situational interest in VR technology leads to higher levels of psychological immersion, which is the actual mechanism facilitating learning (Petersen et al., 2022).

From a theoretical perspective, this relationship can be understood through contemporary motivational frameworks that highlight the role of intrinsic motivation in fostering learner engagement, persistence, and deeper cognitive processing (Makransky & Petersen, 2021; Petersen et al., 2022). Within immersive environments, interest in VR technology can stimulate curiosity and encourage active participation, which in turn strengthens the sense of presence and involvement in the learning process. Such heightened engagement is essential for transforming passive exposure to technology into meaningful and impactful learning experiences.

In the context of VR-based microteaching, technological interest does not directly enhance teaching competence but exerts its influence indirectly through immersive learning experiences that act as mediating mechanisms. This highlights the need for virtual environments that are pedagogically meaningful and engaging, ensuring that enthusiasm for technology is effectively translated into professional growth. While novelty may initially capture learners' attention, sustained outcomes depend on the quality of instructional design and the depth of immersion achieved (Makransky et al., 2021; Radianti et al., 2020). Recent studies further show that well-structured immersive environments can transform interest into active experimentation, reflection,

and skill refinement, thereby reinforcing their role as a bridge between technological interest and genuine pedagogical competence (Bi et al., 2025).

Implications for Rural Teacher Education

Taken together, the findings suggest that VR-based microteaching offers a promising instructional approach for elementary teacher education in rural contexts. Immersive learning experience and teaching efficacy emerge as key contributors to the development of basic teaching skills, while the influence of teaching anxiety appears to be minimized in immersive environments. These results are consistent with prior research highlighting the potential of technology-enhanced learning to address structural limitations in rural education, such as limited access to diverse classrooms and mentoring opportunities (Mazzuki, 2025; Radianti et al., 2020). Integrating such technology can effectively reduce the educational resource gap between urban and rural areas by providing equitable training opportunities (Tang et al., 2024).

From a practical perspective, the adoption of VR-based microteaching within teacher education programs represents a scalable approach for institutions in rural areas that often encounter limitations in infrastructure and restricted access to authentic classroom environments. Immersive simulations enable pre-service teachers to engage with a wide range of classroom scenarios that may not be available locally, thereby broadening their pedagogical exposure and enhancing their readiness to teach (Bi et al., 2025; Radianti et al., 2020). This is particularly relevant in rural contexts where opportunities for varied teaching practice are frequently constrained.

Furthermore, integrating immersive learning experiences with psychological readiness factors such as teaching efficacy suggests that effective teacher preparation should address not only technical competencies but also the development of internal confidence and emotional resilience. Recent studies highlight that technology-supported teacher education can foster adaptive expertise, allowing teachers to respond flexibly to diverse classroom challenges (Makransky & Petersen, 2021; Tang et al., 2024). As a result, VR-based microteaching can contribute to the development of elementary school teachers who are both competent and confident, better equipped to manage the complexities of rural and under-resourced educational environments.

CONCLUSION

This study examined the roles of teaching anxiety, teaching efficacy, immersive learning experience, and interest in virtual reality in shaping basic teaching skills among elementary pre-service teachers in rural contexts. The findings demonstrate that immersive learning experience is the most influential factor in enhancing basic teaching skills, followed by teaching efficacy. These results indicate that virtual reality–based microteaching provides meaningful and effective learning environments that support pedagogical skill development for pre-service teachers.

In contrast, teaching anxiety showed a negative but non-significant direct effect on basic teaching skills, suggesting that immersive and low-risk learning environments may reduce the disruptive impact of anxiety during teaching practice. Additionally, interest in virtual reality was found to influence basic teaching skills indirectly through immersive learning experience, highlighting the importance of learner engagement in technology-enhanced learning. Overall, the results confirm that VR-based microteaching is a promising instructional approach for preparing

elementary pre-service teachers, particularly in rural settings with limited access to diverse teaching experiences.

RECOMMENDATIONS

Based on the findings of this study, it is recommended that teacher education institutions, particularly those in rural contexts, integrate virtual reality–based microteaching into their instructional practices to enhance immersive learning experiences and strengthen teaching efficacy among pre-service teachers. Educators and curriculum designers should focus on developing well-structured and meaningful VR learning activities that support repeated practice and reflective teaching. Future research is encouraged to examine the long-term effects of VR-based microteaching on actual classroom performance and to explore additional psychological and contextual factors that may influence the development of teaching skills in diverse educational settings.

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