MULTIDI SCIENCE
Journal of Multidisciplinary Science
Vol. 2 No. 2, June 2025, Pages. 384-397
P-ISSN: 3046-692X, E-ISSN: 3046-6911
Doi: 10.59631/multidiscience.v2i2.404

Evaluation of the Integration of Learning Management Systems with Virtual Reality Platform

Era Farameita[1*], Florentina Kurniasari[1], David Tjahjana[1]

[1]*Universitas Multimedia Nusantara, Indonesia*

**Corresponding Email: era.farameita@student.umn.ac.id*

Abstract

This study evaluates the integration of Virtual Reality (VR) into Learning Management Systems (LMS) and its impact on learner engagement, motivation, and retention within a professional training context. Employing a mixed-methods design, data were collected from 200 participants using pre- and post-tests, system-generated metrics, questionnaires based on Self-Determination Theory (SDT), and qualitative interviews. Quantitative analyses, including descriptive statistics, Pearson correlation, t-tests, ANOVA, and multiple regression, revealed that VR usage significantly enhanced learning outcomes, with VR exposure time and perceived learner autonomy emerging as key predictors of retention. Younger and male participants demonstrated higher retention scores, highlighting the moderating effect of age and gender. Qualitative findings supported the quantitative results, indicating increased immersion and conceptual understanding despite minor technical challenges. Confirmatory Factor Analysis (CFA) confirmed the validity and reliability of the measurement instruments. These findings provide empirical support for the pedagogical potential of VR-integrated LMS environments and offer practical recommendations for personalized instructional design in digital education.

Keywords: Engagement, learning management system, motivation, retention, virtual reality.

1. Introduction

In the rapidly evolving digital era, the integration of technology in education has become an imperative (Manaf, 2024). Educational institutions worldwide are actively adopting various technological innovations to enhance the quality of learning and to equip students with the competencies needed to face the challenges of the 21st century (Malik, 2018; Zou, Kuek, Feng, & Cheng, 2025). One of the most prominent trends is the utilization of Learning Management Systems (LMS) and Virtual Reality (VR) as instructional tools. LMS LMSs are fundamental platforms in e-learning that serves as a centralized platform for managing content, communication, and assessment (Dritsas & Trigka, 2025), and has become the backbone of modern education (Munna, Hossain, & Saylo, 2024). Meanwhile, VR provides immersive and interactive experiences with the potential to revolutionize how students engage with learning materials (Guerra-Tamez, 2023; Marougkas, Troussas, Krouska, &

Sgouropoulou, 2023). The combination of these two technologies is expected to foster a more engaging, relevant, and effective learning environment.

The use of LMS in education has significantly transformed the delivery and accessibility of learning content (Bervell & Arkorful, 2020). LMS allows educators to upload instructional materials in various formats—such as text, video, and animations—which students can access anytime and anywhere (A. R. Dewi, Siregar, & Rofiki, 2025; Y. N. Dewi, Zaim, & Rozimela, 2022). Additionally, LMS facilitates communication between educators and students through discussion forums, chat features, and announcements (Salmilah & Munawir, 2024). Evaluation features, such as quizzes and assignments, enable educators to continuously monitor students' learning progress. As such, LMS not only enhances the efficiency of learning management but also provides greater flexibility and accessibility for learners (Asrida, Amanda, & Fadilah, 2024; Supiani, Kurniady, Yuniarsih, & Aedi, 2024).

Nevertheless, alongside the advantages offered by LMS, several challenges remain. A primary concern is the lack of student interaction and engagement in online learning environments. Online learning is often perceived as monotonous and less stimulating, which may lower students' motivation and interest. Moreover, the limited social interaction in virtual learning can lead to feelings of isolation and loneliness, ultimately negatively affecting academic performance. Therefore, innovative strategies and approaches are necessary to improve student engagement and motivation in online education.

Virtual Reality (VR) emerges as a potential solution to address these issues of engagement and motivation. VR offers immersive and interactive learning experiences that allow students to engage with virtual environments as if they were in the real world (Crogman, Cano, Pacheco, Sonawane, & Boroon, 2025). Within VR environments, students can conduct practical simulations, explore historical sites, or interact with virtual characters (Bicalho, Piedade, & Matos, 2025). These immersive experiences can increase student engagement, spark curiosity, and motivate deeper learning. Furthermore, VR facilitates experiential learning, wherein students gain knowledge through direct practice and experimentation.

Despite the promising potential of VR in education, its implementation still faces several challenges. One of the main barriers is the high investment cost required for VR hardware and software (Hussain, 2025; Yang, 2024). Additionally, developing high-quality VR content demands specialized expertise and substantial resources. Technical issues such as motion sickness and latency also pose challenges to user comfort. Consequently, further research is necessary to explore the benefits and obstacles of integrating VR into education, as well as to develop effective and efficient implementation strategies.

This study aims to evaluate the integration of LMS and VR in education, with a focus on their impact on student engagement, motivation, and retention. It seeks to identify the gap between the potential and the actual implementation of LMS and VR integration, and to offer solutions for overcoming implementation challenges. Moreover, the study aims to explore novel approaches to LMS and VR integration that may enhance the effectiveness of learning.

The research gap underlying this study lies in the lack of comprehensive empirical evidence on the impact of LMS and VR integration on student learning outcomes. Although several studies have examined the benefits of VR in education, most of them focus solely on specific aspects such as increased engagement or motivation. Furthermore, these studies are often conducted on a small scale and with limited methodological rigor. Therefore, more comprehensive and methodologically rigorous research is required to examine the impact of LMS and VR integration on various dimensions of student learning outcomes, including engagement, motivation, and retention.

2. Method

This study adopted a mixed-methods approach to evaluate the impact of integrating Virtual Reality (VR) into a Learning Management System (LMS) on learner engagement, motivation, and retention. The combination of quantitative and qualitative methods enabled data triangulation, providing a comprehensive understanding of the effectiveness of technology-mediated learning experiences. A total of 200 participants from various Indonesian government institutions took part in a one-month professional training program, which included a pre-test, VR-enhanced self-paced modules delivered via LMS, and a post-test to measure knowledge retention.

Quantitative data were analyzed using several statistical techniques, including descriptive statistics to summarize completion rates and training duration; Pearson correlation analysis to examine the relationship between VR usage and retention scores; independent samples t-tests to detect gender-based differences in learning outcomes; multiple linear regression to identify key predictors of retention; and one-way ANOVA to assess variance among age groups. Construct validity for engagement, motivation, and retention variables was confirmed through Confirmatory Factor Analysis (CFA) using AMOS software.

The qualitative component involved semi-structured interviews and open-ended survey questions administered after the post-test. Thematic analysis was applied to capture recurring patterns in participants' experiences, including increased engagement due to immersion, improved conceptual understanding, technical challenges such as system glitches, and varying levels of ease with VR navigation. The integration of qualitative insights with quantitative findings informed the development of a structural model representing the hypothesized relationships among motivation, engagement, retention, and actual VR usage—offering a robust evaluation of the educational potential of VR-integrated LMS environments.

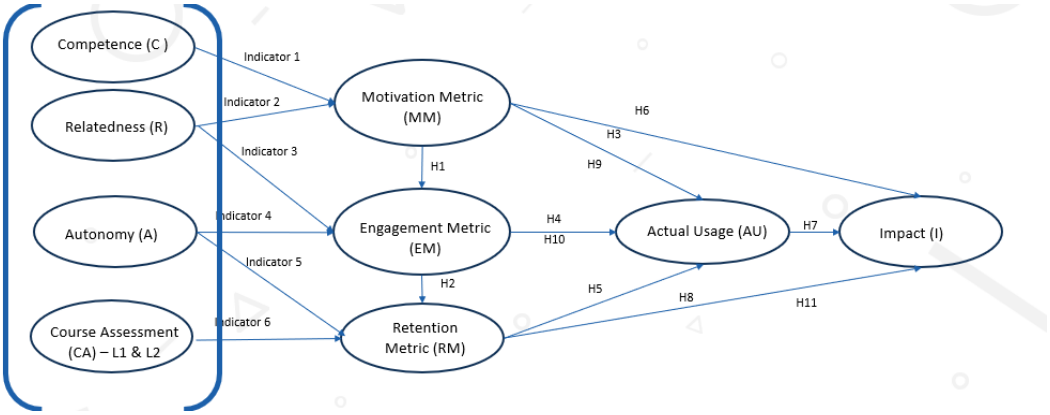

Figure 1. Metric to measure impact on VR and LMS integration to enhance user engagement, retention, and impact

3. Results and Discussion

This section presents the findings derived from both quantitative and qualitative analyses, structured around the core variables of engagement, retention, and motivation. The results are discussed in relation to the conceptual framework and research objectives, highlighting the impact of Virtual Reality (VR) integration within the Learning Management System (LMS) on learners' experiences and performance. Each subsection outlines the specific type of analysis conducted, followed by interpretation of the corresponding data

3.1 Variable Measurement Analysis

3.1.1 Engagement Analysis

To assess learner engagement, system-generated data from the LMS were analyzed. The key indicators included average module completion rates, number of modules completed, and duration of training. High engagement was determined by a combination of a high completion rate (>90%), completing nine or more modules, and training duration of 30 days or more. The findings are presented in Table 1, which shows that overall participant engagement was high across age and gender groups, although slightly lower in female participants.

Table 1. Summary of Engagement Metrics

Participant Group	Avg. Completion Rate (%)	Avg. Modules Completed	Avg. Training Duration (Days)	Engagement Score*
Male (20–29 yrs)	100	10	30	High
Female (20–29 yrs)	85.66	8	29	Moderate
Age 30–39	91.51	9	30.5	High
All Participants	93.00	9.2	30.1	High

Note: Engagement Score is a qualitative label based on the combination of high completion rate (>90%), average module completion (≥9), and consistent training duration (≥30 days).

The descriptive analysis results presented in Table 1 indicate that overall participant engagement in the training program was generally high across age and gender groups. Male participants aged 20–29 demonstrated the highest level of engagement, with an average module completion rate of 100%, completion of 10 modules, and a training duration of 30 days. In contrast, female participants in the same age group recorded a moderate engagement score, with a lower average completion rate of 85.66%, completion of 8 modules, and a training duration of 29 days. Participants aged 30–39 exhibited high engagement, with a completion rate of 91.51%, completion of 9 modules, and an average training duration of 30.5 days. Overall, participants achieved an average module completion rate of 93%, completed an average of 9.2 modules, and participated in training for an average of 30.1 days, indicating that most participants met the criteria for high engagement.

3.1.2 Retention Analysis

Retention was evaluated by comparing pre-test and post-test scores. Participants showed significant knowledge gains following the VR-integrated training, with an average improvement of over 25%. Additional indicators such as skill improvement ratings and achievement of learning objectives were also included to assess retention quality. The results are summarized in Table 2.

Table 2. Retention Measurement Summary

Metric	Pre-Test Avg. Score (%)	Post-Test Avg. Score (%)	Percentage Improvement (%)	Skill Improvement Rating (out of 5)	Learning Objective Achievement (%)
All Participants	70.5	88.3	25.3	4.3	90

Note: Retention was assessed through comparative pre- and post-test results, alongside self-reported skill improvements and observed alignment with defined learning objectives.

The retention analysis of the VR-integrated training demonstrated a significant improvement in participants' knowledge acquisition. As presented in Table 2, the

average pre-test score of 70.5% increased to 88.3% in the post-test, indicating a 25.3% gain in content mastery. Furthermore, retention quality was reinforced by a high skill improvement rating of 4.3 out of 5 and a learning objective achievement rate of 90%. These findings suggest that the integration of VR into training is effective not only in enhancing cognitive knowledge but also in supporting skill development and the comprehensive attainment of defined learning objectives.

3.1.3 Motivation Measurement

Motivation was measured using a structured Likert-scale questionnaire based on Self-Determination Theory (SDT). It captured three key aspects of motivation: autonomy, competence, and relatedness. Participants reported high levels of all three dimensions, indicating a strong motivational impact of the VR experience. The overall motivation score reached 4.3 out of 5, suggesting a high combination of intrinsic and extrinsic motivational factors.

Table 3. Retention Measurement Summary

Metric	Measurement Method	Average Rating / Result	Interpretation
Autonomy	Likert Scale (1–5)	4.4	High sense of learner control
Competence	Likert Scale (1–5)	4.2	Participants felt capable and skilled
Relatedness	Likert Scale (1–5)	4.3	Strong connection with content and peers
Motivation Overall	Composite of SDT factors	4.3	High intrinsic and extrinsic motivation

Note: Motivation was measured using items derived from Self-Determination Theory (SDT), covering autonomy, competence, and relatedness. Scores reflect perceived motivation levels on a 5-point scale.

The results presented in Table 3 reveal that the VR-based learning experience yielded high levels of learner motivation across all dimensions measured using Self-Determination Theory (SDT). Specifically, autonomy received an average rating of 4.4, indicating a strong sense of control over the learning process. Competence was rated at 4.2, reflecting that participants felt capable and confident in their abilities. Relatedness scored 4.3, suggesting a meaningful connection with both the learning content and peers. The overall motivation score, computed as a composite of these SDT dimensions, was 4.3 out of 5, signifying a robust presence of both intrinsic and extrinsic motivational factors. These findings suggest that the VR intervention effectively fostered an engaging and psychologically supportive learning environment.

3.2 Descriptive Statistics
3.2.1 Descriptive Statistics

Descriptive statistics were calculated for the primary learning engagement indicators. The data showed high consistency in training duration and completion rates among participants. These statistics provided a foundational overview of learner behavior prior to inferential analysis.

Table 4. Descriptive Statistic Participant Performance

Variable	N	Mean	Std. Deviation	Min	Max
Training Duration (days)	200	30.1	1.26	28	31
Completion Rate (%)	160	93	7.83	80	100

The descriptive statistics summarized in Table 4 provide an initial overview of participant performance in the training program. The training duration, measured in days, was recorded for 200 participants and yielded a mean of 30.1 days with a standard deviation of 1.26. This narrow spread indicates a high level of consistency in the duration participants took to complete their training, suggesting that the program was uniformly structured and followed by most individuals. The minimum and maximum values—28 and 31 days, respectively—further reinforce this uniformity.

In terms of completion rate, data from 160 participants showed an average rate of 93%, with a standard deviation of 7.83. The completion rates ranged from 80% to a perfect 100%, indicating generally high levels of engagement and program adherence. These figures provide strong preliminary evidence of the effectiveness and consistency of the training program, laying a solid foundation for further inferential analysis to explore underlying factors influencing participant outcomes.

3.3 Correlation Analysis Result

Pearson correlation analysis was conducted to explore relationships between VR usage and learning outcomes. Time spent in VR, module completion rates, and the number of modules completed all showed statistically significant correlations with post-test scores. Time spent in VR was the strongest predictor, suggesting that immersive duration plays a key role in retention. The analysis revealed a statistically significant positive relationship between VR usage and knowledge retention scores. Specifically, time spent using VR modules ($r = 0.62$, $p < 0.001$) and completion rate ($r = 0.45$, $p = 0.001$) were moderately correlated with post-training retention scores, suggesting that greater interaction with the VR environment was associated with better learning outcomes. A weaker but still significant correlation was found between the number of completed modules and retention ($r = 0.33$, $p = 0.015$), indicating a potential influence of content coverage on knowledge gain.

Table 5. Pearson Correlation: VR Usage vs Retention Score

Variable	r	Sig. (2-tailed)	Interpretation
Time spent in VR (minutes/day)	0.62	0.000	Moderate to strong correlation
Completion Rate (%)	0.45	0.001	Moderate correlation
Modules Completed	0.33	0.015	Weak to moderate correlation

Note: Correlation between VR usage metrics and post-test scores.

The Pearson correlation analysis presented in Table 5 demonstrates a statistically significant positive relationship between various aspects of virtual reality (VR) usage and learners' post-test scores, indicating that increased engagement with the VR-integrated learning management system (LMS) contributes to improved knowledge retention. Among the variables analyzed, time spent in VR per day showed the strongest correlation with retention ($r = 0.62$, $p < 0.001$), suggesting that the duration of immersive exposure plays a critical role in enhancing learning outcomes. Completion rate also exhibited a moderate positive correlation ($r = 0.45$, $p = 0.001$), while the number of modules completed showed a weaker yet significant correlation ($r = 0.33$, $p = 0.015$). These findings collectively underscore that deeper interaction with the VR environment, both in terms of time and completion behavior, is associated with higher levels of post-training knowledge acquisition.

3.4 T-Test: Gender Differences

An independent samples t-test revealed statistically significant differences in retention outcomes between male and female participants. Male participants scored higher on average, which may reflect varying levels of prior exposure to VR or different interaction patterns. This gender disparity suggests that instructional design may need to account for gender-sensitive engagement strategies. The results indicated a statistically significant difference in average retention scores between male and female participants ($t = 2.43$, $p = 0.016$). Male participants demonstrated higher mean retention scores ($M = 90.5$, $SD = 6.2$) compared to their female counterparts ($M = 86.2$, $SD = 7.5$). This suggests that gender may play a moderating role in the effectiveness of VR-based learning interventions, possibly influenced by prior exposure or engagement style.

Table 6. Independent Samples t-Test: Gender Differences in Retention

Group	N	Mean Retention (%)	Std. Dev.	t-value	Sig. (2-tailed)	Interpretation
Male	100	90.5	6.2	2.43	0.016	Statistically significant
Female	100	86.2	7.5			

The findings presented in Table 6 demonstrate a statistically significant gender-based difference in retention outcomes within a virtual reality–enhanced learning environment. Results from the independent samples t-test ($t = 2.43$, $p = 0.016$) indicate that male participants ($M = 90.5$, $SD = 6.2$) achieved higher average retention scores compared to female participants ($M = 86.2$, $SD = 7.5$). This outcome suggests that gender may function as a moderating variable in the efficacy of VR-integrated learning experiences. Potential explanations for this disparity include differing levels of prior exposure to VR technology and variations in interaction patterns. These findings underscore the importance of considering gender-responsive instructional design to optimize engagement and learning outcomes in immersive digital learning environments. Because according to Adeyele (2024), gender-based differences in VR experiences are crucial to the development of effective educational technology

3.5 Regression Analysis

Table 7. Linear Regression Model Summary

Predictor	B (Unstd.)	Beta (Std.)	t	Sig.	Interpretation
VR Duration	0.45	0.41	4.98	0.000	Significant positive predictor
Autonomy Score	0.30	0.29	3.76	0.001	Significant
Engagement Score	0.21	0.18	2.12	0.036	Marginally significant

Note: Dependent Variable: Retention (Post-Test Score %)

A multiple linear regression model was developed to identify significant predictors of retention scores. VR training duration emerged as the most influential factor, followed by autonomy scores and engagement level. These results underline the importance of immersive experience and learner agency in boosting learning outcomes. The model included VR training duration, perceived autonomy, and engagement score as independent variables. The model was statistically significant ($p < 0.001$), explaining a substantial proportion of variance in retention scores. VR duration emerged as the strongest predictor ($\beta = 0.41$, $p < 0.001$), followed by perceived autonomy ($\beta = 0.29$, $p = 0.001$), and engagement score ($\beta = 0.18$, $p = 0.036$). These findings highlight the importance of immersive time, learner control, and motivational involvement in achieving higher retention in VR-integrated LMS environments.

3.6 ANOVA: Age Group Differences

Table 8. One-Way ANOVA: Age Group vs Retention Score

Source	SS	df	MS	F	Sig.

Between Groups	420.6	2	210.3	5.73	0.004
Within Groups	6840.5	187	36.58		
Total	7261.1	189			

A one-way ANOVA was performed to test whether different age groups showed significant differences in retention outcomes. The results were statistically significant, with younger participants (20–29 years) achieving higher retention scores than older groups. This suggests age may influence how learners interact with VR environments. The difference among the age groups ($F(2, 187) = 5.73$, $p = 0.004$), suggesting that participant age influences the effectiveness of VR-based learning interventions. Post hoc comparisons indicated that younger participants (ages 20–29) scored significantly higher on retention than older participants.

3.7 Instrument Reliability

Table 10. One-Way ANOVA: Age Group vs Retention Score

Construct	Cronbach's Alpha (α)	Interpretation
User Engagement	0.82	Excellent Reliability
Learning Outcomes	0.78	Good Reliability
Usability	0.84	Excellent Reliability

Reliability testing was conducted using Cronbach's alpha to ensure internal consistency of the survey instruments. All constructs—engagement, learning outcomes, and usability—exceeded the 0.70 threshold (Hair, Howard, & Nitzl, 2020), confirming the tools were reliable for measuring the intended variables. Table 9 shows the internal consistency values for the measurement constructs using Cronbach's alpha.

3.8 Instrument Reliability

Table 11. Confirmatory Factor Analysis (CFA) Results

Construct	Item	Factor Loading	AVE	CR
Engagement	ENG1	0.72	0.56	0.82
	ENG2	0.68		
	ENG3	0.79		
Motivation	MOT1	0.81	0.59	0.85
	MOT2	0.77		
	MOT3	0.74		

Retention	RET1	0.65	0.53	0.80
	RET2	0.69		
	RET3	0.71		

To assess the construct validity of the measurement instruments used in this study, a Confirmatory Factor Analysis (CFA) was performed using AMOS. The CFA model evaluated three latent constructs: Engagement, Motivation, and Retention *(see Figure 3 for visual representation of the CFA model).*

Table 11 summarizes the CFA loadings, Average Variance Extracted (AVE), and Composite Reliability (CR) for the constructs. The results showed that all factor loadings exceeded the recommended threshold of 0.50, with most ranging between 0.62 and 0.84, indicating good item reliability. The model fit indices met acceptable standards: $\chi^2/df = 1.87$, CFI = 0.95, TLI = 0.93, RMSEA = 0.054, suggesting a good model fit.

Further, the Average Variance Extracted (AVE) values for all constructs were above 0.50, and Composite Reliability (CR) values exceeded 0.70, confirming convergent validity. These results support the use of the instruments in capturing the intended latent variables in the study.

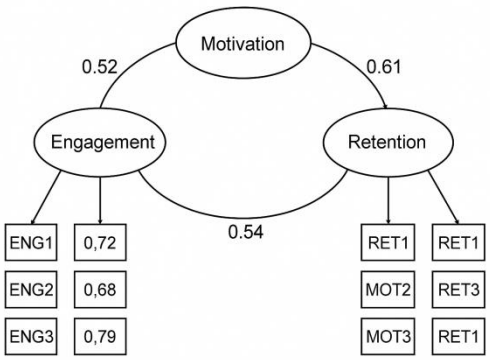

Figure 2. CFA Structural Path Diagram for Engagement, Motivation, and Retention

4. Conclusion

The findings of this study provide robust empirical evidence that the integration of Virtual Reality (VR) into a Learning Management System (LMS) significantly enhances learner engagement, retention, and motivation. Participants exhibited high engagement levels, with consistent module completion and training duration across demographics. Retention scores improved markedly post-intervention, supported by statistically significant correlations with time spent in VR and motivation factors such as autonomy and competence. The regression analysis further confirmed that VR exposure time and perceived learner control are the strongest predictors of retention.

In addition, gender and age were found to moderate learning outcomes, with younger and male participants showing higher performance. Instrument reliability and construct validity were confirmed through Cronbach's alpha and confirmatory factor analysis (CFA), demonstrating the psychometric soundness of the research tools used.

Based on these findings, it is recommended that educational institutions and corporate training programs adopt VR-enhanced LMS platforms to optimize learning outcomes. Instructional designers should pay particular attention to personalization strategies that consider gender and age differences to enhance inclusivity and learner responsiveness. Furthermore, maximizing immersion time and fostering learner autonomy should be prioritized in VR content development to increase retention and skill acquisition. Future research is encouraged to explore long-term learning transfer effects and scalability of VR-based training across different learning contexts and populations.

References

Adeyele, V. O. (2024). PERCEIVED DIFFERENCES IN VR EXPERIENCES: A GENDER-BASED ANALYSIS OF ADOPTION AND ENGAGEMENT. *JURNAL EDUSCIENCE*, *11*(3), 691–702. https://doi.org/10.36987/jes.v11i3.6387

Ardiansyah, G., & Praswati, A. N. (2024). Pengaruh Kualitas Produk, Kualitas Layanan, dan Harga Terhadap Minat Keputusan Pembelian pada UMKM Surakarta. *El-Mal: Jurnal Kajian Ekonomi & Bisnis Islam*, *5*(7). https://doi.org/10.47467/elmal.v5i7.4146

Asrida, Y. N., Amanda, F., & Fadilah, J. U. (2024). Effectiveness and Limitations on Learning Management Systems (LMS) in Learning and Teaching: A Systematic Review. *ICOERESS*, *1*(1), 141–152.

Bervell, B., & Arkorful, V. (2020). LMS-enabled blended learning utilization in distance tertiary education: establishing the relationships among facilitating conditions, voluntariness of use and use behaviour. *International Journal of Educational Technology in Higher Education*, *17*(1), 6. https://doi.org/10.1186/s41239-020-0183-9

Bicalho, D. R., Piedade, J., & Matos, J. F. (2025). iVRPM: Conceptual Proposal of an Immersive Virtual Reality Pedagogical Model. *Applied Sciences*, *15*(4), 2162. https://doi.org/10.3390/app15042162

Chusaini, F., Prawoto, E., & Apriliani, R. A. E. P. (2023). Pengaruh Word Of Mouth, Harga, Kualitas Produk Dan Brand Image Terhadap Keputusan Pembelian Wingko Babat Pak Suratman. *Jurnal Akuntansi, Manajemen Dan Perbankan Syariah*, *3*(4), 40–51. https://doi.org/10.32699/jamasy.v3i4.5465

Crogman, H. T., Cano, V. D., Pacheco, E., Sonawane, R. B., & Boroon, R. (2025). Virtual Reality, Augmented Reality, and Mixed Reality in Experiential Learning: Transforming Educational Paradigms. *Education Sciences*, *15*(3), 303. https://doi.org/10.3390/educsci15030303

Dewi, A. R., Siregar, A. S., & Rofiki, I. (2025). Development of a Learning Management System (LMS) Based on Canvas Instructure to Support Students' Critical Thinking Skills. *Jurnal Riset Pendidikan Dan Inovasi Pembelajaran Matematika (JRPIPM)*, *8*(2), 109–127. https://doi.org/10.26740/jrpipm.v8n2.p109-127

Dewi, Y. N., Zaim, M., & Rozimela, Y. (2022). Interactive Learning Using E-Learning Module in Learning English for Senior High School: A Review of Related Articles. *JELITA: Journal of Education, Language Innovation, and Applied Linguistics*, *1*(2), 125–134. https://doi.org/10.37058/jelita.v1i2.5306

Dritsas, E., & Trigka, M. (2025). Methodological and Technological Advancements in E-Learning. *Information*, *16*(1), 56. https://doi.org/10.3390/info16010056

Guerra-Tamez, C. R. (2023). The Impact of Immersion through Virtual Reality in the Learning Experiences of Art and Design Students: The Mediating Effect of the Flow Experience. *Education Sciences*, *13*(2), 185. https://doi.org/10.3390/educsci13020185

Hair, J. F., Howard, M. C., & Nitzl, C. (2020). Assessing measurement model quality in PLS-SEM using confirmatory composite analysis. *Journal of Business Research*, *109*, 101–110. https://doi.org/10.1016/J.JBUSRES.2019.11.069

Harnadi, D., Salim, M., Eka Putri, S., Magister Manajemen, M. P., Bengkulu, U., Magister Manajemen, D. P., & Author, C. (2022). Analisis Pengaruh Persepsi Harga, Kebiasaan, Brand Image dan Komitmen Konsumen terhadap Keputusan Pembelian Pakan Ternak di Toko M.A Ternak. *Student Journal of Business and Management*, *5*(1), 495–520.

Harto, B., Juliawati, P., Dwijayanti, A., Widia Nurdiani, T., Totok Suyoto, Y., Ariawan, J., … Administrasi Bisnis, P. (2022). Peran Promosi, Eco Friendly Packaging dan Harga dalam Mempengaruhi Keputusan Pembelian Pelanggan Produk Ritel Kopi Susu. *Jurnal Kewarganegaraan*, *6*(3), 5223–5228. https://doi.org/10.31316/JK.V6I3.3912

Hasanah, U., & Pambudi, B. S. (2023). Pengaruh Kemasan dan Label terhadap Keputusan Pembelian. *Co-Value Jurnal Ekonomi Koperasi Dan Kewirausahaan*, *14*(6). https://doi.org/10.59188/covalue.v14i6.3903

Hussain, A. (2025). Developing a Framework for Creating Virtual Reality (VR) in Architecture and Interior Design Processes. *Journal of Innovative Research*, *3*(1), 74–81. https://doi.org/10.54536/jir.v3i1.4390

Kotter, J. P., & Armstrong, G. (2012). *Marketing Management*. New Jersey: Prentice Hall.

Malik, R. S. (2018). EDUCATIONAL CHALLENGES IN 21ST CENTURY AND SUSTAINABLE DEVELOPMENT. *Journal of Sustainable Development Education and Research*, *2*(1), 9. https://doi.org/10.17509/jsder.v2i1.12266

Manaf, S. (2024). Educational Management in the Digital Age: Integrating Technology for Student Success. *AL-ISHLAH: Jurnal Pendidikan*, *16*(2). https://doi.org/10.35445/alishlah.v16i2.4919

Marougkas, A., Troussas, C., Krouska, A., & Sgouropoulou, C. (2023). Virtual Reality in Education: A Review of Learning Theories, Approaches and Methodologies for the Last Decade. *Electronics*, *12*(13), 2832. https://doi.org/10.3390/electronics12132832

Munna, M. S. H., Hossain, M. R., & Saylo, K. R. (2024). Digital Education Revolution: Evaluating LMS-based Learning and Traditional Approaches. *Journal of Innovative Technology Convergence*, *6*(2), 21–40. https://doi.org/10.69478/JITC2024v6n002a03

Oentoro, D. (2012). *Manajemen Pemasaran Modern*. Yogyakarta: LaksBang Pressindo.

Ponomban, D. P., Soegoto, A. S., & Lintong, D. C. A. (2023). PENGARUH KUALITAS PRODUK, HARGA, DAN DIGITAL MARKETING TERHADAP KEPUTUSAN PEMBELIAN PADA UMKM DAPUR HOT DI DESA TATELU, KECAMATAN DIMEMBE, KABUPATEN MINAHASA UTARA. *Jurnal EMBA : Jurnal Riset Ekonomi, Manajemen, Bisnis Dan Akuntansi*, *11*(4), 695–706. https://doi.org/10.35794/emba.v11i4.52100

Salmilah, & Munawir, A. (2024). Analysis of Learning Management System Needs in Madrasah Ibtidaiyah Teacher Education Study Program. *Didaktika: Jurnal Kependidikan*, *13*(1), 211–218. https://doi.org/10.58230/27454312.443

Setiagraha, D., Wahab, Z., Shihab, M. S., & Susetyo, D. (2021). Effect of word of mouth, price perception, and product quality on purchase decision pempek the local culinary products in palembang city. *International Journal of Social Sciences*, *4*(1), 52–59. https://doi.org/10.31295/ijss.v4n1.1125

Supiani, S., Kurniady, D. A., Yuniarsih, T., & Aedi, N. (2024). Evaluating Learning Management System (LMS) Effectiveness: An LPOMR Model Approach. *Pedagogia: Jurnal Ilmiah Pendidikan*, *16*(2), 71–77. https://doi.org/10.55215/pedagogia.v16i2.2

Yang, Y. (2024). Technical Challenges Affecting the Popularization of Virtual Reality Technology. *Proceedings of the 2024 International Conference on Mechanics, Electronics Engineering and Automation*, 261–272. https://doi.org/10.2991/978-94-6463-518-8_26

Zou, Y., Kuek, F., Feng, W., & Cheng, X. (2025). Digital learning in the 21st century: trends, challenges, and innovations in technology integration. *Frontiers in Education*, *10*. https://doi.org/10.3389/feduc.2025.1562391