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# Hybrid Interactive Media Based on Project-Based Learning (PjBL) with VR 360 Technology: An Innovation in Economics Learning for University Students

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**Abstract:** This study aims to develop Hybrid Interactive Media based on Project-Based Learning (PjBL) integrated with 360-degree Virtual Reality (VR) technology to enhance students' conceptual understanding and 21st-century skills. This research employed a Research and Development (R&D) approach using the ADDIE model, encompassing needs analysis, prototype design, media development, implementation, and evaluation. Data were collected through expert validation sheets, lecturer and student response questionnaires, and learning outcome tests, and were analyzed using descriptive statistics and paired-sample t-tests. Expert assessments indicated that the media was highly valid (M = 4.42), while practicality was supported by lecturers' responses (M = 4.36, highly practical) and students' responses (M = 4.29, practical). Effectiveness testing using a one-group pre-test–post-test design showed significant improvement in learning outcomes, with mean scores increasing from 63.1 to 82.5 ($t(29) = 10.12$, $p < 0.001$). Students' critical thinking skills also improved from 2.8 to 4.0 (scale 1–5). These findings indicate that integrating VR 360 with PjBL effectively enhances conceptual understanding, critical thinking, and learning motivation in economics education. This study contributes to the literature by extending the application of VR technology beyond STEM fields into economics education and offers practical insights for innovative learning in higher education.

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## Introduction

Economics learning in higher education often faces challenges, particularly due to the abstract nature of the subject, which is considered difficult to connect with everyday life. Students frequently struggle to relate economic concepts to social dynamics, business practices, and public policy, which may lead to limited engagement and a lack of deep understanding (Begum, 2024; Chankseliani & McCowan, 2020). On the other hand, advances in digital technology—particularly the use of Virtual Reality (VR)—offer innovative solutions for creating more immersive, contextual, and interactive learning experiences. Previous studies have shown that integrating VR into education enhances comprehension of complex concepts that were once considered difficult to grasp (Aruanno et al., 2025; Azis & Cantafio, 2023).

VR serves as an effective tool for students to explore and understand economic aspects through real-world situations and simulated scenarios. Immersive learning experiences enable students to actively engage, increase motivation, and accelerate their learning process (Deng, 2024; Saidakhror, 2024). For example, prior research demonstrated that implementing VR in learning significantly improved the understanding of abstract concepts (Cabural, 2024). This is particularly important given the strong link between

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education and economic growth, as effective education contributes directly to societal economic development (Deng, 2024; H. Huang, 2024).

The use of VR in education not only strengthens conceptual understanding but also supports the development of relevant skills required in the labor market. This underscores the need for higher education institutions to adapt to emerging technologies in order to enhance student competencies and better prepare them for the evolving demands of the workforce (Kononets et al., 2021; Zhou et al., 2023). Within this context, VR has been found to positively influence communication and collaboration skills, both of which are essential for economics graduates (Begum, 2024; Kononets et al., 2021). Employing VR alongside appropriate pedagogical approaches can therefore foster learning environments that are not only engaging but also aligned with real-world needs. Consequently, higher education institutions must seriously consider integrating digital technologies into their curricula to prepare students for future social and economic challenges (Azis & Cantafio, 2023; Tene et al., 2024).

The integration of 360-degree VR in instructional media allows students to explore real-world economic contexts, such as market simulations, production activities, and global economic phenomena. This approach enhances student engagement and knowledge retention, as VR provides immersive and realistic learning experiences (Mustikasari et al., 2024; Robi'in et al., 2022). When combined with Project-Based Learning (PjBL), economics education can shift from being predominantly theory-driven to a more practice-oriented process focused on solving real-world problems through collaborative projects. This fosters the development of 21st-century skills such as critical thinking, creativity, communication, and collaboration among students (Jailani & Qudsiyah, 2020).

Although previous studies have demonstrated the effectiveness of Virtual Reality in enhancing motivation, conceptual understanding, and immersive learning experiences, most of this research has been concentrated in STEM fields, with limited application in the social sciences, particularly economics education. Existing studies also tend to use VR primarily as a visualization tool, without integrating it into pedagogical approaches that require active student engagement, such as Project-Based Learning (PjBL). Yet, the combination of 360° VR and PjBL has significant potential to create more contextual, collaborative, and problem-oriented learning experiences. This gap is especially evident in the lack of research exploring how 360° VR media can be systematically designed to support project-based economic tasks that demand analysis, creativity, and real-world application of economic concepts. Therefore, this study is essential in addressing these shortcomings by developing and evaluating interactive learning media that integrate 360° VR with PjBL specifically for economics education in higher education settings. Previous studies have shown that deep learning experiences facilitated by VR and collaborative projects significantly improve students' understanding and analytical skills (Jailani & Qudsiyah, 2020). Thus, integrating modern technologies such as VR into economics learning is crucial not only for capturing student interest but also for preparing them to face real-world challenges (Purnasari & Sadewo, 2020).

Research on the integration of VR in education has repeatedly demonstrated its effectiveness in enhancing student motivation and learning outcomes (C.-L. Huang et al., 2020; Radianti et al., 2020). However, the existing literature reveals a notable tendency: most studies have focused on science, technology, engineering, and mathematics (STEM), while its application in the social sciences, particularly economics, remains limited (Duncan et al., 2022). Addressing this research gap, the present study occupies a strategic position. Rather than merely adopting VR, this study specifically develops more accessible 360° VR media

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and integrates it with a Project-Based Learning (PjBL) approach within the context of economics education in higher education. This combination is expected to create immersive and contextual learning environments where students can translate economic theories into real-world applications through simulated projects in virtual spaces. Therefore, this study aims to fill the empirical gap by developing and testing interactive media designed for project-based economics learning at the university level.

## Research Method

This study employed a Research and Development (R&D) approach using the ADDIE model (Analysis, Design, Development, Implementation, and Evaluation). In the analysis stage, the needs of students and lecturers were identified through interviews, questionnaires, and curriculum review of economics courses to better understand student characteristics. During the design stage, a prototype of interactive learning media incorporating 360° VR content was developed to support both macroeconomics and microeconomics topics. In the development stage, the interactive media was created and validated by three experts from relevant fields (Saurik et al., 2019).

The implementation stage was carried out through a limited trial with students of the Economics Education study program, using a one-group pre-test–post-test design to assess media effectiveness. The evaluation phase involved analyzing the validity, practicality, and cost-effectiveness of the media through research instruments such as expert validation questionnaires and economics learning achievement tests (Wahyuni et al., 2023). Validation results were analyzed using descriptive quantitative methods, while effectiveness was measured using paired-sample t-tests. Student and lecturer responses were analyzed descriptively to assess media acceptance. The data analysis was conducted using SPSS, which was employed to perform descriptive statistics and paired-sample t-tests. Before running the t-test, key statistical assumptions—normality and homogeneity of variance—were examined to ensure the appropriateness of the analysis. The criteria for determining the quality of the developed media were as follows: validity was established if expert evaluation scores met the "valid" category ($\geq 4.00$ on a 5-point scale), practicality was confirmed when lecturer and student response scores reached the "practical" or "very practical" level ($\geq 4.00$), and effectiveness was demonstrated through a statistically significant improvement in learning outcomes ($p < 0.05$) between the pre-test and post-test.

The study was conducted at Universitas PGRI Argopuro Jember, specifically within the Economics Education study program. This location was chosen due to the need to enhance the quality of economics learning through innovative digital interactive media, supported by institutional commitment to technology-based instructional development. The research subjects consisted of students enrolled in the Economics Education program. The participants in this study were selected using purposive sampling to ensure alignment with the research objectives. A total of 30 students participated in the limited trial, chosen based on specific criteria such as enrollment in the Economics Education study program, completion of foundational economics courses, and readiness to engage in VR-based learning activities. In addition to the student participants, two lecturers were involved as practitioner validators who provided assessments of the media's practicality. For content, design, and technological validation, the media was evaluated by three experts consisting of an economics subject-matter expert, an instructional media expert, and an educational technology expert.

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## Results and Discussion

### Media Validity

The expert validation results indicated that the Hybrid Interactive Media based on Project-Based Learning (PjBL) with 360° VR technology achieved an average score of 4.42, categorized as *very valid*. Specifically, the assessed aspects included content relevance, media design quality, integration of the PjBL model, ease of use, and the attractiveness of VR content. The highest scores were obtained for content alignment with the curriculum (4.70) and the attractiveness of VR content (4.60). These findings demonstrate that the media is considered highly relevant to the needs of economics learning and effective in enhancing student motivation through immersive experiences.

Nevertheless, a weakness was identified in the aspect of VR navigation ease (3.90), suggesting the need for further simplification to improve user-friendliness. Overall, the expert validation results confirm that the media is feasible for classroom implementation, with only minor revisions required—particularly in addressing technical navigation issues.

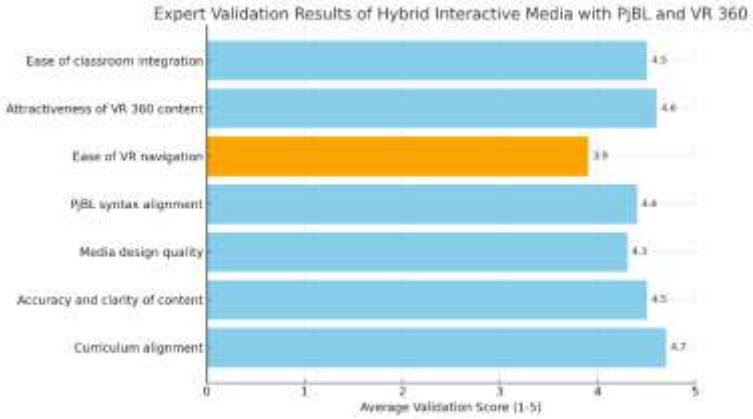


**Figure 1. Expert Validation of Hybrid Interactive Media Based on PjBL with 360° VR Technology.**

### Media Practicality

The practicality test results indicated that the learning media received positive feedback from both lecturers and students. The average score from lecturers was 4.36, categorized as *very practical*. This suggests that lecturers found the media effective in facilitating teaching, particularly in supporting collaborative project-based learning. Meanwhile, student responses yielded an average score of 4.29, categorized as *practical*. Students reported that the media helped them better understand the connection between economic theory and real-world practice, while also increasing their learning motivation through the immersive experiences offered by 360° VR technology. The difference between lecturer and student scores was relatively small, indicating a consistent perception that the media is suitable for classroom use.

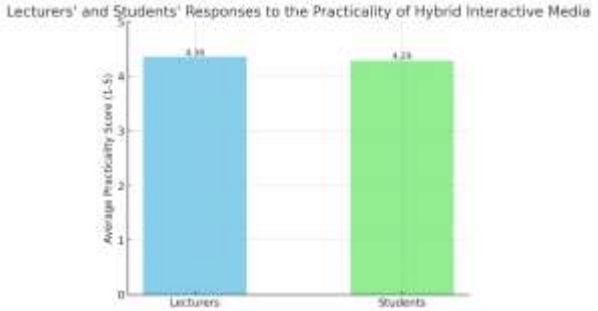


**Figure 2. Lecturers' and Students' Responses**

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Overall, the data presented in Figure 2 confirms that both lecturers and students rated the media within the practical–very practical range, with a generally positive tendency toward its classroom implementation.

**Media Effectiveness**

The results of the paired sample t-test revealed a significant improvement in student learning outcomes after using the Hybrid Interactive Media based on Project-Based Learning (PjBL) with 360° VR technology. The mean pre-test score was 63.1 (SD = 7.4), which increased to 82.5 (SD = 6.7) on the post-test. Statistical analysis produced $t(29) = 10.12$, $p < 0.001$, indicating a significant difference between learning outcomes before and after the intervention.

In addition, students' critical thinking skills also showed notable improvement. The average score increased from 2.8 at baseline to 4.0 after using the media (on a 1–5 scale). These findings demonstrate that the media is effective not only in enhancing conceptual understanding of economics but also in strengthening students' critical thinking skills in solving project-based problems.

**Table 1. Results of Paired Sample t-test on Student Learning Outcomes**

| Variable | Pre-test (M ± SD) | Post-test (M ± SD) | t(df) | p-value | Remarks |
|---|---|---|---|---|---|
| Learning Outcomes | 63.1 ± 7.4 | 82.5 ± 6.7 | 10.12 (29) | < 0.001 | Significant |
| Critical Thinking | 2.8 (scale 1–5) | 4.0 (scale 1–5) | – | – | Significantly improved |

Table 1. Results of the paired sample t-test indicate a significant improvement in students' learning outcomes after using the Hybrid Interactive Media based on PjBL with 360° VR technology. The mean score increased from 63.1 (SD = 7.4) in the pre-test to 82.5 (SD = 6.7) in the post-test, $t(29) = 10.12$, $p < 0.001$. In addition, students' critical thinking skills improved from an average of 2.8 to 4.0 (on a 1–5 scale), showing a notable enhancement.

**Discussion**

The findings of this study indicate that Hybrid Interactive Media integrating Project-Based Learning (PjBL) with 360° VR technology is valid, practical, and effective for university-level economics learning. Expert evaluations confirmed that the media meets essential content, design, and technological criteria, particularly in terms of curriculum alignment and the immersive quality of its VR components, demonstrating its suitability for instructional use. In terms of practicality, both lecturers and students reported that the media was easy to apply in classroom settings and supported collaborative, project-oriented learning. Students also noted that the immersive VR environment helped them better connect economic theories with real-world contexts. Beyond usability, the media proved effective in improving students' learning outcomes and critical thinking skills, with post-intervention performance showing clear gains compared to the baseline. These improvements suggest that combining VR 360° with PjBL provides a meaningful learning experience that enhances not only conceptual understanding but also higher-order thinking—competencies increasingly central to economics education in the digital era.

This study demonstrates that Hybrid Interactive Media with PjBL and VR 360 technology is valid, practical, and effective for economics learning in higher education. The results align with previous research showing that VR technology enhances student engagement and comprehension of complex concepts. For example, (Bhatia & Hesse, 2023; Rafiq et al., 2022) confirmed that VR in technical and vocational education provides

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immersive learning experiences, enhances student engagement, and contributes positively to learning outcomes. In science, VR has also been shown to help students understand abstract and complex concepts, such as microbiology (Mokmin & Apandi, 2025) and physics kinematics (Tito Cruz et al., 2023). Thus, this study strengthens the evidence that VR is not merely a visualization tool but a transformative medium for student interaction with knowledge.

The novelty of this research lies in its application to economics by integrating VR with PjBL. While most studies have focused on science, engineering, and STEM fields, the application of VR in social sciences—particularly economics—remains limited. The integration of VR into PjBL allows students to directly experience simulations of markets, consumer behavior, and production dynamics in virtual contexts that closely resemble real-world conditions. This finding is consistent with (Lopez-Ozieblo et al., 2025; Shah & Riener, 2025), who emphasize that VR creates dynamic learning environments that support experiential and collaborative learning. In economics, this approach not only strengthens theoretical understanding but also develops 21st-century skills such as critical thinking, problem-solving, communication, and collaboration.

The application of VR in PjBL also has significant implications for the role of lecturers. Findings show that lecturers view the media as highly practical in facilitating collaborative learning. This signals a shift in the role of lecturers from mere knowledge transmitters to facilitators who guide students in constructing knowledge through real-world projects. This view aligns with (Oumaima et al., 2023), who noted that VR enhances collaboration and social engagement in learning. Similarly, Bhogayata et al. (2025) stressed the importance of lecturers' pedagogical readiness in using VR technology to maximize its cognitive impact on students.

Nevertheless, several challenges remain in implementing VR 360. First, technical aspects such as ease of navigation need further improvement. Expert validation indicated that navigation scored lower compared to other indicators, suggesting the need for a simplified and user-friendly interface. Second, limited access to technology in many Indonesian universities may hinder equal opportunities for adopting VR. This is reinforced by (Ramadhan et al., 2024), who emphasized the importance of addressing ethical issues, accessibility, and user health concerns, such as motion sickness. Therefore, developing VR-based media in economics requires not only technological innovation but also infrastructure support, policy alignment, and pedagogical capacity building for lecturers.

Overall, this study reinforces the literature that VR can improve engagement and conceptual understanding in learning, as has been proven in science and engineering. The novelty of this research highlights that the same principles can be effectively applied in economics through PjBL. By offering immersive learning experiences integrated with real projects, students are not only able to understand economic concepts more deeply but are also encouraged to develop critical thinking, collaboration, and creativity. This finding expands the scope of VR applications from STEM to the social sciences and contributes to innovation in higher education learning practices.

The findings of this study contribute to the literature on VR in education by integrating PjBL in the social sciences, specifically economics. Theoretically, this research extends the scope of VR studies—previously dominated by STEM—into economics. The results reinforce constructivist learning theory, which emphasizes the importance of contextual and collaborative learning for deeper understanding.

Interviews with lecturers revealed that the media transformed their roles from knowledge transmitters to facilitators, aligning with 21st-century teaching paradigms. This

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supports (Oumaima et al., 2023), who highlighted VR's role in fostering social interaction and collaboration. Moreover, students reported that the VR-based media helped them connect theory with real-world practice, supporting Kolb's experiential learning theory, which emphasizes the importance of direct experience in the learning process. Thus, this research not only validates the effectiveness of VR but also proposes a new conceptual model for integrating VR with PjBL in economics education.

From a practical perspective, the findings provide several implications for lecturers, students, and educational institutions.

1) For lecturers, VR 360-based Hybrid Interactive Media simplifies the facilitation of collaborative learning. Interviews revealed that the media helps them design more varied and contextual learning, reducing reliance on lecture-dominated methods.
2) For students, the media increases motivation and understanding of economic concepts. Students reported greater interest and an improved ability to relate theory to real-world scenarios, such as market simulations or production dynamics. This highlights VR 360 as an effective tool for bridging theory and practice, while also fostering critical thinking and problem-solving skills.
3) For institutions, the study recommends adopting VR technology in economics programs. However, interviews also revealed barriers such as limited devices and technology access. Therefore, successful implementation requires not only technological infrastructure but also pedagogical training for lecturers and supportive institutional policies to ensure VR adoption becomes a long-term educational strategy.

The main limitation of this study lies in its small-scale trial within a single study program, suggesting that future research should expand to larger samples, diverse contexts, and cross-disciplinary applications.

## Conclusion

This study concludes that Hybrid Interactive Media based on PjBL with VR 360 technology is valid, practical, and effective in economics learning at the university level. Expert validation confirmed the alignment of the media with the curriculum and the attractiveness of the VR content, although navigation requires further refinement. Lecturers and students responded positively, particularly regarding the facilitation of collaborative learning and the connection between theory and practice. In terms of effectiveness, the media significantly improved students' learning outcomes and critical thinking skills. The findings support the literature showing that VR enhances engagement and conceptual understanding and extend its application to economics through PjBL integration. Theoretically, this study enriches constructivist and experiential learning theories by incorporating VR in the social sciences. Practically, the results provide recommendations for universities to adopt VR-based media to foster more interactive, collaborative, and meaningful learning experiences. However, the study remains limited to a single program with a small sample. Future research should expand the scope, compare the media with other instructional models, and examine the long-term effects on students' competencies across disciplines.

## Recommendation

Future research on Hybrid Interactive Media integrating Project-Based Learning (PjBL) with 360° VR technology should extend toward broader implementation and long-term evaluation. Studies involving larger and more diverse samples across multiple universities and disciplines are needed to examine the generalizability of the findings beyond economics education. Longitudinal investigations would also provide insight into the

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durability of improvements in conceptual understanding, critical thinking, and collaborative skills. Comparative research between VR-based PjBL and other emerging pedagogical innovations—such as gamification, adaptive learning, or AI-driven personalized instruction—could help determine which approaches are most effective for different learning contexts. Furthermore, future studies may benefit from integrating VR with complementary technologies such as Artificial Intelligence (AI), Augmented Reality (AR), or Learning Analytics to create more adaptive, data-informed, and immersive learning environments.

Despite its promise, several challenges must be addressed. Technical issues such as navigation complexity, motion sickness, and device compatibility can reduce learning effectiveness, while disparities in technological infrastructure and the high cost of VR equipment pose barriers for institutions with limited resources. To support wider adoption, universities need to prepare concrete institutional strategies, including sustainable funding models for VR equipment, structured training programs to build lecturers' digital pedagogical competence, and curriculum adjustments that embed immersive project-based activities into course designs. Policymakers play an essential role in establishing national or regional guidelines for digital transformation in higher education, allocating targeted grants to support VR-based innovation, and ensuring equitable access across institutions. Meanwhile, technology developers should collaborate closely with educators to design user-friendly VR platforms, develop low-bandwidth alternatives, improve navigation and accessibility features, and ensure that content aligns with pedagogical needs. Coordinated efforts among universities, policymakers, and technology developers are therefore crucial to enable the sustainable, equitable, and effective scaling of VR-based PjBL in higher education.

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