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AUGMENTED REALITY IN LEARNING AS AN IMPLEMENTATION OF PROGRESSIVISM EDUCATION IN VOCATIONAL EDUCATION: A LITERATURE REVIEW

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ABSTRACT

This study aims to analyze how the application of Augmented Reality (AR) in vocational education represents the principles of progressivism learning and to identify its pedagogical impacts, opportunities, and challenges. Using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) approach, sixteen relevant research articles published in Sinta 1 and Sinta 2 accredited journals between 2021 and 2025 were systematically reviewed. The findings indicate that AR implementation in vocational education strongly embodies progressivist principles by fostering experiential, student-centered, and technology-integrated learning. AR enhances conceptual understanding, practical skills, and learning motivation while promoting creativity, collaboration, and problem-solving abilities aligned with Dewey's learning by doing philosophy. Moreover, AR supports contextual and reflective learning environments that prepare students for industrial and technological realities. However, challenges remain in teacher digital competence, development costs, and limited infrastructure. Overall, AR serves as a progressive pedagogical innovation that bridges theory and practice in vocational education, and its transformative potential can be fully realized through systemic readiness, institutional support, and equitable access to digital technology.

ABSTRAK

Penelitian ini bertujuan untuk mengetahui bagaimana penerapan Augmented Reality (AR) dalam pendidikan vokasional mencerminkan prinsip-prinsip pembelajaran progresivisme, serta mengidentifikasi dampak pedagogis, peluang, dan tantangan yang muncul. Dengan menggunakan pendekatan PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses), sebanyak enam belas artikel yang dipublikasikan pada jurnal terakreditasi Sinta 1 dan Sinta 2 periode 2021 hingga 2025 dianalisis secara sistematis. Hasil telaah menunjukkan bahwa penggunaan AR dalam pembelajaran vokasional sangat sejalan dengan gagasan progresivisme, terutama karena AR mampu menghadirkan pengalaman belajar yang lebih aktif, berpusat pada peserta didik, dan terintegrasi dengan teknologi. AR tidak hanya meningkatkan pemahaman konsep dan keterampilan praktis, tetapi juga menumbuhkan motivasi belajar, kreativitas, kolaborasi, serta kemampuan pemecahan masalah yang sejalan dengan filosofi learning by doing dari Dewey. Selain itu, AR membantu menciptakan suasana belajar yang kontekstual dan reflektif sehingga siswa lebih siap menghadapi kebutuhan industri dan kemajuan teknologi. Meski demikian, tantangan seperti kompetensi digital guru, biaya pengembangan, dan keterbatasan infrastruktur masih perlu mendapat perhatian. Secara keseluruhan, AR berpotensi menjadi inovasi pedagogis yang progresif dan mampu menjembatani teori dengan praktik dalam pendidikan vokasional, terutama jika didukung oleh kesiapan sistem, dukungan institusi, dan akses teknologi yang merata.

Kata kunci: *Augmented Reality, Progresivisme, Filsafat Pendidikan, Vokasional.*

INTRODUCTION

Education in the twenty-first century is characterized by an era of rapid transformation, driven by advances in digital technology and shifting learning paradigms. Vocational education, which prepares students for the workforce, must adapt to these dynamics by integrating innovative learning media that align with industry demands and technological advancements. The integration of Augmented Reality (AR) has emerged as one of the most promising innovations to create interactive, contextual, and student-centered learning environments. AR technology combines virtual and real-world elements, allowing learners to visualize abstract concepts and engage directly with learning materials in a more meaningful way (Luthfi et al., 2024; Mukhlisin et al., 2025) .

The use of AR in vocational education has demonstrated significant potential to improve learning outcomes, motivation, and skill mastery across diverse technical domains. Studies on AR-based instructional media in microcontroller systems, electrical circuits, engineering drawing, and automotive learning consistently show increases in conceptual understanding, engagement, and 3D visualization skills (Luthfi et al., 2024; Mizian et al., 2025; Mukhlisin et al., 2025; Yana et al., 2022). These findings affirm that AR acts not only as a visualization enhancement but also as a bridge between theoretical knowledge and real-world practice, which is essential in vocational learning.

From a pedagogical standpoint, AR integration aligns strongly with the principles of progressivism, which emphasize experiential, inquiry-based, and student-centered learning. Dewey's progressivism asserts that knowledge develops through experience, problem-solving, and interaction rather than passive reception. The emphasis on creativity, autonomy, and adaptability mirrors the core characteristics of AR-based learning environments(Pratama et al., 2023; Sugihartini & Swisnandy, 2025). The relevance of progressivism is also reflected in contemporary educational developments, including Indonesia's Merdeka Belajar curriculum, which promotes learner independence, contextual learning experiences, and the development of individual potential. These values align with the progressive education philosophy, which prioritizes freedom, experiential engagement, and the cultivation of students' talents (Nuha & Gustama, 2024).

Evidence from various educational contexts further strengthens the connection between AR and progressivism. Research shows that progressivist principles have been implemented across multiple educational entities in Indonesia, enhancing autonomy, creativity, and experiential learning at different levels of schooling (Bahri & Mubarok, 2024). Other literature highlights how progressive learning fosters inquiry, collaboration, and deep conceptual understanding in learning, as well as blended learning and other innovative pedagogies that center on student agency (Hamidah & Ghafar, 2025; Tuazon, 2025). International perspectives also demonstrate that progressive teaching encourages adaptable and student-centered practices (Poudel et al., 2024; Wasosa & Mutelo, 2025). These insights reinforce the theoretical grounding of AR as a medium that supports exploration, interaction, and experience-based knowledge construction.

Moreover, several studies in vocational education show that AR-based learning fosters engagement and autonomy among learners. Students can manipulate 3D objects, conduct simulated experiments, and receive real-time feedback, encouraging reflective and self-directed learning behaviors (Alvendri et al., 2024; Maulana et al., 2023). This characteristic aligns with the progressive conviction that education must continuously evolve in response to societal and technological shifts, positioning students as active participants in shaping their learning trajectories (Hidayat et al., 2025).

Despite its potential, the adoption of AR in vocational education presents several challenges. Limited infrastructure, insufficient digital competence among educators, high development costs, and misalignment between AR-based content and curriculum standards often hinder optimal implementation (Efendi et al., 2023; Hidayat et al., 2025; Purwaningtyas et al., 2022). Addressing these challenges requires thoughtful instructional design, strategic institutional support, and adequate professional development for teachers to ensure that AR can be meaningfully integrated.

Based on these considerations, AR-based learning represents not only a technological advancement but also a pedagogical transformation rooted in the philosophy of progressivism. It embodies a shift from teacher-centered to learner-centered education by integrating experience, inquiry, and technological engagement as essential foundations for developing vocational competence. Accordingly, this study aims to explore how AR-based learning reflects the principles of progressivism in vocational education and to analyze its pedagogical impacts, opportunities, and challenges. Therefore, the research questions (RQ) formulated for this review are as follows:

RQ1 : How does the application of Augmented Reality (AR) in vocational education represent the principles of progressivism learning?

RQ2 : What are the pedagogical impacts, opportunities, and challenges of implementing AR-based learning in vocational education?

METHOD

This study used the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) methodology. Relevant articles were identified, screened, and then systematically analyzed (Page et al., 2021). The article search strategy in this study was developed following the PRISMA flow through a systematic and transparent selection process. Literature sources were obtained by accessing https://sinta.kemdiktisaintek.go.id/.

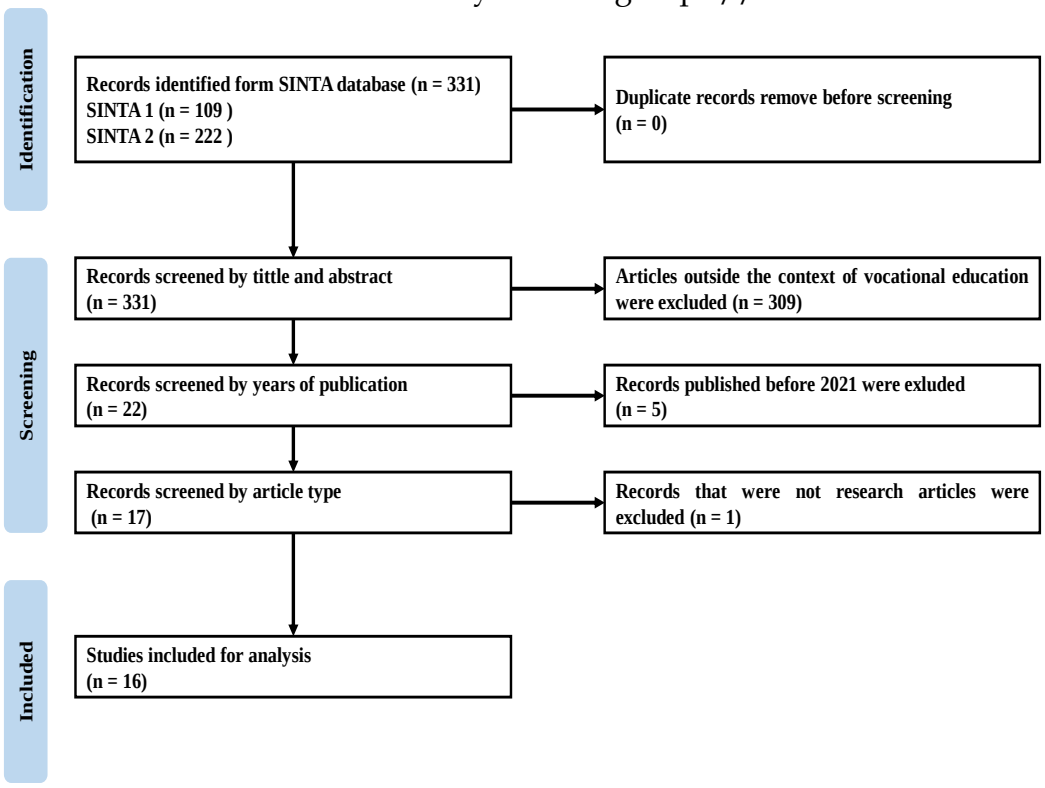

Figure 1. PRISMA Flow Diagram

Resulting in 109 and 222 national journals accredited by Sinta 1 and Sinta 2 in the fields of Education and Engineering, respectively. For each journal, an article search was conducted using the keyword "Augmented Reality," then all search results were combined to eliminate duplication. From this process, 331 articles were collected, which were then screened based on their title and abstract to assess their relevance to the context of vocational education. At this stage, 309 articles were eliminated because they did not align with the study's focus. The remaining 22 articles were then re-selected based on the publication year range of 2021–2025, resulting in five articles being excluded. A further screening stage was conducted to exclude review articles, resulting in a final selection of 16 articles deemed suitable for analysis. Table 1 displays the findings from the examination of selected articles. The complete flow of the literature selection process based on PRISMA is presented in Figure 1.

RESULTS AND DISCUSSION

Table 1. Selected Articles for literature review

Authors	Source	Results
(Sugihartini & Swisnandy, 2025)	Indonesian Journal of Educational Development (IJED)	The results of this study indicate that the combination of AR-based Project-based learning media produced superior learning outcomes compared to AR-only and conventional approaches. This demonstrates that integrating AR with project-based learning is the most effective method for enhancing student achievement in computer systems learning at the vocational high school level.
(Mukhlisin et al., 2025)	Jurnal Inovasi Teknologi Pendidikan	The results of this study indicate that AR-based instructional media effectively enhance conceptual understanding, improve learning quality, and increase student engagement in technical education.
(Mizian et al., 2025)	AL-ISHLAH: Jurnal Pendidikan	The results of this study indicate that the AR-assisted module was deemed highly feasible based on expert evaluations and proved effective in improving students' understanding, as evidenced by substantial learning gains and high levels of student satisfaction, thereby enhancing their ability to interpret engineering drawings.
(Yuliansah et al., 2025)	IJORER : International Journal of Recent Educational Research	The results of this study indicate that the augmented reality program for family archive management in vocational education was rated very good across all evaluated aspects, demonstrating its suitability for wider implementation and further classroom effectiveness testing.
(Luthfi et al., 2024)	Jurnal Penelitian Pendidikan IPA	The results of this study indicate that AR-based learning media effectively in visualize electrical circuit concepts interactively through features such as 3D simulations, videos, and practice questions accessible via mobile devices, thereby supporting the teaching and learning process of electrical circuit courses.
(Alawyah et al., 2024)	Jurnal Penelitian Pendidikan IPA	The results of this study indicate that the material for the bridge parts consists largely of abstract

Authors	Source	Results
		concepts that cannot be effectively visualised using printed textbooks alone. This highlights the need for enhanced media support, such as A-media, to facilitate a better three-dimensional understanding for both teachers and students.
(Alvendri et al., 2024)	Jurnal Penelitian Pendidikan IPA	The results of this study indicate that the STEAM-based AR learning media were validated by both media and material experts, who confirmed their feasibility. Meanwhile, responses from teachers and students demonstrated a high level of practicality, making it suitable for use in a robotics systems course at the Vocational High School.
(Maulana et al., 2023)	Indonesian Journal of Electrical Engineering and Computer Science	The results indicated that most respondents found the FunAR application easy to use and its information easy to understand.
(Efendi et al., 2023)	Jurnal Penelitian dan Pengembangan Pendidikan	The results of this study indicate that competency-based Augmented Reality media was rated highly valid by media and material experts. Students responded positively, noting that it facilitated their understanding and increased their motivation to learn.
(Ropawandi et al., 2023)	Jurnal Pendidikan IPA Indonesia	The results of this study indicate that student achievement in the Electricity subchapter of Physics improved in both online and offline classes through the use of augmented reality–based media during the COVID-19 pandemic, although offline classes demonstrated comparatively higher gains.
(Dinata et al., 2023)	Jurnal Nasional Pendidikan Teknik Informatika (JANAPATI)	The results of this study indicate that the immersive online exhibition effectively stimulated user interest, particularly in terms of stimulation, attractiveness, and novelty. This suggests that the web-based Virtual and augmented Reality experience successfully increased users' curiosity to explore the virtual reality environment.
(Yana et al., 2022)	Jurnal Pendidikan Teknologi dan Kejuruan	The results of this study indicate that the augmented reality–based automotive basics Special Service Tools learning module is highly feasible and practical, as confirmed by evaluations from material and media experts as well as small and large group trials.
(Purwaningtyas et al., 2022)	Jurnal Pendidikan IPA Indonesia	The results of this study indicate that integrating an augmented reality–based virtual laboratory into the LMS for radar learning within a Virtual Learning Environment (VLE) enhances student learning outcomes by enabling more engaging activities that reduce cognitive load and facilitate accessible theory–practice integration.
(Salim et al., 2022)	AL-ISHLAH: Jurnal Pendidikan	The results of this study indicate that the augmented reality media achieved a very valid rating from

Authors	Source	Results
		media experts, material experts, and small group trials, making it highly suitable for use as a learning resource in Information Technology courses.
(Redyantanu & Asri, 2021)	DIMENSI (Journal of Architecture and Built Environment)	The results of this study indicate that lecturers possess a solid understanding of virtual visualization technologies such as animation, augmented reality, and virtual reality, recognize their effectiveness in communicating architectural concepts to broader audiences, actively apply them beyond mandatory tasks to support the learning process, and express optimism toward continued adoption as long as the technologies remain accessible and user-friendly.
(Risdianto et al., 2021)	AL-ISHLAH: Jurnal Pendidikan	The results of this study indicate that the BMA model used within the MOOCs system during the COVID-19 pandemic received highly positive responses from prospective educators, supported by valid and reliable instrument data.

Implementation of Augmented Reality (AR) in Vocational Education as a Representation of Progressivist Principles

The findings of this literature review suggest that the implementation of AR in vocational education closely aligns with the core principles of educational progressivism, which emphasize experiential, student-centered, and technology-integrated learning. AR transforms traditional classrooms into interactive environments where students actively engage with digital three-dimensional models, making abstract concepts more concrete and meaningful, in line with Dewey's view that authentic learning emerges from direct experience and reflective interaction with real-life contexts. Previous studies further demonstrate that AR supports constructivist and contextual learning by promoting collaboration, problem-solving, and creativity, particularly when integrated with Project-Based Learning to enhance learning outcomes in vocational settings (Sugihartini & Swisnandy, 2025).

AR has also been shown to strengthen experiential learning in technical subjects. The development of AR-assisted learning modules for engineering drawing courses has proven both feasible and effective, enabling students to visualize three-dimensional objects more accurately and improving their spatial interpretation, which enhances both cognitive and psychomotor performance (Mizian et al., 2025). The use of STEAM-based AR media in robotics learning likewise demonstrates high validity and practicality, fostering creativity, interdisciplinary thinking, and collaborative engagement, thereby expanding the traditional function of vocational education toward holistic learner development (Alvendri et al., 2024).

Across the reviewed literature, AR consistently aligns with progressive pedagogy by encouraging experiential engagement, active problem-solving, and learning through hands-on experiences. Students can interact directly with digital representations of complex technical concepts, enabling them to construct knowledge through exploration and application in realistic learning contexts (Anwar et al., 2025). AR further contributes to the development of higher-order thinking by enabling learners to manipulate virtual objects, test ideas, and reflect on their actions, resulting in improved cognitive engagement and

strengthened problem-solving skills (Yuniarti et al., 2024). Enhancements in computational and critical thinking, as reported in AR-based learning activities, further reinforce its alignment with inquiry-driven and constructivist approaches (Dewi et al., 2025).

Moreover, AR-rich environments support progressivist emphasis on learner autonomy and self-direction. Research indicates that self-regulated learning plays a crucial role in AR adoption, contributing to increased learning confidence among vocational students. In turn, enables them to take greater initiative and develop independence in their learning processes (Hidayat et al., 2024a). AR's capacity to cultivate active participation, intrinsic motivation, and reflective thinking further strengthens its role in nurturing learners who are adaptive and engaged in continuous improvement (Hidayat et al., 2024b). Collectively, these findings demonstrate that AR operationalizes progressivist principles by providing authentic, problem-focused, and experience-rich learning opportunities that position students as active constructors of knowledge in vocational education (Yulia et al., 2024).

Therefore, the integration of AR in vocational education represents an authentic realization of educational progressivism. It shifts the focus from passive knowledge transmission toward dynamic, reflective, and adaptive learning experiences that better prepare students to respond to accelerating technological and industrial changes (Yulia et al., 2024).

Pedagogical Impacts, Opportunities, and Challenges of AR-Based Learning in Vocational Education

From a pedagogical perspective, AR-based learning has been shown to positively influence students' conceptual understanding, skill acquisition, and learning motivation. The integration of AR in Microcontroller courses resulted in significant improvements, with an average gain score of 0.75 categorized as high, demonstrating that immersive visualization strengthens the relationship between theory and practice in ways that reflect progressivism's emphasis on experiential and action-oriented learning (Mukhlisin et al., 2025). Similar positive outcomes were identified in the development of an AR application for family archive management, which received very high ratings in usability, content quality, and visual appeal. The incorporation of multimedia elements within AR environments enhances student engagement and comprehension, providing innovative pathways to connect digital literacy with subject mastery while fostering experimentation, reflection, and self-directed inquiry in line with progressivist learning principles (Yuliansah et al., 2025).

Despite these advantages, several challenges remain in effectively implementing AR-based learning. Key obstacles include high development costs, limited digital competence among teachers and students, and insufficient technological infrastructure in vocational institutions. These issues illustrate that progressivist transformation in education requires systemic readiness, including comprehensive teacher professional development, supportive institutional and policy frameworks, and equitable access to digital resources to ensure sustainable integration of AR technologies (Hidayat et al., 2024b). Even so, a number of studies highlight substantial opportunities offered by AR. Its demonstrated average effectiveness score of 84.96 percent indicates not only strong support for learning achievement but also the development of essential 21st-century competencies such as creativity, communication, and collaboration, which are critical in progressive learning environments emphasizing autonomy and problem-solving ability (Pratama et al., 2023).

Further opportunities arise from the integration of AR with virtual laboratory

environments, particularly when combined with the 5E learning model to reduce cognitive load and personalize learning according to individual needs. This instructional framework aligns with Dewey's vision that education should foster inquiry, experimentation, and reflection through active engagement with real-world contexts, affirming AR's potential to enhance the quality and relevance of vocational learning (Purwaningtyas et al., 2022). The reviewed studies consistently demonstrate that AR contributes significant cognitive and affective benefits. Immersive visualization enhances students' mastery of abstract technical concepts and strengthens problem-solving performance by improving conceptual clarity in complex subject areas (Anwar et al., 2025). AR also supports the development of higher-order thinking, including critical thinking, computational thinking, and digital literacy, which are increasingly essential in modern vocational fields (Dewi et al., 2025; Yuniarti et al., 2024).

Beyond cognitive gains, AR influences motivational and psychological dimensions of learning. Students' engagement and continued intention to use AR are shaped by perceived ease of use and perceived usefulness, which collectively contribute to increased intrinsic motivation and learning confidence (Hidayat et al., 2024b; Yulia et al., 2024). AR-rich environments also enhance students' readiness to apply vocational competencies in real-world contexts by strengthening self-competence and fostering positive learning dispositions, confirming its role in supporting progressive educational outcomes (Hidayat et al., 2024a).

Nevertheless, the adoption of AR presents notable challenges that must be addressed. Students may initially experience difficulty or unfamiliarity with AR tools, affecting the effectiveness of early learning stages, while digital literacy, device readiness, and institutional support remain inconsistent across vocational schools (Anwar et al., 2025; Yuniarti et al., 2024). Some studies also report moderate perceptions of AR's usefulness despite high ease-of-use ratings, suggesting a need for stronger instructional alignment to ensure that AR activities directly support vocational learning objectives (Dewi et al., 2025). Teacher readiness further emerges as a critical factor, as effective AR-based instruction depends heavily on well-designed pedagogy supported by adequate training and technological competence. Technical constraints such as device compatibility, software stability, and the cost of content development continue to limit widespread implementation, particularly in resource-limited institutions (Hidayat al., 2024a; Yulia et al., 2024).

Based on the reviewed literature, it is evident that AR-based learning in vocational education serves as a practical embodiment of educational progressivism by facilitating active, experiential, and context-driven learning aligned with industrial and technological realities. AR strengthens cognitive and technical abilities while enhancing learners' adaptability and creative thinking, which are central to the progressivist philosophy of holistic, inquiry-driven education. However, the full realization of AR's transformative potential depends on the readiness of the educational ecosystem, particularly regarding teacher competency, infrastructure, and policy support. When these foundational conditions are met, AR emerges as a progressive pedagogical innovation capable of equipping vocational learners to thrive in the rapidly evolving landscape of twenty-first-century industry and society.

CONCLUSION

This study concludes that the application of AR in vocational education authentically represents the principles of progressivism learning. AR promotes experiential, student-centered, and contextual learning through interactive visualization and direct engagement

with digital models. Such approaches align with Dewey's concept of learning by doing, emphasizing active participation and reflective experience. Pedagogically, AR-based learning has proven effective in improving students' understanding, skills, and motivation, while fostering creativity, collaboration, and problem-solving abilities that are essential for 21st-century competencies. However, challenges remain in terms of teacher digital competence, development costs, and technological infrastructure. Overall, AR stands as a progressive pedagogical innovation that bridges theory and practice in vocational education. Its transformative potential can only be fully realized through systemic readiness comprising teacher training, institutional support, and equitable access to technology, enabling vocational learners to adapt and thrive in the dynamic landscape of the twenty-first century.

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