

Bibliometric Analysis of Experiential and Technology-Integrated Pedagogy in Vocational Design Education

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ABSTRACT

This study utilizes a bibliometric analysis to examine the intersection of experiential learning, technology integration, and cultural responsiveness in vocational design education. A total of 241 open-access articles published between 2015 and 2025 were identified and analyzed using the search keywords ("design education" OR "creative arts education") AND ("experiential learning") AND ("technology integration") AND ("vocational education"). The findings reveal a growing body of research exploring each theme individually, with increasing attention to innovative pedagogical practices, digital tools such as CAD and AI, and inclusive approaches to teaching and learning. Despite this growth, integrated studies that holistically address all three dimensions remain limited. Key themes emerging from the analysis include project-based learning, immersive technologies, digital assessment, and efforts to enhance cultural competence. Contributions are concentrated in countries such as China, Indonesia, and the United States, though cross-national collaboration remains scarce. This study underscores notable lacunae in the extant literature and underscores the necessity for cohesive frameworks that integrate experiential, technological, and culturally responsive strategies within the context of vocational design education. A key limitation is the focus on a single open-access database, which may not capture the full scope of existing research. Future studies should expand the scope and adopt interdisciplinary and global perspectives to strengthen the field and inform practice.

Keywords: Vocational Design Education, Experiential Learning, Technology Integration, Cultural Responsiveness, Bibliometric Analysis

INTRODUCTION

In today's rapidly evolving educational landscape, vocational education is under increasing pressure to provide learning experiences that are both practical and future oriented. One significant development is the growing emphasis on experiential learning and the integration of technology into teaching practices. These two approaches are becoming central to the transformation of vocational education, offering promising ways to equip students with relevant competencies for the modern workforce. Experiential learning, which promotes learning through active participation and reflection, has proven to be especially effective in vocational settings where hands-on skills are essential. According to (Syam et al., 2024), this approach not only boosts student engagement but also improves critical thinking and emotional well-being. (Napier & Wada, 2024) similarly highlight that combining experiential learning with service-learning and problem-based learning helps students build confidence in applying their knowledge in real-world scenarios.

At the same time, advancements in educational technology are reshaping how vocational subjects are delivered. Tools such as augmented reality (AR), virtual reality (VR), and computer-aided design (CAD) have introduced immersive, interactive, and personalized learning experiences. These technologies allow learners to experiment in simulated environments, offering safe and adaptable spaces for skill development (Nazlidou et al., 2024). For instance, (Zhang, 2024) explored how reinforcement learning algorithms can be used to improve practical skills training in technical education. Another significant development is the adoption of digital portfolios, which provide platforms for students to document and reflect on their learning journeys. Studies by (Nourdad & Banagozar, 2022) and (Putu Yoga Laksana et al., 2024) found that digital portfolios support learner autonomy and deepen students' understanding of their academic progress.

In vocational design education, the potential of combining experiential learning strategies with digital tools is increasingly recognized. (Gao et al., 2025) examined how CAD and neural network technologies can enhance instructional effectiveness and foster student innovation. Similarly, (Fauzansyah et al., 2025) demonstrated that integrating project-based learning with CAD software significantly improved students' technical drawing skills. Although these studies show how experiential and technological elements can complement each other, there is still a lack of comprehensive understanding of how they intersect to improve learning outcomes in vocational design education. (Lin, 2025) stressed the importance of aligning vocational mathematics curricula with industry needs, and (Yulastri, 2023) provided evidence supporting the use of problem-based learning, these works do not explicitly explore how technological tools and experiential methods work together in vocational design contexts.

In addition to experiential and technological elements, cultural responsiveness has emerged as a crucial factor in vocational education. As students increasingly come from diverse cultural backgrounds, the ability to navigate multicultural environments is becoming a vital workplace skill. (Cochrane et al., 2021) showed that mixed reality simulations can enhance students' cultural competence, preparing them to engage effectively with diverse populations. (Louie et al., 2022) emphasized the importance of designing educational technologies that reflect cultural diversity, while (Ghaderi, 2023) highlighted the role of equity-focused pedagogy in addressing systemic barriers in education. (Sudarsono et al., 2023) proposed an industry-oriented experiential learning model that integrates cultural sensitivity into vocational training scenarios. Despite these important contributions, the integration of cultural responsiveness into broader discussions on experiential and technology-based learning in vocational education remains limited.

Overall, while the existing literature provides valuable insights into experiential learning, educational technology, and cultural responsiveness, these elements are often studied in isolation. There is a clear gap in understanding how these three dimensions can be combined to create more effective and inclusive learning environments in vocational design education. As (Karunanayaka, 2023) observed, the challenge is not only to adopt new pedagogical tools, but also to bring them together into cohesive and meaningful instructional practices. Although scholars like (Achdiat et al., 2025) and (Hetian & Naeim, 2025) have explored innovative approaches such as design thinking, there is still a lack of emphasis on how these innovations can be supported and enhanced by technology and experiential strategies.

This study addresses this gap by examining the convergence of experiential learning, technology integration, and cultural responsiveness in vocational design education. Through a literature-based and bibliometric analysis, this research aims to offer a more integrated perspective on how these approaches can work together to better prepare students for the demands of a diverse and rapidly changing workforce.

Research Questions

1. What are the dominant research trends related to experiential learning, technology integration, and cultural responsiveness in vocational design education?
2. How are experiential learning, technology integration, and cultural responsiveness integrated into current literature?
3. What theoretical and practical gaps exist in combining experiential learning, technology integration, and cultural responsiveness?
4. How can vocational design education be improved by implementing an integrated pedagogical framework that incorporates experiential learning, technology, and cultural responsiveness?

Research Objectives

1. To analyze scholarly literature on experiential learning, technology integration, and cultural responsiveness in vocational design education.
2. To identify conceptual and practical gaps at the intersection of these educational elements.
3. To map emerging research trends and clusters using bibliometric analysis.
4. To propose an integrated conceptual framework that supports vocational design education through experiential, technological, and culturally responsive pedagogies.

LITERATURE REVIEW

Experiential Learning in Vocational Education

Vocational education has increasingly embraced experiential learning as a core pedagogical approach that fosters hands-on engagement and deepens understanding. Rather than relying solely on theoretical instruction, experiential learning allows students to immerse themselves in real-world tasks and reflective processes that are closely aligned with workplace demands. It emphasizes active participation, critical thinking, and personal relevance. This is particularly important for vocational students who require not only theoretical knowledge but also technical proficiency and soft skills.

Experiential learning models have proven to enhance students' engagement and practical capabilities. By encouraging learners to reflect on what they do, these models support the development of problem-solving skills and professional readiness. For instance, Industry-Oriented Experiential Learning has been found to prepare vocational students for employment by simulating workplace conditions and focusing on industry-aligned competencies (Sudarsono et al., 2023). Service-learning and project-based learning approaches similarly promote meaningful learning experiences by connecting students with real clients and practical challenges.

Another key benefit of experiential education is its ability to accommodate different learning styles. Vocational students often possess diverse cognitive and emotional needs. Tailoring instruction through hands-on experiences allows for more inclusive and personalized learning environments. This model not only supports knowledge acquisition but also enhances emotional resilience and learner motivation (Syam et al., 2024).

Despite the growing support for experiential learning, there remains a lack of comprehensive models that integrate these methods with emerging educational technologies. As the demands of the workforce evolve, there is a growing need for instructional frameworks that blend hands-on learning with digital tools to create scalable and effective vocational education programs.

Technology-Enhanced Learning in Vocational Contexts

In the past decade, educational technologies such as augmented reality (AR), virtual reality (VR), and computer-aided design (CAD) have been introduced into vocational training to simulate professional tasks and environments. These tools are particularly useful in fields such as design, engineering, and healthcare, where spatial visualization, technical accuracy, and risk-free practice are critical.

Studies show that CAD software improves learners' ability to conceptualize, model, and revise technical drawings. When integrated with project-based learning, it enhances not only technical accuracy but also students' creativity and design thinking (Fauzansyah et al., 2025). Advanced applications of CAD, combined with machine learning or neural networks, allow educators to customize learning paths and provide instant feedback, further increasing students' mastery of vocational tasks (Gao et al., 2025).

Immersive technologies such as AR and VR also offer promising opportunities. These platforms allow students to interact with simulated environments, which replicate the complexities of real-world settings. In vocational education, they are especially effective in training scenarios that are otherwise too costly or hazardous to replicate in traditional classrooms. Mixed reality tools have been shown to foster cultural awareness, clinical reasoning, and communication skills, especially in fields like paramedicine (Cochrane et al., 2021).

In spite of these technological advances, literature tends to treat experiential learning and digital innovation as separate domains. The extant research in this area is limited in scope and does not yet represent a systematic investigation of the potential for technology to enrich experiential learning, particularly within the context of vocational design education.

The Role of Digital Portfolios

Digital portfolios, or e-portfolios, have become increasingly prevalent in vocational education as tools for assessment, reflection, and learner autonomy. E-portfolios enable students to document their projects, monitor progress, and receive feedback over time. This process encourages students to take ownership of their learning journey and engage in critical self-reflection.

Beyond assessment, e-portfolios foster self-directed learning and professional identity development. Students can present their work to external stakeholders, such as employers, through organized and accessible digital formats. E-portfolios can incorporate multimedia content, such as images, CAD files, and videos, to provide a holistic view of students' skills and creativity (Putu Yoga Laksana et al., 2024).

Additionally, the use of e-portfolios has been associated with improved language and cognitive skills. For example, in foreign language learning contexts, e-portfolio assessment has enhanced vocabulary retention and learner autonomy (Nourdad & Banagozar, 2022). Although this finding is from a different domain, it underscores the potential of e-portfolios to promote metacognitive skills, which are equally valuable in vocational settings.

Despite these benefits, the integration of e-portfolios with AR, VR, and experiential learning methodologies is still under-researched. Future frameworks should consider e-portfolios as central to capturing, connecting, and reflecting on digitally enhanced learning experiences in vocational education.

Culturally Responsive Practices in Vocational Learning

Cultural responsiveness has become an essential component of inclusive and equitable education. In vocational classrooms, where learners often represent diverse linguistic, ethnic, and socioeconomic backgrounds, incorporating culturally responsive pedagogy can significantly enhance engagement, motivation, and performance.

Recent studies have shown that embedding cultural awareness into simulation-based training can increase empathy and real-world preparedness. For example, MR simulations designed with cultural dimensions prepare students to interact effectively with clients from different cultural backgrounds (Cochrane et al., 2021). In design and engineering education, technology can be adapted to reflect students' cultural identities and values, increasing relevance and ownership.

(Louie et al., 2022) argue that culturally responsive design in educational technology enhances student connection with the content. Their research on participatory design for social robots illustrates how technology can serve as both a learning tool and a medium for cultural expression. Similarly, equity-focused instructional design, such as that advocated by (Ghaderi, 2023), supports access for marginalized learners by tailoring teaching methods to students' lived experiences.

Despite the promise of culturally responsive pedagogy, its integration with experiential and technology-enhanced learning in vocational education has not been fully explored. Most studies treat these aspects independently, leaving a gap in understanding how they can be strategically combined to support inclusive, engaging, and industry-relevant instruction.

Identified Gaps and Future Research Opportunities

While current literature has advanced our understanding of experiential learning, technology-enhanced pedagogy, and cultural responsiveness in vocational education, their intersection remains understudied. Several works examine each domain in isolation. For instance, (Zhang, 2024) explores reinforcement learning algorithms to support technical education but does not focus on experiential components. (Lin, 2025) advocates for task-driven instruction in vocational mathematics but does not include technological or cultural considerations.

The need for comprehensive mapping studies that address the confluence of these educational approaches is clear. Integrating experiential methods with tools like CAD, AR, and e-portfolios, while embedding cultural relevance, can create dynamic, learner-centered environments. This would better prepare vocational students for complex, multicultural workplaces that require not only technical proficiency but also adaptability and intercultural competence.

Future research should aim to fill this gap by designing and evaluating pedagogical frameworks that bring together experiential learning, technology integration, and cultural responsiveness. Such studies would contribute significantly to both theory and practice, helping vocational educators build inclusive, future-ready learning environments.

METHODOLOGY

This study employed a bibliometric analysis to explore research trends on experiential and technology-integrated pedagogy in vocational design education. Data were retrieved from the Dimensions AI database using the keywords: ("design education" OR "creative arts education") AND ("experiential learning") AND ("technology integration") AND ("vocational education"). The search was limited to open access articles published between 2015 and 2025 to ensure accessibility and relevance. A total of 241 articles were initially collected.

The dataset was processed in Microsoft Excel to remove duplicates, incomplete entries, and irrelevant results. After cleaning, the final dataset was analyzed using VOSviewer to visualize co-authorship patterns, keyword co-occurrence, and bibliographic coupling. This method enabled the identification of influential publications, key research clusters, and thematic developments within the field.

FINDINGS AND DISCUSSION

Publication Trends

The bibliometric analysis of 241 open-access articles published between 2015 and 2025 revealed a steady increase in research related to experiential learning, technology integration, and cultural responsiveness in vocational education.

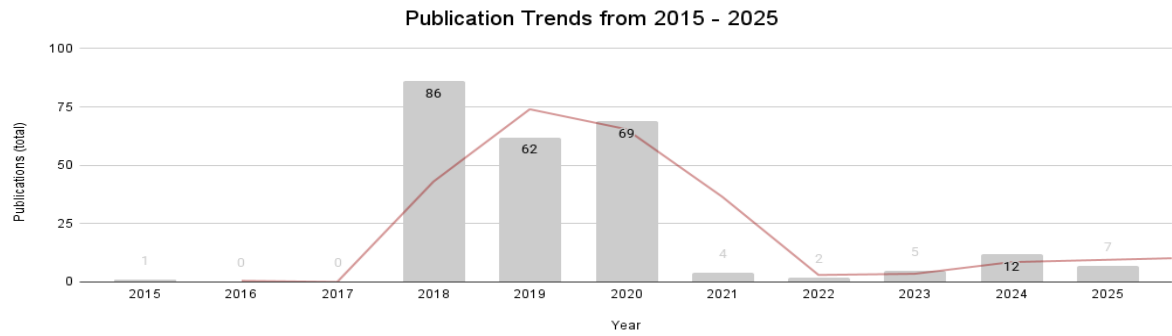


Figure 1. Publication Trend from 2015-2025

A notable rise in publications occurred during the pandemic years and continued into the post-pandemic period. This increase reflects a growing global interest in innovative educational strategies, particularly those that support flexible and industry-relevant learning. Despite this upward trend, studies that focus specifically on vocational design education and their integration of all three themes remain limited in number.

Research Category

The dataset revealed four major research categories: pedagogical innovation, digital technology, design-focused learning, and inclusive vocational practices. Among these, pedagogical innovation led in frequency, particularly in studies exploring experiential learning approaches.

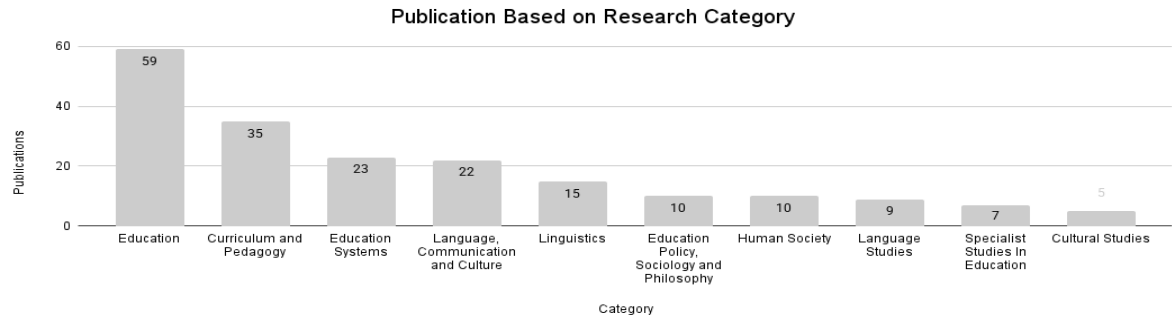


Figure 2. Publication Basen on Research Category

Technology-focused research often emphasized tools like CAD and VR, while cultural responsiveness was more commonly explored in separate education fields. Few studies examined how these dimensions could be systematically integrated, suggesting that more research is needed to connect experiential, technological, and cultural perspectives in vocational design education.

Most Cited Countries

China, Indonesia, and the United States were identified as the most frequently cited countries. Chinese studies focused on technological enhancement and curriculum reform in vocational training. Indonesian research explored experiential learning and project-based education in vocational high schools.



Figure 3. Most Cited Countries

Meanwhile, U.S. studies highlighted cultural responsiveness and digital inclusion. However, cross-country collaboration was relatively rare, indicating a need for more global and comparative approaches. These could foster

shared insights into integrating experiential learning, technology, and equity within diverse vocational education contexts.

Key Themes

Four dominant themes emerged from the analysis: immersive technology, project-based learning, cultural competence, and digital assessment. Several articles discussed how tools such as VR and CAD contributed to skill development in design-related programs.

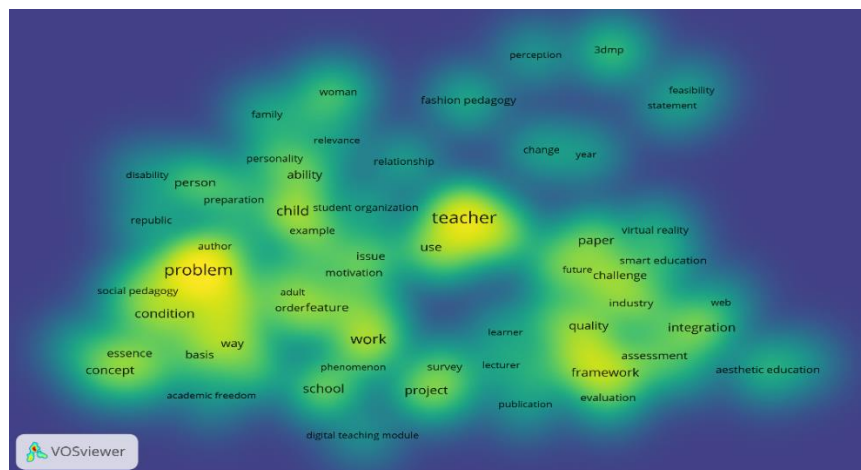


Figure 4. Mapping

Other works focused on experiential strategies that promoted learner autonomy and job readiness. Cultural competence was examined through mixed reality simulations and participatory design. However, most studies explored these themes independently, revealing a need for integrated approaches that holistically address the learning needs of vocational design students.

DISCUSSION

The findings of this bibliometric analysis highlight a growing body of research related to experiential learning, technology use, and cultural responsiveness in vocational education. However, the lack of studies that integrate all three elements within the specific context of vocational design education reflects a significant research gap. This discussion elaborates on each theme, supported by previous literature, to address the research questions and inform future directions.

The steady increase in relevant publications over the last decade coincides with global shifts in educational needs, especially during and after the COVID-19 pandemic. As (Karunanayaka, 2023) pointed out, the pandemic accelerated the adoption of digital tools and challenged educators to redesign learning environments. In vocational design programs, this period saw increased experimentation with tools such as digital modules and e-portfolios (Putu Yoga Laksana et al., 2024), which encouraged student autonomy and flexibility. Despite these advances, studies that explicitly combine digital innovation with experiential learning and cultural sensitivity are limited.

Experiential learning has long been recognized as essential in vocational education. Its emphasis on direct application, reflection, and skill development aligns well with the goals of design education. (Syam et al., 2024) emphasized that experiential learning caters to different learning styles and enhances student engagement. (Napier & Wada, 2024) argued that experiential activities grounded in real-world challenges help bridge the gap between classroom theory and industry expectations. Despite this, many experiential learning models have yet to incorporate meaningful digital or cultural dimensions.

Technological integration is another critical focus in vocational education, particularly in design programs. Studies by (Gao et al., 2025) and (Zhang, 2024) demonstrated how technologies such as CAD and reinforcement learning algorithms can personalize instruction and support practical skill development. These tools are especially relevant in creative fields where visual representation and rapid prototyping are essential. However, few studies contextualize these technological innovations within broader pedagogical frameworks. This limits their potential to support holistic learning that is both experiential and culturally aware.

Cultural responsiveness is increasingly emphasized in broader educational discourse but remains underrepresented in vocational design literature. (Cochrane et al., 2021) and (Louie et al., 2022) illustrated how simulation and robotics can be used to develop learners' cultural competence. These studies, however, are more

common in health and robotics education. In design education, where students often create artifacts for diverse communities, integrating cultural awareness into learning processes is essential. (Ghaderi, 2023) argued for equity-focused approaches in curriculum design, while (Achdiat et al., 2025) introduced design thinking as a strategy for experiential entrepreneurship learning. Yet, these frameworks often lack explicit technological components or cultural sensitivity elements, especially in vocational education settings.

The citation distribution reveals that China, Indonesia, and the United States each bring distinct strengths to this field. (Hetian & Naeim, 2025) emphasized the importance of curriculum reform and talent development in China using design thinking. Indonesian scholars like (Sudarsono et al., 2023) explored experiential learning models that align with local vocational needs. Meanwhile, U.S. literature frequently engages with digital equity and inclusive pedagogy. Despite these regional contributions, international collaborations remain minimal. Joint research projects could facilitate the exchange of knowledge and support the development of integrated frameworks that reflect diverse educational realities.

(Nazlidou et al., 2024) reviewed digital innovations in creative product design, noting their positive effect on learner outcomes. However, they did not connect these tools with experiential frameworks or cultural responsiveness. Similarly, (Lin, 2025) proposed aligning vocational mathematics instruction with industry needs, the study did not link its findings to inclusive or reflective practices. These examples illustrate a common trend in literature: a tendency to focus on one or two dimensions of pedagogy without exploring their interconnections.

The findings point to a significant opportunity for future research and curriculum development. A robust pedagogical model for vocational design education would integrate hands-on learning, digital technologies, and culturally responsive approaches. Such a model would prepare students not only with technical skills but also with empathy, adaptability, and critical thinking needed to succeed in diverse professional environments. Educators and researchers should collaborate across disciplines and borders to co-create inclusive, innovative, and practice-oriented learning strategies.

CONCLUSION

This bibliometric study explored the intersection of experiential learning, technology integration, and cultural responsiveness within vocational design education by analyzing 248 open-access articles published between 2015 and 2025. The findings revealed increasing scholarly interest in each theme individually, yet few studies addressed their integration in a coherent and systemic way. Key themes such as immersive technology, project-based learning, and cultural competence emerged, with notable contributions from countries like China, Indonesia, and the United States. However, the lack of cross-country collaboration and holistic frameworks signals a significant gap in the literature.

A key limitation of this study is its reliance on a single database, which may exclude relevant articles indexed elsewhere. Additionally, the focus on open-access publications might have led to the omission of influential but paywalled research. Despite these limitations, the study offers a comprehensive overview of current trends and highlights the need for more integrated, inclusive, and innovative approaches in vocational design education. Future research should explore these intersections more deeply through interdisciplinary and international collaboration.

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