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EFFECTIVE TEACHING METHODS IN VOCATIONAL EDUCATION: A SYSTEMATIC REVIEW

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Abstract

Vocational Education and Training (VET) plays a crucial role in preparing a competent workforce that is aligned with the demands of Industry 4.0 and digital transformation. However, the inconsistency of teaching methods and their inalignment with industry needs often undermine learning outcomes and readiness of graduates. This study systematically analyzes the types of effective teaching methods in Vocational Education (VE). Using the PRISMA protocol, 232 Scopus indexed articles were screened, and 22 studies met the PICOS inclusion criteria focusing on the effectiveness of teaching methods in VET. The results revealed seven dominant categories of effective methods, namely immersive learning and simulation, adaptive and AI-based learning, project-based learning and practicum, game-based learning, active collaborative learning, andragogy with visual communication, and Learning Process Orchestration and Design. These findings show that no single method is universally superior. Instead, the pedagogical synergy between the integration of technology, real-world practices, and adaptive design results in optimal outputs. The study underscores the need for institutional support, teacher training, and ongoing industry collaboration to achieve modern, innovative, and globally competitive VE.

Keywords: *Please state 5 keywords that related to your research*

INTRODUCTION

Vocational Education and Training (VET) plays a strategic role in human resource development at the global and national levels. International organizations such as UNESCO, ILO, and OECD have consistently encouraged the strengthening of VET as a key pillar in workforce upskilling development, education policy formulation, and harmonization of cross-border vocational standards (Klassen, 2025). VET contributes directly to the job readiness of the younger generation through a learning approach oriented to the development of professional skills, active involvement of learners, hands-on practice in the real world, and an emphasis on the efficiency and quality of graduates (Sakdapat, 2024). In the context of the development of industry 4.0 and digital transformation, the relevance of learning topics in VET is becoming increasingly important. Adapting curriculum and teaching methods to industry needs and cutting-edge technological advances are the main requirements for VET graduates to be able to compete in the global job market (Magagula & Awodiji, 2024).

The issue of the effectiveness of teaching methods in Vocational Education (VE) and Training (VET) is an urgent strategic issue to be studied in depth. Inappropriate teaching methods not only reduce student motivation and engagement, but also have an impact on the low quality of learning outcomes as well as the development of teachers' competencies as key

actors in the learning process (Hatısaru & Küçükturan, 2009; He & Jen, 2025). As reported by Suharno (Suharno et al., 2020), as many as 74% of students feel bored during the learning process, which reflects the inaccuracy of the teaching approach used. On the other hand, there is still a significant gap between the learning strategies implemented in VE institutions and the ever-evolving demands of the workforce, particularly in terms of graduates' readiness to enter and survive in the industry (Bruin et al., 2025). This shows the urgency of determining teaching methods that are more contextual, innovative, and in line with the real needs of the world of work, including through curriculum synchronization and practice-based learning approaches (Yoto et al., 2024). Some studies also confirm that the selection of inappropriate teaching methods contributes to the low effectiveness of learning strategies, as well as a decrease in students' motivation and active participation (Kuril et al., 2021).

Previous studies in the field of VE have shown that various teaching methods such as Problem-Based Learning (PBL), Project-Based Learning (PjBL), Work-Based Learning (WBL), and Blended Learning have been widely applied to improve the skills and professional competence of graduates (Chen & Chan, 2024; Cui et al., 2025; Jalinus et al., 2023; Koçoğlu & Kanadlı, 2025; Rafiq et al., 2023; Rahdiyanta et al., 2019; Rahim et al., 2024; Triono Ahmad et al., 2023). PBL and PjBL have proven to be effective in encouraging students' active engagement, concept mastery, and the development of critical and collaborative thinking skills (Koçoğlu & Kanadlı, 2025; Rafiq et al., 2023; Rahim et al., 2024; Triono Ahmad et al., 2023), while WBL provides real-world experiences relevant to the industry (Jalinus et al., 2023; Rahdiyanta et al., 2019), and Blended Learning offers flexibility in integrating online and face-to-face learning (Chen & Chan, 2024; Cui et al., 2025). However, these findings also reveal limitations such as material mismatch with current industry needs, lack of supporting facilities, and variations in teachers' pedagogical competencies that affect the quality of method implementation (Jalinus et al., 2023; Koçoğlu & Kanadlı, 2025; Rahim et al., 2024; Triono Ahmad et al., 2023). This gap underscores the importance of a comprehensive study to analyze and identify the most effective, contextual, and sustainable teaching methods to optimize learning outcomes in VE.

Although various studies have examined the application of teaching methods such as Problem-Based Learning (PBL), Project-Based Learning (PjBL), Work-Based Learning (WBL), and Blended Learning in VE, until now there has been no systematic study that comprehensively analyzes the effectiveness of these methods to identify which ones are the most relevant and have the optimal impact. Existing research is still fragmented based on context, field of expertise (Hasan Maksum et al., 2025), or specific region (González et al., 2025), so it does not provide a comprehensive picture that can be used as a reference in the development of VET learning strategies that are integrated with industry demands. To address this gap, this study proposes a systematic review approach to integrate findings across studies, map effective teaching methods, and provide evidence-based recommendations that can support improving the quality of learning in VE.

This study aims to analyze the types of effective teaching methods in learning in VE The focus of the analysis is directed to the core question, which method is the most effective in learning in VE. The main contribution of this study lies in the preparation of a systematic review-based teaching method map that can be a strategic reference for the development of

vocational teaching theories as well as a practical guide for educators, as well as policy makers in designing learning that is in sync with skills in the needs of the job market. The advantage of the approach used lies in its ability to integrate findings across studies from various contexts and areas of expertise, resulting in evidence-based recommendations that are comprehensive, accurate, and applicable to improving the quality of learning in VE.

RESEARCH METHOD

This systematic review was carried out with reference to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol (Page et al., 2021). The literature search is focused on a reputable international database, namely Scopus. Scopus was chosen because it has a wide scope of publications and globally recognized indexation standards (Pranckutė, 2021). The selection of this database ensures that only articles from indexed journals are analyzed, so that the validity and reliability of the findings can be guaranteed. The search is not limited by the year of publication so that all relevant studies can be accommodated, so all articles published from the beginning of indexing to August 2025 are included. The publications considered include various languages, including English, Spanish, Russian, Polish, Portuguese, Mandarin, and Hungarian, to expand the representation of literature in the analysis.

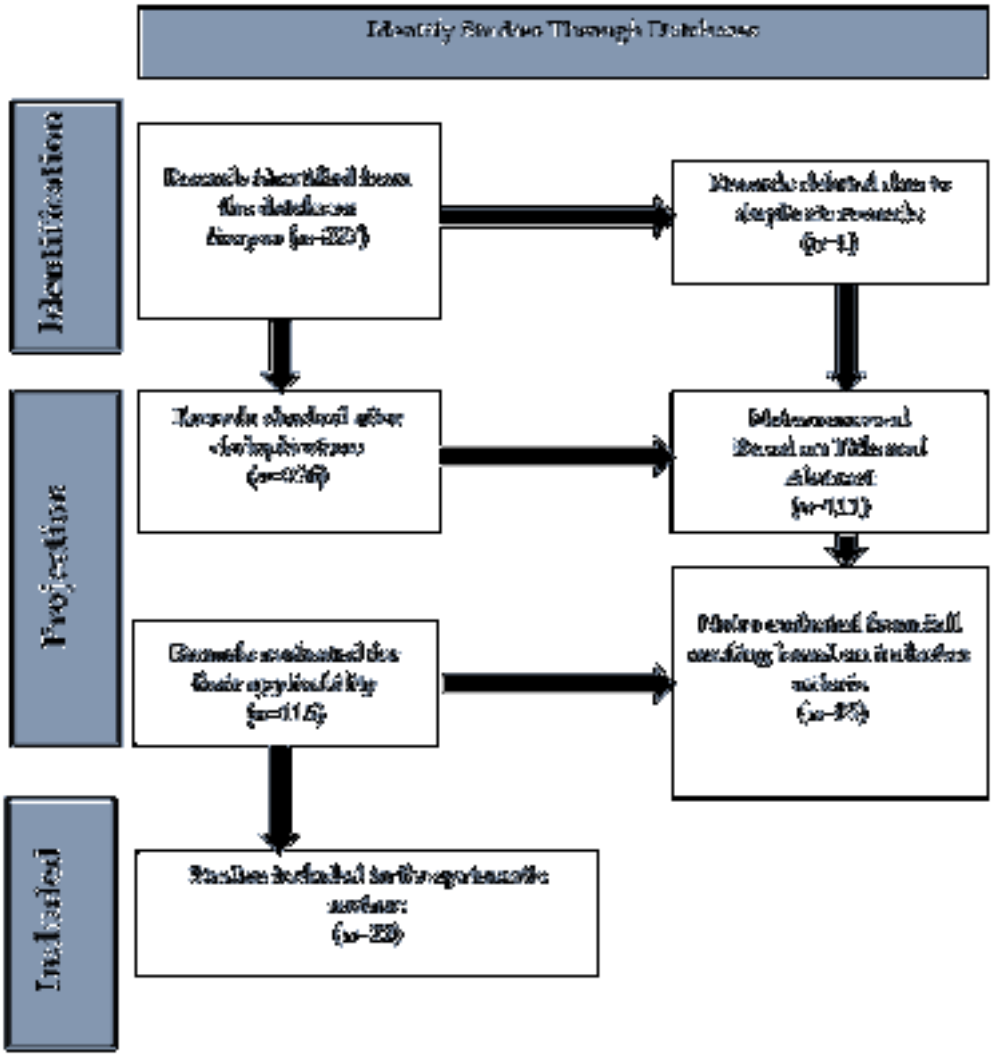
The literature search strategy in this study was carried out by reviewing, summarizing, and analyzing the titles and important content from the database. The search process uses a combination of titles, abstracts and keywords that are systematically designed with Boolean operators AND/OR: ("Teaching method" OR "Instructional method" OR "Teaching strategy" OR "Instructional strategy" OR "Teaching approach" OR "Instructional approach" OR "Teaching technique" OR "Instructional technique" OR "Teaching model" OR "Instructional model" OR "Pedagogical method" OR "Educational method") AND ("Technical and Vocational Education and "Training" OR "Vocational Education and Training" OR "Vocational Education" OR "Technical Education" OR "Career and Technical Education" OR "Professional and Technical Education" OR "Further Education and Training" OR "Competency-based training" OR "Polytechnic education" OR "vocational high school") AND ("effective" OR "effectiveness" OR "efficacious" OR "efficacy" OR "effectuality"). The process of combining titles, abstracts and keywords aims to expand the representation of the literature that is netted, while the final decision on the inclusion of the study is made collaboratively by the authors through a thorough review.

The inclusion criteria in this study were determined by referring to the PICOS (Population, Intervention, Comparator, Outcome, Study Design) framework. Articles included in the systematic review must meet the following requirements: (a) Population: students, teachers, or instructors at the VE level; (b) Intervention/Interest: research that evaluates different types of teaching methods in the context of VE; (c) Comparator: studies that compare the effectiveness between teaching methods or variations of instructional approaches; (d) Outcome: results that show positive or negative impacts of the application of teaching methods in VE; and (e) Study Design: empirical research that directly examines the implementation of teaching methods in the VE environment. Meanwhile, excluded articles include: (a) publications in the form of systematic reviews or meta-analyses; (b) the proceedings of the

conference; (c) books; (d) studies that do not present clear or specific results related to teaching methods in VE; and (e) articles that are not available in the final version.

The study selection procedure in this study follows the PRISMA flow systematically. From the initial search results, 232 academic articles were obtained that were relevant to the topic of teaching methods in VE. A total of 45 duplicate articles were removed using Mendeley's reference management software and manually re-verified by two reviewers to ensure accuracy. Furthermore, 82 articles were eliminated after a review of titles and abstracts, while another 57 articles were removed based on an in-depth evaluation of the full text. The entire screening process was carried out independently by two reviewers, with disagreements resolved through discussion and consensus with the third author to ensure objectivity and minimize potential bias. The flow of the search strategy and the study selection process are visualized in Figure 1.

Figure 1. PRISMA Flow Diagram of the Study Search and Selection Process



RESULT AND DISCUSSION

Based on the results of the classification in table 1, it can be concluded that research on the effectiveness of teaching methods in VE includes various approaches that illustrate the transformation of the learning paradigm from conventional models to innovative, adaptive, and technology-oriented learning and industrial practices.

Table 1. Study Classification Based on Selected Research Theme

Category	Category	Refrence
Immersive Learning and Simulation	Immersive virtual reality (IVR)	(Kablitz, 2025; Sami Ur Rehman et al., 2023)
	Mixed reality (virtual reality + augmented reality)	(Bödding et al., 2025)
	Case methods integrated with virtual reality	(Rzanova et al., 2024)
	Wireman based computer simulation	(Nwineh & Okwelle, 2018)
Adaptive and Artificial Intelligence-Based Learning	Data driven adaptive learning methods	(Y. Liu & Song, 2025)
	Smart teaching platform with video feedback	(Li et al., 2023)
	Practice based learning embedded teaching system with deep learning support	(H. Liu et al., 2021)
Real Projects, Practicums, and Tools	Smart home training kit-based learning	(Sukardi et al., 2025)
	Guided Co-Construction with artefak visual	(van Schaik et al., 2014)
	Digital resource based learning	(Marín-Marín et al., 2020)
Game and Puzzle-Based Learning	Kahoot based gamification	(Peña, 2025)
	Online Puzzle Activities (OPS)	(Genç & Aydemir, 2015)
	Computer Aided Music Instruction	(Lou et al., 2011)
Active and Collaborative Learning	Learning based on student active participation	(López et al., 2023)
	Small Group Work	(Czakó & Győri, 2017)
Andragogy and Visual Communication	Visual-based interactive learning with andragogic and motivational strategies	(Abdulrasool & Mishra, 2010)
Orchestration of Learning Processes and Design	Integrated classes based on TECHS (class presentations, laboratory practices, assignments, and quizzes)	(Bejan et al., 2020)
	Learning Cycle	(PURNOMO et al., 2020)

Immersive Learning and Simulation

The results of the synthesis indicate that immersive learning and simulation are among the most effective approaches for improving students technical skills and engagement in VE. The application of Immersive Virtual Reality (IVR), Mixed Reality (a combination of VR and AR), and computer simulations such as Wireman Simulator has proven capable of creating a realistic and safe learning experience. Students can practice technical skills without the risk of tool damage or occupational safety hazards. In addition to increasing motivation, this method also contributes to increasing the accuracy and speed of students' work in completing practicum tasks.

However, the effectiveness of this method is highly dependent on the readiness of the infrastructure and the competence of teachers in utilizing technology. The use of VR and AR devices requires considerable investment costs and training for educators to be able to integrate simulations into learning activities in a meaningful way. Therefore, the success of the implementation of immersive learning is not only determined by technology, but also by pedagogic capabilities in designing learning experiences that are relevant to the needs of the industry.

Adaptive and Artificial Intelligence-Based Learning

Artificial intelligence (AI)-based adaptive learning methods provide new opportunities to improve the personalization and effectiveness of vocational learning. The data-driven adaptive platform and intelligent teaching system with video feedback are able to adjust the difficulty level of the material according to the individual abilities of the learner. In addition, the application of a deep learning-based embedded teaching system allows students to obtain automatic guidance during the learning process.

Findings from related studies show that adaptive methods can accelerate the mastery of concepts and improve the efficiency of learning time. Learners gain a more interactive learning experience that is responsive to their needs. However, the implementation of this method requires good data system readiness and teachers' ability to analyze AI-based learning outcomes. Limited data privacy and variations in digital literacy levels are also challenges that need to be overcome so that this method can be applied optimally.

Learning Projects, Practicums, and Real Tools

This category includes a variety of hands-on practice-based methods, including smart home training kit-based learning, guided co-construction with visual artifacts, and digital resource-based learning. All of these methods have a common characteristic, namely, placing students as the center of learning activities through real activities that resemble industrial conditions.

The results of the study show that the application of project-based learning and real tools can improve students' technical skills, critical thinking skills, and work readiness. Through hands-on practical activities, students can understand the relationship between theory and application in the world of work. In addition, the use of digital media also enriches the learning experience and makes it easier for students to understand complex concepts. The main challenge of implementing this method is the need for adequate practice facilities and active involvement from the industry to provide a contextual learning experience.

Game- and Puzzle-Based Learning

The game- and puzzle-based learning approach (gamification) is also an effective strategy in increasing student motivation and participation. Methods such as Kahoot-based gamification, Online Puzzle Activities (OPS), and computer-aided music instruction have been proven to be able to create a more interesting and interactive learning atmosphere. Through the game element, students become more focused and active in understanding the material being taught.

However, the results of some studies show that the impact of gamification is stronger on affective aspects such as motivation and enthusiasm for learning, while its effect on cognitive and psychomotor learning outcomes still varies. Therefore, the application of this method should be combined with real practice activities in order to have a more comprehensive impact on students' competencies.

Active and Collaborative Learning

Active and collaborative learning focuses on students' active participation through cooperation in small groups. This method emphasizes interaction between students to solve problems, discuss, and share knowledge with each other. In the context of VE, this approach is particularly relevant because it mimics work situations in industries that demand collaboration across areas of expertise.

The analyzed studies show that collaborative learning can improve communication skills, leadership, and a sense of responsibility in completing group tasks. In addition, students become more confident in coming up with ideas and making decisions. The effectiveness of this method depends on the role of the teacher as a facilitator who is able to create a conducive and inclusive learning environment for all participants.

Andragogy and Visual Communication-Based Learning

Andragogic approaches and visual communication are widely applied in the context of training or learning for adult learners. These methods include lecture-based learning, printed materials, and motivational feedback, as well as visual-based interactive learning strategies. The main principles of andragogy emphasize learning independence, relevance of the material to the participants' experience, and direct application to work.

Research shows that this method is able to increase the engagement and learning motivation of adult participants. The use of visual media also helps in clarifying abstract concepts and strengthening the understanding of the material. Thus, andragogy and visual communication approaches are effectively applied in vocational training targeting participants with work experience or lifelong learners.

Orchestration of Learning Processes and Design

The effectiveness of teaching methods depends not only on the type of method used, but also on how teachers design and orchestrate the learning process as a whole. Several studies highlight the success of the TECHS model which consists of classroom presentation stages, laboratory practices, assignments, and quizzes as well as the systematic learning cycle in improving the consistency and coherence of the material.

This approach helps teachers in integrating various methods in harmony so that each stage of learning supports the other. Learning orchestration also allows for the implementation of continuous formative evaluation and strategic adjustment based on learners' needs. Thus,

teachers play the role of learning designers who ensure that each component of learning activities contributes to the achievement of vocational competence optimally.

CONCLUSION

Based on the results of a review of various studies, it can be concluded that the effectiveness of teaching methods in VE is greatly influenced by the ability of teachers and educational institutions to integrate real-world practice-based approaches, digital technology, and adaptive pedagogic principles. Immersive learning and simulation have proven to be effective in improving technical skills and occupational safety, while AI-based adaptive learning is able to personalize the learning experience. On the other hand, project learning and real practice remain the main foundation in building students' professional competence and job readiness.

Gamification methods, active and collaborative learning, and visual andragogy contribute greatly to increased student motivation and engagement, while the orchestrated learning design ensures each method is systematically integrated. Thus, there is no single most effective, but it is the synergy between approaches that creates the best learning outcomes. The success of the implementation of vocational learning methods also depends on institutional policy support, technological readiness, and active collaboration between educational institutions and the industrial world. For this reason, continuous training is needed for teachers in instructional design and the use of technology so that vocational learning can adapt to the times.

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