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PEDAGOGICAL STRATEGIES FOR DEVELOPING DIGITAL SKILLS IN VOCATIONAL EDUCATION STUDENTS

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Abstract:
Digitalisation rapidly changes labor market needs in the contemporary era and therefore, vocational education systems must adapt their lessons and introduce new technology. This article will discuss six pedagogical approaches to digital skill development in vocational education students: Competency-Based Training (CBT), Project-Based Learning (PBL), Blended Learning, Simulation-Based Training, Work-Based Learning (WBL), and the Scaffolding Method. The research results indicate that Competency-Based Training ensures a learning process oriented towards the outcomes in line with industry standards. Project-Based Learning develops critical thinking, collaboration, and innovation capabilities. Blended Learning provides flexibility and effectiveness. Simulation-Based Training enables practical skill formation in safe environments. Work-Based Learning offers opportunities for gaining real professional experience. Based on Vygotsky's Zone of Proximal Development theory, the Scaffolding Method develops independent learning abilities through gradual support. These strategies are further discussed in terms of how to integrate them in order to facilitate the general development of digital skills. In this article, the authors offer suggestions towards its integration and practical application.

Keywords
Digital skills, vocational education, competency-based training, project-based learning, blended learning, simulation-based training, work-based learning, scaffolding method, pedagogical strategies

Introduction

With the rapid development of digital technologies, the modern labor market is undergoing fundamental transformations in many respects. In this context, vocational education institutions have the responsibility to equip students not only with traditional professional knowledge but also with comprehensive digital skills. Digital literacy, digital competencies, and digital skills have become inseparable requirements for modern specialists, serving as the primary factors determining graduates' competitiveness in the labor market. It is vital to select effective pedagogical strategies for educating vocational students on digital skill use and to embed them into the learning process. Pedagogical strategies fundamentally mold the students' potential to leverage digital technologies, developing and reinforcing their critical thinking, problem-solving skills, as well as innovative approaches (Dai, 2024).

Competency-Based Training (CBT) is an educational strategy designed to teach skills or competencies, including knowledge, attitude, and skills in students towards professional practice and outcomes that are clearly defined for those students. This model of learning is aligned with industry and employer's needs. The CBT approach has four salient features: outcome orientation—the learning process emphasizes the achievement of clearly defined competencies; individual pacing—students are given the means to learn at their own pace; practical orientation—theoretical knowledge is embedded with practical skills; modular structure—content is organized into independent modules. CBT is a highly effective intervention for digital skill development in vocational education, as this methodology allows for the articulation of digital competencies, goal setting, the formulation of achievement criteria, and the objective assessment of the readiness levels of students (Fitrihana & Nurdiyanto, 2023).

Project-Based Learning (PBL) is an active learning style where students learn through working on projects to solve problems that develop in the real world. PBL is centered around students' thinking critically, working together, communicating, and solving problems (Nayak et al., 2024). PBL draws upon numerous primary perspectives which are embedded in its foundational concepts: authentic tasks—projects based on genuine professional problems; active student participation—learners are at the center of the learning process; collaborative learning—through group work, students acquire teamwork skills; reflection—students have the ability to analyze and critique their own work (Dzulkurnain et al., 2024). The teaching of digital behaviors is best done through PBL. Digital technology-related projects allow students practical experience, technical problem-solving, and innovative solution-making. It has been shown through research that PBL has resulted in students gaining digital skills such as coding competences, data analysis, and digital content creation skills (Mahtani et al., 2024).

Blended Learning is an educational method that involves classroom use with online components. It combines the strengths of teaching formats that allow for an adaptive and effective learning environment. There are several models of blended learning: rotation model—students alternate between in-person education and online sessions; flex model—primary instruction is delivered online, with classroom sessions used for additional support; flipped classroom model—students study theoretical materials independently, while practical exercises are conducted in classes. Blended learning possesses unique advantages for developing digital skills. Online aspects allow students to cultivate skills in digital platforms, independent learning, and the management of information. Classroom sessions help reinforce practical skills, obtain answers to questions, and participate in group projects.

Simulation-Based Training is a practice where students learn relevant skills in a practical atmosphere through simulations of real-life scenarios in a controlled environment. It involves virtual reality (VR), augmented reality (AR), computer simulations, and physical simulators (Korneeva, 2024; Fortuna et al., 2024). The following kinds of simulation are commonly employed in vocational studies: virtual reality (VR) provides immersive digital environments; augmented reality (AR) enriches and incorporates new digital objects into

the environment; computer simulations model complex operations; and physical simulators create working models of existing machinery (Wulansari et al., 2024; Ghosh & Ravichandran, 2024). Training based on simulation is highly effective for the development of digital skills. VR and AR tech allow students to interact with elaborate digital systems, experience perilous processes in a confined space, and re-learn core skills in the form of repetitive exercises. Study conducted has proven that through simulation-based training critical thinking skills and decision making ability significantly enhanced (Isak et al., 2023).
Work-Based Learning (WBL) is an approach to education that focuses on enabling students to gain professional competences and skills in the workplace by providing them with exposure to the real workplaces. WBL is the result of a partnership between educational institutions and employers with the goal of translating theoretical knowledge into practice. WBL has various forms like apprenticeship—long-term practical training programs; internship—short-term practical experience; cooperative education—alternation of study and work periods; and virtual internship—remote work experience. Students can benefit from digital skills under the supervision of experienced professionals and WBL assists them in realizing the usage of digital technologies in an interactive workplace.
The Scaffolding Method is based on L.S. Vygotsky's Zone of Proximal Development theory that helps students perform complex tasks through gradual support. Scaffolding is the temporary support provided by the teacher which is gradually withdrawn as the student's competence increases. This scaffolding consists of: modeling—the teacher demonstrates how a task is going to be performed; guiding questions—asking questions designed to shape pupils' thinking; explanation—explaining complex phenomena in simple language; feedback—providing consistent constructive feedback; and task decomposition—dividing complex tasks into small parts. Since the development of digital skills is complex and may be challenging for students, the scaffolding method is vital. Scaffolding guides students to use digital tools, to learn programming languages, and to accomplish complex digital projects. AI tools (ChatGPT, Claude, Gemini) allow more efficient use of the scaffolding approach since adaptive support can be personalized to students' needs.
The aim of this study is to comprehensively analyze six key pedagogical strategies for developing digital skills in vocational education institutions—Competency-Based Training, Project-Based Learning, Blended Learning, Simulation-Based Training, Work-Based Learning, and the Scaffolding Method—to evaluate their effectiveness and provide recommendations for practice.

2. Methods

This study utilized a systematic approach to literature review. The research included literature identification, thematic analysis, and synthesis of findings. The literature was extracted through structured searches of research databases (Scopus; Web of Science; ERIC; Google Scholar). Search terms were combinations of «vocational education», «digital skills», «competency-based training», «project-based learning», «blended learning», «simulation-based training», «work-based learning», and «scaffolding method».

Empirical studies, systematic reviews, and practice reports published between 2020 and 2024 received priority. A total of 95 sources met the inclusion criteria and were thematically analyzed. The findings were organised into the pedagogical approach type, the implementation aspects, and the assessment mechanisms.

3. Results

3.1 Comparative Analysis of Pedagogical Strategies

Each of the six pedagogical strategies analyzed possesses unique advantages and application areas. Table 1 presents a comparative analysis of these strategies.

Strategy	**Primary Focus**	**Skills Developed**	**Implementation Requirements**
CBT	Outcome-oriented, aligned with industry standards	Technical digital skills, professional competencies	Clearly defined competency frameworks
PBL	Authentic projects, real problem-solving	Critical thinking, collaboration, innovation	Industry partnerships, adequate time
Blended Learning	Online and offline integration	Independent learning, digital literacy	LMS platform, internet infrastructure
Simulation	Practical exercises in safe environment	Practical skills, decision-making	VR/AR equipment, software
WBL	Experience in real workplaces	Professional digital skills, networking	Employer partnerships
Scaffolding	Gradual support provision	Independence, deep understanding	Qualified teachers, AI tools

Table 1. Comparative Analysis of Pedagogical Strategies

3.2 Competency-Based Training Outcomes

The analysis revealed that Competency-Based Training (CBT) demonstrates significant effectiveness in developing measurable digital skills aligned with industry requirements. CBT's outcome-oriented approach ensures that students acquire specific technical competencies that meet employer expectations. Research indicates that informatics-based vocational education utilizing competency frameworks leads to improved student performance in digital skill assessments (Fitrihana & Nurdiyanto, 2023). The modular structure of CBT allows for flexible pacing, enabling students to master foundational digital skills before progressing to more complex competencies. This approach is particularly effective for developing technical proficiencies in areas such as software operation, data management, and digital content creation.

3.3 Project-Based Learning Outcomes

Project-Based Learning emerged as a highly effective strategy for developing complex digital competencies. The findings demonstrate that PBL significantly enhances students' practical skills through authentic project experiences (Dzulkurnain et al., 2024). Students engaged in digital technology projects showed marked improvements in critical thinking, problem-solving, and collaborative skills. Research on implementing innovation in project-based learning in engineering education confirms that PBL develops both technical competencies and soft skills essential for digital workplaces (Mahtani et al., 2024). The project-based learning approach facilitates the integration of theoretical knowledge with practical application, enabling students to develop comprehensive digital skill sets (Nayak et al., 2024). Students demonstrated increased motivation and engagement when working on real-world digital projects, leading to deeper learning outcomes and better retention of technical skills.

3.4 Blended Learning Outcomes

Blended learning showed considerable advantages for digital skills development through its integration of online and face-to-face instruction. The flexibility offered by blended learning environments allows students to develop self-directed learning skills while accessing digital resources at their own pace. Online components provide opportunities for students to practice digital literacy skills, including information management, digital communication, and online collaboration. The analysis revealed that blended learning is particularly effective when combined with other pedagogical approaches, creating comprehensive learning experiences that address multiple dimensions of digital competency. Students in blended learning environments demonstrated improved digital literacy and increased comfort with various digital platforms and tools.

3.5 Simulation-Based Training Outcomes

Simulation-based training demonstrated exceptional effectiveness for developing practical digital skills in controlled environments. The use of VR, AR, MR, and XR technologies in vocational training provides immersive learning experiences that significantly enhance skill acquisition (Korneeva, 2024). Research on augmented reality and virtual reality in vocational education confirms that these technologies represent modern learning paradigms that transform how digital skills are taught and practiced (Fortuna et al., 2024). The integration of gamification with augmented reality technologies has shown revolutionary potential for vocational education, increasing student engagement and learning effectiveness (Wulansari et al., 2024). Emerging technologies in vocational education and training provide safe environments for students to practice complex digital tasks, make mistakes, and refine their skills without real-world consequences (Ghosh & Ravichandran, 2024). Students who participated in simulation-based training showed significant improvements in critical thinking skills and decision-making abilities (Isak et al., 2023). The repetitive practice opportunities afforded by simulations enable students to achieve mastery of technical skills more efficiently than traditional instruction methods.

3.6 Work-Based Learning Outcomes

Work-Based Learning demonstrated unique value in developing professional digital skills within authentic workplace contexts. Students participating in WBL programs gained exposure to industry-standard digital tools, software applications, and professional communication platforms. The partnership between educational institutions and employers ensures that digital skill development aligns with current labor market demands. WBL provides opportunities for students to observe and learn from experienced professionals, facilitating the transfer of tacit knowledge about digital technology use in professional settings. Students who completed WBL experiences reported increased confidence in their digital abilities and better understanding of how digital skills are applied in real work environments.

3.7 Scaffolding Method Outcomes

The scaffolding method emerged as the most versatile and effective central methodology for digital skill development. Based on Vygotsky's Zone of Proximal Development theory, scaffolding provides structured support that is gradually withdrawn as student competence increases. The analysis revealed that scaffolding is particularly crucial for complex digital skill development, as it guides students through challenging learning processes while building independence. Digital literacy education benefits significantly from scaffolding approaches that cultivate 21st century key competencies through graduated support systems (Dai, 2024). The integration of AI tools such as ChatGPT and Claude with scaffolding methodology enables personalized, adaptive support that responds to individual student needs in real-time. Research on digital tools in professional education training confirms that technology-enhanced scaffolding significantly improves learning outcomes compared to traditional instructional methods (Isak et al., 2023). Students who received scaffolded instruction demonstrated deeper understanding of digital concepts, greater independence in applying digital skills, and more successful transfer of learning to new contexts.

3.8 Integration Effects

The analysis revealed significant synergistic effects when multiple pedagogical strategies are integrated within a scaffolding framework. When CBT provides competency targets, PBL offers authentic application contexts, blended learning ensures resource accessibility, simulation enables safe practice, and WBL provides professional experience—all coordinated through scaffolding principles—students achieve comprehensive digital skill development. The scaffolding method serves as the unifying pedagogical approach that optimizes the effectiveness of all other strategies by ensuring that instruction is appropriately matched to students' developmental levels and that support is systematically reduced as competence grows.

4. Discussion

4.1 Integration of Strategies and the Central Role of Scaffolding

The analysis of the results shows that the development of digital skills necessitates the integrated application of multiple pedagogical approaches. Every tactic has its own benefits, and when they are combined, they produce synergistic effects. Nevertheless, the analysis shows that the scaffolding method is the most successful central methodology that, when used in conjunction with all other strategies, greatly increases their effectiveness.

Based on Vygotsky's Zone of Proximal Development theory, the scaffolding method offers an instructional framework that maximizes the use of other tactics. More individualized and flexible learning experiences are made possible when scaffolding is incorporated as the primary methodology, leading to quantifiably better learning outcomes. Research indicates that scaffolding-enhanced instruction results in significantly more skill acquisition than conventional teaching methods.

The CBT model, as an integrated framework, provides a framework for developing personal learning goals, while PBL provides a useful framework for achieving those goals. WBL offers real-world professional experience, simulation establishes a secure practice environment, and the blended learning approach increases access to resources. Scaffolding, on the other hand, functions as the unifying methodology that establishes individualized student growth pathways across all of these approaches, guaranteeing that support is adjusted to each student's present competency level and progressively reduced as mastery advances.

One particularly promising development is the incorporation of artificial intelligence tools like ChatGPT and Claude with the scaffolding method. AI-enhanced scaffolding makes it possible to provide personalized guidance, quick feedback, and real-time adaptive support—things that were previously unattainable at scale. Preliminary research indicates that AI-assisted scaffolding can increase learning efficiency by offering expert-level guidance around-the-clock while preserving the gradual release of responsibility that is essential to successful scaffolding practice.

4.2 Recommendations for Practical Application

The following suggestions for enhancing digital skills in vocational education institutions have been developed based on the analysis's findings, with a focus on using the scaffolding method as the primary pedagogical approach:

First, the primary pedagogical approach should be scaffolding. Institutions should prioritize training educators in scaffolding techniques and incorporate scaffolding principles into all digital skills curricula. This entails creating assessment rubrics that monitor students' advancement toward independence and structured procedures for the progressive transfer of responsibilities.

Second, scaffolding systems with AI enhancements ought to be put into place. To offer individualized, flexible scaffolding support, artificial intelligence tools like ChatGPT and Claude should be methodically incorporated into the educational setting. These tools can provide instant feedback, create personalized practice problems, explain ideas at suitable levels of difficulty, and progressively lessen support as student proficiency rises.

Third, it is necessary to create competency frameworks that are in line with scaffolding principles. For every professional specialty, digital competency frameworks based on international standards like DigComp 2.2 should be created. These frameworks should have distinct progression pathways that enable scaffolded instruction from novice to expert levels.

Fourth, scaffolding features should be included in blended learning infrastructure. Online resource databases and learning management systems (LMS) must be built or set up to facilitate adaptive scaffolding, which includes tools for monitoring student progress, modifying the level of difficulty of the content, and offering graduated assistance and hints.

Fifth, scaffolding integration is necessary to improve industry partnerships. Scaffolding principles should be incorporated into WBL and PBL experiences through collaboration with employers. Workplace mentors should be trained in scaffolding techniques to support the gradual development of skills in real-world professional contexts.

Sixth, scaffolding architecture should be incorporated into the design of simulation labs. Scaffolding features, such as progressive challenge sequences, adjustable difficulty levels, and embedded guidance systems that fade as learner competence increases, should be incorporated into VR/AR technologies and computer simulations.

Seventh, it is crucial that teachers receive thorough professional development in scaffolding methodology. In order to diagnose students' zones of proximal development, assess students' readiness for independence, and successfully incorporate AI tools as scaffolding aids, educators must receive specialized, in-depth training in scaffolding techniques.

4.3 Conclusions and Future Directions

Six important pedagogical approaches for helping vocational education students acquire digital skills have been thoroughly examined in this study: Competency-Based Training (CBT), Project-Based Learning (PBL), Blended Learning, Simulation-Based Training, Work-Based Learning (WBL), and the Scaffolding Method. Although each strategy has its own advantages, the analysis shows that the scaffolding method is the most successful central methodology for attaining better learning outcomes.

According to research, scaffolding, which is based on Vygotsky's Zone of Proximal Development theory, offers the pedagogical framework that greatly increases the efficacy of all other tactics. Personalized learning trajectories, adaptive support tailored to each student's needs, and the methodical development of autonomous learning skills are all made possible when scaffolding is used as the primary methodology. Research shows that scaffolding-enhanced instruction yields significantly more effective outcomes than traditional methods, with quantifiable gains in knowledge retention, skill acquisition rates, and learning transfer to new contexts.

A revolutionary opportunity for vocational education is presented by the scaffolding method's integration with artificial intelligence tools. Unprecedented scalability of personalized instruction is made possible by AI-enhanced scaffolding through tools like ChatGPT and Claude, which simultaneously offers all students expert-level adaptive support. This combination maintains the fundamental efficacy of scaffolding while addressing one of its historical drawbacks: the heavy demands on instructor time and expertise.

CBT guarantees learning that is focused on results and compliant with industry norms. PBL fosters creativity, teamwork, and critical thinking. Flexibility and wide access opportunities are offered by blended learning. Practical skill development in secure settings is made possible by simulation-based training. Gaining actual professional experience is facilitated by WBL. The unifying framework, however, is the scaffolding method, which optimizes each of these tactics by making sure that instruction is suitably matched to students' developmental stages and that support is methodically reduced as competence grows.

In order to adequately prepare students for the digital economy, vocational education institutions must strategically adopt the scaffolding method as their primary pedagogical approach. Digital technologies have emerged as one of the key pillars of the contemporary labor market. In this process, cooperation between government agencies, business representatives, and educational institutions is crucial, especially when it comes to building the infrastructure and teacher competencies required for successful scaffolding implementation.

Future studies should concentrate on measuring the efficiency gains from scaffolding-enhanced instruction in various vocational domains, refining AI-scaffolding integration protocols, creating validated tools to evaluate scaffolding fidelity, and figuring out the precise circumstances in which scaffolding yields the greatest advantages. Policy development and institutional investment decisions would benefit greatly from long-term longitudinal studies that monitor the career outcomes of students educated using scaffolding-centered approaches.

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