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Diversification of Learning Models in Strengthening Students' Employability Skills: A Systematic Literature Review (2015–2025)

Indah Nursanti[1], Yoto[2], Imam Alfianto[3]

[1,2,3]Master's Program in Vocational Education, Postgraduate School, Universitas Negeri Malang, Indonesia

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Corresponding Author:
Author Name*: Indah Nursanti
Email*: indah.nursanti.2405518@students.um.ac.id

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ABSTRACT

This study aims to examine the diversification of learning models that strengthen employability skills among students of Vocational High Schools (Sekolah Menengah Kejuruan; SMK) based on scientific publications published from 2015 to 2025. Vocational High School (SMK) graduates are expected to master technical competencies while also possessing 21st-century skills, such as communication, teamwork, problem-solving, creativity, digital literacy, and leadership, to adapt to the demands of the business and industrial sectors in the era of the Industrial Revolution 4.0. This study employed a Systematic Literature Review (SLR) approach, following the PRISMA Statement protocol, to select and analyze relevant articles published over the past decade. The results of the review indicate that six main learning models support the improvement of employability skills, namely Project-Based Learning (PBL), Problem-Based Learning (PBL), Work-Based Learning (WBL), Teaching Factory (TeFa), Blended Learning or Flipped Classroom, and Cooperative Learning. Each model provides a distinct contribution: PjBL and PBL strengthen critical thinking, problem solving, and collaboration skills; WBL and TeFa enhance adaptability, professional communication, and technological literacy; Blended Learning emphasizes digital literacy and learner autonomy; while Cooperative Learning reinforces interpersonal communication, teamwork, and leadership. This study concludes that no single learning model can comprehensively accommodate all aspects of employability skills. Therefore, the diversification and integration of various learning models during the 2015 to 2025 period becomes an essential strategy for building a vocational education ecosystem that is relevant and responsive to industry needs.

Keywords: employability skills, learning models, vocational education

INTRODUCTION

Vocational education, particularly Vocational High Schools (*Sekolah Menengah Kejuruan*; SMK), has a primary mandate to prepare graduates who are capable of competing in the world of work. In the era of the Industrial Revolution 4.0, workforce demands do not emphasize only technical skills (hard skills) but also employability skills such as communication, teamwork, problem-solving, creativity, and digital literacy [1]. These skills are fundamental provisions that enable SMK graduates to adapt to continuously changing industrial dynamics and to face global challenges [2]. Therefore, strengthening employability skills has become a strategic priority in the development of vocational education. Several studies indicate a gap between the skills of Vocational High School (SMK) graduates and the competencies required by the business and industrial sectors. Graduates are often perceived as lacking the adaptive capacity, collaborative skills, and critical thinking abilities demanded by the modern labor market [3]. This condition affects the low absorption of Vocational High School graduates into the formal sector, thereby widening the gap between the education system and the needs of the world of work. These facts highlight the need for innovation in Vocational High Schools' learning practices to make them more contextually relevant and aligned with industry demands.

The diversification of learning models is considered an important strategy to address these issues. Innovative models such as Project-Based Learning have been shown to enhance collaboration and problem-solving skills [4], while Problem-Based Learning has been shown to strengthen critical thinking abilities [5]. In addition, Work-Based Learning and Teaching Factory play a role in reinforcing the linkage between schools and the industrial sector, thereby enabling students to gain learning experiences that closely resemble real workplace practices. The diversity of learning models provides opportunities for Vocational High Schools (SMKs) to design more targeted learning strategies in strengthening employability skills. Previous studies have extensively examined the effectiveness of each learning model; however, research that integrates these findings comprehensively remains limited. A systematic mapping of the diversification of

learning models to strengthen the employability skills of Vocational High School (SMK) students is not yet available. A Systematic Literature Review (SLR) is required to summarize, compare, and analyze learning models that have been implemented, while simultaneously identifying their strengths, weaknesses, and potential for integration within the context of vocational education.

This review is expected to provide both theoretical and practical contributions. From a theoretical perspective, this SLR enriches the literature on strengthening employability skills through innovations in vocational learning. From a practical perspective, the findings can serve as a reference for educators, curriculum developers, and policymakers in formulating learning strategies that align with industry needs in the digital era. The results of this review are expected to bridge gaps in previous research while supporting the realization of the link and match between Vocational High Schools (SMKs) and the world of work. Improving the quality of vocational education requires serious attention to the curriculum's relevance to industry needs. Learning that emphasizes technical skills alone without integrating employability skills will produce graduates who are less prepared to face the dynamics of the labor market. Recent studies confirm that graduates who possess a combination of technical and nontechnical skills tend to adapt more easily to technological change and are more competitive in the global labor market [6]. The integration of these two skill aspects needs to be managed through appropriate learning design; thus, Vocational High Schools graduates develop a competency profile that aligns with industry needs.

The literature review results indicate that most previous studies have focused on a single learning model independently, resulting in the absence of a comprehensive mapping that integrates the six main learning models Project-Based Learning, Problem-Based Learning, Work-Based Learning, Teaching Factory, Blended or Flipped Learning, and Cooperative Learning within the context of strengthening the employability skills of Vocational High School (SMK) students. In addition, no cross-model comparative analysis has explained the specific contributions of each learning model to the dimensions of employability skills, leaving schools without a strong theoretical foundation for determining the most effective combination of learning strategies. Previous studies have also not examined in depth the relationships among learning models, for example, how Project-Based Learning can synergize with Teaching Factory or how Work-Based Learning can operate alongside Blended Learning within a digital ecosystem. In addition, SLR studies that specifically examine the context of Indonesian vocational education remain limited, even though Indonesian Vocational High Schools (SMKs) face distinctive challenges in curriculum design, infrastructure readiness, and industry partnerships. The absence of a systematic conceptual map linking learning models to employability skills indicators also represents a significant gap, which tends to make pedagogical decision-making in Vocational High Schools (SMKs) partial and less evidence-based [7], [8], [9].

This study offers novelty by developing a comprehensive mapping, based on a Systematic Literature Review and the PRISMA Statement protocol, to analyze six main learning models that strengthen employability skills in vocational education. This study produces a matrix linking learning models with employability skills that has not been provided by previous research, thereby offering a new analytical framework that can be used as a foundation for instructional design in Vocational High Schools (SMKs). In addition, this study integrates findings across countries and levels of vocational education, then interprets them specifically for the needs of Indonesian Vocational High Schools (SMKs), thereby generating a new perspective for formulating link-and-match policies. Another element of novelty lies in identifying potential synergies among learning models, which opens opportunities to develop hybrid learning designs better aligned with the demands of Industry 4.0. This study also provides evidence-based practical recommendations on learning diversification, thus not only strengthening the academic literature but also supporting teachers and policymakers in developing more relevant and measurable vocational learning strategies [10], [11], [12].

The strengthening of employability skills cannot be separated from the transformation of learning paradigms in Vocational High School (SMK). Learning orientations that were previously teacher-centered need to shift toward student-centered approaches, emphasizing contextual, collaborative, and real-world, experience-based learning. Recent studies indicate that project-based learning models, industry-oriented practice, and digital technology-based learning can encourage students to develop higher-order thinking skills while simultaneously instilling the work ethic required in professional environments [13]. This paradigm shift further underlines the need to diversify learning strategies in Vocational High Schools (SMKs). The context of globalization and digitalization adds urgency to the strengthening of employability skills. The advancement of artificial intelligence, automation, and the Internet of Things demands a workforce that is not only technically competent but also flexible, resilient, and skilled in cross-cultural communication [14]. Vocational High Schools (SMKs) students must be equipped to continuously learn, adapt, and innovate to remain relevant in an increasingly competitive labor market. Achieving this objective requires educational interventions that use learning models that balance the needs for technical and generic skills.

A Systematic Literature Review plays an important role in providing a comprehensive overview of best practices that have been implemented in strengthening employability skills in Vocational High Schools (SMKs). A systematic analysis of previous studies enables the development of a conceptual map that can guide educators and policymakers in designing

more effective learning strategies. By systematically synthesizing empirical evidence, this review identifies trends, gaps, and directions for future research. This effort is expected to support the creation of a vocational education ecosystem that is more adaptive, innovative, and aligned with industry needs. The purpose of writing this article is to systematically examine various learning models used in strengthening the employability skills of Vocational High School (SMK) students, including Project-Based Learning, Problem-Based Learning, Work-Based Learning, Teaching Factory, and other innovative models. This review aims to analyze the contributions of these models to work-related skills such as communication, collaboration, problem-solving, creativity, and digital literacy, while also developing a conceptual map that illustrates the diversification of vocational learning strategies. Through a Systematic Literature Review (SLR) approach, this article is expected to provide a comprehensive overview of research trends, patterns, and gaps, thereby enriching the academic literature and serving as a practical reference for teachers, curriculum developers, and policymakers in designing Vocational High School (SMK) learning strategies that are more aligned with the needs of the business and industrial sectors.

The research questions addressed in this Systematic Literature Review focus on how various learning models strengthen employability skills among Vocational High School (SMK) students. Specifically, this SLR aims to answer the following research questions:

1. What learning models have been applied in vocational education to support the development of employability skills?
2. Which aspects of employability skills are strengthened by each of these learning models?
3. What gaps, patterns, and trends emerge from previous research findings regarding the effectiveness of each model in the context of vocational education?
4. How can mapping the relationships between learning models and employability skills dimensions provide a conceptual foundation for designing learning strategies that are more aligned with industry needs?

RESEARCH METHODS

The use of the PRISMA Statement protocol in this study is driven by the need for an international standard to ensure transparency, traceability, and reproducibility in the literature review process. PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) is widely recommended as a standard for conducting an SLR because it provides a systematic, structured reporting framework that spans search strategies and article selection through to the data synthesis process. According to Page et al. [15], the PRISMA 2020 Statement provides more comprehensive and relevant guidelines for improving the quality of reporting in systematic review studies, particularly in ensuring that the processes of literature identification and screening are conducted transparently and can be replicated by other researchers. Therefore, the PRISMA protocol was used in this study to ensure methodological validity and the credibility of the systematic review findings.

The review process began with a comprehensive literature search conducted through several academic databases, namely Scopus, Web of Science, ERIC, DOAJ, Google Scholar, and Sinta, using keywords such as “Employability Skills”, “Vocational Education”, “Project-Based Learning”, “Problem-Based Learning”, “Teaching Factory”, “Work-Based Learning”, “Blended Learning”, and “Cooperative Learning”. The selection of Scopus, Web of Science, ERIC, DOAJ, Google Scholar, and Sinta was undertaken because each database offers complementary strengths and is relevant to the topic of vocational education and learning models. Scopus and Web of Science were used because they are internationally reputable databases with broad coverage of rigorously indexed scientific journals, thereby ensuring the quality of the articles reviewed. ERIC was selected because it specifically includes research in education and pedagogy, which is relevant to the focus of this review on learning models. DOAJ was used to access credible open-access journals and to broaden the scope of the literature. Google Scholar served as a complementary source to identify relevant articles that might not be indexed in the primary databases. Meanwhile, Sinta was selected to accommodate the Indonesian national context, given that many studies on vocational education and Vocational High Schools (SMKs) are published in nationally indexed Sinta journals. The literature search was conducted from July to September 2025, covering publications from the past 10 years (2015 to 2025) to capture recent developments in the diversification of learning models to strengthen employability skills. This time span was chosen because it is closely associated with the period of vocational education transformation in response to the demands of the Industrial Revolution 4.0.

The initial search yielded 457 articles. After duplicate removal, 312 unique articles were obtained and included in the subsequent stage. The next stage involved applying the inclusion and exclusion criteria. Articles that did not meet reputable publication standards (peer-reviewed) or were not relevant to the research focus were excluded, leaving 46 articles analyzed based on their titles and abstracts. At this stage, 266 articles were eliminated for failing to meet predetermined criteria for content relevance, methodology, or research context. Of the 46 articles examined in greater depth, 29 articles were deemed irrelevant because they did not specifically address the relationship between learning models and employability skills in vocational education.

The research data in this SLR were obtained from a combination of several international and national academic databases, namely Scopus, Web of Science, ERIC, DOAJ, Google Scholar, and Sinta. All articles that constituted the final SLR dataset originated from an integrated search across these six databases. Scopus and

Web of Science were used to capture high quality articles from reputable international journals; ERIC was used specifically because it contains research in education and pedagogy; DOAJ was utilized to obtain credible open access articles; Google Scholar was employed as a complementary search to ensure that no relevant articles were overlooked; while Sinta was used to capture national publications that are relevant to the context of vocational education in Indonesia. Accordingly, the data analyzed in this SLR were synthesized from all the databases used, rather than from a single database.

The article selection process used inclusion and exclusion criteria to ensure only relevant, high-quality articles were analyzed; the criteria applied in this review are presented in Table 1.

Table 1. Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Research Focus	Studies in the context of vocational education/TVET/SMK that focus on learning models for strengthening employability skills	Studies outside vocational education; studies not focused on learning models; studies that do not address employability skills
Publication Period	January 2015 to January 2025	Before January 2015
Document Type	Articles in the form of scientific journals and conference proceedings that discuss vocational learning and employability skills	Book chapters; books; non-empirical literature review articles; editorials or opinion pieces
Language	English	Languages other than English
Publication Status	Final published articles	In Press Early Access or Preprint

The inclusion criteria in this study comprised: (1) articles published in reputable journals and having undergone a peer review process; (2) articles published within the 2015 to 2025 period to capture recent developments in line with the demands of the Industrial Revolution 4.0; (3) articles that discuss learning models in vocational education or TVET; and (4) articles that explicitly examine or report the relationship between learning models and employability skills. Meanwhile, exclusion criteria were applied to remove less relevant articles, namely: (1) articles that did not undergo a peer review process; (2) articles that focused solely on general or non vocational education contexts; (3) articles that did not address employability skills; (4) articles with unverifiable methodologies or those that did not report research procedures; and (5) duplicate articles or preprint versions. The application of these criteria provided an objective basis for filtering the initial 457 articles to 17 final articles deemed suitable for in-depth analysis.

The final stage of the screening process yielded 17 eligible articles for in-depth review. These articles were then systematically analyzed by extracting key information, such as author names, year of publication, research location, methodology, research focus, and main findings. Subsequently, a thematic analysis was conducted to identify patterns, similarities, and differences across studies and their implications for vocational education practice. This selection process is visualized in Figure 1, which illustrates the stages from the initial search to the determination of the final set of eligible articles.

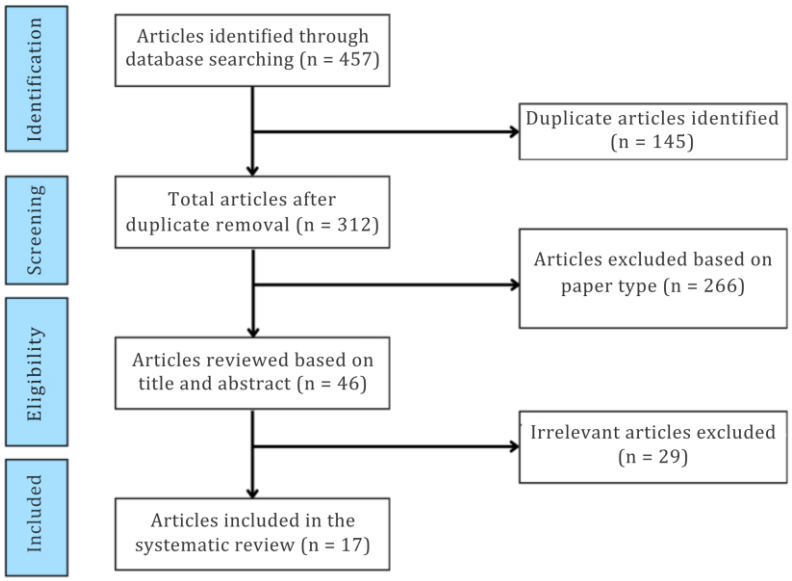

Figure 1. PRISMA Statement Flow Diagram

RESULTS AND DISCUSSION

The results of the systematic review of the 17 articles that met the inclusion criteria indicate that there are six main learning models most frequently used in efforts to strengthen the employability skills of Vocational High Schools (SMK) students, namely Project-Based Learning (PjBL), Problem-Based Learning (PBL), Work-Based Learning (WBL), Teaching Factory (TeFa), Blended Learning or Flipped Classroom, and Cooperative Learning. Each learning model contributes differently to the development of work-related skills required by vocational graduates, such as communication, teamwork, problem-solving, creativity, digital literacy, leadership, and responsibility.

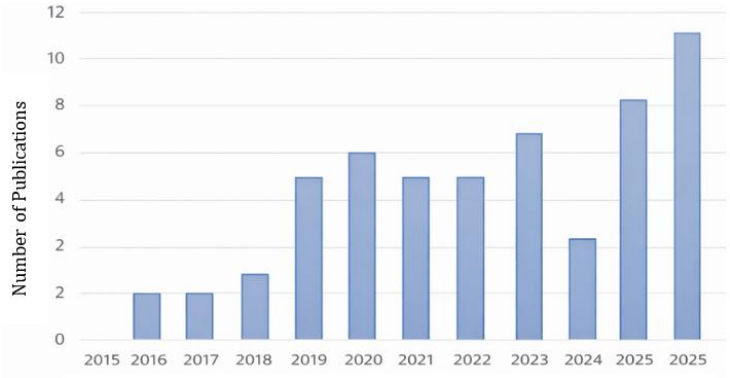

Figure 2. Number of Publications Related to Vocational Education, TVET, or SMK Learning Models with a Focus on Strengthening Employability Skills

Figure 2 shows the trend in the number of publications related to learning models in vocational education, TVET, or SMK that focus on strengthening employability skills during the 2015 to 2025 period. This visualization illustrates the dynamics of research development and shows the increasing academic interest in this topic over the past decade.

In general, previous studies indicate that Project-Based Learning and Problem-Based Learning emphasize the strengthening of critical thinking, problem-solving, and collaboration skills. Work-Based Learning and Teaching Factory provides authentic work experiences that enhance adaptability, professional communication, discipline, and work ethic. Meanwhile, Blended Learning, or the Flipped Classroom, plays a substantial role in strengthening digital literacy, learner autonomy, and technology-mediated communication. Cooperative Learning makes a significant contribution to interpersonal skills, teamwork, leadership, and collaboration. These findings reinforce the argument that diversification of learning models is necessary to produce SMK graduates with a comprehensive skill profile that aligns with industry needs.

Table 2. Results of the Systematic Review of Articles Related to Learning Models for Strengthening Employability Skills in Vocational High School (SMK)

No	Author and Year	Learning Model	Employability Skills Strengthened	Findings / Relevance for SMK / Vocational Education
1	Taufiqur Rahman et al. (2023)	Project-Based Learning (PjBL)	Communication, collaboration, critical thinking, problem solving, and self-confidence	PjBL influences students' employability skills by strengthening communication, collaboration, critical thinking, and the application of theory to practice.
2	Hart (2019)	Project-Based Learning (PjBL)	Communication, teamwork, problem-solving, and critical thinking	PjBL, designed by embedding employability skills directly into the curriculum, improves students' abilities in communication, teamwork, and problem-solving.
3	González-Cespón et al. (2024)	Project-Based Learning (PjBL)	Communication, teamwork, and self-management	Cross-disciplinary projects enhance perceived gains in employability skills such as communication, teamwork, and self-management.
4	Sunardi and Hasanuddin (2019)	Project-Based Learning (PjBL)	Collaboration, communication, and initiative	The study shows that PjBL supports the development of soft skills such as collaboration and communication among vocational engineering students.
5	Zhang (2023)	Work-Based Learning (WBL)	Teamwork, responsibility, and adaptability	WBL implemented through teamwork activities in Vocational High School (SMK) is proven to enhance students' employability skills.

No	Author and Year	Learning Model	Employability Skills Strengthened	Findings / Relevance for SMK / Vocational Education
6	Thapa, H. S. (2024)	Work-Based Learning (WBL)	Communication, teamwork, problem solving, leadership, and ethics	In a WBL study within TVET institutions, students obtained technical, soft, and personal skills, including self-confidence and work ethic.
7	D. Hafid et al.	Work-Based Learning (WBL)	Industry curriculum alignment, and industry collaboration	Vocational schools implementing WBL align school curricula with industry competencies through programs such as T-TEP and Teaching Factory.
8	Khanna and Bigham (2021)	Design Factory / Hybrid approach	Personal growth, self-awareness, and graduate attributes	A study of engineering and design students shows that Design Factory modules and practice-based projects can develop graduate attributes and work-ready skills through self-reflection and integrated practice.
9	Klegeris (2021)	Mixed-mode / Active team-based learning	Generic problem-solving skills, and collaboration	The combination of learning modes (blended face-to-face and online) in small teams improves students' generic problem-solving skills.
10	Halili et al. (2022)	Work-Based Learning (WBL)	Communication, interpersonal skills, problem-solving, entrepreneurship, and self-management	This study identifies six Employability Skills 4.0 (communication, interpersonal skills, IT, problem solving, entrepreneurship, and self-management). The results indicate that communication, interpersonal skills, problem-solving, and entrepreneurship are significantly associated with WBL readiness.
11	Thapa (2024)	Work-Based Learning (WBL)	Hard skills and soft skills, leadership, and work ethics	In the context of TVET institutions, WBL successfully enhances the combination of technical and non-technical skills, including leadership and work ethics, through direct practical experience.
12	Subekti et al. (2019)	Teaching Factory / WBL hybrid	Technical skills and employability-related (soft skills)	The Work-Based Learning–Teaching Factory model in Indonesia is presented as a strategy to improve the employability skills of vocational graduates by linking schools and industry through small-scale production settings.
13	Suranto et al. (2022)	Teaching Factory (TeFa)	School–industry collaboration, communication, problem solving, practicality	In Vocational High School (SMK), the implementation of the Teaching Factory provides authentic production experiences and industry engagement, helping students understand work standards and apply communication and teamwork skills in a vocational context.
14	Fitriyah et al. (2023)	Teaching Factory (TeFa)	Self-efficacy, employability skills, and technopreneurship readiness	A strong relationship was found between understanding of the Teaching Factory, employability skills, and self-efficacy; students who master the Teaching Factory concept demonstrate higher readiness for technopreneurship.
15	Balogun and Miller (2022)	Project-based / Learning club (Drone Club)	STEM skills and employability skills (teamwork, creativity, problem solving)	Extracurricular drone club activities are examined as informal learning experiences that foster the development of both technical and soft skills among engineering students.
16	Mari et al. (2022)	Not explicitly defined model (implicative)	Industry perspectives on employability skills among architecture	This study explores employers' views on graduate skills in architecture, emphasizing the importance of communication, creativity, and adaptability as key employability skills.

No	Author and Year	Learning Model	Employability Skills Strengthened	Findings / Relevance for SMK / Vocational Education
			graduates	
17	Oviawe and Anetekhai (2020)	Cooperative Learning	All aspects of soft skills: communication, teamwork, problem-solving	The cooperative learning approach among engineering students in Nigerian polytechnics demonstrates that nearly all aspects of employability skills can be developed through structured group work.

Table 2 presents a summary of the 17 reviewed articles and shows that research on strengthening employability skills in vocational education is dominated by Project-Based Learning (PjBL), Work-Based Learning (WBL), and Teaching Factory (TeFa) models, followed by several other approaches such as Design Factory, mixed-mode active learning, and cooperative approaches. The main finding from this table is that most studies do not merely assess cognitive learning outcomes, but explicitly link learning models with the development of 21st-century skills such as communication, collaboration, leadership, creativity, and self-management. This pattern indicates a shift in research focus from simply "teaching technical skills" to "preparing comprehensive work readiness". In other words, the studies presented in Table 2 collectively reinforce the argument that instructional design in Vocational High Schools (SMKs) should be oriented toward the formation of a holistic graduate profile rather than focusing solely on technical competence.

From a cause-and-effect perspective, the dominance of Project-Based Learning, Work-Based Learning, and Teaching Factory in Table 2 can be explained by the characteristics of these three models, which are closely aligned with real workplace contexts. Project-Based Learning, which positions students as project implementers, requires the ability to plan, communicate, and solve problems collaboratively; therefore, studies by Rahman et al. [16], [17], [18], Hart [19], and González-Cespón et al. [20], [21], [22], [23] consistently report the strengthening of communication, teamwork, problem-solving, and self-management skills. Work-Based Learning and Teaching Factory, as reported by Zhang [24], Thapa [25], Subekti et al. [26], and Suranto et al. [27], provides authentic industrial practice and real production experiences, which logically reinforce work ethic, responsibility, discipline, and adaptability. This element of authentic experience functions as the key "link" between learning models and the enhancement of employability skills: the more authentic students' engagement with the world of work, the stronger the work-related skills that are developed.

Table 2 also shows that several studies have begun to explore more innovative and hybrid models such as Design Factory [28], STEM-based Drone clubs [2], and mixed-mode active learning [29]. These models contribute to the development of a combination of technical skills and soft skills, including creativity, self-awareness, graduate attributes, and generic problem-solving abilities. These findings broaden the spectrum of learning strategies that have traditionally been dominated by "mainstream" models such as Project-Based Learning and Work-Based Learning. The factor underlying these outcomes is the need for universities and vocational institutions to respond swiftly to technological transformation and labor market demands, which has led them to develop learning environments resembling studios, innovation laboratories, or engineering clubs as more flexible platforms for fostering employability skills.

From a strengths perspective, Table 2 demonstrates the value of this study in synthesizing a wide range of contexts (vocational high schools, polytechnics, and universities), countries, and learning models into a single, coherent comparative framework. This matrix enables readers to clearly identify which learning models are used, which skills are emphasized, and how they are relevant to vocational education. However, Table 2 also reveals several limitations: most studies focus on specific soft skills, such as communication, teamwork, and problem-solving, while other areas, such as creativity, entrepreneurship, and digital literacy, have not been extensively explored. In addition, not all articles employ rigorous research designs (e.g., controlled experimental studies); thus, the level of causality between learning models and employability skills in some studies remains indicative rather than conclusive.

When compared with the state-of-the-art presented in the introduction, the findings in Table 2 are generally aligned with previous studies while offering an expanded interpretation. For example, results that confirm the effectiveness of Project-Based Learning in developing employability skills are consistent with the studies by Hart and Isa; the strengthening of work readiness through Work-Based Learning is in line with the findings of Thapa and Halili; while the contribution of Teaching Factory to school–industry synchronization reinforces the reports by Subekti and Suranto. The difference is that those studies typically stand alone and examine a single model in a single context. This SLR constructs a "new narrative" by integrating all of these findings into a comparative table, making it evident that employability skills emerge from a diverse configuration of learning models rather than from a single approach. This represents the main added value of the present study compared with previous research.

To obtain a more comprehensive understanding, the review's findings were subsequently mapped in a matrix illustrating the relationships between learning models and the employability skills they strengthen. This mapping is important for highlighting the skill areas most consistently reinforced by each model and identifying potential synergies among models.

Accordingly, teachers and policymakers in Vocational High School (SMK) can select learning strategies that align with students' specific needs and the competency demands of the industrial sector.

Table 3. Matrix Mapping of Learning Models and Employability Skills in Vocational Education

Learning Model	Communication	Teamwork	Problem-Solving	Creativity	Critical Thinking	Digital Literacy	Leadership	Self-Management
Project-Based Learning (PjBL)	✓	✓	✓	✓	✓	±	±	✓
Problem-Based Learning (PBL)	✓	✓	✓	±	✓	±	±	✓
Work-Based Learning (WBL)	✓	✓	✓	±	✓	±	✓	✓
Teaching Factory (TeFa)	✓	✓	✓	±	±	✓	±	✓
Blended/Flipped Learning	✓	±	±	±	✓	✓	±	✓
Cooperative Learning	✓	✓	✓	±	±	±	✓	±

Table 3 concisely shows how each learning model makes different contributions to various aspects of employability skills. The symbol "✓" indicates a strong and consistent contribution, whereas "±" reflects a moderate or less consistent contribution. The most immediately visible pattern is that no single learning model can comprehensively strengthen all dimensions of employability skills. Project-Based Learning, Problem-Based Learning, and Work-Based Learning appear to be dominant in problem-solving and critical thinking, while Teaching Factory and Work-Based Learning are more prominent in digital literacy and leadership within workplace contexts. This condition represents an important finding, as it confirms that vocational education requires strategies to diversify and integrate learning models rather than relying on a single model.

From a cause-and-effect perspective, the strong contributions of Project-Based Learning and Problem-Based Learning to communication, teamwork, problem solving, and critical thinking can be explained by the instructional characteristics of these two models. Project-Based Learning places students in complex projects that require coordination with peers, planning, and presentation of outcomes, thereby naturally training communication and collaboration skills. Problem-Based Learning, which centers on the analysis of authentic problems, encourages students to identify root causes, evaluate alternative solutions, and construct logical arguments. It is this learning mechanism that causes both models to consistently display the "✓" mark across several key columns in Table 3. These findings are consistent with studies reporting significant improvements in critical thinking and teamwork through the implementation of Project-Based Learning and Problem-Based Learning; however, this SLR extends the evidence by revealing cross-model and cross-skill patterns.

The strong contributions of Work-Based Learning and Teaching Factory to communication, teamwork, problem solving, leadership, and self-management also have a logical relationship with their real-world, workplace-based nature. In Work-Based Learning, students are directly engaged in industrial environments, working toward production targets, meeting quality standards, and receiving professional supervision. These experiences require them to manage time, adapt to workplace culture, and interact with various stakeholders, making it reasonable that Work-Based Learning receives a "✓" mark in the areas of communication, teamwork, problem-solving, and self-management. Similarly, Teaching Factory integrates production processes into the school environment, using standards similar to those of industry; students learn to lead small groups, make rapid decisions, and take responsibility for product quality, thereby strengthening leadership and digital literacy. These findings are consistent with reports [21], [22], but this study offers a new narrative by demonstrating that Work-Based Learning and Teaching Factory are not only relevant for hard skills, but also function as the primary "engines" for shaping self-management and leadership.

Blended or Flipped Learning and Cooperative Learning exhibit different yet complementary contribution patterns. Blended or Flipped Learning shows a "✓" mark for communication, critical thinking, and digital literacy, while only a "±" for teamwork and problem solving. This pattern can be understood because this model places many learning activities in online and self-directed domains; students practice seeking information, managing learning materials, and preparing themselves before face-to-face sessions, thereby fostering rapid development of digital literacy and learner autonomy. On the other hand, Cooperative Learning receives a "✓" mark for communication, teamwork, and leadership, but its contribution to digital literacy and self-management is not as strong as that of other models. Structured group work with clearly differentiated roles enables students to learn how to lead, follow directions, and complete tasks collaboratively. These findings are consistent with Oviawe and Anetekhai [30]; however, this SLR explicitly positions Cooperative Learning in relation to other models, allowing teachers to clearly identify the aspects in which it is most effective.

From Table 2, it can be concluded that the main findings of this study are as follows: (1) each learning model has its own "zone of strength" in relation to specific dimensions of employability skills; (2) a combination of multiple learning models is required to develop a holistic skill profile; and (3) digital literacy and leadership tend to emerge more strongly when learning models directly engage with technology and authentic workplace contexts. The factors underlying these patterns include the design of learning activities (projects, problem solving, industrial practice, and group work), the level of student engagement, and the degree to which learning is closely connected to real-world work contexts. Models that are based on direct experience and real responsibility tend to strengthen self-management and leadership, whereas models that emphasize problem investigation and concept exploration tend to enhance critical thinking and problem-solving skills. Accordingly, the cause-and-effect relationship between model characteristics and the skills that emerge can be logically explained through constructivist learning theory and experiential learning.

From a methodological perspective, the matrix presented in Table 2 has several strengths. First, this matrix synthesizes the findings of 17 articles into a clear and accessible visual representation, making it easier for teachers and policymakers to quickly understand the contributions of each learning model. Second, the matrix does not merely compile findings, but also classifies the strengths of each model through categories of strong ("✓") and moderate ("±") contributions, thereby providing a conceptual foundation for designing combinations of learning models. Third, this matrix clearly shows that self-management and leadership are relatively underrepresented in several models, thereby opening opportunities for further research to develop more targeted interventions. However, Table 2 also has limitations; for example, the assessment of strong or moderate contributions relies heavily on how results are reported in the source articles and is not supported by a quantitative meta-analysis. In addition, not all employability skill domains are represented equally in the studies, which may bias results toward certain models or skill areas.

When compared with previous studies, the mapping results presented in Table 2 demonstrate both consistency and an extension of existing findings. Consistently, this study aligns with Hart and Rahman in affirming that Project-Based Learning is effective in developing communication and teamwork skills; it also corresponds with Thapa and Halili et al., who state that Work-Based Learning plays a major role in enhancing work readiness and work ethic; and it supports the findings of Lane [31], [32], [33], [34] and Nuryatin and Putri [35] regarding the role of Blended Learning in strengthening digital literacy. The difference is that those studies generally focus on only one learning model or a single group of skills. This SLR offers a new narrative by integrating these studies into a single, systematic comparative framework, providing teachers and policymakers with a comprehensive map of the relationships between learning models and employability skills. Accordingly, Table 2 serves not merely as a summary of findings but also as a new conceptual tool that underscores the urgency of diversifying and integrating learning models in vocational education.

1. **RQ1: What learning models have been applied in vocational education to support the development of employability skills?**

   The results of the Systematic Literature Review indicate that six main learning models are consistently used in strengthening employability skills in vocational education, namely Project-Based Learning (PjBL), Problem-Based Learning (PBL), Work-Based Learning (WBL), Teaching Factory (TeFa), Blended or Flipped Learning, and Cooperative Learning. These six models are used across various vocational education contexts and implemented in Vocational High Schools (SMKs), polytechnics, and vocational higher education institutions. The dominance of these models indicates that vocational education has shifted toward more contextual, collaborative, and experiential learning approaches. This shift aligns with industry demands that require students not only to master technical skills, but also to develop adaptive skills such as communication, collaboration, and problem-solving. Accordingly, the diversity of these learning models represents a response to the complexity of competencies required in the era of the Industrial Revolution 4.0 [36], [37].

   Project-Based Learning (PjBL) and Problem-Based Learning (PBL) are the two most frequently used models because they create learning experiences that closely resemble real-world workplace situations. Project-Based Learning emphasizes completing real-world projects that require collaboration, creativity, time management, and responsibility. Problem-Based Learning, on the other hand, focuses on processes of problem analysis, decision making, and scientific argumentation, thereby strengthening students' critical thinking skills. The SLR results show that these two models were selected because they are highly relevant to industry needs for graduates with higher-order thinking abilities and complex problem-solving skills. Accordingly, PjBL and PBL play a strategic role in building the generic competencies required of vocational graduates across various fields of expertise [38], [39], [40].

   Work-Based Learning (WBL) and Teaching Factory (TeFa) are learning models that most closely approximate real workplace conditions because they directly involve students in industrial environments or production units operating under industry standards. Work-Based Learning provides internship experiences, field practice, or industry-based activities that strengthen work ethic, discipline, adaptability, and professional communication. Teaching Factory, as a distinctive

model of vocational education in Indonesia, integrates production processes into learning, enabling students to become accustomed to meeting work targets, maintaining production quality, and working within team dynamics. Both models appear consistently in the reviewed articles, indicating the importance of direct experience in fostering work readiness. These findings reinforce the view that vocational skills cannot be developed solely through simulation, but require authentic work experiences [41], [42].

Blended or Flipped Learning and Cooperative Learning complement the range of learning models used in strengthening employability skills by emphasizing technological aspects and interpersonal collaboration. Blended or Flipped Learning emerges within the context of educational digitalization, in which students are required to possess digital literacy, learner autonomy, and the ability to manage information through online platforms. Cooperative Learning, in contrast, focuses on intensive group interactions to build interpersonal communication, leadership, and teamwork skills. These two models are selected because they support the needs of the modern workplace, which is increasingly digital and collaborative. Accordingly, the variety of learning models identified in this SLR indicates that strengthening employability skills requires diverse and complementary instructional approaches [43], [44].

2. **RQ2: Which aspects of employability skills are strengthened by each learning model?**

The SLR results indicate that each learning model contributes differently to specific employability skills, indicating that no single model can develop all skills comprehensively. Project-Based Learning (PjBL) shows a strong tendency to enhance creativity, communication, collaboration, problem-solving, and self-management, as project-based learning processes require students to design and execute tasks independently. Within PjBL, students are also required to present and defend their ideas, which significantly improves communication skills. These findings are consistent with studies [45], [46] indicating that Project-Based Learning enhances a combination of technical and non-technical skills. This contribution helps explain why Project-Based Learning has become one of the most widely implemented models in vocational education.

Problem-Based Learning (PBL) significantly strengthens critical thinking, analytical skills, scientific argumentation, and complex problem-solving. These skills develop because the PBL learning process places students in problematic situations without a single definitive solution, thereby encouraging them to critically evaluate alternatives. PBL also enhances communication skills, as students are required to engage in discussion, clarify ideas, and make group-based decisions. The study by Sunardi and Hasanuddin [36] supports these findings by explaining that Problem-Based Learning provides opportunities for students to develop reflective and systematic thinking patterns. Accordingly, Problem-Based Learning serves as a learning model that sharpens higher-order cognitive skills highly required in the modern workplace.

Work-Based Learning (WBL) and Teaching Factory (TeFa) make strong contributions to the development of work adaptability, work ethic, responsibility, technological literacy, and professional communication. In Work-Based Learning, students gain direct experience through industrial practice, enabling them to learn how to handle pressure, meet targets, and meet real professional standards. Teaching Factory, as a production-based learning model, trains students to collaborate in teams to produce goods that meet industry standards, thereby strengthening discipline, accuracy, and teamwork skills. These findings are consistent with studies [47], [48] which state that authentic industry experience is a key factor in building genuine work readiness. Therefore, Work-Based Learning and Teaching Factory emerge as the learning models that make the greatest contribution to the work readiness aspect.

Blended or Flipped Learning and Cooperative Learning strengthen digital skills, learner autonomy, time management, interpersonal communication, and leadership. Blended Learning enables students to access learning materials independently through digital technology, thereby enhancing their ability to manage information and solve problems autonomously [49], [50], [51]. Cooperative Learning, through structured group work, reinforces students' abilities to negotiate, collaborate, and lead groups. The study by Oviawe and Anetekhai shows that Cooperative Learning is an effective means of developing interpersonal soft skills in the context of vocational education. Accordingly, this model complements aspects of employability skills that are not fully developed through industry-based or project-based learning models.

3. **RQ3: What gaps, patterns, and trends emerge from previous research findings regarding the effectiveness of each model in the context of vocational education?**

The SLR analysis reveals a clear pattern indicating that project-based and problem-based learning models, such as Project-Based Learning and Problem-Based Learning, are consistently associated with improvements in higher-order thinking skills. This pattern emerges from studies showing that learning activities involving situation analysis, planning, and problem resolution directly impact the development of critical thinking and problem-solving skills. The studies by Hart and Isa

reinforce this pattern by showing that Project-Based Learning not only improves technical learning outcomes but also strengthens collaboration and creativity. This consistency indicates that challenge-based learning constitutes an effective strategy across various vocational contexts. Accordingly, it can be concluded that project-based and problem-based models serve as a primary foundation for the development of cognitively oriented employability skills [52], [53].

The second pattern indicates that workplace-based learning models, namely Work-Based Learning and Teaching Factory, have a strong capacity to develop work-readiness skills such as adaptability, work ethic, responsibility, and professional communication. The analyzed articles consistently state that these skills develop because students directly experience the culture, rhythm, and demands of the workplace [54], [55], [56], [57]. These findings align with Thapa's research, which emphasizes the importance of industrial experience in building self-confidence and interpersonal skills. The study by Halili also supports this pattern by identifying six Employability Skills 4.0, most of which are developed through authentic workplace practice. This pattern indicates that authentic experience cannot be fully replaced by classroom-based learning.

The third pattern indicates that technology-based learning models, particularly Blended or Flipped Learning, are closely associated with improvements in digital literacy, learner autonomy, and time management skills. Differences emerge from studies conducted in institutions that are more digitally ready than most Vocational High Schools (SMKs) contexts, which leads to variations in findings. Lane reported that this model can enhance the use of technology for independent task completion, while Nuryatin and Putri found that technology integration can strengthen employability skills in the context of language learning. However, several access limitations lead to different outcomes in schools that do not yet have adequate technological infrastructure. This indicates that the effectiveness of Blended Learning is strongly affected by institutional readiness [58], [59].

Although clear patterns and similarities are evident, this study also identifies differences in findings across articles based on national context, educational level, and school readiness. Several studies indicate that models such as Cooperative Learning are more effective in certain social contexts, whereas Work-Based Learning is stronger in countries with well-established industry partnerships [60], [61], [62]. These differences demonstrate that the effectiveness of learning models is strongly affected by each country's vocational education ecosystem. However, overall, the findings of this study are consistent with the state of the art, which emphasizes the need to integrate learning models. Accordingly, these results both reinforce and extend the understanding of the importance of diversifying learning strategies in vocational education [63], [64].

4. **RQ4: How can conceptual mapping across learning models be used for learning strategies in Vocational High Schools (SMKs)?**

The conceptual mapping generated from the SLR analysis shows that each learning model has unique strengths that can complement one another in strengthening various aspects of employability skills. Project-Based Learning demonstrates strong potential in developing creativity and problem-solving skills, whereas Work-Based Learning and Teaching Factory strengthen adaptability and work ethic through direct experiential learning. Cooperative Learning contributes to the development of interpersonal communication and teamwork, two competencies that are highly required in the modern workplace. Accordingly, this mapping indicates that integrating learning models represents the most effective strategy for achieving comprehensive strengthening of employability skills.

These findings indicate that Vocational High School (SMK) teachers need to design learning strategies that do not rely on a single model but instead combine elements from multiple approaches. For example, integrating Project-Based Learning with Blended Learning can enhance creativity while simultaneously strengthening digital literacy, whereas combining Work-Based Learning with Cooperative Learning can reinforce professional communication and teamwork skills. This integrative approach allows students to experience a richer, deeper, and more industry-aligned learning experience. In addition, this strategy enables teachers to tailor learning to the subject matter's characteristics and students' specific competency needs. Accordingly, this conceptual mapping provides a practical foundation for designing learning that is more responsive and adaptive [65], [66], [67].

The SLR results also show that integrating learning models can create a learning ecosystem more relevant to Industry 4.0's demands, with technology, creativity, and collaboration as core foundations. Contemporary industry requires graduates who can work in dynamic, flexible, technology-based environments. Therefore, combining learning models that strengthen cognitive, interpersonal, and digital skills has become increasingly important. Previous studies, such as those by Mari and Friesel, support this argument by stating that modern work competencies require the integration of technical and non-technical abilities. This indicates that the mapping presented in this study is relevant not

only for SMK in Indonesia, but also in a broader global context [68], [69].

With this mapping in place, the study provides a practical framework for schools to determine learning model priorities based on the competency profiles they aim to achieve. If the learning objective is to strengthen digital literacy, Blended Learning can serve as the primary option; if the focus is on industry readiness, Work-Based Learning and Teaching Factory are more suitable to implement. Teachers can also adapt this mapping to design more targeted learning modules, assessments, and classroom activities. In addition, this mapping makes a theoretical contribution by offering an integrative concept that previous studies have not proposed. Accordingly, this study delivers both novelty and practical value for the development of vocational education [70], [71].

CONCLUSION

This systematic review confirms that various learning models, including Project-Based Learning, Problem-Based Learning, Work-Based Learning, Teaching Factory, Blended or Flipped Learning, and Cooperative Learning, make distinct yet complementary contributions to strengthening the employability skills of Vocational High School (SMK) students. The mapping results indicate that each model reinforces specific employability skills, such as critical thinking, problem-solving, work adaptability, collaboration, professional communication, digital literacy, and leadership, and that no single model can develop all employability skills comprehensively. This pattern of findings indicates that the characteristics of each learning model directly strengthen specific skills; for example, project-based models enhance creativity, while industry-based models foster work ethic and responsibility, suggesting that the most effective learning strategy is cross-model integration. Accordingly, this study concludes that diversifying learning models is a necessary approach to building a vocational learning ecosystem that is more adaptive and relevant to Industry 4.0 demands, while underscoring the importance of policy support, enhanced teacher competencies, and industry collaboration to ensure optimal implementation.

REFERENCES

[1] Sunardi and Hasanuddin, "Pengembangan Employability Skill Mahasiswa Vokasi Melalui Pembelajaran Stem-Project Based Learning," *SemanTECH*, vol. 3, no. 4, 2019.

[2] A. O. Balogun and J. Miller, "Drone Club: Exploring Engineering and Employability Skills Outside the Classroom," *TechTrends*, vol. 66, no. 6, 2022, doi: 10.1007/s11528-022-00798-7.

[3] M. Schultz, K. Young, T. K. Gunning, and M. L. Harvey, "Defining and measuring authentic assessment: a case study in the context of tertiary science," *Assess Eval High Educ*, vol. 47, no. 1, 2022, doi: 10.1080/02602938.2021.1887811.

[4] M. U. Isa, Y. Bin Kamin, Y. I. Salihu, H. Shuaibu, and A. M. Cledumas, "Enhancing employability skills of woodwork technology education students through project-based learning at colleges of education (technical) in Nigeria," *Universal Journal of Educational Research*, vol. 8, no. 9A, 2020, doi: 10.13189/ujer.2020.082005.

[5] Paryanto *et al.*, "Implementation of project-based learning model to improve employability skills and student achievement," in *AIP Conference Proceedings*, 2023. doi: 10.1063/5.0116444.

[6] W. Mainga, M. B. M. Braynen, R. Moxey, and S. A. Quddus, "Graduate Employability of Business Students," *Adm Sci*, vol. 12, no. 3, 2022, doi: 10.3390/admsci12030072.

[7] S. Nurfaijah, W. Sumarni, S. Sumarti, and C. Kurniawan, "Chemistry in Education PENGARUH PROJECT BASED LEARNING TERINTEGRASI STEM PADA PEMBELAJARAN HIDROLISIS GARAM TERHADAP KEAKTIFAN SISWA," *Chemistry in Education*, vol. 10, no. 2, 2021.

[8] A. R. Yusuf, Marji, E. Sutadji, and M. Sugandi, "Integration of STEM Project-Based Learning into 21st Century Learning and Innovation Skills (4Cs) in Vocational Education Using SEM Model Analysis," *Hacettepe Egitim Dergisi*, vol. 38, no. 4, 2023, doi: 10.16986/HUJE.2023.499.

[9] M. A. Martawijaya, S. Rahmadhanningsih, A. Swandi, M. Hasyim, and E. H. Sujiono, "THE EFFECT OF APPLYING THE ETHNO-STEM-PROJECT-BASED LEARNING MODEL ON STUDENTS' HIGHER-ORDER THINKING SKILL AND MISCONCEPTION OF PHYSICS TOPICS RELATED TO LAKE TEMPE, INDONESIA," *Jurnal Pendidikan IPA Indonesia*, vol. 12, no. 1, 2023, doi: 10.15294/jpii.v12i1.38703.

[10] C. C. Chang and W. H. Yen, "The role of learning style in engineering design thinking via project-based STEM course," *Asia Pacific Journal of Education*, vol. 43, no. 4, 2023, doi: 10.1080/02188791.2021.1957776.

[11] M. I. Effendi, H. Elmunsyah, L. Nurjanah, F. Firdausia, F. Riza, and P. Kejuruan Sekolah Pascasarjana Universitas Negeri Malang, "Diversification of STEM (Science, Technology, Engineering, and Mathematics) Integrated Learning Models as an Innovation in Vocational Learning in the Merdeka Belajar Era," *Didaktika: Jurnal Kependidikan*, vol. 13, no. 1, pp. 87–96, Feb. 2024, doi: https://doi.org/10.58230/27454312.380.

[12] M. A. Samsudin, S. M. Jamali, A. N. M. Zain, and N. A. Ebrahim, "The effect of STEM project based learning on self-efficacy among high-school physics students," *Journal of Turkish Science Education*, vol. 17, no. 1, 2020, doi: 10.36681/tused.2020.15.

[13] W. F. W. Abdullah, K. M. Salleh, N. L. Sulaiman, and M. Kamarrudin, "Employability Skills in the TVET Trainer Training Program: The perception Between Experienced Trainers and Novices Trainers," *Journal of Technical Education and*

Training, vol. 14, no. 1, 2022, doi: 10.30880/jtet.2022.14.01.013.

[14] N. Nawai, "EMPLOYERS' PERCEPTIONS OF THE EMPLOYABILITY SKILLS OF ISLAMIC BUSINESS ADMINISTRATION GRADUATES IN UNIVERSITI SAINS ISLAM MALAYSIA," *International Journal of Islamic Economics and Finance Research*, vol. 4, no. 1 July, 2021, doi: 10.53840/ijiefer47.

[15] M. J. Page *et al.*, "The PRISMA 2020 statement: An updated guideline for reporting systematic reviews," Mar. 29, 2021, *BMJ Publishing Group*. doi: 10.1136/bmj.n71.

[16] Taufiqur Rahman, Nurul Fitria, Evi Nurhidayah, and Ika Yuliandani, "Effects of Project-Based Learning on Employability Skills," *Review of Islamic Studies*, vol. 2, no. 1, 2023, doi: 10.35316/ris.v2i1.473.

[17] M. Tang, T. Pham, and E. Saito, "Contributions of Employability Capitals to the Employability of Chinese International Graduates in Australia," *J Stud Int Educ*, 2024, doi: 10.1177/10283153241262464.

[18] G. Newlands, "'This isn't forever for me': Perceived employability and migrant gig work in Norway and Sweden," *Environ Plan A*, vol. 56, no. 4, 2024, doi: 10.1177/0308518X221083021.

[19] J. Hart, "Interdisciplinary project-based learning as a means of developing employability skills in undergraduate science degree programs," *Journal of Teaching and Learning for Graduate Employability*, vol. 10, no. 2, 2019, doi: 10.21153/jtlge2019vol10no2art827.

[20] J. L. González-Cespón, J. A. Alonso-Rodríguez, S. Rodríguez-Barcia, P. P. Gallego, and M. R. Pino-Juste, "Enhancing Employability Skills of Biology Graduates through an Interdisciplinary Project-Based Service Learning Experience with Engineering and Translation Undergraduate Students," *Educ Sci (Basel)*, vol. 14, no. 1, 2024, doi: 10.3390/educsci14010095.

[21] N. van der Baan, W. Nuis, S. Beausaert, W. Gijselaers, and I. Gast, "Developing employability competences through career coaching in higher education: supporting students' learning process," *Studies in Higher Education*, vol. 49, no. 12, 2024, doi: 10.1080/03075079.2024.2307976.

[22] P. M. Nimmi, K. A. Zakkariya, and A. V. Philip, "Enhancing employee wellbeing – an employability perspective," *Benchmarking*, vol. 30, no. 1, 2023, doi: 10.1108/BIJ-03-2021-0116.

[23] L. Jiang, Z. Chen, and C. Lei, "Current college graduates' employability factors based on university graduates in Shaanxi Province, China," *Front Psychol*, vol. 13, 2023, doi: 10.3389/fpsyg.2022.1042243.

[24] D. Zhang, "INNOVATIVE WORK-BASED LEARNING AND EMPLOYABILITY SKILLS TRAINING FOR LEARNERS WITH SPECIAL NEEDS," in *Education and New Developments 2023 – Volume 1*, Jun. 2023, pp. 177–180. doi: 10.36315/2023v1end038.

[25] H. S. Thapa, "Development of Employability Skills through Work-Based Learning," *Journal of Technical and Vocational Education and Training*, vol. 18, no. 1, 2024, doi: 10.3126/tvet.v18i1.62750.

[26] S. Subekti, A. Ana, M. S. Barliana, and I. Khoerunnisa, "Work-Based Learning-Teaching Factory in Indonesia as a Model to Increase Employability Skills," *In: TVET@Asia*, no. 13, 2019.

[27] Suranto, W. Rohmah, I. Nuryana, Sutama, S. Narimo, and B. Amanda, "Using Teaching Factory Model for Improving Student Employability Skills in Vocational High School," in *Proceedings of the 7th Progressive and Fun Education International Conference (PROFUNEDU 2022)*, 2022. doi: 10.2991/978-2-494069-71-8_13.

[28] J. Khanna and A. Bigham, "The Development of Personal Growth, Self-Awareness & Graduate Attributes in Engineering & Design Factory Students - Part 1," in *9th Research in Engineering Education Symposium and 32nd Australasian Association for Engineering Education Conference, REES AAEE 2021: Engineering Education Research Capability Development*, 2021. doi: 10.52202/066488-0069.

[29] A. Klegeris, "Mixed-mode instruction using active learning in small teams improves generic problem-solving skills of university students," *J Furth High Educ*, vol. 45, no. 7, 2021, doi: 10.1080/0309877X.2020.1826036.

[30] J. I. Oviawe and A. O. Anetekhai, "Sprouting employability skills in building technology students' using cooperative learning approaches in Nigerian Polytechnics," *Asian Journal Of Assessment In Teaching And Learning*, vol. 10, no. 1, 2020, doi: 10.37134/ajatel.vol10.1.7.2020.

[31] S. Lane, "Developing Employability Skills by Using Blended Learning," *Am J Educ Res*, vol. 4, no. 1, 2016.

[32] N. Mezhoudi, R. Alghamdi, R. Aljunaid, G. Krichna, and D. Düştegör, "Employability prediction: a survey of current approaches, research challenges and applications," *J Ambient Intell Humaniz Comput*, vol. 14, no. 3, 2023, doi: 10.1007/s12652-021-03276-9.

[33] J. Decius, M. Knappstein, and K. Klug, "Which way of learning benefits your career? The role of different forms of work-related learning for different types of perceived employability," *European Journal of Work and Organizational Psychology*, vol. 33, no. 1, 2024, doi: 10.1080/1359432X.2023.2191846.

[34] J. Akkermans, W. E. Donald, D. Jackson, and A. Forrier, "Are we talking about the same thing? The case for stronger connections between graduate and worker employability research," *Career Development International*, vol. 29, no. 1, 2024, doi: 10.1108/CDI-08-2023-0278.

[35] A. Nuryatin and N. A. S. M. Putri, "Need analysis of English learning to improve employability skills based on blended learning," *Journal Universitas Muhammadiyah Gresik Engineering, Social Science,*

and Health International Conference (UMGESHIC), vol. 1, no. 1, 2021.
[36] Sunardi and Hasanuddin, "Pengembangan Employability Skill Mahasiswa Vokasi Melalui Pembelajaran Stem-Project Based Learning," *SemanTECH*, vol. 3, no. 4, 2019.
[37] Roemintoyo and M. K. Budiarto, "Project-based Learning Model to Support 21st Century Learning: Case Studies in Vocational High Schools," *Journal of Education Research and Evaluation*, vol. 7, no. 4, pp. 662–670, Dec. 2023, doi: 10.23887/jere.v7i4.63806.
[38] B. Sudarsono *et al.*, "Development of Integrated Project-Based (PjBL-T) Model to Improve Work Readiness of Vocational High School Students," *Jurnal Pendidikan Vokasi*, vol. 12, no. 3, pp. 222–235, 2022, doi: 10.21831/jpv.v12i3.53158.
[39] B. Sudarsono *et al.*, "Development of Integrated Project-Based (PjBL-T) Model to Improve Work Readiness of Vocational High School Students," *Jurnal Pendidikan Vokasi*, vol. 12, no. 3, pp. 222–235, 2022, doi: 10.21831/jpv.v12i3.53158.
[40] M. I. Effendi and Y. Yoto, "Pembelajaran Abad-21 Melalui Model Project Based Learning Terintegrasi STEM (PJBL-STEM) dalam Meningkatkan Kemampuan Berpikir Tingkat Tinggi," *Briliant: Jurnal Riset dan Konseptual*, vol. 9, no. 1, 2024, doi: 10.28926/briliant.v9i1.1637.
[41] A. Y. Jafarudin, F. Roshayanti, and J. Siswanto, "Penerapan PJBL Berbasis Steam dalam Implementasi Pembelajaran IPAS Siswa Kelas X SMK PGRI 2 Taman," *Jurnal Inovasi Pembelajaran di Sekolah*, vol. 4, no. 2, 2023, doi: 10.51874/jips.v4i2.140.
[42] D. Triana, Y. U. Anggraito, and S. Ridlo, "Effectiveness of Environmental Change Learning Tools Based on STEM-PjBL Towards 4C Skills of Students," *Journal of Innovative Science Education*, vol. 9, no. 2, 2020.
[43] I. Rahmania, "Project Based Learning (PjBL) Learning Model with STEM Approach in Natural Science Learning for the 21st Century," *Budapest International Research and Critics Institute (BIRCI-Journal): Humanities and Social Sciences*, vol. 4, no. 1, 2021, doi: 10.33258/birci.v4i1.1727.
[44] U. B. Harun, "Project-Based Learning Integrated To Stem (Stem-Pjbl) To Enhance Arabic Learning Hots-Based," *Al-Bidayah: Jurnal Pendidikan Dasar Islam*, vol. 12, no. 1, 2020, doi: 10.14421/al-bidayah.v12i1.230.
[45] A. Friesel, E. Tovar, L. Previati, E. Vizzarro, L. E. Eriksson, and P. Binelli, "Empowering STEM candidates for employability and entrepreneurship," in *EAEEIE 2023 - Proceedings of the 2023 32nd Annual Conference of the European Association for Education in Electrical and Information Engineering*, 2023. doi: 10.23919/EAEEIE55804.2023.10181377.
[46] S. H. Halili, N. Fathima, and R. Razak, "Exploring Relevant Employability Skills 4.0 For University Students' Readiness in The Work-Based Learning Program," *Journal of Technical Education and Training*, vol. 14, no. 3, 2022, doi: 10.30880/jtet.2022.14.03.007.
[47] P. M. L. Ng, J. K. Y. Chan, T. M. Wut, M. F. Lo, and I. Szeto, "What makes better career opportunities for young graduates? Examining acquired employability skills in higher education institutions," *Education and Training*, vol. 63, no. 6, 2021, doi: 10.1108/ET-08-2020-0231.
[48] M. Y. P. Peng and X. Yue, "Enhancing Career Decision Status of Socioeconomically Disadvantaged Students Through Learning Engagement: Perspective of SOR Model," *Front Psychol*, vol. 13, 2022, doi: 10.3389/fpsyg.2022.778928.
[49] M. Tight, "Employability: a core role of higher education?," *Research in Post-Compulsory Education*, vol. 28, no. 4, 2023, doi: 10.1080/13596748.2023.2253649.
[50] S. Gorbatov, J. K. Oostrom, and S. N. Khapova, "Work does not speak for itself: examining the incremental validity of personal branding in predicting knowledge workers' employability," *European Journal of Work and Organizational Psychology*, vol. 33, no. 1, 2024, doi: 10.1080/1359432X.2023.2276533.
[51] M. A. I. Gazi *et al.*, "Mediating role of entrepreneurial intention on the relationship between entrepreneurship education and employability: a study on university students from a developing country," *Cogent Business and Management*, vol. 11, no. 1, 2024, doi: 10.1080/23311975.2023.2294514.
[52] T. S. Mari, V. Ng, S. Gunasagaran, and S. Kuppusamy, "Are they ready yet: Architecture Graduates Employability Skills from Employers' Perspective," *Journal of Design and Built Environment*, vol. 22, no. 1, 2022, doi: 10.22452/jdbe.vol22no1.6.
[53] A. K. Reedy, M. L. Guerrero Farías, L. H. Reyes, and D. Pradilla, "Improving employability skills through non-placement work-integrated learning in chemical and food engineering: A case study," *Education for Chemical Engineers*, vol. 33, 2020, doi: 10.1016/j.ece.2020.09.002.
[54] S. Suyitno *et al.*, "The Effect of Work-Based Learning on Employability Skills: The Role of Self-Efficacy and Vocational Identity," *European Journal of Educational Research*, vol. 14, no. 1, 2025, doi: 10.12973/eu-jer.14.1.309.
[55] J. Akkermans, P. Le Blanc, B. Van der Heijden, and A. De Vos, "Toward a contextualized perspective of employability development," *European Journal of Work and Organizational Psychology*, vol. 33, no. 1, 2024, doi: 10.1080/1359432X.2023.2291763.
[56] N. Zulmi and F. Tentama, "The effect of entrepreneurial readiness, adversity quotient, and social intelligence on employability students," *Journal of Education and Learning*, vol. 18, no. 1, 2024, doi: 10.11591/edulearn.v18i1.20770.
[57] E. Twyford and B. A. Dean, "Inviting students to talk the talk: developing employability skills in

accounting education through industry-led experiences," *Accounting Education*, vol. 33, no. 3, 2024, doi: 10.1080/09639284.2023.2191288.
[58] S. Sulistiani and B. Yulianto, "Employability Skills of Vocational Graduates: Implementation of Curriculum IQF Level 2," 2020. doi: 10.2991/icei-19.2019.2.
[59] F. Fitriyah, S. C. Putro, and Y. Rahmawati, "Hubungan Pemahaman Teaching Factory dan Employability Skills Terhadap Self Efficacy Serta Dampaknya Pada Kesiapan Technopreneurship di Era Digitalisasi Siswa SMKN di Kota Malang," *JAVIT : Jurnal Vokasi Informatika*, 2023, doi: 10.24036/javit.v3i3.161.
[60] W. Doden, I. Grosemans, N. De Cuyper, C. Tschopp, and G. Grote, "Employability in the post-job security era: testing competing effects of perceived job insecurity on perceived employability change," *European Journal of Work and Organizational Psychology*, vol. 33, no. 1, 2024, doi: 10.1080/1359432X.2023.2263201.
[61] W. E. Donald, Y. Baruch, and M. J. Ashleigh, "Construction and operationalisation of an Employability Capital Growth Model (ECGM) via a systematic literature review (2016–2022)," *Studies in Higher Education*, vol. 49, no. 1, 2024, doi: 10.1080/03075079.2023.2219270.
[62] D. Jackson, C. Lambert, R. Sibson, R. Bridgstock, and M. Tofa, "Student employability-building activities: participation and contribution to graduate outcomes," *Higher Education Research and Development*, vol. 43, no. 6, 2024, doi: 10.1080/07294360.2024.2325154.
[63] V. Seevaratnam, D. Gannaway, and J. Lodge, "Design thinking-learning and lifelong learning for employability in the 21st century," *Journal of Teaching and Learning for Graduate Employability*, vol. 14, no. 1, 2023, doi: 10.21153/JTLGE2023VOL14NO1ART1631.
[64] F. Ponikwer and B. A. Patel, "Work-Integrated Learning: A Game-Based Learning Activity That Enhances Student Employability," *J Chem Educ*, vol. 98, no. 3, 2021, doi: 10.1021/acs.jchemed.0c00919.
[65] M. Healy, "Careers and employability learning: pedagogical principles for higher education," *Studies in Higher Education*, vol. 48, no. 8, 2023, doi: 10.1080/03075079.2023.2196997.
[66] I. Römgens, R. Scoupe, and S. Beausaert, "Unraveling the concept of employability, bringing together research on employability in higher education and the workplace," *Studies in Higher Education*, vol. 45, no. 12, 2020, doi: 10.1080/03075079.2019.1623770.
[67] Z. S. Bisschoff and L. Massyn, "A conceptual soft skills competency framework for enhancing graduate intern employability," *Higher Education, Skills and Work-based Learning*, vol. 15, no. 7, 2024, doi: 10.1108/HESWBL-08-2023-0239.
[68] H. K. Duggal, W. M. Lim, P. Khatri, A. Thomas, and A. Shiva, "The state of the art on self-perceived employability," 2024. doi: 10.1002/joe.22245.
[69] J. Akkermans, M. Tomlinson, and V. Anderson, "Initial employability development: introducing a conceptual model integrating signalling and social exchange mechanisms," *European Journal of Work and Organizational Psychology*, vol. 33, no. 1, 2024, doi: 10.1080/1359432X.2023.2186783.
[70] L. T. Tran, N. T. H. Ngo, H. T. M. Nguyen, T. T. T. Le, and T. T. H. Ho, "'Employability in context': graduate employability attributes expected by employers in regional Vietnam and implications for career guidance," *Int J Educ Vocat Guid*, vol. 24, no. 2, 2024, doi: 10.1007/s10775-022-09560-0.
[71] S. J. Mgaiwa, "Fostering Graduate Employability: Rethinking Tanzania's University Practices," *Sage Open*, vol. 11, no. 2, 2021, doi: 10.1177/21582440211006709.