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### Corresponding author:

Ahmad Sholahuddin

Email: [ahmadsholahuddin@gmail.com](mailto:ahmadsholahuddin@gmail.com)

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## DIGITAL TRANSFORMATION OF ISLAMIC VOCATIONAL EDUCATION IN THE INDUSTRY 5.0 ERA: A PRISMA-BASED REVIEW

Ahmad Sholahuddin<sup>1</sup>

<sup>1</sup>Universitas Islam Negeri Sunan Kudus, Indonesia

### ABSTRACT

**Objective:** This study systematically maps the forms, strategies, achievements, and challenges of digital transformation in Islamic vocational education in response to the Industry 5.0 era, emphasizing the integration of digital competencies, Islamic values, and industry relevance.

**Research Design & Methods:** A Systematic Literature Review (SLR) was conducted following the PRISMA 2020 guidelines. Literature was collected from Scopus, Web of Science, Google Scholar, DOAJ, and SINTA databases covering publications from 2019–2025. From 612 initial records, 34 eligible articles were selected and analyzed using thematic analysis.

**Findings:** Five major themes emerged: (1) digitization of curricula and learning materials grounded in Islamic values; (2) enhancement of digital literacy among students and educators; (3) integration of adaptive learning technologies and artificial intelligence; (4) institutional, infrastructural, and digital divide challenges; and (5) the transformation of vocational education toward a human-centric Industry 5.0 model. The review reveals that successful digital transformation depends on visionary leadership, human resource readiness, adequate technological infrastructure, and the effective integration of spiritual values into digital learning environments.

**Contributions:** This study provides a comprehensive synthesis of digital transformation trends in Islamic vocational education and offers practical insights for policymakers, educational leaders, and industry stakeholders in developing vocational education models aligned with Industry 5.0 requirements.

**Novelty:** This study proposes an integrative model connecting technological competence, Islamic character, and industry relevance to enhance workforce readiness in the Industry 5.0 era while synthesizing fragmented literature on digital transformation in Islamic vocational education.

**Keywords:** Digital Transformation; Islamic Vocational Education; Industry 5.0

JEL codes: I21, I28, O33

**Article type:** review paper

## INTRODUCTION

The global industrial world is undergoing a transformation from the paradigm of the Fourth Industrial Revolution toward Industry 5.0, which no longer focuses solely on automation, digitization, and data-driven efficiency, but also places humans at the center (human-centricity) in collaboration with smart technology. Industry 5.0 emphasizes a balance between technological advancement, sustainability, and the resilience of both production and social systems, making human resource development just as important as technological innovation (Ghobakhloo et al., 2023; Zizic et al., 2022). This concept requires the future workforce to possess multidimensional competencies that include digital literacy, critical thinking skills, creativity, collaboration, emotional intelligence, and ethical awareness in utilizing technology (Pacher et al., 2023; Tóth et al., 2023). Educational institutions can no longer focus solely on the mastery of technical skills; they must also be able to produce graduates who are adaptable, innovative, and possess strong character so that they can contribute to the Industry 5.0 ecosystem.

Indonesia's vocational education system plays a strategic role in providing a skilled workforce that meets the needs of the business and industrial sectors. Nevertheless, various studies indicate that vocational education still faces a number of challenges, such as a gap between graduates' competencies and industry needs, limited access to technology-based practical facilities, the low quality of partnerships with the business and industrial sectors, and the suboptimal integration of digital technology into the learning process (Suharno et al., 2020). These issues become even more complex in Islamic-based vocational education institutions, such as pesantren-based vocational high schools, vocational madrasah aliyah, and Islamic vocational colleges. In addition to being required to produce professionally competent graduates, these institutions also have a responsibility to integrate Islamic

values, character building, and professional ethics into the educational process so that graduates are able to use technology responsibly in accordance with Islamic principles (Dimyathi et al., 2025; Muslim, 2024).

Digital transformation in Islamic education has shown a wide range of developments, ranging from the digitization of school management and governance (Rohita & Rahmadini Hidayat, 2023), the development of digital teaching materials for Islamic religious education in vocational schools (Arifah & Fawait, 2025), the strengthening of digital literacy among madrasah students (Sopandi et al., 2023), to issues of digital ethics in Islamic studies (Muslim, 2024). Nevertheless, most research still focuses on general aspects of Islamic education or vocational education in isolation. Studies that specifically integrate the perspectives of digital transformation, Islamic vocational education, and Industry 5.0 competency requirements remain relatively limited and are scattered across various disciplines and types of publications. As a result, there is currently no comprehensive synthesis available that can describe the development of research, implementation strategies, achievements, or the challenges still faced in realizing Islamic vocational education that is relevant to the Industry 5.0 paradigm.

Based on this gap, this study aims to provide a comprehensive mapping of digital transformation in Islamic vocational education through a Systematic Literature Review (SLR) approach. Specifically, this study aims to: (1) identify the forms, strategies, and trends in the implementation of digital transformation in Islamic vocational education; (2) analyze the impact of digital transformation on improving graduates' competencies and work readiness in meeting the demands of Industry 5.0; and (3) identify various challenges related to institutional aspects, infrastructure, human resources, and the integration of Islamic values in the digital transformation process. To achieve these objectives, this study applied the PRISMA 2020 protocol developed by Page et al., (2021) so that the processes of literature identification, selection, evaluation, and synthesis were conducted systematically, transparently, and in a manner that can be replicated by other researchers. The results of this study are expected to provide a conceptual contribution that enriches the literature on Islamic vocational education in the Industry 5.0 era, while also serving as a foundation for the development of digital transformation policies and practices that align with industrial needs and Islamic values.

## LITERATURE REVIEW

### The Concept of Industry 5.0 and Its Implications for Education

Industry 5.0 is a further evolution of Industry 4.0 that is not solely focused on the automation and digitization of production processes, but rather integrates three main pillars: human-centricity, sustainability, and resilience (Ghobakhloo et al., 2023; Zizic et al., 2022). Under the pillar of human-centricity, technology is positioned as a collaborative partner for humans, not a replacement for human roles; consequently, competencies such as critical thinking, creativity, and emotional intelligence become increasingly relevant compared to mere technical skills (Chigbu & Makapela, 2025). The implications for the world of education, including vocational education, are the need to reorient curricula and learning models to produce not merely technology operators, but individuals capable of collaborating ethically with intelligent systems (Tóth et al., 2023).

The study by Pacher et al., (2023) on vocational education and training (VET) indicates that Industry 5.0 competencies include advanced digital literacy, human-machine collaboration skills, and sustainability awareness, all of which need to be integrated into graduate competency profiles. In line with this Chigbu & Makapela (2025) emphasize the convergence of Industry 5.0, Education 5.0, and Work 5.0 as an interconnected paradigm, in which curriculum reform, mastery of artificial intelligence (AI), and the alignment of labor policies must proceed hand in hand.

### Vocational Education in Indonesia

Vocational education in Indonesia has a long history as part of a human resource development strategy focused on mastering job skills and meeting the needs of the labor market. Since its inception, vocational education has been designed to produce graduates ready for the workforce through a learning approach that emphasizes a balance between theory and practice. Over time, the government has continued to implement various reforms, ranging from aligning competency-based curricula and strengthening industry-based education to implementing the "link and match" concept between educational institutions and the business and industrial sectors (DUDI). Nevertheless, various studies indicate that vocational education still faces a number of structural challenges, such as a skills gap between graduates and industry needs, limited laboratory facilities and practical equipment, low digital competencies among some educators, and suboptimal partnerships with the industrial sector (Suharno et al., 2020). These challenges result in low graduate competitiveness in the job market and underscore the need for a transformation of the vocational education system to make it more adaptive to technological advancements, changing labor market needs, and the dynamics of the Fourth Industrial Revolution and Society 5.0.

This transformation has become increasingly relevant with the growing digitalization of vocational learning processes. Various technological innovations, such as the Internet of Things (IoT), artificial intelligence (AI), Learning Management Systems (LMS), virtual reality-based simulations, and digital laboratories, are beginning to be integrated into learning to enhance the effectiveness of practical training, the efficiency of learning management,

and graduates' readiness to face the modern workplace. One concrete implementation is the use of the Internet of Things (IoT) in urban vocational high schools as part of efforts to improve institutional digital readiness and strengthen technology-based learning (Suwastika et al., 2025). However, digital transformation in vocational education requires not only infrastructure readiness and technological competencies but also the ability of institutions to preserve the character and values that define their identity. In the context of Islamic-values-based vocational education, this challenge becomes more complex because digital transformation must proceed hand in hand with the internalization of Islamic values, the cultivation of moral character, professional ethics, and the strengthening of students' character. Therefore, the development of Islamic vocational education models must integrate technological innovation with the principles of Islamic education in order to produce graduates who are not only technically competent but also possess moral integrity, spirituality, and professionalism that align with the needs of contemporary society and the workforce.

### Digital Transformation in Islamic Education

Studies on the digitization of Islamic education reveal progress in various aspects. At the management and governance level, digital information systems have been utilized for instructional planning and school administration (Rohita & Rahmadini Hidayat, 2023). At the curriculum and instructional materials level, the development of digital textbooks on Islamic religious education for vocational schools shows the potential to increase student engagement and understanding (Arifah & Fawait, 2025). Meanwhile, the issue of digital literacy has become a major concern, both in terms of its benefits and risks, as demonstrated in a study on digital literacy among senior high madrasah students (Sopandi et al., 2023) and the urgency of digital literacy in fostering critical thinking among students (Salisah et al., 2024). Digital ethics is also a key focus, given that the integration of digital technology into Islamic education must be accompanied by the instillation of moral values to prevent the erosion of the spiritual dimension of learning (Muslim, 2024).

At a more specific institutional level—namely, pesantren as centers of Islamic vocational education—comparative research on several pesantren-based vocational high schools indicates that digital transformation contributes to improvements in students' digital literacy, professional communication, collaboration, and Islamic work ethic (Dimyathi et al., 2025). This study also introduced the concept of "Digital Employability Skills for Pesantren Students," which integrates technological competencies, Islamic character, and industry relevance as the foundation for workforce readiness in the digital age. Furthermore, Islamic religious educational institutions are generally considered to play a strategic role as alternative educational institutions that continue to adapt to global demands, including digitalization (Hussin et al., 2024), while also being called upon to strengthen the moral and intellectual integration of students amid the rapid pace of technological advancement (Ningsih et al., 2024).

### Research Questions and Novelty of the Review

Building on the gap identified above, this review is guided by three research questions (RQs) that structured the search, screening, and thematic synthesis reported in the Methods and Result sections: RQ1 – What forms and strategies of digital transformation have been implemented in Islamic vocational education institutions to date? RQ2 – How does digital transformation influence graduates' competencies and work readiness in relation to the demands of Industry 5.0? RQ3 – What institutional, infrastructural, and human-resource challenges constrain the integration of digital transformation with Islamic values in vocational education? Taken together, the literature reviewed above shows that Industry 5.0 competency frameworks, vocational education research, and Islamic education scholarship have so far developed largely as separate strands, with only isolated studies—such as the Digital Employability Skills for Pesantren Students concept—attempting to connect them. The novelty of the present review therefore lies in synthesizing these three strands into a single, integrative account of digital transformation in Islamic vocational education, rather than treating technological, competency, and values-based perspectives in isolation.

## METHODS

### Research Design

This study employed a systematic literature review (SLR) design in accordance with the 2020 Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol (Page et al., 2021). The SLR approach was chosen because it allows for a transparent, systematic, and replicable process of identifying, screening, and synthesizing the literature (Snyder, 2019).

### Search Strategy

A literature search was conducted in five databases—Scopus, Web of Science, Google Scholar, the Directory of Open Access Journals (DOAJ), and the Science and Technology Index (SINTA)—for publications released between 2019 and 2025. Search keywords were formulated using a combination of Boolean operators, including: ("digital transformation" OR "digitalization" OR "transformasi digital") AND ("Islamic vocational education" OR "pesantren" OR "madrasah kejuruan" OR "pendidikan vokasi Islam") AND ("Industry 5.0" OR "Society

5.0" OR "Industri 5.0"). The search was conducted in the title, abstract, and keywords fields of the articles.

### Inclusion and Exclusion Criteria

Inclusion criteria include: (a) scientific articles in Indonesian or English; (b) published between 2019 and 2025; (c) articles discussing the topics of digitization, learning technologies, or digital transformation in the context of Islamic education and/or vocational education; (d) empirical, conceptual, or literature review articles with full-text access. Exclusion criteria include: (a) articles without full-text access; (b) non-peer-reviewed conference proceedings, editorials, or short opinion pieces; (c) articles that are not relevant to the intersection of digitalization, Islamic education, vocational education, and Industry 5.0 after a full-text review.

### Data Selection and Extraction Process

The selection process was conducted in four stages in accordance with the PRISMA flowchart: identification, title-and-abstract screening, full-text eligibility assessment, and final selection of included studies (see Figure 1). Data extraction was performed on information regarding the authors, year, methods, institutional context, and main findings of each article, which were then synthesized thematically using a narrative thematic analysis approach to identify recurring patterns and categories of findings.

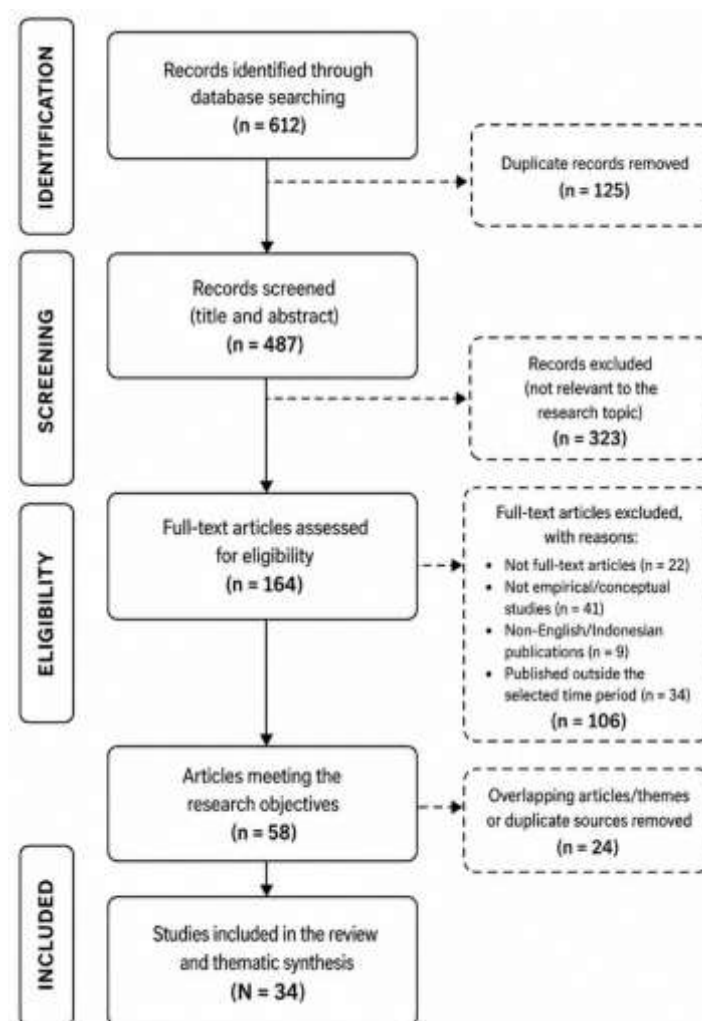


Figure 1. PRISMA Flowchart for the Study Selection Process

Source: results of data analysis from a literature review, based on [Page et al., \(2021\)](#).

### Quality Appraisal and Reliability Procedures

Several additional procedures were applied to strengthen the rigor and transparency of the review. Duplicate records retrieved across the five databases were identified and removed using reference-manager deduplication supplemented by manual verification of title, author, and year. Title-and-abstract screening and full-text eligibility assessment were each conducted independently by two reviewers against the inclusion and exclusion criteria; disagreements were resolved through discussion, and a third reviewer was consulted where consensus

could not be reached, which is reported here as a measure of inter-reviewer reliability rather than a quantified kappa statistic. The methodological quality of the included empirical studies was appraised using criteria adapted from the Mixed Methods Appraisal Tool (MMAT), covering clarity of research questions, appropriateness of the design, and adequacy of data analysis, while conceptual and literature-review articles were assessed for the clarity of their argumentation and the transparency of their sources; studies of markedly weak quality were retained only where they contributed uniquely relevant evidence, and this is noted as a limitation of the review. Thematic coding followed an inductive process in which recurring concepts were first identified line-by-line from the extracted data, grouped into candidate categories, and iteratively refined through comparison across articles until five stable themes emerged; coding decisions were cross-checked between reviewers to reduce the risk of idiosyncratic interpretation.

## RESULT

Based on the PRISMA selection process shown in Figure 1, 34 articles met the inclusion criteria and were analyzed further. The characteristics of all 34 included studies used as references for the thematic analysis are presented in Table 1.

Table 1. Characteristics of All 34 Studies Included in the Review

| No | References                                      | Methods                      | Research Focus                                                                                    |
|----|-------------------------------------------------|------------------------------|---------------------------------------------------------------------------------------------------|
| 1  | <a href="#">Suharno et al., (2020)</a>          | Descriptive-quantitative     | The Development of Vocational Education in Indonesia                                              |
| 2  | <a href="#">Hendra et al., (2025)</a>           | Library research             | The Future of Islamic Education in Society 5.0                                                    |
| 3  | <a href="#">Hidayat &amp; Rukmanda (2024)</a>   | Library research             | Innovations in Islamic Education in the Industry 5.0 Era                                          |
| 4  | <a href="#">Yuliyana &amp; Hendrawat (2025)</a> | Qualitative                  | Quality Management in Digital Islamic Education                                                   |
| 5  | <a href="#">Agustin (2025)</a>                  | Descriptive qualitative      | Opportunities and Challenges for Islamic Education in the Digital Era                             |
| 6  | <a href="#">Zizic et al., (2022)</a>            | Narrative review             | The Transition from Industry 4.0 to Industry 5.0                                                  |
| 7  | <a href="#">Masruri et al., (2025)</a>          | Qualitative (case study)     | Islamic Education Management in the Face of Industry 5.0                                          |
| 8  | <a href="#">Ghobakhloo et al., (2023)</a>       | Systematic literature review | Concepts, Principles, and Characteristics of Industry 5.0                                         |
| 9  | <a href="#">Pacher et al., (2023)</a>           | Competency study             | Industry 5.0-Based TVET Competencies                                                              |
| 10 | <a href="#">Tóth et al., (2023)</a>             | Model development            | Human-Centric Collaboration in Industry 5.0                                                       |
| 11 | <a href="#">Ahmad et al., (2023)</a>            | Review                       | Education 5.0 and Supporting Educational Technologies                                             |
| 12 | <a href="#">Adiyono et al., (2024)</a>          | Mixed methods                | Islamic Character Education in the Industry 5.0 Era                                               |
| 13 | <a href="#">Amadi (2024)</a>                    | Conceptual                   | Learning Technologies in the Industry 5.0 Era                                                     |
| 14 | <a href="#">Muslim (2024)</a>                   | Qualitative                  | Digitalization of Islamic Education                                                               |
| 15 | <a href="#">Hussin et al., (2024)</a>           | Bibliometric                 | Islamic Schools as Alternative Institutions                                                       |
| 16 | <a href="#">Ningsih et al., (2024)</a>          | Qualitative                  | Integration of Moral and Intellectual Development in Islamic Higher Education Institutions (PTKI) |
| 17 | <a href="#">Salisah et al., (2024)</a>          | Literature review            | Islamic Religious Education (PAI) and Digital Character Development                               |
| 18 | <a href="#">Hastutiningsih et al., (2024)</a>   | Qualitative                  | Evaluation of Vocational Education Management in Society 5.0                                      |
| 19 | <a href="#">Herlandy et al., (2024)</a>         | Research and Development     | Digital Modules on Islamic Values in Vocational High Schools                                      |
| 20 | <a href="#">Sari (2025)</a>                     | Qualitative                  | Curriculum Transformation in Islamic Education in the Industry 5.0 Era                            |
| 21 | <a href="#">Fitsilis et al., (2024)</a>         | AI-based literature analysis | Research Trends in Industry 5.0                                                                   |
| 22 | <a href="#">Firmansyah &amp; Fadilah (2025)</a> | Library research             | Islamic Basic Education and the Society 5.0 Era                                                   |
| 23 | <a href="#">Dimyathi et al., (2025)</a>         | Comparative case study       | Digital Transformation of Islamic Boarding Schools                                                |
| 24 | <a href="#">Arifah &amp; Fawait (2025)</a>      | Research and Development     | Digital PAI Textbooks for Vocational High Schools                                                 |
| 25 | <a href="#">Suwastika et al., (2025)</a>        | Case study                   | IoT Readiness Models in Vocational High Schools                                                   |
| 26 | <a href="#">Chigbu &amp; Makapela (2025)</a>    | Integrative review           | Convergence of Industry 5.0, Education 5.0, and Work 5.0                                          |
| 27 | <a href="#">Meditama et al., (2025)</a>         | Implementation study         | Industry 5.0-Based IoT Teaching Factory                                                           |
| 28 | <a href="#">Wulandari et al., (2025)</a>        | Evaluative                   | Evaluation of Vocational Education in the Society 5.0 Era                                         |
| 29 | <a href="#">Hidayatulloh et al., (2025)</a>     | Qualitative (case study)     | Integration of Islamic Values into Vocational Education                                           |
| 30 | <a href="#">Movahed et al., (2025)</a>          | Meta-synthesis               | Smart Manufacturing and Industry 5.0                                                              |
| 31 | <a href="#">Syafaruddin (2024)</a>              | Systematic review            | Modernization of Islamic Education                                                                |
| 32 | <a href="#">Groeneveld et al., (2019)</a>       | Systematic Literature Review | Software Engineering Education                                                                    |
| 33 | <a href="#">Xu et al., (2021)</a>               | Review                       | Industry 5.0 and Smart Manufacturing                                                              |
| 34 | <a href="#">Zhang &amp; Leong (2024)</a>        | Quantitative                 | Transformation of Vocational Education through Technology                                         |

Source: adapted from the studies included in the review.

To aid interpretation of how the included studies are distributed across the five themes reported below, the approximate number of articles contributing to each theme is reported alongside the theme in the corresponding subsection (for example, 11 of 34 articles for adaptive learning and artificial intelligence, and 16 of 34 for institutional and infrastructure challenges). These thematic counts, together with the integrative conceptual model presented in the Discussion (Figure 2), are intended to give readers a visual and quantitative sense of how the synthesized findings map onto the three components of digital technology competence, Islamic character, and industry relevance.

A thematic analysis of the 34 included studies yielded the following five main themes:

### **Digitization of Curricula and Instructional Materials Based on Islamic Values**

A literature review indicates that the transformation of Islamic vocational education in the Industry 5.0 era no longer focuses solely on the digitization of the learning process, but also on the reconstruction of curricula capable of integrating digital technology with Islamic values. This shift reflects a paradigm shift from a curriculum oriented toward mastery of subject matter to one that emphasizes the development of digital competencies, critical thinking skills, creativity, collaboration, and the cultivation of Islamic character as the primary foundation for vocational education graduates.

[Hidayat and Rukmanda \(2024\)](#) explain that innovation in Islamic education in the Industry 5.0 era requires a curriculum that is more flexible, adaptive, and responsive to developments in digital technology. The curriculum is no longer viewed as an administrative document, but rather as a strategic instrument capable of preparing students to face the increasingly dynamic changes in the world of work. In line with these findings, [Sari \(2025\)](#) emphasizes that curriculum transformation must integrate digital competencies, the use of Artificial Intelligence (AI), the Internet of Things (IoT), data analysis, and project-based learning without neglecting the primary goals of Islamic education: the cultivation of noble morals, spirituality, and character in students.

This curriculum transformation was implemented through the development of various forms of digital instructional materials that are more interactive and contextual. [Herlandy et al. \(2024\)](#) developed digital modules based on Islamic values for vocational high school (SMK) students, which have been shown to increase student engagement and the effectiveness of the learning process. These findings indicate that the digitization of instructional materials not only enhances accessibility and flexibility in learning but also provides opportunities for the internalization of Islamic values through learning media that are more engaging and aligned with the characteristics of the digital generation. Similar results were also reported by [Arifah and Fawait \(2025\)](#), who developed a digital textbook on Islamic Religious Education using an approach tailored to the needs of vocational students, thereby more effectively linking professional competencies with the development of religious character.

At the institutional level, curriculum transformation requires the support of an educational governance system capable of integrating technological innovation with the principles of Islamic education. [Masruri et al. \(2025\)](#) emphasize that curriculum modernization must be supported by Islamic educational management oriented toward the integration of digital technology with the principles of maqashid al-sharia, so that the innovations implemented remain aligned with the objectives of public welfare, justice, and the development of human resources. In line with this, [Ningsih et al. \(2024\)](#) argue that curriculum development at Islamic Religious Higher Education Institutions (PTKI) must be built on a balance between strengthening intellectual competencies, digital literacy, and moral development, so that graduates not only possess global competitiveness but also high integrity and social responsibility.

These findings are also consistent with the research by [Firmansyah and Fadilah \(2025\)](#), [Muslim \(2024\)](#), [Syafaruddin \(2024\)](#), [Arnadi \(2024\)](#), [Adiyono et al. \(2024\)](#), [Hidayatulloh et al. \(2025\)](#), and [Agustin \(2025\)](#). In general, these studies confirm that curriculum digitization cannot be interpreted merely as the adoption of technological tools or the digitization of learning materials. Rather, curriculum transformation must be directed toward integrating technology with Islamic values, ethics, academic culture, and the strengthening of institutional identity so that Islamic vocational education retains its distinctive character amid rapid technological development. Thus, technology serves as a means to improve the quality of learning, not as the ultimate goal of the educational process.

Taken together, these studies point to a paradigm shift in the development of Islamic vocational education curricula in the Industry 5.0 era. Curricula are no longer oriented solely toward content delivery but are evolving toward competency-based curricula that integrate digital literacy, adaptive learning, the use of smart technologies, and the strengthening of Islamic character. These findings indicate that the success of the transformation of Islamic vocational education is largely determined by the ability of educational institutions to strike a balance between technological innovation, the needs of the industrial world, and the internalization of Islamic values as the primary foundation for developing professional, competitive, and morally upright human resources.

### **Strengthening Digital Literacy Among Students and Educators**

Based on the synthesis results, approximately 12 of the 34 articles identify digital literacy as a strategic competency that must be possessed by all stakeholders in education—including students, educators, and educational institution administrators. This indicates that educational transformation cannot be achieved solely

through the provision of technological infrastructure; it also requires capacity building for human resources so that they can utilize technology effectively, critically, responsibly, and in alignment with Islamic values.

Salisah et al. (2024) explain that digital literacy in Islamic education has a broader scope than simply the ability to operate technological devices. Digital literacy encompasses the ability to critically search for, evaluate, process, and utilize information, while also fostering a digital ethic grounded in Islamic values. Thus, students are not only prepared to become competent technology users but also individuals capable of using technology wisely, responsibly, and for the greater good.

From the educators' perspective, various studies show that teachers' digital competencies are a determining factor in the successful implementation of technology-based learning. Muslim (2024) argues that the digitization of Islamic education requires teachers to possess more comprehensive digital pedagogical competencies than in previous eras. Teachers are not only expected to be able to operate various digital devices but must also be able to design innovative learning strategies, integrate technology into the teaching-learning process, and create interactive, student-centered learning experiences. In line with these findings, Agustin (2025) identified that the low level of digital competence among some Islamic Religious Education teachers remains one of the main obstacles to the implementation of technology-based learning. This situation indicates that the transformation of Islamic vocational education requires a sustainable capacity-building program through training, mentoring, and professional development for teachers.

Digital literacy also plays a crucial role in supporting the internalization of Islamic character values in the digital age. Adiyono et al. (2024) demonstrate that character education can still be effectively implemented through digital media if teachers possess adequate digital literacy. Mastery of technology enables educators to develop interactive, communicative, and contextual learning media without compromising the substance of moral education and the moral development of students. Thus, technology is not positioned as a substitute for Islamic educational values but rather as a tool that strengthens the learning process and character development.

At the higher education level, digital literacy is also a key factor in the success of institutional transformation. Ningsih et al. (2024) emphasize that the level of digital literacy among faculty members at Islamic Religious Universities (PTKI) significantly influences the success of technology integration in the learning process. Faculty members with strong digital competencies tend to be better able to develop technology-based learning, make optimal use of various digital platforms, and create a collaborative learning environment that adapts to technological advancements.

In the context of vocational education, educators' ability to utilize learning technologies is one of the indicators of the successful implementation of the Society 5.0 concept. Hastutiningsih et al. (2024) found that the effectiveness of vocational education management is greatly influenced by teachers' ability to utilize Learning Management Systems (LMS), interactive learning media, collaborative platforms, and various other digital tools. The use of these technologies enables the learning process to be more flexible, personalized, and aligned with the needs of the workforce, which is constantly changing due to advancements in digital technology.

Findings at the international level show trends consistent with research results in Indonesia. Ahmad et al. (2023) identify digital literacy as one of the core competencies within the Education 5.0 framework, which emphasizes the importance of technological proficiency, creativity, collaboration, and problem-solving skills. Meanwhile, Pacher et al. (2023) identify digital competence as one of the key competencies for graduates of Technical and Vocational Education and Training (TVET), given that the modern industrial world increasingly requires a workforce capable of adapting to developments in digital technology, artificial intelligence, and automation systems.

Overall, the literature review indicates that strengthening digital literacy is a key prerequisite for the successful transformation of Islamic vocational education toward Industry 5.0. Digital literacy is not only understood as the technical ability to use digital devices but also encompasses critical thinking skills, digital ethics, pedagogical abilities, and the internalization of Islamic values in the use of technology. Therefore, efforts to enhance the digital capacity of educators, educational staff, and students must be carried out systematically and continuously so that educational transformation can produce graduates who possess professional competencies, are adaptable to technological developments, and embody Islamic character.

### **The Integration of Adaptive Learning Technology and Artificial Intelligence**

The integration of adaptive learning technology and artificial intelligence as part of the transformation of Islamic vocational education toward Industry 5.0. Based on the synthesis results, approximately 11 out of 34 articles discussed the use of technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), Big Data, Machine Learning, and adaptive learning systems as key elements in creating an educational ecosystem that is more responsive to students' needs and developments in the industrial world. These findings indicate that educational transformation in the Industry 5.0 era focuses not only on the digitization of the learning process but also on the use of smart technologies capable of supporting more personalized, flexible, and human-centered learning.

Ahmad et al. (2023) explain that the concept of Education 5.0 positions artificial intelligence technology

as the primary tool for supporting personalized learning. Through the use of AI, learning systems can tailor content, methods, learning pace, and assessment formats based on each student's characteristics, abilities, and needs. This approach makes the learning process more effective because students receive learning experiences that align with their competency levels and learning styles. Thus, technology serves not only as a medium for learning but also as a tool capable of enhancing the quality of individual learning experiences.

This development is further reinforced by the findings of [Chigbu and Makapela \(2025\)](#), which show that the convergence of Industry 5.0, Education 5.0, and Work 5.0 has driven educational institutions to develop learning systems that are more collaborative, adaptive, and based on smart technology. In this paradigm, technology is not intended to replace the role of humans, but rather to enhance human capabilities through a harmonious collaboration between human intelligence and machine intelligence. Therefore, educational institutions are required to produce graduates who not only master technology but also possess critical thinking, creativity, communication, and complex problem-solving skills.

In the context of vocational education, the integration of smart technology is becoming increasingly relevant because it is directly linked to the needs of the modern workplace. [Meditama et al. \(2025\)](#) show that the implementation of an IoT-based Teaching Factory can enhance graduates' readiness to face an increasingly digitized industrial environment. Through the application of IoT technology, students can gain learning experiences that more closely mirror real-world conditions in the industry, making the competencies they develop more contextual and applicable. This finding is supported by research by [Suwastika et al. \(2025\)](#), who developed an IoT readiness model for vocational high schools (SMK) and found that the integration of digital technology into the learning process contributes to improvements in students' technical competencies and work readiness.

At the conceptual level, [Tóth et al. \(2023\)](#) emphasize that the Industry 5.0 paradigm is built on the principle of human-machine collaboration. Unlike Industry 4.0, which places greater emphasis on automation and efficiency, Industry 5.0 positions humans at the center of innovation by leveraging technology as a partner in the value-creation process. This perspective has important implications for vocational education, as curricula and learning processes must be designed to equip students with the ability to work alongside smart technologies, rather than merely operating them.

The need for these competencies is also evident in the research by [Xu et al. \(2021\)](#) and [Movahed et al. \(2025\)](#), which shows that the development of smart manufacturing and intelligent production systems demands a workforce with a higher level of digital competency than that required in the Industry 4.0 era. The required competencies encompass not only mastery of digital technology but also data analysis skills, the application of AI, technology-based problem-solving, and the ability to adapt to rapid change. Therefore, vocational education institutions need to adjust their curricula and learning strategies to produce graduates who meet the needs of the future industry.

This trend is also reflected in the study by [Fitsilis et al. \(2024\)](#), which used AI-based analysis to map the direction of Industry 5.0 research. The study's findings indicate that the global research focus is increasingly shifting toward the integration of Artificial Intelligence, Machine Learning, Digital Twins, the Internet of Things, and other smart technologies across various sectors, including vocational education and training. These findings suggest that the use of smart technologies will become an increasingly important component in the future transformation of education.

Nevertheless, a number of studies emphasize that the application of advanced technology in Islamic education cannot be separated from values and ethics. [Masruri et al. \(2025\)](#) and [Hidayat and Rukmanda \(2024\)](#) emphasize that the integration of AI, IoT, and various digital technologies must remain oriented toward the goals of Islamic education, which include the cultivation of moral character, the strengthening of spirituality, and the development of students' character. From this perspective, technology is positioned as a tool that supports the educational process, not as a factor that undermines humanistic and Islamic values. Therefore, the development of educational technology within Islamic educational institutions must be carried out in a balanced manner, taking into account ethical considerations, social responsibility, and moral values.

In sum, this body of evidence suggests that artificial intelligence, adaptive technology, and various other smart technologies have become among the main drivers of transformation in vocational education in the Industry 5.0 era. These technologies offer significant opportunities to create learning experiences that are more personalized, effective, and relevant to the needs of modern industry. However, their implementation in Indonesian Islamic educational institutions is still in its early stages and faces various challenges, such as infrastructure limitations, human resource readiness, and the need to integrate technological innovation with Islamic values. Therefore, the future development of Islamic vocational education must be directed toward the utilization of smart technologies that not only improve the quality of learning but also preserve Islamic identity, ethics, and character as the primary foundation of education.

### **Institutional, Infrastructure, and Digital Divide Challenges**

Institutional, infrastructure, and digital divide challenges are among the most prominent issues in the

literature, with 16 of 34 articles identifying various obstacles to the implementation of the transformation of Islamic vocational education toward the Industry 5.0 era. The synthesis results indicate that the success of the transformation is not only determined by the availability of digital technology but also heavily depends on institutional readiness, the quality of human resources, an adaptive organizational culture, visionary leadership, and equitable access to digital infrastructure.

One of the most significant challenges is the lack of technological infrastructure. [Suwastika et al. \(2025\)](#) found that many vocational high schools (SMK) still lack supporting facilities such as Internet of Things (IoT) devices, digital laboratories, high-speed internet networks, and adequate technology-based learning systems. These conditions prevent the optimal implementation of learning digitization, particularly in resource-constrained areas. Consequently, the implementation of the Industry 5.0 concept in vocational education still faces a gap between the needs of the industrial sector and the capacity of educational institutions.

In addition to infrastructure limitations, disparities in the quality of digital transformation implementation also pose a significant challenge. [Wulandari et al. \(2025\)](#) show that the level of readiness among vocational schools to implement the Society 5.0 concept varies greatly. These differences are influenced by the availability of facilities and infrastructure, the capacity of educators, policy support, and the ability of each institution to manage change. These conditions indicate that educational transformation has not yet taken place evenly, potentially widening the gap in the quality of vocational education between regions and among institutions.

The challenge of transformation in the context of Islamic education is even more complex because educational institutions are not only required to adapt to technological advancements but also to preserve their Islamic identity and values as the defining characteristics of the institution. [Hussin et al. \(2024\)](#) explain that Islamic schools and educational institutions face a dual challenge: modernizing the educational system through the use of digital technology while simultaneously maintaining a learning orientation grounded in Islamic values. Therefore, digital transformation cannot be achieved solely through the adoption of technology but must be accompanied by a strengthening of ethical, spiritual, and character-building aspects so that the resulting innovations remain aligned with the goals of Islamic education.

Leadership and organizational culture are also key factors in determining the success of institutional transformation. [Dimyathi et al. \(2025\)](#) show that the success of digital transformation in Islamic boarding schools is greatly influenced by visionary leadership, an organizational culture that is adaptable to change, and the readiness of human resources to embrace technological innovation. These findings indicate that institutional change requires strong organizational commitment, effective change management strategies, and collaboration among all stakeholders to ensure that the transformation can proceed sustainably.

On the other hand, the readiness of human resources—particularly educators—remains a challenge that requires serious attention. [Agustin \(2025\)](#) identified that some teachers' resistance to the use of digital technology remains one of the main barriers to the implementation of technology-based learning. This resistance is generally influenced by limited digital competencies, low self-confidence in utilizing technology, and a lack of ongoing training. These findings are supported by [Masruri et al. \(2025\)](#), [Muslim \(2024\)](#), [Hastutiningsih et al. \(2024\)](#), and [Syafaruddin \(2024\)](#), who consistently demonstrate that organizational change in educational institutions tends to proceed more slowly than the pace of technological development. This situation has created a gap between the demands of digital transformation and the readiness of educational institutions to implement it.

Findings at the global level show a similar trend. [Zizic et al. \(2022\)](#) and [Ghobakhloo et al. \(2023\)](#) emphasize that the transition to Industry 5.0 requires investments that focus not only on technology procurement but also on developing human resource competencies, transforming organizational culture, enhancing leadership capacity, and strengthening collaboration among the government, the education sector, and the industrial sector. This perspective highlights that digital transformation is a multidimensional process that requires synergy among various stakeholders to achieve sustainable impact.

Taken as a whole, these findings show that the challenges of transforming Islamic vocational education toward Industry 5.0 are complex and multidimensional. The obstacles faced are not only related to limitations in technological infrastructure but also include the digital divide among institutions, human resource readiness, organizational culture, leadership, funding, and the institutions' ability to manage change. Therefore, the success of this transformation requires a comprehensive strategy through institutional capacity building, equitable access to technology, the enhancement of educators' digital competencies, and closer collaboration among educational institutions, the government, and the business and industrial sectors to realize an adaptive, inclusive, and competitive Islamic vocational education in the Industry 5.0 era.

### **The Transformation of Vocational Education Toward a Human-Centric Industry 5.0 Model**

The transformation of vocational education toward a human-centric Industry 5.0 model is a synthesis that integrates nearly all the findings from the analyzed articles and outlines the direction for the development of Islamic vocational education in the Industry 5.0 era. Unlike the Industry 4.0 paradigm, which places greater emphasis on technology-based automation and efficiency, Industry 5.0 prioritizes a human-centric approach, so that vocational

education is no longer oriented solely toward the mastery of technical skills (hard skills), but also on the development of multidimensional competencies that include creativity, critical thinking, collaboration, leadership, adaptability, and moral integrity. In the context of Islamic education, this paradigm holds strong relevance because it aligns with educational goals that view the development of knowledge, character, and spirituality as an integrated and mutually reinforcing whole. Therefore, the transformation of Islamic vocational education in the Industry 5.0 era is aimed at producing graduates who are not only professionally excellent and adaptable to technological developments but also possess Islamic character traits that enable them to make positive contributions to society and sustainable development.

Ghobakhloo et al. (2023) explain that Industry 5.0 is built on three main principles: human-centricity, sustainability, and resilience. These three principles shift the focus of vocational education from merely producing a workforce ready to enter the job market toward developing human resources capable of adapting to change, collaborating with smart technologies, demonstrating a commitment to sustainability, and resiliently addressing various global challenges. Thus, the success of vocational education is no longer measured solely by the rate at which graduates are absorbed into the workforce, but also by their ability to create innovations, provide added value to society, and contribute to sustainable development.

This paradigm shift is reflected in the competencies required of vocational education graduates in the Industry 5.0 era. Pacher et al. (2023) identified that Technical and Vocational Education and Training (TVET) graduates need to possess a combination of competencies, including digital competence, systems thinking, creativity, ethical reasoning, sustainability awareness, and collaboration skills. These findings indicate that technical competencies alone are no longer sufficient to navigate the dynamics of the modern workplace. Instead, graduates are expected to possess the ability to think systemically, solve problems innovatively, and make decisions that take ethical and sustainability considerations into account.

In line with these needs, Tóth et al. (2023) emphasize that vocational education must develop learning models that integrate collaboration between humans and intelligent technology (human-machine collaboration). In this paradigm, technologies such as Artificial Intelligence (AI), the Internet of Things (IoT), Big Data, and automation systems are positioned as tools that support the improvement of learning quality, not as substitutes for the human role. This approach enables learners to gain a more personalized, adaptive, and contextual learning experience, while also developing the ability to work collaboratively with technology—a key characteristic of the future workplace. These findings are reinforced by Zhang and Leong (2024), who demonstrate that digital transformation in vocational education significantly contributes to improving graduates' readiness to meet the demands of the modern workplace, particularly through the strengthening of digital competencies, adaptability, and technology-based learning experiences.

The transformation of vocational education in Indonesia continues to face various challenges related to the skills gap between graduates and the needs of the business and industrial sectors. Suharno et al. (2020) point out that vocational education in Indonesia still grapples with the issue of graduates' skills failing to keep pace with technological advancements and the ever-changing needs of industry. This situation indicates that vocational education reform is an urgent necessity so that educational institutions can produce graduates who are more adaptable, innovative, and globally competitive. Therefore, the implementation of the Industry 5.0 paradigm is viewed as a key strategy for strengthening the relevance of vocational education to future industrial developments.

For Islamic vocational education, this paradigm shift also opens up opportunities to develop an educational model with distinctive characteristics. Hendra et al. (2025), Hidayat and Rukmanda (2024), Masruri et al. (2025), and Sari (2025) consistently emphasize that Islamic vocational education has great potential to become a human-centric educational model if it can integrate the use of digital technology with adaptive learning, the strengthening of vocational competencies, and the internalization of Islamic values. This integration enables graduates not only to possess professional competencies aligned with industry needs but also to embody moral character, ethics, social responsibility, and spiritual awareness as a foundation for facing global challenges. Thus, Islamic vocational education holds a comparative advantage in striking a balance between technological mastery and character development.

Overall, a synthesis of the 34 articles reveals a consensus that the transformation of Islamic vocational education toward the Human-Centric Industry 5.0 paradigm must be carried out comprehensively and sustainably. This transformation cannot be achieved through the adoption of digital technology alone; it also requires adaptive curriculum reform, the strengthening of digital literacy, the enhancement of educators' competencies, the provision of adequate infrastructure, the strengthening of institutional governance, and the internalization of Islamic values throughout the entire learning process. With this holistic approach, Islamic vocational education is expected to produce graduates who are not only competitive and ready to face technological developments but also possess moral integrity, the ability to collaborate, a commitment to sustainability, and Islamic character—which serve as the foundation for addressing the challenges of society and industry in the Industry 5.0 era.

## DISCUSSION

The findings of this review confirm that the digital transformation of Islamic vocational education cannot be understood merely as a process of technology adoption, but rather as a socio-technical process involving curriculum adaptation, human resource capacity building, and the negotiation of values between modernization and the preservation of Islamic identity. In line with the principle of human-centricity in Industry 5.0 (Ghobakhloo et al., 2023), the success of digital transformation in Islamic vocational education institutions is largely determined by the extent to which technology is positioned as a tool that reinforces—rather than replaces—the role of educators and spiritual values in the learning process.

The themes of curriculum digitization and the strengthening of digital literacy identified in this review align with the findings of Chigbu and Makapela (2025) regarding the need for curriculum reform that integrates technological literacy with human-centric skills within the framework of Education 5.0. However, compared to the general context of vocational education, which is more oriented toward technical-industrial competencies (Pacher et al., 2023), Islamic vocational education has an additional dimension in the form of instilling an Islamic work ethic and spiritual values, as reflected in the concept of Digital Employability Skills for Santri (Dimyathi et al., 2025). These findings reinforce the argument that the model of work readiness in Islamic vocational education is multidimensional, simultaneously encompassing technological, character, and industry-relevance dimensions.

The theme of industry partnerships and competency alignment indicates that Islamic vocational education faces challenges similar to those of vocational education in general in Indonesia, namely the gap between graduates' competencies and the needs of the workforce (Suharno et al., 2020). Nevertheless, partnerships with industry in the context of Islamic boarding schools require a more cautious approach so as not to compromise the institutional autonomy and religious values that characterize them. This study found that institutions that successfully integrated industry partnerships with the reinforcement of Islamic values tended to produce more sustainable models of digital transformation compared to institutions that merely adopted technology without contextual adaptation.

Looking across the included studies more critically, the findings are not uniform. Studies grounded in single-institution case designs, such as the comparative pesantren study introducing the Digital Employability Skills for Pesantren Students concept, report relatively concrete and positive outcomes because the object of study is a specific, often better-resourced institution. In contrast, studies with a broader institutional or bibliometric scope tend to describe transformation as uneven, fragmented, or still in an early stage, with digital competence and infrastructure varying widely between urban and rural settings. This contrast suggests that the largely positive picture emerging from curriculum- and literacy-focused studies should not be generalized across the sector: institutional readiness, rather than the availability of digital tools alone, appears to be the factor that most consistently differentiates studies reporting successful transformation from those reporting persistent barriers. Reconciling these differences is one motivation for the integrative conceptual model proposed below, which treats institutional enabling factors as a precondition for, rather than a byproduct of, technological and curricular change.

The institutional challenges and digital divides identified in this review align with the challenges of technology adoption in vocational education in Indonesia more broadly, including limitations in infrastructure and human resource readiness (Suwastika et al., 2025). In the context of Industry 5.0, which demands the integration of advanced technologies such as artificial intelligence and adaptive learning systems (Tóth et al., 2023), these gaps have the potential to widen disparities between Islamic vocational education institutions in urban and rural areas, thus requiring policy interventions that prioritize equitable access to technology.

Based on a synthesis of these findings, this study proposes an integrative conceptual model that identifies three main components as the foundation for the digital transformation of Islamic vocational education in the Industry 5.0 era, namely: (1) digital technology competencies and Industry 5.0 literacy; (2) Islamic character and work ethic; and (3) industry relevance and partnerships. These three components are intertwined and supported by enabling factors—namely, visionary leadership, infrastructure readiness, and supportive policies at both the institutional and national levels—in line with the agenda of the Indonesian Digital Education Roadmap.

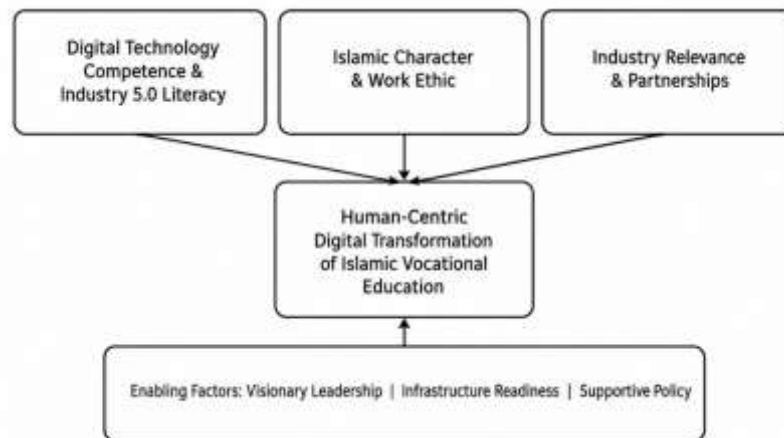


Figure 2. Integrative Conceptual Model of Digital Transformation in Islamic Vocational Education

## CONCLUSION

This systematic literature review, based on the PRISMA protocol, identified 34 articles relevant to the digital transformation of Islamic vocational education in the context of Industry 5.0 out of a total of 612 initial records. The results of the thematic analysis revealed five main themes: the digitization of curricula and teaching materials based on Islamic values; the enhancement of digital literacy among students and educators; the integration of adaptive learning technologies and artificial intelligence; industry partnerships and the alignment of competencies with Industry 5.0; and institutional challenges, infrastructure issues, and the digital divide.

This study concludes that the success of the digital transformation of Islamic vocational education depends on the ability of institutions to simultaneously integrate three dimensions: digital technology competencies, Islamic character and work ethic, and relevance to industry needs in the human-centric era. The practical implication of these findings is the need to develop policies and capacity-building programs that explicitly integrate these three dimensions, rather than treating digitalization merely as the procurement of technological devices.

Theoretically, this review advances the literature on Islamic vocational education by moving beyond single-dimension accounts of digital transformation—which typically foreground either technological adoption or values preservation—toward an integrative model in which digital technology competence, Islamic character and work ethic, and industry relevance are treated as co-dependent components rather than competing priorities. By extending the Digital Employability Skills for Pesantren Students concept from a single-institution finding into a generalizable three-component framework supported by enabling factors, the study offers a conceptual structure that future empirical research can test, refine, or falsify across different types of Islamic vocational institutions, thereby contributing a testable theoretical proposition rather than a purely descriptive synthesis.

This study has several limitations, including the scope of the database, which, although extensive, does not fully cover all relevant gray literature and policy reports, as well as the narrative-thematic nature of the review, which precludes a quantitative meta-analytic analysis. Future research is recommended to conduct a multi-case empirical study on various types of Islamic vocational educational institutions to test the validity of the proposed integrative conceptual model and to further explore the role of artificial intelligence in vocational learning based on Islamic values.

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