

# The Role of AI In Vocational Education: A Systematic Literature Review

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## ABSTRACT

*This research aims to comprehensively investigate and explain the important role of Artificial Intelligence (AI) in the field of education, with a particular focus on vocational education. Using the systematic literature review (SLR) method as the chosen research approach, the researchers carefully scrutinized a selection of articles published in the time span between 2018 to 2023, which were carefully selected from the Scopus database. The PRISMA method, renowned for its precision, was carefully applied to screen and filter out documents that did not fit the strict inclusion and exclusion criteria outlined for the study. Upon examination and review of the selected articles, an interesting pattern emerged, underscoring the considerable impact and transformative potential of AI in the education sector, with a particular emphasis on vocational education. The advent of AI technologies has ushered in a new era, one that is brimming with potential to revolutionize and enhance the teaching-learning experience in educational settings. It is quite clear that a thoughtful and strategic implementation of AI promises to improve the efficiency, personalization, and overall effectiveness of education, thus paving the way for a brighter and more adaptive educational landscape.*

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## **Introduction**

All systems that we currently utilize are closely related to technological breakthroughs such as the Internet of Things (IoT), Cloud Computing, Big Data, robots, Artificial Intelligence (AI), machine vision, machine education, and various other innovations (Dornelles et al., n.d.; Javaid et al., 2022). The ongoing industrial era 4.0 requires the education sector to stay in the flow of technological developments that continue to move forward. Education is one of the key sectors that must be able to adapt to technological dynamics, not only in application but also in understanding and development. Amidst this situation, in the education sector, the most obvious technology is artificial intelligence (AI) and its supporting algorithms such as Machine Learning (ML). Artificial Intelligence (AI) itself is a form of artificial intelligence designed to mimic the ability of human thinking, which is used for various activities such as the development of learning materials and problem solving in the context of education (Shinde & Shah, 2018). With the rapid development in the field of artificial intelligence, its impact will be felt in a variety of situations, ranging from broad social changes to learning and administrative processes in classrooms and school environments. Schools are expected to adapt to the digital age and integrate 21st century skills into their core curriculum, as educational institutions are one of the key entities that will be greatly affected by the rapid changes in the domain of artificial intelligence (Gocen & Aydemir, 2020).

The implementation of AI in Technical and Vocational Education and Training (TVET) has the potential to revolutionize vocational education. It can enhance the learning experience, improve skills development, and prepare students for the demands of the job market. AI technologies like machine learning, natural language processing, and computer vision offer various applications in TVET, spanning curriculum development, personalized learning, assessment, career guidance, and job placement. AI's ability to analyze vast amounts of data enables the creation of more relevant and up-to-date curricula, aligning them with industry needs. By harnessing AI-powered adaptive learning systems, TVET institutions can offer personalized learning experiences tailored to each student's unique needs and learning styles, resulting in increased engagement, retention, and skill acquisition. Additionally, in the realm of career guidance and job placement, AI can analyze labor market data, match individual skills and interests with available job opportunities, and furnish personalized career path recommendations. This aids students in making informed decisions about their future and boosting their employability. In conclusion, AI's integration in TVET promises to elevate vocational education's quality and relevance, augment learning outcomes, and bridge the gap between education and industry demands. However, ethical and responsible AI implementation remains crucial, with considerations for issues such as data privacy, bias, and transparency (P. Chen, 2022; T. Li et al., 2021; Spöttl & Windelband, 2020).

This article deeply discusses the application of AI for the advancement of education, especially in the realm of vocational education. Therefore, the main focus of this paper is to identify the role played by artificial intelligence (AI) in the context of vocational education, and the impact of AI in vocational education. This research adopts the PRISMA method as an approach in conducting a comprehensive review of various relevant literature sources. This method provides a systematic approach in the process of selecting, screening, and analyzing literature so as to produce accurate, reliable, and representative data. By applying the PRISMA method, this research was able to gather relevant and in-depth information on the role of artificial intelligence (AI) in the context of vocational education.

## **Method**

This study implements the systematic literature review (SLR) method to investigate the use of AI in the field of vocational education. As literature review is a key component of academic analysis, it must prove to be legitimate, trustworthy, and repeatable (Xiao & Watson, 2019). A comprehensive examination of the scholarly journal literature in a particular discipline plays an important role in identifying research problems and provides important support for future research in the field (Vicente Torres-Carrion et al., 2018).

## **Data Collection**

This research aims to find published articles that specifically address the issue of AI in education and vocational by focusing on specific terms in the title, keywords and abstract, in this methodology helps to limit the scope and relevance of the articles presented in the review. The Scopus database was used as a source of data from which more reliable sources could be extracted and access could be gained to a wide range of scholarly articles and publications covering a variety of fields. In order to link the relevance of this article, which provides a detailed analysis of the data or sources available through the literature works on the application of AI in education and vocational, a specific search string was used. The search string used was: "artificial intelligence" AND "application" AND "vocational high school\*" OR "secondary vocational school\*" OR "vocational\*" OR "engineer\*" OR "engineering edu\*" OR "technical edu\*" OR "tveter" OR "vet" OR "career technical education (CTE)" AND "edu\*".

## **Study Selection**

In this study, a meticulous process of inclusion and exclusion in table 1 has been diligently conducted to safeguard both the security and quality of the research endeavor. This rigorous approach was implemented to procure the most relevant and trustworthy data, which, in turn,

would enable us to derive the appropriate results essential for addressing the research questions at hand. Moreover, to fortify the robustness of our findings, a comprehensive set of reliable indicators was thoughtfully established, thereby further enhancing the overall integrity of this research.

Table 1. Inclusion and Exclusion Criteria

<i>Inclusion</i>	<i>Exclusion</i>
Research related to artificial intelligence (AI) in vocational and educational sector	Research not related to artificial intelligence (AI) in vocational and educational
Articles published of the year 2018 to 2023	Articles published outside of the year 2018 to 2023
Research articles are published and produced in English	Research articles are produced in languages other than English
Articles and research papers are openly accessible and full versions can be downloaded	Research articles are not available to download in the complete version

## Result and Discussion

### Research Results

Based on extensive search results retrieved from the Scopus database and keywords used, a total of 1287 documents were published between 1983 and 2023. These results, covering a broad spectrum of research, were subjected to a rigorous evaluation process using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) procedure. This careful assessment methodology ensured the completeness and methodological rigor of the included documents, facilitating the extraction of valuable insights and conclusions for ongoing research efforts.

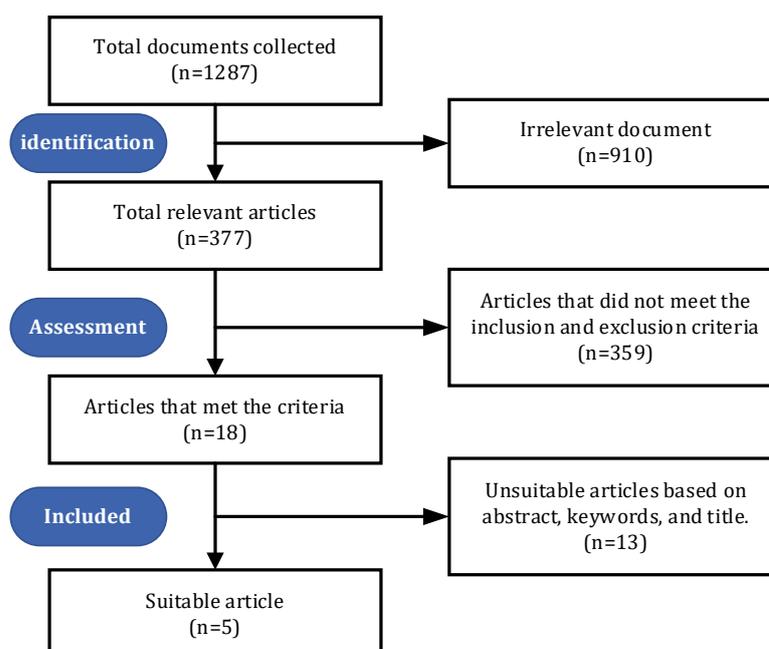


Fig1: PRISMA flowchart

The 1287 documents selected using the PRISMA method, 910 documents were irrelevant because they were not articles. of the 377 article documents, 114 articles were published before 2018, and 215 articles were not freely accessible. The analysis showed that there were 18 articles that met the inclusion and exclusion criteria. Further in-depth analysis was carried out by identifying the objectives, formulation of research problems in accordance with the objectives of this study, until 5 articles were obtained. The following articles were included in this study after a rigorous selection process:

Table 2. Selected articles title

<i>Authors</i>	<i>Title of Publication</i>	<i>Year</i>
Santosa S.; Suharto S.; Santosa Y.P.; Setiadi D.R.I.M.; Alzami F.	Design and Evaluation of Virtual Compression Testing Machine Based on Multilayer Perceptron for Vocational-Education Virtual Laboratory (Santosa et al., 2023)	2023
Chou C.-M.; Shen T.-C.; Shen T.-C.; Shen C.-H.	The level of perceived efficacy from teachers to access AI-based teaching applications (Chou et al., 2023)	2023
Yao X.	Design and Research of Artificial Intelligence in Multimedia Intelligent Question-Answering System and Self-Test System (Yao, 2022)	2022
Chen P.	Design and Construction of an Interactive Intelligent Learning System for English Learners in Higher Education Institutions (P. Chen, 2022)	2022
Hassan R.H.; Hassan M.T.; Naseer S.; Khan Z.; Jeon M.	ICT enabled TVET education: a systematic literature review (Hassan et al., 2021)	2021

### Review Article

The results of the literature review are presented as findings relevant to the research questions posed. The researcher will systematically structure and explain the findings, possibly organizing them according to discernible themes or concepts that emerge from the analysis. In addition, the researcher will carefully evaluate the sources identified to ensure the veracity and reliability of the findings presented.

**RQ1:** What is the role of artificial intelligence in vocational education?

Table 3. Role of Artificial Intelligence

<i>Title of Publication</i>	<i>The Role of AI in vocational education</i>
Design and Evaluation of Virtual Compression Testing Machine Based on Multilayer Perceptron for Vocational-Education Virtual Laboratory	The Virtual Compression Testing Machine (VCTM) is a useful tool for vocational students, allowing them to learn virtually either individually or in groups. Virtual laboratories, especially during times like the Covid-19 pandemic, are crucial for vocational education institutions that prioritize skill development. The Computational Engineering Research Area focuses on studying Virtual Machine Computing Models, combining Artificial Intelligence and experimental techniques.

<i>Title of Publication</i>	<i>The Role of AI in vocational education</i>
	<p>According to Santosa et al. their research highlights the significance of findings, in the development of VCTM (Virtual Concrete Testing Machine). Numerous computations have been conducted to predict concrete's strength. Wang et al. (Wang et al., 2019) have recently made progress in this area while Deng et al. (Albawi et al., 2018; Deng et al., 2018) have explored the use of CNN (Convolutional Neural Network) for compression testing prediction. Additionally de Béjar has successfully constructed a cement and concrete testing laboratory utilizing a finite element modeling approach (de Béjar, 2019). However it is worth mentioning that these studies are yet to be implemented as part of a compression testing machine. Nevertheless the results obtained from this testing machine demonstrate that VCTM possesses capabilities, for application within a virtual concrete compression testing setting.</p> <p>This research aims to create a VCTM for a concrete virtual laboratory using artificial intelligence computing models, specifically Deep Neural Networks (DNN) with Multilayer Perceptron (MLP). The application of VCTM in concrete compressive test practice has been successful, efficiently serving groups of students and allowing them to quickly and accurately predict the strength of concrete by inputting the material composition into VCTM. However, one disadvantage of VCTM is that it does not provide hands-on experiences in making and maintaining test specimens, as well as physically crushing concrete during testing, which are important for students with certain learning styles (Santosa et al., 2023).</p>
The level of perceived efficacy from teachers to access AI-based teaching applications	<p>This study investigates the efficacy perceptions of teachers regarding AI-based teaching applications. The study introduces a scale called 'Teachers' Efficacy Perceptions of the AI-based Teaching Applications (TEP-AITA), consisting of six factors: resource support, innovative teaching, cross-disciplinary, professional learning, learner demands, and self-reflection. The findings indicate that the TEP-AITA scale is reliable and valid, making it a useful tool for teachers to assess the application of AI in teaching. Teachers evaluate the effectiveness of AI products based on criteria such as accuracy, content creativity, and readability. AI-based inquiry learning contributes to curriculum integration, cooperative teaching, and ICT integrated teaching strategies, ultimately improving students' critical thinking skills.</p> <p>Scholars assert that AI education primarily focuses on applying AI technology to enhance problem analysis, in teaching. For instance as a teachers assistant and classroom analyst AI has significantly contributed to teaching by improving efficiency, accuracy and diversity (Liu et al., n.d.). The process of AI education encompasses guiding, nurturing and stimulating students' curiosity and potential through imparting AI skills and knowledge. Facilitating the growth of students application of AI is also an objective and responsibility of AI education (Liu et al., n.d.; Xia et al., 2021). According to Cook et al (2018), the AI education application for teachers aims to emphasize the accurate understanding of students' psychology and learning status, diagnose their learning problems and needs, and then provide educational interventions and AI or big data to accurately diagnose and understand their learning problems (Cook et al., 2018). The capabilities of AI educational applications and learning mechanisms are based on the stages of diagnosis, prediction, guidance, and prevention of "precision education" (Fahimirad et al., n.d.; Guilherme, 2019; Systems &amp; 2016, n.d.).</p>

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<i>Title of Publication</i>	<i>The Role of AI in vocational education</i>
Design and Research of Artificial Intelligence in Multimedia Intelligent Question-Answering System and Self-Test System	<p data-bbox="564 338 1439 618">Ngoc and Van (2021) propose an AI system platform that detects students' sexual orientation and best learning style through AI, which can use Bloom's levels of thinking and Gardener's categories of multiple intelligence, and the school can detect students' aptitudes and best learning methods to guide them in their learning (Mozer et al., 2019; Ngoc et al., n.d.). Teachers could use AI educational applications to combine information and communication technology (ICT) and AI technologies, build a teaching platform, provide virtual or real teaching situations, and improve students' abilities (Nakata, 2019; Simonov et al., n.d.).</p> <p data-bbox="564 622 1439 965">The study (Chou et al., 2023) also reveals that male teachers implement innovative teaching more than female teachers, while executive staff show higher scores in various factors. Private school teachers have higher efficacy in self-reflection compared to public school teachers. Additionally, teachers with over three years of AI teaching experience exhibit higher needs in cross-disciplinary development and professional learning. The research results provide valuable insights for educational units to promote AI information technology skills and cross-field teaching training among teachers. However, the study acknowledges certain limitations, suggesting the need for future research on school-level factors, social expectations, and a case study approach to understand teachers' instructional beliefs in AI implementation.</p> <p data-bbox="564 994 1439 1585">The rapid growth of computer networks has greatly impacted online education, providing a strong foundation for hardware and software development (Cheng, Wei, et al., n.d.; Cheng, Yang, et al., n.d.; Hou et al., 2019). The recent epidemic has also created favorable conditions for the advancement of online education, allowing students to access courses at any time and from anywhere. In addition to focusing on online teaching, the online education system now places importance on managing pre- and post-class learning to ensure efficiency and positive outcomes. However, despite the accelerated development of online education, the back-end learning management system has not kept up, particularly in terms of multimedia intelligent question answering and self-testing. Therefore, the design and research of an intelligent question answering and self-test system within a multimedia environment is crucial. This system incorporates artificial intelligence to process questions and encompasses both browser-side (students, teachers, administrators) and server-side (knowledge base) components. By utilizing spatial vector and Boolean models, the system searches and matches segmented and analyzed questions to provide relevant answers to students. If no automatic answers are available, manual answering is an option.</p> <p data-bbox="564 1590 1439 1863">This paper proposes the design and implementation of an intelligent question answering and self-test system using artificial intelligence technology, allowing for immediate feedback to student inquiries. By integrating the system database with Internet databases, the proposed algorithm enables the system to analyze and solve problems in the information-rich era. The practical application of this system has demonstrated a satisfaction rate approximately 13% higher than traditional systems, indicating the positive impact on integrating teaching resources, reducing student isolation, and alleviating teacher responsibilities.</p>

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<b>Title of Publication</b>	<b>The Role of AI in vocational education</b>
Design and Construction of an Interactive Intelligent Learning System for English Learners in Higher Education Institutions	<p>China's economic development and international cooperation have increased the need for professionals with good English communication skills. However, English teaching in vocational colleges in China still relies on traditional teacher-centered classroom methods and neglects the comprehensive development of English application ability (C. Chen, Li, et al., n.d.; C. Chen, Zeng, et al., n.d.; P. Chen, 2022; Zhao et al., n.d.). In this new situation, interactive learning using multimedia and network computer technology is considered more suitable to meet the needs of vocational higher education. Interactive learning provides an interactive learning environment through the use of multimedia courseware or online resources so that students can communicate with teachers and fellow students (C. Chen, Jiang, et al., n.d.; N. Li et al., n.d.; Wan et al., 2021). This approach emphasizes active, constructive, socially interactive and contextual learning. This learning method is based on the theory of communicative competence and communicative language teaching methods, which aim to develop students' communicative competence.</p> <p>Linguists point out that interaction is a two-way communication between two or more parties through language, in which one party influences the other. In communicative language teaching, interaction is the main focus, so language learning in the classroom should be interactive from beginning to end. This interactive classroom model involves information exchange between teachers and students, as well as between students, which can help students improve language comprehension through language practice activities. In this context, artificial intelligence technology, information technology and educational technology play an important role in enhancing the learning experience. However, the shortage of English teachers and the lack of real language practice environments are challenges in English learning (Alyousify et al., n.d.; B. Q. Chen, N. Y. Zeng, X. C. Cao, S. Zhou, W. He,... - Google Scholar, n.d.; L. Jae-Jin, "A Trends of Sharing Platform for Intellige... - Google Scholar, n.d.; Pacella et al., n.d.; You et al., n.d.). Therefore, this study proposes the use of an artificial intelligence-based interactive intelligent learning system to improve English teaching in higher education institutions. This system can provide efficient teaching software and help improve the efficiency of students' learning and testing arrangements.</p> <p>This paper discusses the operation and impact of an English interactive intelligent learning system designed for teachers in schools. The system serves as fully functional teaching software and effectively improves the efficiency of student learning and testing. The use of interactive multimedia technology in English teaching in vocational education institutions is highlighted as a way to enhance students' communicative ability and facilitate the learning of professional knowledge. The interactive intelligent learning system, based on AI algorithms, is presented as a student-centered approach that enhances English learning in higher education institutions. The mode of teaching emphasizes active and socially interactive learning, with learners acquiring knowledge and improving skills through interaction with learning resources, peers, and learning interfaces. Theoretical foundations for this interactive teaching mode are based on communicative competence and communicative language teaching methods. The study also discusses the experimental setup, which uses non-public internal data from an English language education research institute in China to evaluate and compare benchmark models for building an English interactive intelligent learning quiz system.</p>

<b>Title of Publication</b>	<b>The Role of AI in vocational education</b>
ICT enabled TVET education: a systematic literature review	<p>A literature review was conducted to identify research related to TVET education that supports the use of ICT (Hassan et al., 2021). A total of 2445 documents were collected from 11 databases over the period January 2010 to December 2020, with 134 documents selected for this study following the application of inclusion/exclusion criteria. The study concludes that the overall level of ICT literacy in TVET education is low and needs attention from industry, academia, researchers, policy makers, TVET training providers and donor agencies to improve this aspect. IEEE Explore contributed 76.87% to this study and the majority of the documents were published in conference proceedings. The COVID-19 pandemic also affected TVET education streams, with the number of publications decreasing in 2020. China was the largest contributor with 37 publications, followed by the United States. Asian countries, including Malaysia, Indonesia, and India, also had significant contributions in ICT-based TVET education. Some challenges and gaps in research were also identified, including a lack of focus on ICT technologies and specific functional areas, and a lack of attention to specific teaching/learning environments in TVET.</p> <p>The demand for skilled labor with digital technology knowledge is increasing in the rapidly developing world economy. However, research indicates that the use of information technology in technical and vocational education and training (TVET) is still low, particularly in areas such as monitoring and evaluation, career guidance, trainee assessment, and teacher training. The focus needs to be on incorporating Artificial Intelligence, Data Science, IoT, and Robotics into TVET programs. The use of technology in TVET education needs more emphasis from industry, academia, researchers, policy makers, training providers, and donor agencies. Failure to increase the integration of technology into TVET curricula, laboratories, teachers, and learning environments may result in a mismatch between the skills of the workforce produced and those required by the job market. The COVID-19 pandemic has also had an impact on TVET education, similar to other forms of education. China is the leading contributor to publications on ICT-enabled TVET education, followed by the United States and other Asian countries. There is a need for more attention from academia and other journals in this field. Overall, there is a lack of focus on specific industries and teaching/learning environments in TVET education.</p>

The collection of summarized research papers underscores the growing significance of integrating artificial intelligence (AI) into diverse educational contexts. The first study centers on the development of a Virtual Compression Testing Machine (VCTM) using advanced Deep Neural Networks (DNN) technology, providing vocational students with a virtual platform to predict concrete strength. While the VCTM offers a valuable learning tool, it lacks the tactile experience of physically creating and testing concrete specimens (Santosa et al., 2023). In the second paper, teachers' perceptions of AI-based teaching tools are investigated, introducing a comprehensive efficacy scale that delves into factors like resource support, innovative teaching methods, and professional learning. The study not only highlights the positive impact of AI on enhancing teaching strategies but also underscores the need for accurate criteria to evaluate AI's effectiveness in the classroom (Chou et al., 2023). Furthermore, the third paper's focus on an AI-powered question-

answering and self-test system within a multimedia environment offers students immediate feedback and integrates teaching resources to optimize learning experiences. This system's successful implementation indicates its potential to bridge gaps between traditional and technology-enhanced teaching methodologies (Yao, 2022).

Proposing an AI-based interactive learning system for English language education, the fourth paper emphasizes a student-centered approach that aligns with communicative language teaching methodologies. By leveraging AI algorithms and multimedia tools, the system aims to foster communicative competence and language application skills, thereby enriching higher education English instruction (P. Chen, 2022). Finally, the comprehensive literature review on the integration of information and communication technology (ICT) in technical and vocational education and training (TVET) presents a holistic perspective on the role of AI and emerging technologies in addressing skill gaps and preparing a technologically savvy workforce (Hassan et al., 2021). These studies collectively underscore the transformative potential of AI across educational domains while acknowledging the challenges and gaps that require further exploration.

**RQ2:** What is the impact of Artificial Intelligence in Vocational Education?

Table 4. Impact of Artificial Intelligence

<i>Title of Publication</i>	<i>The Impact of AI in vocational education</i>
Design and Evaluation of Virtual Compression Testing Machine Based on Multilayer Perceptron for Vocational-Education Virtual Laboratory	The Virtual Compression Testing Machine (VCTM) has had a significant impact on vocational education. VCTM was created as part of a virtual laboratory (VLab) to address the difficulties encountered in traditional concrete mixtures design practicums in vocational education. Conventional laboratories are expensive and time-consuming, making laboratory facilities difficult to provide in institutions with limited technical expertise and budgets. VCTM offers a solution by allowing students to access the virtual laboratory individually or in groups, at any time and from any location. This is especially useful in situations like the Covid-19 pandemic, where VCTM ensures the continuity of concrete compression test learning. The use of VCTM has successfully transformed students' learning experiences by allowing them to apply their knowledge.
The level of perceived efficacy from teachers to access AI-based teaching applications	The emergence of artificial intelligence (AI) technology is significantly impacting vocational education. Taiwan's Ministry of Education is actively promoting the incorporation of AI trends into vocational education with the aim of equipping individuals with problem-solving skills, fostering creative decision-making abilities, and nurturing good judgment. As part of Taiwan's AI Action Plan, AI-specific courses are being integrated into the broader AI talent development strategy for elementary and middle schools. This initiative seeks to provide students with meaningful exposure to AI and emerging technologies, enhancing their cognitive understanding and cultivating a genuine interest in these fields. Nevertheless, vocational high school teachers are confronted with the challenge of specializing in teaching within the context of the AI education trend. To effectively translate AI lesson plans into teaching activities, teachers need to employ available support resources and innovative teaching methods.

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<i>Title of Publication</i>	<i>The Impact of AI in vocational education</i>
Design and Research of Artificial Intelligence in Multimedia Intelligent Question-Answering System and Self-Test System	<p>Furthermore, the professional training of AI application teachers focuses on equipping educators with the necessary knowledge, emotional intelligence, and professional attitude to meet the individual potential of their students. Teachers who can master interdisciplinary skills and engage in self-reflection are better equipped to excel in teaching AI-related subjects. In summary, the impact of AI on vocational education encompasses the integration of AI-specific courses, the demand for innovative teaching approaches, and the development of teachers' AI teaching capabilities.</p> <p>Research on the effects of vocational education has revealed numerous positive outcomes. For instance, a study by Cox and Prestridge in 2020 found that fully online vocational education can provide flexible learning opportunities and enhance students' technical skills and employability. Additionally, vocational education is believed to enhance students' problem-solving skills, critical thinking abilities, and readiness for the workforce (Gravett &amp; Kroon, 2021; Rastrullo-Guerrero et al., 2020). Moreover, vocational education has been shown to significantly contribute to economic development by supplying a highly skilled workforce and meeting industry demands (Guan et al., 2020). It also plays a crucial role in reducing unemployment rates and addressing skills gaps in specific fields (van Esch et al., 2019). The research further underscores the importance of teacher training and ongoing professional development in the realm of vocational education. Effective teacher preparation programs and continuous professional development opportunities can enhance teachers' pedagogical skills and their ability to integrate technology and innovative teaching methods into vocational instruction (Du et al., 2020; Guggemos &amp; Seufert, 2021). In conclusion, research on vocational education emphasizes its positive impact on students' employability, skill development, economic growth, and underscores the significance of ongoing teacher education and development to enhance their expertise.</p> <p>The impact of online education on professional education is significant. Online professional education has provided learners with greater flexibility and access to acquire new skills and knowledge. Learners can access professional courses anytime, anywhere, allowing them to balance their studies with work or other commitments. Additionally, online professional education has expanded the range of courses available to learners, offering a wider range of subjects and specialist expertise. This allows learners to choose courses that suit their career goals and interests, thereby improving their employment opportunities and employment prospects. The use of technology in online professional education also facilitates interactive and engaging learning experiences. Virtual simulations, multimedia resources, and online collaboration tools enable learners to practice and apply their professional skills in a realistic and engaging environment. This improves the effectiveness of professional training and prepares learners for real work situations.</p> <p>Overall, online professional education has revolutionized the traditional professional education model, providing learners with more opportunities, flexibility, and interactive learning experiences. It has become an essential part of vocational education systems worldwide, contributing to the development of a skilled and adaptable workforce. There is little research specifically focused on the impact of online professional education. However, several studies have highlighted the potential benefits and positive outcomes of vocational education in general.</p>

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<b>Title of Publication</b>	<b>The Impact of AI in vocational education</b>
	<p>A study conducted by the US National Center for Education Statistics found that people who complete vocational training programs have higher employment rates and earnings than those who do not participate in such programs (Aud et al., 2013). This shows that vocational education can improve employability and lead to better economic outcomes for individuals.</p> <p>Another study in Australia found that vocational education and training (VET) graduates had higher levels of job satisfaction and were more likely to be employed in their field of study than their peers. university graduates (Research, 2017). This indicates that vocational education can provide practical skills and knowledge that are directly applicable to the workforce. Additionally, research has shown that vocational education can help reduce skills gaps and meet labor market needs. A study conducted in Germany found that vocational education and training programs play an important role in addressing the shortage of skilled labor in the country. This highlights the importance of vocational education in providing the specific skills and competencies needed in different industries.</p> <p>Overall, research shows that vocational education can have a positive impact on employment outcomes, job satisfaction and reducing skills gaps in the labor market. However, additional research is needed to specifically examine the impact of online professional education on these outcomes.</p>
Design and Construction of an Interactive Intelligent Learning System for English Learners in Higher Education Institutions	<p>The research on interactive intelligent learning systems for English learners in higher education institutions has a significant impact on vocational education. It addresses the limitations of traditional teaching methods in higher vocational colleges, which often prioritize reading ability over listening and speaking skills. The proposed interactive teaching mode, supported by artificial intelligence algorithms, focuses on cultivating students' language application ability and communicative skills. This new teaching system promotes student-centered learning and creates a two-way interactive environment between teachers and students. By integrating multimedia technology and interactive learning resources, students can improve their English communicative ability more effectively and develop their language skills. This research contributes to the transformation of teaching methods in higher vocational education, emphasizing the importance of comprehensive language application and preparing students for employment.</p>
ICT enabled TVET education: a systematic literature review	<p>The research findings regarding the low level of ICT integration in Technical and Vocational Education and Training (TVET) have significant implications for the field. These implications highlight the pressing need for modernization and digital transformation in TVET education to address the challenges of the current era and to prepare a digitally skilled workforce. Here are some key takeaways from this research:</p> <p>Firstly, the study identifies that the level of ICT integration in the TVET training cycle is low, particularly in areas such as monitoring and evaluation, career guidance and job placement, trainee's assessment, and teacher's training. This suggests a critical gap in leveraging technology to enhance the effectiveness of vocational education. Furthermore, this research emphasizes the importance of incorporating information and communication technologies in vocational education to meet the challenges of the current era and to produce a digitally equipped skilled workforce. With the increasing demand for digital skills in the job market, TVET institutions must adapt their programs to ensure graduates are prepared for the evolving workplace landscape.</p>

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<i>Title of Publication</i>	<i>The Impact of AI in vocational education</i>
	<p>Additionally, this research provides valuable insights for TVET training institutes, policymakers, industry leaders, researchers, and academics. It underscores the need to focus on upgrading curriculum, labs, equipment, and developing technology-oriented policies for skilled workforce development. TVET institutions should prioritize investments in modern infrastructure and teacher training to facilitate ICT integration, while policymakers should consider formulating strategies that support this transition.</p> <p>In conclusion, the research findings shed light on the urgency of embracing technology in vocational education. By addressing the identified gaps and implementing ICT-enabled solutions, TVET institutions can better prepare their students for success in a digital-driven job market, ultimately contributing to the growth and competitiveness of the workforce.</p>

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These articles encourage change and adaptation in vocational education to ensure students are ready to compete in an increasingly complex world of work. They highlight the expansion of accessibility of vocational education through technology, such as Virtual Compression Testing Machine (VCTM) and online professional education, which allows students to learn from anywhere. In addition, these articles emphasize the need for teacher training in integrating artificial intelligence and technology in teaching, as well as the importance of developing speaking and communication skills in English. Digital transformation in Technology and Vocational Education (TVET) is also a focus, with implications on the importance of investment in technology infrastructure and the development of supportive policies. Finally, all the articles point out that vocational education can improve employment opportunities and individual incomes, but needs to focus on developing skills that are relevant to the evolving needs of the job market.

## **Discussion**

In the context of using artificial intelligence (AI) in vocational education, there are several important aspects to consider. AI has the potential to enhance the student learning experience in various ways, such as the use of an AI-based Virtual Compression Testing Machine (VCTM) that allows students to virtually predict concrete strength, making learning more interactive and fun. AI also enables personalization of learning, which can be tailored to the individual needs of students. In addition, AI also affects teaching efficiency with AI-based question-answer and self-test systems that provide instant feedback to students. However, challenges such as lack of practical experience and differences in teachers' perceptions of AI's effectiveness must be overcome to optimize the role of AI in vocational education. The main findings also reveal the positive impacts of AI, including increased accessibility and flexibility, especially in difficult situations such as the Covid-19 pandemic, where AI integration empowers students with problem-solving skills and creative decision-making abilities, in line with the goal of vocational education in preparing individuals for the world of work. Nonetheless, challenges remain, including the need for better teacher training

and development to effectively implement AI-based education, as well as the lack of specialized research on its impact in the context of vocational education. The findings also emphasize the urgent need to further integrate Information and Communication Technology (ICT) in Technical and Vocational Education (TVET) to produce a digitally skilled workforce, which requires improved infrastructure, curriculum and teacher training to match the demands of the modern job market.

### **Conclusion**

Artificial Intelligence (AI) has ushered in a transformation within vocational education, offering an array of applications that bolster and refine the learning experience. Through data analysis, AI optimizes the learning journey by deciphering student learning patterns and furnishing bespoke recommendations. Overall, the analyzed articles underline the importance of integrating artificial intelligence (AI) in various educational contexts, from vocational. These articles show that technologies such as Virtual Compression Testing Machine (VCTM) and AI-based learning systems have expanded the accessibility of education, allowing students to learn from anywhere. Moreover, AI paves the way for inventive and interactive pedagogies, including immersive game-based learning and virtual simulations, which foster high student motivation and active participation. Simultaneously, AI extends personalized guidance through virtual assistants or chatbots, providing quick and accurate resolutions to student queries, tutoring assistance, and instant feedback. However, to successfully implement these technologies, special attention needs to be paid to teacher training, communication skills development, and investment in technological infrastructure. In addition, these articles provide insights into the importance of digital transformation in Technology and Vocational Education (TVET) and its implications on the preparation of a technology-skilled workforce. In the face of an increasingly complex world of work, adaptation and change in vocational education is crucial. As such, these articles stimulate change and adaptation in education to ensure that students are prepared to compete in an ever-evolving work environment, with the potential for increased employment opportunities and better individual incomes.

Future research in the use of artificial intelligence (AI) in vocational education should focus on evaluating the effectiveness of AI implementation, the role of teacher training in adopting AI technology, and the impact of AI use on students' problem-solving and decision-making abilities. Studies can also further examine how AI can enhance students' learning experience and its impact on their career preparation. In addition, research needs to look at how the integration of AI and information and communication technology (ICT) in Technology and Vocational Education (TVET) can affect the accessibility of vocational education and students' ability to adapt to current labor market needs. Through this research, we can better understand how AI can be effectively used to transform vocational education, improve the quality of learning, and better prepare students for a

challenging future.

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