



## Enhancing TVET Education for the Future: A Comprehensive Review of Strategies and Approaches

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### ABSTRACT

This systematic literature review investigates the future enhancement of TVET education. The review examines a variety of studies and research articles to gain insight into the role of vocational education in shaping and improving the TVET system. The review begins with an introduction that provides background information on the importance of TVET and vocational education in preparing individuals for the workforce. The review's objective is to analyse and synthesize existing literature to identify the critical role of vocational education in developing the TVET system. In the method section, we describe the systematic approach we used to identify relevant studies and select appropriate articles for review. In this paper, we provide a systematic review analysis based on preferred reporting items for the Systematic Reviews and Meta-Analysis (PRISMA) technique for virtual reality implementation. We conduct advanced searches using two robust databases: Scopus and Eric. Our search finally yielded the primary data (n = 35), which we will analyse using the synthesis approach. Four central themes were decided: (1) career development and employability in TVET; (2) digital transformation in TVET; (3) pedagogy and teaching approaches in TVET; and (4) assessing competency and training in TVET education. The findings section presents the key findings extracted from the selected studies, highlighting vocational education's various roles and contributions to the TVET system. The conclusion section summarizes the review's main findings and provides insights into the importance of vocational education in fostering the growth and effectiveness of the TVET system. The review highlights the need for continued research and collaboration to further enhance the role of vocational education in TVET education and meet the evolving demands of the workforce.

#### Keywords:

Technical and vocational education (TVET); Vocational education; IR 4.0

### 1. Introduction

The field of vocational education plays a crucial role in preparing individuals for the ever-evolving demands of the workforce. Among the various educational approaches, vocational education has gained significant attention for its focus on equipping individuals with specific skills and knowledge

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required in specific industries [1]. In recent years, there has been a growing recognition of the importance of Technical and Vocational Education and Training (TVET) systems in fostering economic growth and societal development. The TVET system encompasses a range of educational and training programs that aim to bridge the gap between theoretical knowledge and practical skills, providing individuals with the necessary competencies to succeed in their chosen careers [2]. Vocational education, as an integral part of the TVET system, plays a vital role in shaping and enhancing its effectiveness. However, despite the growing importance of vocational education in the development of TVET systems, there is a need to explore and understand the specific roles and contributions it brings [3]. To address this gap, this systematic literature review aims to examine the enhancement of TVET education for the future. The review explores various studies and research articles to gain insights into the contributions of vocational education in shaping and enhancing the TVET system. Ultimately, this review aims to emphasize the significance of vocational education and highlight the need for continued research and collaboration to further enhance its role in TVET education. By recognizing the strengths and areas of improvement in the current system, stakeholders can work together to ensure that vocational education effectively prepares individuals for the demands of the modern workplace [4]. The selected studies will be analysed using a synthesis approach, allowing for the identification of key themes and findings related to the role of vocational education in the TVET system.

### *1.1 Literature Review*

The integration of Industry 4.0 technologies in Technical and Vocational Education and Training (TVET) has gained significant attention in recent years. Industry 4.0, characterized by the fusion of digital technologies and manufacturing processes, presents new opportunities and challenges for TVET. According to previous studies [5], the integration of Industry 4.0 in TVET education enhances the relevance and effectiveness of vocational programs by equipping students with the digital skills and competencies required in the modern workforce. This integration involves incorporating emerging technologies such as the Internet of Things (IoT), artificial intelligence (AI), and automation into the TVET curriculum and instructional methods. The existence of a skills gap and mismatch in TVET is a persistent challenge for both students and industries. Research also highlights that the skills gap refers to the mismatch between the skills possessed by TVET graduates and the skills demanded by employers [6,44]. This discrepancy often leads to unemployment or underemployment among TVET graduates. To address this issue, it is crucial to align the TVET curriculum with the current and future needs of industries. This requires close collaboration between TVET institutions, employers, and industry associations to identify and bridge the gaps in skills and competencies through curriculum development, industry-driven training programs, and work-integrated learning opportunities. Thus, promoting student engagement and active learning in TVET programs is essential for enhancing student outcomes and preparing them for successful careers. Previous TVET research [7-10] emphasizes the importance of learner-centred approaches in TVET, such as problem-based learning, hands-on training, and internships. These approaches foster student engagement by connecting theoretical knowledge with practical applications, enabling students to develop critical thinking, problem-solving, and teamwork skills. Furthermore, incorporating technology-enhanced learning platforms and interactive teaching methods can enhance student motivation and participation in TVET programs. Effective career development and planning support is crucial for TVET students to make informed choices and successfully transition into the workforce. Previous TVET researches [8,20,21] highlights the significance of career guidance services, mentorship programs, and industry partnerships in facilitating career development in TVET. These

initiatives provide students with exposure to the world of work, opportunities for networking, and guidance in exploring career pathways. Additionally, integrating entrepreneurship education within TVET programs can empower students to develop entrepreneurial skills and consider self-employment as a viable career option. This literature review has explored several key themes in TVET education, including career development and employability in TVET, integration of Industry 4.0 and digital learning in TVET, pedagogy and teaching approaches in TVET and curriculum development and quality assurance in TVET. Addressing these themes through strategic partnerships, curriculum innovation, learner-centred approaches, and career support services can contribute to the enhancement of TVET programs and the preparation of students for the evolving demands of the labour market.

## 2. Material and Methods

The most relevant papers for our report unfolded in three critical stages. The initial phase was dedicated to identifying key terms and their related concepts, drawing on resources like thesauri, dictionaries, encyclopaedias, and prior research for comprehensive term mapping. Following the determination of essential keywords, we crafted targeted search queries for use in the Scopus and Eric databases, as detailed in Table 1. This meticulous approach paid off in the first phase of our systematic review, yielding a fruitful collection of 68 papers from both databases, laying a solid foundation for our research work.

**Table 1**

The search strings

Scopus	TITLE-ABS-KEY ( "vocational education" AND tvet OR "TECHNICAL VOCATIONAL EDUCATION TRAINING" ) AND PUBYEAR > 2018 AND PUBYEAR < 2024 AND ( LIMIT-TO ( AFFILCOUNTRY , "Malaysia" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) ) AND ( LIMIT-TO ( PUBSTAGE , "final" ) ) AND ( LIMIT-TO ( DOCTYPE , "ar" ) )
ERIC	vocational+college++and+TVET&ff1=pubJournal+Articles&ff2=locMalaysia PUBYEAR > 2018 AND PUBYEAR < 2024 AND ( LIMIT-TO ( AFFILCOUNTRY , "Malaysia" ) )

### 2.1 Screening

During the initial round of screening, duplicate papers were eliminated. The first stage of the study rejected 751 papers, whereas the second stage screened 22 papers based on the scholars' various exclusion and inclusion criteria. As literature (research articles) is the major source of practical advice, it was the first criterion used. It also covers systematic reviews, reviews, meta synthesis, meta-analysis, books, book series, chapters, and conference proceedings excluded from the latest research. Furthermore, the review was limited to English-language publications. It is important to keep in mind that the plan was established for the past four-year period (2019-2022). In order to meet the analysis objective, only research executed within Malaysian jurisdiction was chosen. In all, 35 publications were eliminated predicated on particular criteria.

### 2.2 Eligibility

In the third phase of our selection process, named the eligibility stage, we meticulously examined 46 articles, focusing on their titles and key content to ensure they met our inclusion criteria and aligned with the research goals of our study. This careful evaluation led to the exclusion of 11 papers whose titles and abstracts lacked the necessary relevance or empirical data related to our study's objectives. Consequently, we narrowed our review to 35 pertinent articles, as detailed in Table 2,

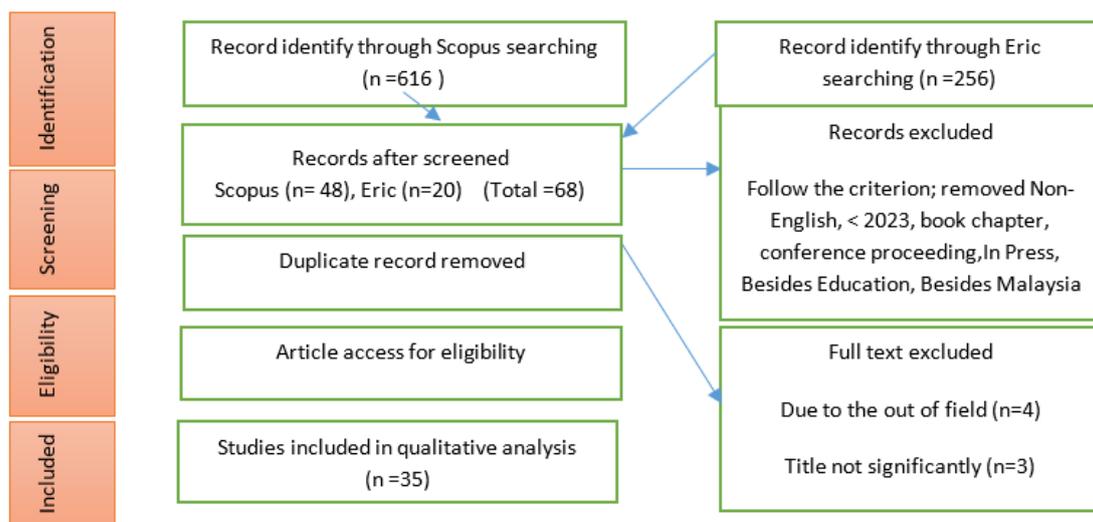
each chosen for their potential to contribute significantly to our research.

**Table 2**  
 The selection criterion is searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Time line	2019 – 2023	< 2023
Literature type	Journal (Article)	Conference, Book, Review
Publication Stage	Final	In Press
Subject Area	Education	Besides Education
Country	Malaysia	Besides Malaysia

### 2.3 Data Abstraction and Analysis

An integrative analysis was used as one of the assessment strategies in this study to examine and synthesize a variety of research designs (quantitative, qualitative, and mixed methods). The goal of the competent study was to identify relevant topics and subtopics. The stage of data collection was the first step in the development of the theme. Figure 1 shows how the authors meticulously analysed a compilation of 35 publications for assertions or material relevant to the topics of the current study. The authors then evaluated the current significant studies related to TVET development in vocational education. The methodology used in all studies, as well as the research results, are being investigated. Next, the author collaborated with other co-authors to develop themes based on the evidence in this study’s context. A log was kept throughout the data analysis process to record any analyses, viewpoints, riddles, or other thoughts relevant to the data interpretation. Finally, the authors compared the results to see if there were any inconsistencies in the theme design process. It is worth noting that, if there are any disagreements between the concepts, the authors discuss them amongst themselves. The produced themes were eventually tweaked to ensure consistency. The analysis selection was carried out by two experts in TVET systems. Experts determine the validity of the problems. The expert review phase ensures the clarity, importance, and suitability of each subtheme by establishing the domain.



**Fig. 1.** Flow diagram of the proposed searching study (Moher D, Liberati A, Tetzlaff J, 2009)

### **3. Result and Finding**

Vocational Education is essential for preparing and empowering the workforce to embrace and excel in the era of Industry 4.0. Based on the searching technique, 35 articles were extracted and analysed. All articles were categorised based on four main themes, which are Career Development and Employability in TVET (10 articles), Pedagogy and Teaching Approaches in TVET (8 articles), Digital Transformation in TVET (8 articles) and Assessing Competency and Training in TVET Education (9 articles).

#### *3.1 Career Development and Employability in TVET*

This paragraph discusses a collection of 10 articles centred on career development and employability within the context of Technical and Vocational Education and Training (TVET). The insights gained from these studies are particularly useful for those shaping policy and making decisions in the technical and vocational education sector. A key focus of the research is the importance of fostering Career Management Skills (CMS) and Career Decision-Making Abilities (CDA) among students. This aspect is crucial for future assessments and strategic planning in technical colleges, aiming to prepare students to be productive contributors in their chosen fields [9-12]. Different departments in educational institutions adopt distinct methods to combine teaching and learning for their students [10]. This study offers valuable support and improvement opportunities for TVET programs in higher education, especially in polytechnics and industry settings. The goal is to provide students with relevant training and skills for real-world job success. TVET is identified as a critical facilitator of job opportunities, particularly in technology-driven sectors. Employment in these sectors contributes to the socio-economic advancement of individuals [45]. The research stresses the need for setting specific career goals and aiming for higher earnings as part of an entrepreneur's skill set [11]. It's also essential to explore how life and career skills are integrated into higher education, ensuring these skills align with students' personalities, beliefs, and self-motivation, thus enabling effective career planning. Higher Education Institutions (HEIs) are encouraged to continually reassess and enhance the qualities deemed essential for producing employable graduates, thereby supporting national human capital needs [12,26]. Maintaining a balance between demand and supply is crucial for improving the job prospects of local graduates. Future research should concentrate on establishing an effective framework for the alignment and assessment of TVET academic programs. In this context, there is a growing need for higher competence among graduates, due to employer demands, industry changes, competition, and evolving global economic trends [13,47]. To boost the quality of TVET programs and enhance graduate employability, incorporating industry input into curriculum development is considered a significant step [14].

**Table 3**  
 Research Article Finding Based on Career Development and Employability in TVET

Authors	Title	Year	Source title	Objectives	Findings
<b>Abdullah N.S.; Sumarwati S.; Aziz M.I.A.; Ziden A.A.; Razak N.A.; Jalil S.A. [11]</b>	Life and career skills amongst technical and vocational education and training (TVET) students	2020	International Journal of Innovation, Creativity and Change	This study aims to investigate differences between life and career skills amongst technical and vocational education and training (TVET) students in various departments in Malaysia. A gap between the skills required by employers and possessed by graduates is one of the factors affecting unemployment.	It is important to investigate whether life and career skills are embedded by higher education institutions
<b>Hasnan K.A.; Zakariya Z.; Yin K.Y.; Aziz S.N.A. [10]</b>	Skill mismatch among instructors across technical and vocational education training (TVET) institutions in Malaysia	2019	International Journal of Innovation, Creativity and Change	The objective of this research was to explore the level of job satisfaction and the intention to leave work. The findings show that average respondents have the ability and capability to perform tasks.	Respondents were satisfied with the content of their work, the wages they received and the guarantee of employment and have no intention of retiring as instructors in TVET.
<b>Jamaludin K.A.; Alias N.; Dewitt D.; Razzaq A.R.A. [14]</b>	Framework for technical communication skills content development for students in Malaysian vocational colleges: A fuzzy Delphi study	2019	Journal of Technical Education and Training	This study is aimed at proposing a framework for technical communication development for effective implementation in Malaysian Vocational Colleges.	Generally, the findings suggest that all clusters of technical communication skills (oral technical, written technical, interpersonal and researching skills) are important to be emphasised as the content of learning.
<b>Ghavifekr S.; Radwan O. [9]</b>	The effect of career management skills on career development abilities: Perspectives from TVET college students.	2021	Malaysian Online Journal of Educational Management	The paper aimed to analyse the effect of Career Management Skills (CMS) on Career Development Abilities (CDA) from TVET college students' perspectives. The results showed that CMS has a significant direct effect on CDA of TVET college students.	Gender has no moderating effect on CMS and CDA of TVET college students. Therefore, the findings of this study will be more helpful for technical and vocational education policy and decision-makers.

<b>Ibrahim A.; Nashir I.M. [13]</b>	Demand-supply Mismatch in TVET Academic Programmes: What Is It and What Should It Be?	2022	Journal of Technical Education and Training	This study aims to clarify the demand-supply mismatch of the programmes offered by Malaysian Polytechnic Technical Vocational Education and Training (TVET) based on the perspectives of the employers, top management, lecturers, and students. Following these findings, this study proposed a realignment of the TVET programme by taking into consideration all stakeholders' necessities.	The demand-supply will be balanced, thus increasing the employability of the local graduates. It is beneficial for future research to employ an appropriate framework of alignment when examining TVET academic programmes, taking into account the needs of all stakeholders to guarantee that TVET programmes remain relevant.
<b>Rodzalan S.A.; Noor N.N.M.; Abdullah N.H.; Saat M.M. [12]</b>	TVET Skills Gap Analysis in Electrical and Electronic Industry: Perspectives from Academicians and Industry Players	2022	Journal of Technical Education and Training	This study aims to identify the occupational skills (including both soft and hard skills) that are perceived as important by those in public Higher Education Institutions (HEI) and the electrical and electronic (E&E) industry which represent the manufacturing industry.	The results revealed that there are skills gaps in terms of both soft and hard skills, which all skills are skills related to the career in E&E industry. The outcomes of this study should enable the Ministry of Higher Education, mainly in TVET to devise strategies to improve graduate employability.
<b>Hussain M.A.M.; Zulkifli R.M.; Kamis A.; Threton M.D.; Omar K. [26]</b>	Industrial Engagement in the Technical and Vocational Training (TVET) System	2021	International Journal of Learning, Teaching and Educational Research	The goal of this research is to look at what the Malaysian government has done to strengthen industrial involvement in the country's TVET system from 2010 to 2021, as well as to make recommendations for any future changes.	Improvements have been suggested to boost the industry-TVET relationship in Malaysia, particularly by giving connected industries some obligations to participate in the country's human-resource development, in comparison to the German model of the dual Apprenticeship programme.

<b>Ohagwu O.; Nwanesi P.K.; Bala P. [27]</b>	Skill acquisition (TVET) and employment in Sarawak	2022	International Social Science Journal	This paper examines the role of technical and vocational education and training (TVET) as a booster of employment opportunities in Sarawak, highlighting the importance of TVET as a catalyst that promotes individuals' chances to gain employment, with the ultimate goal of improving their socioeconomic living conditions and overall development.	TVET plays significant roles in facilitating individuals' or groups' employment chances, especially within tech-based industries, and employments are rewarded with remunerations and thus facilitate individuals' socio-economic developments.
<b>Azid N.; Rawian R.; Shaik-Abdullah S.; Kiong T.T. [28]</b>	The development of interactive case-based smart thinking and industrial problem-solving stimulator to enhance TVET students' thinking skills	2019	Journal of Engineering Science and Technology	This study investigated the development of Smart Thinking and Industrial Problem-Solving Stimulator (STIPSS) that was created as a platform for supporting interactive use of industrial cases to enhance TVET students' thinking skills.	The qualitative data, on the other hand, showed that a panel of experts agreed that STIPSS is a good pedagogical tool to stimulate analytical, practical and creative thinking skills among TVET students.
<b>Amiron E.; Latib A.A.; Subari K. [29]</b>	Industry revolution 4.0 skills and enablers in technical and vocational education and training curriculum	2019	International Journal of Recent Technology and Engineering	A Conceptual Framework has been developed to identify and confirm the list of Industry 4.0 Generic Skills and Enablers of an Industry 4.0 working environment. By identifying the enablers for Industry 4.0 in TVET curriculum, TVET training institutions will be able to design and establish an Industry 4.0 training environment that will equip TVET trainees with the skills required.	By identifying the enablers for Industry 4.0 in TVET curriculum, TVET training institutions will be able to design and establish an Industry 4.0 training environment that will equip TVET trainees with the skills required.

### 3.2 Pedagogy and Teaching Approaches in TVET

Evaluation serves as a means to assess learning levels and involves the documentation of knowledge, attitudes, skills, and beliefs. This type of literacy evaluation provides instructors with the chance to implement strategies and processes deemed effective in their teaching. Earlier studies [15] highlight that the open learning system's approach to building knowledge has significantly aided TVET practitioners in successfully completing subject-specific tasks and in continually developing meaningful knowledge. It's suggested that these practitioners delve deeper into information and knowledge to substantiate their responses more thoroughly. Regarding TVET teacher training programs in Malaysia, it has been observed that they are exceptionally successful in producing vocationally skilled teachers and workers. However, there is a degree of uncertainty about how well these vocational educators are prepared in sustainability competencies and literacies. A major concern is the diminished potential of TVET as a tool for Education for Sustainable Development (ESD)

when the teachers responsible for training lack essential sustainability education competencies [16]. In light of this, the study advocates for a curriculum framework dedicated to sustainability literacy in technical and vocational teacher training programs. Consequently, TVET institutions are facing the challenge head-on by revising their curriculum and teaching methods to ensure students acquire both knowledge and practical skills [17]. The shift in teaching and learning extends beyond traditional classroom-focused methods to include the latest technological advancements [46]. This necessitates that teachers stay abreast of new technologies, such as using mobile devices for instructional delivery, and possess the necessary knowledge for effective planning and content dissemination.

**Table 4**

The research article finding based on Pedagogy and Teaching Approaches in TVET

<b>Authors</b>	<b>Title</b>	<b>Year</b>	<b>Source title</b>	<b>Objectives</b>	<b>Findings</b>
<b>Aripin M.; Hisham M.; Zainuddin M.; Pairan; Hamid M.; Al-Shami S.A. [39]</b>	Role of Malaysia TVET Teachers' Training Institutions toward Industry and Education 4.0	2021	Review of International Geographical Education Online	The purpose of this review is to investigate current strategy of Malaysian TVET teachers training institutions and to identify the drivers to move forward.	In Malaysia, the development of hands-on things should be able to cope with the market need which now relies more on Information and Communication Technology (ICT), automation and Internet of Things (IoT).
<b>Muridan N.D.; Rasul M.S.; Yasin R.M.; Rauf R.A.A.; Yahaya N.; Nor A.R.M. [15]</b>	Using nominal group technique to identify career decision elements for TVET entrepreneurs	2019	International Journal of Innovation, Creativity and Change	This study aims to identify and assess the psychological, social and economic determinants for Technical and Vocational Education and Training (TVET) entrepreneurs making career decisions. NGT requires five stages: study briefings, idea generation, sharing and discussion ideas, voting for the best ideas, and the presentation of research findings. Therefore, the findings of this study will be the most important point of reference in the construction of career path models for TVET entrepreneurs.	Psychological determinants, social determinants and economic determinants are three of the most important elements before a career decision is made by TVET entrepreneurs. Interest is an important element in making a psychological decision, even if an individual inherited skills from his or her family.

<b>Razak A.N.A.; Noordin M.K.; Khanan M.F.A. [17]</b>	Digital Learning in Technical and Vocational Education and Training (TVET) In Public University, Malaysia	2022	Journal of Technical Education and Training	TVET face-to-face teaching is more practical than online teaching. A preliminary study was conducted to look at the need for a framework in digital learning on TVET in Public University, Malaysia.	It is proven that there is a significant need in developing a proper framework in online TVET teaching and learning to ensure the process is effective where subsequently, this can produce a graduate which meets the requirement of industries
<b>Kamaruddin A.; Rasdi R.M. [30]</b>	Work value orientation and TVET Students' career decision-making self-efficacy: The mediating role of academic major satisfaction	2021	Pertanika Journal of Social Sciences and Humanities	The present study assessed the influence of work value orientation on Career Decision-Making Self-Efficacy (CDMSE) and the mediating role of Academic Major Satisfaction (AMS) on the relationship between work value orientation and CDMSE of TVET students.	The future for TVET graduates certainly looks brighter, what with the government's efforts to raise TVET certification to a level similar to academic qualifications. Strong collaboration between industries and TVET institutions, attractive remuneration, and opportunities to be absorbed into large organizations with career assurance are some of the strategies to improve the enrolment of students at TVET institutions.
<b>Zulnaidi K.; Majid M.Z.A. [31]</b>	Readiness and understanding of technical vocational education and training (TVET) lecturers in the integration of industrial revolution 4.0	2020	International Journal of Innovation, Creativity and Change	This study aims to determine the readiness and understanding of Technical Vocational Education and Training (TVET) lecturers in the implementation of Industrial Revolution 4.0 (IR4.0).	All higher learning institutions should be prepared to face this challenge by providing various activities towards the production of competitive graduates. Ultimately, lecturers have to be mentally and physically ready to address the challenges of IR4.0.
<b>Hashim S.; Rahman M.H.A.; Nincarean D.; Jumaat N.F.; Utami P. [32]</b>	Knowledge construction process in open learning system among technical and vocational education and training (TVET) practitioners	2019	Journal of Technical Education and Training	This study was conducted to investigate whether the process of knowledge construction in an open learning system can assist TVET practitioners in performing tasks that needed to be completed as an important element in assessment in one of their class subjects.	Results revealed that open learning system has helped TVET practitioners to perform the tasks in online group discussion. The interaction that exists online group discussion has triggered active participation among TVET practitioners and in turn, this enabled the tasks to be completed within the given time frame.

<b>Noor S.F.M.; Mohamed H.; Zaini N.A.; Daiman D. [33]</b>	Use of Interactive Multimedia e- Learning in TVET Education	2022	International Journal of Advanced Computer Science and Applications	There is a need to expose students to the online learning revolution, which conceptualises using computerised systems to facilitate the learning process. Thus, an e-Learning system, known as SpmilLP, has been designed and developed accordingly for an interactive multimedia course to encourage online interaction among students and lecturers, as well as to enhance human learning and cognitive development.	The e-learning system has benefited the users in learning interactive multimedia subjects. The rapid growth of online learning methods was due to the advancement of learning technologies and students' needs
<b>Chinedu C.C.; Saleem A.; Wan Muda W.H.N. [16]</b>	Teaching and Learning Approaches: Curriculum Framework for Sustainability Literacy for Technical and Vocational Teacher Training Programmes in Malaysia	2022	MDPI sustainability	This study was undertaken to propose a curriculum framework for sustainability literacy for technical and vocational teacher training programmes.	A conscious effort had to be taken to ensure that vocational teachers develop competencies in Education for Sustainable Development (ESD). Therefore, there is a need for a curriculum framework to reorient TVET teacher training programmes. In transformational ESD, consensus on what is to be transformed and maintained is often left ambiguous due to the absence of holistic contents and pluralistic pedagogies in most ESD frameworks

### 3.3 Digital Transformation in TVET

This paragraph summarizes eight articles focused on the fusion of Industry 4.0 and Digital Learning within the scope of Technical and Vocational Education and Training (TVET) in Malaysia. The research underscores the critical role of Malaysian TVET teachers' training institutions in the era of Industry 4.0 and Education 4.0 [18]. These institutions are instrumental in preparing TVET educators to arm their students with the skills and knowledge needed to navigate the fast-changing industrial and technological landscapes of the Fourth Industrial Revolution. Additionally, there's a discussion on the application and effects of digital learning in TVET programs at public universities in Malaysia. This segment examines how incorporating technology into the TVET curriculum not only enhances the educational experience but also promotes skill development, preparing students for success in the digital era. The preparedness and comprehension of TVET lecturers in Malaysia regarding the integration of Industrial Revolution 4.0 in their teaching and curricula are also explored. The study identifies the challenges these educators face in adapting to the new industrial paradigm and the

opportunities for bridging the knowledge gap [19]. The findings indicate a high level of readiness, understanding, and implementation of Industry 4.0 principles among TVET lecturers, noting a significant relationship between readiness, understanding, and implementation. The lecturers' understanding acts as a mediator between readiness and implementation of these principles. The results suggest an enhanced effort by lecturers to implement Industry 4.0 concepts to fulfil the Mission of 2020. However, addressing current and future challenges is crucial to ensure the efficient use of taxpayers' money. Given the rapid global technological advancements, the path of TVET is complex and challenging. To ensure effective 21st-century learning with multimedia elements, especially those based on art content, administrators must guarantee that students have easy access to multimedia-based learning resources [20,48].

**Table 5**

The research article finding based on Digital Transformation in TVET

Authors	Title	Year	Source title	Objectives	Findings
<b>Hassan S.; Shamsudin M.F.; Mustapha I. [34]</b>	The effect of service quality and corporate image on student satisfaction and loyalty in TVET higher learning institutes (HLIs)	2019	Journal of Technical Education and Training	The main objective of this research is to measure the linkages of service quality, corporate image, student satisfaction and loyalty in one framework for TVET HLIs. This research suggested that future research to investigate the mediating effect in the research framework and the scope of study to be extended to other TVET HLIs.	This study contributed to management of TVET HLIs, whereby level of service quality, corporate image, student satisfaction and student loyalty is collected and presented. This study established a comprehensive framework and valuable insights into the relationships between service quality, corporate image, student satisfaction and student loyalty in TVET HLIs.
<b>Yaakob M.F.M.; Awang H.; Ismail M.Z.; Zain F.M.; Kasim M.; Adnan A.A.Z. [35]</b>	Backward and Forward Reviews on Technical and Vocational Education and Training (TVET) in Malaysia: The Evolution and ICT-Driven Future Prospect	2020	Universal Journal of Educational Research	Therefore, this paper contributes to the existing knowledge by relating the past and the future of TVET education in Malaysia	TVET education in Malaysia has its own unique challenges that determine the sustainability and future direction of the implementation. Therefore, the current and future challenges need to be addressed properly so that no taxpayers' money would come into a waste. Moreover, with the rapid pace of technological advancement that happens globally, the direction of TVET is certainly not straight and smooth.

<b>Samah L.A.; Ismail A.; Hasan M.K. [36]</b>	The Effectiveness of Gamification for Students' Engagement in Technical and Vocational Education and Training	2022	International Journal of Advanced Computer Science and Applications	This paper proposes the design and development research (DDR) approach with the adaptation of the ADDIE model to build a learning content prototype. According to the findings, gamification during learning activities can increase student engagement by boosting performance through a more significant pre-and post-test mean score difference and creating a positive learning experience.	This study successfully created a gamified mobile app prototype to assess the effectiveness of gamification on student engagement in TVET blended learning. Gamification assists students in improving their achievement and having a better learning experience.
<b>Razali S.S.; Ismail A.; Yazid F.M.; Ahmad M.F.; Hashim S.; Rohanai R.; Mohamed Shafieek M.S. [20]</b>	TVET in the 21st Century: Exploring Multimedia Elements in Digital Teaching and Learning Based On Art Content	2023	International Journal of Advanced Science and Technology	This paper explores the elements of multimedia components in T&L for TVET based on art content. Art content refers to the subject matter or the message conveyed by the presentation. Findings indicates that forty items out of four components which are emotional, subjective, execution, and psychological have been validated by the experts and reach 75 per cent of consensus. In conclusion, multimedia components based on art content in digital T&L for TVET should be utilized as a reference in developing digital content to provide future T&L standards for educators.	Using multimedia components and creative surroundings necessitates educators to provide straightforward methods for pupils to comprehend the subject matter. To guarantee that multimedia elements based on art content may be applied successfully during 21st-century learning, the administrator must ensure that students can access multimedia-based learning resources easily.

<b>Jam N.A.M.; Puteh S. [18]</b>	Exploring the teaching and learning indicators towards education 4.0 in mtun, Malaysia	2022	International Journal of Information and Education Technology	This study aims to determine the indicators and elements of teaching towards Education 4.0 for Engineering Technology in MTUN. mains construct which are essential to implement in the Engineering Technology programme in MTUN. There are curriculum and educator professional development. Further studies, which take these variables into account will need to be undertaken.	The findings of this study provide insight into a need for educators to recognise and implement the outcomes of this study in teaching towards Education 4.0. Educators' self-qualities are key to ensuring students' excellence as a whole. Educators should be equipped with knowledge and skills to handle the advanced 4IR technology so their knowledge and skills could be used to assist students exploring these technologies in Technology & Learning.
<b>Kuntadi I.; Ana; Rohendi D.; Suryadi D.; Halim F.A.; Sari A.R.; Muksiarni; Dwiyanti V. [37]</b>	Towards Digital TVET: A Comparative Study on Students' Readiness in The Industry Digital Demands in Indonesia and Malaysia	2022	Journal of Technical Education and Training	The study involves two universities, Universitas Pendidikan Indonesia (UPI) and University Tun Hussein Onn Malaysia (UTHM). By using an online questionnaire, 259 students from UPI and the result shows that on average, both UPI and UTHM students scored in the intermediate level, with UTHM students scoring slightly higher than UPI students on average. Interestingly, both UPI and UTHM students scored the highest in the information domain and the lowest in problem-solving. It shows that the hypothesis was not accepted as there is a significant difference in the digital skills of the students from both countries. Based on the findings, the result is expected to provide input and improvement in the targeted aspects based on the findings.	The responsibility of preparing students' readiness lies heavily in the university's role. However, it should be noted that universities also need to collaborate with the industry in developing benchmark and standards to measure and set what skill set should be taught and prepared at school. Internship in the industry can be the simulation how well students perform in a professional setting.

<b>Abdullah S.A., Saud M.S., Kamin Y. [38]</b>	M-learning for technical and vocational education training (TVET)	2019	International Journal of Recent Technology and Engineering	Specifically, this paper discusses the concepts of mobile learning in technical and vocational contexts, devices used in Mobile Learning, benefits of Mobile Learning, and challenges that exist in the implementation of Mobile Learning.	The development of ICT has had a great impact on the national education system and it has brought new challenges to the TVET teachers. The teaching methods in the TVET setting should balance both theoretical and practical learning for students' labour market.
<b>Ismail A.A., Hassan R. [19]</b>	Technical competencies in digital technology towards industrial revolution 4.0	2019	Journal of Technical Education and Training	Therefore, this study identifies the technical competency needed by industries towards future industrial revolution for TVET graduates. Findings from the survey concluded that the respondents' level of knowledge and skills to most of the technical competency is still at the average level and requires a lot of improvement. This implies that new technical knowledge should be embedded in the new curriculum on technology for their future knowledge, in order to fit with the need of changes in technology	The respondents' level of knowledge and skills of most of the crucial elements and components needed for IR 4.0 technology advancement is still at the average level which requires lots of improvement. It shows that, forcing to realise what will happen in the future is not enough without doing something to it, at least reducing the skill gap between job demand skills and the current skills.

### 3.4 Assessing Competency and Training in TVET Education

This paragraph presents various findings related to the competency levels of TVET CTCE (Technical and Vocational Education and Training- Curriculum, Teaching, and Educational Technology) lecturers in vocational colleges in Malaysia. It reveals that these lecturers generally possess a high level of professional competency based on their job grade, while their entrepreneurship skill competency is moderately rated. This distinction in competency levels is a significant observation [21]. The research also emphasizes the importance of all clusters of technical communication skills, including oral and written technical skills, interpersonal skills, and researching skills, as crucial components of the learning content. Additionally, the role of ICT (Information and Communication Technology) in TVET education is discussed in various contexts, such as its historical integration, benefits and drawbacks, and the challenges and readiness required to meet rapidly evolving industrial demands. Higher Education Institutions (HEIs) are advised to review and address attributes within the “concentrate here” and “possible overkill” quadrants to make necessary corrections and improvements [22]. This approach is aimed at producing technically skilled graduates who can meet the nation's human capital needs, supporting Malaysia's goal of becoming a developed nation by 2020. Further findings indicate that the general professional competency of TVET CTCE vocational college lecturers, as determined by their years of teaching experience, is high. However, there are concerns about some lecturers' lack

of professional ethics or understanding of such principles, posing obstacles to Malaysia's adoption of Industry 4.0 [23]. In light of evolving business and marketing trends and the widespread application of the gig economy, the study identifies a range of entrepreneurial skills as key to shaping the future orientation of entrepreneurial fields [24]. Specific criteria for the TVET Teacher Education Programme include specialization, work-based design, dynamism, interactive teaching and learning, and an international syllabus. The study's outcomes are expected to contribute to the sustainability of the TVET Teacher Education program in Malaysia, thereby enhancing the quality of TVET graduates and supporting the nation's ambition to become a high-income country [25]. Challenges and issues in Vocational College On-the-Job Training (OJT) have also been identified, including the suitability of training venues, OJT supervision, evaluation processes, and allowances. A key recommendation for future best practices is the creation of a database of local industries offering OJT placements, to ensure students are placed in areas that match their skill sets.

**Table 6**

The research article finding based on Assessing Competency and Training in TVET Education

<b>Authors</b>	<b>Title</b>	<b>Year</b>	<b>Source title</b>	<b>Abstract</b>	<b>Remarks</b>
<b>Hong C.M.; Ch'ng C.K.; Roslan T.R.N. [40]</b>	Predicting Students' Inclination to TVET Enrolment Using Various Classifiers	2023	Pertanika Journal of Science and Technology	This study aims to utilise several classifiers (Decision Tree, Neural Network, Logistic Regression and Naïve Bayes) to predict students' inclination to join TVET programmes.	The findings revealed that the Decision Tree-based Gini Index with three branches prevail against other classifiers with a misclassification rate of 0.1938. Therefore, the classifier could act as a steer for the Kedah Department of Education (DOE), related parties, and the TVET agency in implementing effective strategies to enliven and inspire students to join TVET programs.
<b>Muridan N.D.; Rasul M.S.; Yasin R.M.; Nor A.R.M.; Rauf R.A.A.; Jalaludin N.A. [41]</b>	Career Planning Indicators of Successful TVET Entrepreneurs	2023	MDPI sustainability	The aim of this article is to identify the career planning indicators of high-income entrepreneurs who are graduates with a technical and vocational education and training [TVET] background.	The findings have shown two indicators to get a high consensus, which are focus and self-efficacy in career. In fact, assigning a specific career objective and striving to achieve high salary are crucial and must be within entrepreneurs' skillset (realistic).

<b>Omar M.K.; Ismail K.; Abdullah A.; Kadir S.A.; Jusoh R. [42]</b>	Embedding entrepreneurial knowledge in vocational college curriculum: A case study of the competency of TVET instructors	2021	Pertanika Journal of Social Sciences and Humanities	A case study was conducted to explore the competency requirement of teachers related to the teaching of entrepreneurial-based knowledge and to investigate the process of teaching and learning entrepreneurship curriculum in the classroom settings.	The findings demonstrated that entrepreneurial competency is important for the engineering TVET instructors to pass on the necessary entrepreneurial skills to students. In view of the latest trends in business and marketing strategies and wide application of gig economy, the range of competency in entrepreneurial skills identified in shaping the future orientation of entrepreneurial fields.
<b>Abdullah Z., Hoque K.E., Ramlan N.H., Shafee S. [23]</b>	Designing the Structural Model of TVET Lecturers' Professionalism and Generic Skills Based on an Empirical Study in Malaysia.	2019	SAGE	This study seeks to identify the level of general competency of technical and vocational education and training (TVET) lecturers of construction technology civil engineering (CTCE) of vocational college using the standard model of competency requirement based on grade of lecturer and years of teaching experience.	Finding shows that the professional general competency level of TVET CTCE vocational college lecturers based on years of teaching experience is high with satisfactory interpretation. It also shows that the level of professional competency of TVET CTCE lecturer of vocational college based on grade of the post is high, whereas the level of entrepreneurship skill competency as a whole is at moderate level.
<b>Rajadurai J., Sapuan N.M., Daud S., Abidin N. [22]</b>	The Marketability of Technical Graduates from Higher Educational Institutions (HEIs) Offering Technical Education and Training (TVET): A Case from Malaysia	2018	Asia-Pacific Education Researcher	This study aims to investigate the gap between the key attributes of Higher Education Institutions' (HEIs') technical graduates and their actual performance of these attributes in employment as assessed by the Human Resource Managers.	HEIs should take immediate action to review the attributes located in the "concentrate here" and the "possible overkill" quadrants. This approach will enable HEIs to take corrective action and instigate efforts to improve the attributes considered to be important in producing marketable technical graduates to support the human capital required by the nation to be a developed nation by the year 2020.

<p><b>Wafi A.A., Subri U.S., Asshaari I., Zulkifli R.M., Mohamed S., Hanapi Z., Che' Rus R., Kamal M.F.M. [43]</b></p>	<p>Turning Job Seekers to Job Creators': Talent Management Module Development for TVET Graduates</p>	<p>2023</p>	<p>Journal of Technical Education and Training</p>	<p>Post-pandemic prompted a shift in the perspective; rather than waiting for jobs, it seems that individuals needed to become job creators. In this regard, the Technical and Vocational Education and Training (TVET) is believed to be a prominent field of study that could facilitate graduates to become job creators. Nevertheless, some of graduates would not consider owning businesses after graduation, indicating the difficulty of becoming job creators.</p>	<p>Therefore, this study emphasising TVET program built and validated a Talent Management Module (MTM) involving creation (Job Creator) based on the Cognitive Information Processing (CIP) theory. The development of this module might better be considered to encourage graduates to create prospective job creation that could reduce the unemployment rate. Therefore, the proposed MTM might be an appropriate solution to address unemployment through the identified important components in the implementation and empowerment of career programmes across TVET graduates.</p>
<p><b>Husain S.H., Che-Ani A.I., Affandi H.M., Nasri N.M., Musid N.A. [21]</b></p>	<p>Mismatch in supply and demand of building surveying graduates' skills: A triangulation perspective</p>	<p>2020</p>	<p>Journal of Technical Education and Training</p>	<p>This study offers an important insight into the building surveying programme towards the improvement of the programme's syllabus and its learning outcomes.</p>	<p>The study suggests that building surveying graduates should acquire and demonstrate both technical and non-technical skills that are demanded by the industry. Further research is suggested to identify the competency level among entry-level building surveyor graduates in real working practices.</p>

<b>Yunos J.M., Sern L.C., Hamdan N.H. [24]</b>	Criteria for sustainable curriculum of TVET teacher education programme in Malaysia	2019	Journal of Technical Education and Training	Hence, this study was carried out to explore the criteria for the sustainable curriculum of TVET Teacher Education programmes in Malaysia. Utilising this approach allowed the researcher to focus on experts' knowledge and experiences based on the issues explored.	The finding highlighted these specific criteria for TVET Teacher Education Programme as i) specialization; ii) work-based design; iii) dynamic; iv) interactive teaching and learning, and v) international syllabus. It is hoped that the outcome of this study will contribute towards the sustainability of TVET Teacher Education programme in Malaysia thus improving the quality of TVET graduates to achieve the national plan of becoming a high-income nation.
<b>Othman et al., [25]</b>	On-the-Job Training in Vocational College: Issue and Improvement Plan	2022	International Journal of Learning, Teaching and Educational Research	This study was conducted to identify the issues and problems which arise from the perceptions of students, lecturers, supervisors and the industry towards the on-the-job training (OJT) program, which was implemented in Malaysian Vocational College (KV) for 6 months in selected industries.	This study has identified several challenges and issues in Vocational College OJT involving the suitability of the training ground, OJT supervision, the evaluation process and the allowance which affects the implementation of OJT. An important suggestion for future best practise, is to come up with a database of local industries that offer OJT places. This is necessary to avoid the placement of students outside the skill area.

## 5. Discussion and Conclusion

By incorporating career counselling, guidance, and job placement services into the TVET curriculum, students can gain a deeper understanding of their strengths, interests, and career aspirations. These services can also assist them in identifying suitable career paths, exploring opportunities, and making informed decisions about their future. Moreover, fostering a strong partnership with industries allows TVET institutions to align their training programs with the current demands of the job market, ensuring that graduates are equipped with relevant skills that employers seek. As the Fourth Industrial Revolution unfolds, TVET institutions must adapt to the changing landscape of industries by incorporating digital technologies and Industry 4.0 concepts into their curriculum and teaching methods. The integration of technologies like artificial intelligence, the Internet of Things, virtual reality, and data analytics can revolutionize the way technical subjects are taught and learned. Embracing digital learning platforms and tools in TVET not only enhances the accessibility and flexibility of education but also replicates real-world work environments. Through

interactive simulations and hands-on experiences, students can gain practical exposure to cutting-edge technologies, preparing them for the technologically advanced workplaces of the future. Moreover, providing opportunities for experiential learning through internships, apprenticeships, and work-based learning programs can bridge the gap between theoretical knowledge and real-world application. These experiences not only allow students to practice their skills but also cultivate a sense of professional identity and responsibility. To maintain high standards of education, quality assurance mechanisms are necessary. These mechanisms may include accreditation processes, external evaluations, and continuous feedback loops involving employers, alumni, and other stakeholders. By implementing quality assurance measures, TVET institutions can demonstrate their commitment to excellence and continuous improvement. This comprehensive review explored several key themes in Technical and Vocational Education and Training (TVET), namely, career development and employability, integration of Industry 4.0 and digital learning, learner-centred pedagogical approaches, and curriculum development with quality assurance. To enhance TVET programs and prepare students for the evolving demands of the labour market, it is crucial for institutions to integrate career development and employability skills within the curriculum. By providing comprehensive career support services and forming strategic partnerships with industries, TVET institutions can equip students with the necessary skills and knowledge to secure meaningful employment. The Fourth Industrial Revolution presents an opportunity for TVET institutions to adapt and thrive by incorporating digital technologies and Industry 4.0 concepts. By embracing digital learning platforms, educators can provide students with practical exposure to cutting-edge technologies, preparing them for the technologically advanced workplaces of the future. Industry partnerships also play a significant role in guiding curriculum development to match the current needs of the job market. Innovative and learner-centred pedagogical approaches contribute to the effectiveness of TVET education. By incorporating active learning methods and experiential learning opportunities, educators can foster critical thinking, creativity, and practical skills among students, making them job-ready and adaptable to various work environments. Finally, well-designed and quality-assured curricula are essential to maintain the relevance and excellence of TVET programs. Regular reviews and updates, along with quality assurance mechanisms, demonstrate the commitment of TVET institutions to continuous improvement and meeting industry standards.

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