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Navigating complexities in on-the-job training at vocational institutions: a systematic literature review

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ABSTRACT

This study aims to systematically review and analyze the integration of fourth industrial revolution (IR 4.0) technologies into technical and vocational education and training (TVET) through on-the-job training (OJT), focusing on key themes such as skills development in the digital age, workforce productivity, relevance of IR 4.0 technologies, and the role of OJT in TVET. Additionally, it seeks to identify the challenges and best practices associated with this integration, offering actionable insights for policymakers, educators, and industry stakeholders to enhance skills development and workforce adaptability in the context of the IR 4.0. A systematic literature review was conducted to understand the multifaceted challenges and opportunities surrounding OJT programs within TVET institutions. Given TVET's vital role in equipping individuals with workforce-relevant skills, optimizing OJT programs is crucial for meeting modern industry demands. The PRISMA framework guided the review, using advanced search techniques on databases such as Scopus, ERIC, and IEEE, leading to the analysis of 35 primary sources. The review addressed areas including the adaptation of training to modern technologies, labor market outcomes, innovative practices for competency development, and ensuring equity and access in vocational training. It identified best practices, highlighted knowledge gaps, and provided recommendations to optimize OJT in TVET. Key findings emphasized aligning OJT with emerging technologies, enhancing employment outcomes, promoting innovative training methods, and ensuring inclusive and effective vocational training. The study concludes by offering recommendations to improve the quality and outcomes of OJT in TVET, ensuring alignment with evolving workforce and industry needs.

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1. INTRODUCTION

In the evolving landscape of technical and vocational education and training (TVET), on-the-job training (OJT) emerges as a pivotal component, bridging the gap between theoretical knowledge and practical skills. This systematic literature review explores multifaceted nature of OJT within TVET institutions, aiming to unravel its complexities and derive insights for effective implementation [1]–[4]. The criticality of OJT in TVET is underscored by the rapidly changing technological and industrial environments, which demand not only a skilled workforce but also one that is adaptable and continuously evolving. The review begins by establishing the context of TVET in the global education framework, highlighting its role in

fostering employability, entrepreneurship, and economic development [5]. It then transitions into a comprehensive exploration of OJT, examining its conceptual foundations, historical evolution, and its current state influenced by emerging technologies and changing workforce dynamics. The synthesis of literature reveals a diverse range of strategies, challenges, and outcomes associated with OJT in TVET, reflecting the sector's inherent complexity. The review also scrutinizes the policy landscape surrounding TVET OJT, uncovering the interplay between governmental regulations, institutional policies, and industry collaboration [6]. This study employs a systematic approach to literature review, meticulously sourcing and analyzing relevant academic and professional texts. By dissecting studies from various geographical contexts and industries, the review presents a global perspective, acknowledging both the universality and locality of OJT challenges and strategies in TVET [7]. The ultimate aim is to provide educators, policymakers, and industry stakeholders with a nuanced understanding of OJT's complexities within TVET, offering evidence-based recommendations to enhance its effectiveness and adaptability in an ever-changing world [8], [9].

Objective of this study are: i) To systematically review and analyze existing literature on the integration of fourth industrial revolution (IR 4.0) technologies into TVET through OJT, focusing on key themes such as skills development in the digital age, impact on workforce productivity, relevance of IR 4.0 technologies in TVET, and the role of OJT; and ii) To identify the key challenges and best practices associated with the integration of IR 4.0 technologies into OJT within TVET systems, and to provide actionable insights and recommendations for policymakers, educators, and industry stakeholders to enhance skill development and workforce adaptability in the context of the IR 4.0.

This study is significant as it addresses the critical need for modernizing TVET systems in response to the rapid technological advancements characterizing the IR 4.0. As industries increasingly adopt advanced technologies such as artificial intelligence, big data, and the internet of things (IoT), the demand for a workforce skilled in these areas has become more pressing. By exploring the integration of IR 4.0 technologies into OJT, this study provides valuable insights into how TVET programs can be enhanced to meet the evolving needs of modern industries. The findings of this study will contribute to the development of more effective training methods and curricula, ensuring that TVET graduates are not only equipped with the technical skills required by current and future job markets but also capable of adapting to ongoing technological changes. Furthermore, by identifying the challenges and best practices in this area, the study will offer practical guidance for policymakers, educators, and industry stakeholders in implementing successful TVET programs that are aligned with the demands of IR 4.0.

2. LITERATURE REVIEW

Previous studies have delved into the multifaceted aspects of OJT within TVET institutions, shedding light on the intricacies and challenges inherent in this educational process. A study conducted in Indonesia, for instance, identified nine pivotal factors contributing to the lack of alignment between TVET offerings and industry requirements, underscoring the pressing need to enhance the pertinence and suitability of TVET programs with regard to industry demands [10]. This underscores the critical importance of harmonizing TVET curricula with industry prerequisites to ensure that graduates possess the requisite skills for success in the job market. OJT in vocational colleges, while immensely beneficial, introduces its own set of complexities [11]. To begin with, orchestrating OJT placements presents a formidable challenge. Vocational colleges must actively cultivate partnerships with local industries and employers to secure appropriate training opportunities for their students. This endeavor can be time-intensive and contingent on the willingness of industries to participate. Additionally, the imperative of ensuring that these placements dovetail seamlessly with the curriculum and adhere to educational standards presents its own logistical demands. Furthermore, the process of monitoring and assessing students during OJT can be an intricate undertaking [12]. Overseeing students in a diverse array of workplace environments, where their experiences may vary significantly, can be quite demanding. Vocational colleges must therefore establish comprehensive systems for tracking student progress, evaluating competencies, and guaranteeing that students gain a comprehensive range of experiences that align with educational objectives. Achieving this necessitates transparent communication and robust collaboration between vocational colleges, employers, and students to ensure that learning outcomes are realized and that the training is not only effective but also enriching.

While OJT in vocational colleges affords students invaluable practical experience, the intricacies lie in securing fitting placements, ensuring alignment with educational objectives, and effectively monitoring student progress across a wide spectrum of workplace settings. Overcoming these challenges is imperative in furnishing students with a well-rounded and efficacious vocational education [13]. Beyond these complexities, there are additional facets that merit consideration within the realm of TVET. For instance, a literature review on vocational education for parents and students unearthed the expectation among parents that their children will secure employment after completing vocational education, aligning with students' aspirations [14]. Family expectations exert a significant influence on students' career choices in vocational

education. Furthermore, another literature review explored the impact of the IR 4.0 on TVET, concluding that while automation will undoubtedly transform various occupations, certain areas within TVET may undergo transformation rather than elimination [15]. Therefore, TVET institutions must adapt to meet evolving job market demands and technological advancements effectively. In addition, vocational education encompasses a diverse range of specialized fields, each with its unique requirements. Consequently, the tailoring of OJT experiences to align with the specific needs of students and the demands of their chosen industries is essential. Ensuring that such training remains relevant and up-to-date presents it is own challenges, given the constant evolution of industry standards and technologies.

Financial considerations further complicate the implementation of OJT programs within vocational colleges. These institutions may find themselves obligated to allocate resources for student stipends, cover travel expenses, and provide the necessary equipment or materials for effective training. The coordination of funding sources and the assurance that students have access to financial support during their OJT can prove to be a formidable logistical challenge. TVET institutions undeniably play a pivotal role in supplying a skilled workforce. However, the persistent misalignment with industry needs remains a significant hurdle, often resulting in unemployed graduates [16]. These insights not only address the challenges associated with OJT within TVET institutions but also highlight various opportunities and areas that warrant attention, including industry alignment, sustainability education, parental expectations, and the impact of technological advancements on vocational education. Furthermore, a comprehensive analysis, which encompassed stakeholder interviews and a thorough examination of TVET implementation across diverse countries, sought to assess how well TVET education meets labor market requirements. It aimed to pinpoint factors that could enhance the linkage between TVET and industry needs, ultimately proposing strategies to achieve alignment [17]. Moreover, a systematic review underscored the pivotal role of technical and vocational teachers in promoting sustainability and emphasized the necessity of enhancing their education in this critical area, ultimately preparing workers for societal well-being and community development [18]. The review also considered factors like educational backgrounds and the type of vocational high school in shaping students' expectations and goals in vocational education, thereby reinforcing the importance of aligning TVET programs with industry requirements [19].

3. METHOD

3.1. Identification

This investigation utilized a thorough three-stage systematic review process to select a significant number of relevant studies. Initially, the process involved selecting key terms and searching for related words using resources like thesauruses, dictionaries, encyclopedias, and existing research. This step led to the formulation of specific search strings for databases such as Scopus, ERIC, and IEEE Xplore, as detailed in Table 1. In this initial phase, a total of 3,031 pertinent articles were identified and retrieved from these databases, forming the foundation for the current research project.

Table 1. The search string

Data base	Query
Scopus	TITLE-ABS-KEY ((“On-the-Job Training”) OR (“TVET education”) OR (“college vocational”)) AND PUBYEAR>2018 AND PUBYEAR<2023 AND (LIMIT-TO (SUBJAREA, “SOCI”) OR LIMIT-TO (SUBJAREA, “ENGI”)) AND (LIMIT-TO (DOCTYPE, “ar”)) AND (LIMIT-TO (LANGUAGE, “English”)) AND (LIMIT-TO (EXACTKEYWORD, “Education”))
ERIC	(“On-the-Job Training”) OR (“TVET education”) OR (“college vocational”) pubyearmin:2018 pubyearmax:2023
IEEE Xplore	(“On-the-Job Training”) OR (“TVET education”) OR (“college vocational”)

3.2. Screening

During the screening phase of this study, a careful examination of the gathered research materials was conducted to identify content that aligns with the specific research questions. This phase predominantly focused on selecting studies related to the complexities of OJT at TVET institutions. As part of this process, five duplicate studies were systematically removed from the collection. The initial screening step resulted in the exclusion of 41 publications. Subsequently, 88 papers were closely evaluated in the second phase using distinct exclusion and inclusion criteria specific to this study, as detailed in Table 2. The primary focus was on literature (research papers) due to their critical role in providing practical insights. This included reviews, meta-syntheses, meta-analyses, books, book series, chapters, and conference proceedings not covered in the most recent studies. Additionally, the review was limited to works published in English and focused exclusively on the period from 2021 to 2024. Ultimately, five publications were discarded due to being duplicates.

Table 2. The selection criterion is searching

Criterion	Inclusion	Exclusion
Language	English	Non-English
Time line	2018-2023	<2018
Literature type	Journal (article)	Conference, book, review
Publication stage	Final	In press
Subject area	Social sciences and engineering	Besides social sciences and engineering

3.3. Eligibility

Upon fulfilling all inclusion and exclusion criteria, the final selection of studies for review was established. It is crucial to transparently present all research items included in this final compilation, as this clarity is vital for readers to grasp the foundation of the review's conclusions. During the eligibility phase, a total of 42 articles were initially considered. Each article underwent a thorough examination of its title and key content to ensure alignment with the study's inclusion criteria and relevance to its research objectives. As a result, seven articles were eliminated due to insufficient connection between their titles and abstracts and the empirical aims of the study. Ultimately, 35 papers were identified for comprehensive analysis and evaluation, as depicted in Figure 1.

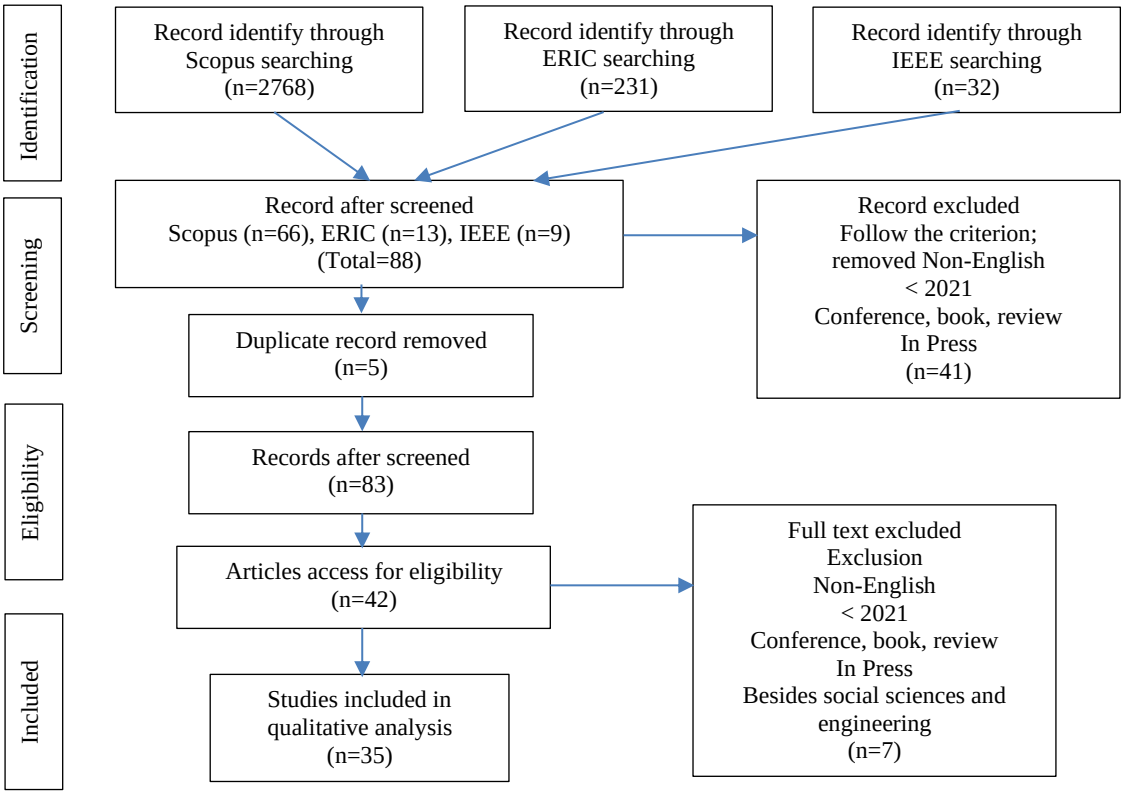

Figure 1. Flow diagram of the proposed searching study

3.4. Data abstraction and analysis

An integrative analysis served as a key assessment strategy in this study, allowing for the examination and synthesis of diverse quantitative research designs. The primary aim was to pinpoint relevant topics and subtopics, with data collection marking the initial phase of theme development. As illustrated in Figure 1, the authors conducted a thorough analysis of 35 publications to extract assertions pertinent to their study's focus. Following this, they reviewed significant existing studies regarding the complexities of OJT in TVET institutions, scrutinizing both methodologies and findings. Subsequently, the authors collaborated with co-authors to establish themes grounded in the evidence gathered. Throughout the data analysis, a log was maintained to capture analyses, insights, challenges, and reflections related to data interpretation. The authors also compared results to identify any inconsistencies in theme development. Notably, any disagreements on concepts were discussed among the authors to refine the themes for consistency. The validity of the identified

issues was confirmed by two experts: Prof. Hattori Mina in Education Development and Rian Vebrianto in Industrial Engineering. This expert review phase ensured that each subtheme was clear, significant, and appropriately aligned with its domain.

4. RESULTS

OJT is essential for preparing and empowering the workforce to embrace and excel in the era of IR 4.0. It ensures that employees have the skills, knowledge, and adaptability required to work with advanced technologies, ultimately benefiting both individuals and organizations in terms of productivity, efficiency, safety, and innovation based on the searching technique, 35 articles were extracted and analyzed. All articles were categorized based on four main themes, which are adaptation of training to modern technologies and IR 4.0 (10 articles), employment outcomes and labor market inclusion (10 articles), innovative training practices and competency development (eight articles) and equity, access, and effectiveness of vocational training (seven articles), as shown in Table 3.

Table 3. List of articles

No	Authors	Scopus	ERIC	IEEE
1.	Othman *et al.* [2]	/		
2.	Montalbo [3]	/		
3.	Sunny and Ismail [4]	/		
4.	Dey and Devi [5]	/		
5.	Talento *et al.* [6]	/		
6.	Bano *et al.* [7]	/		
7.	Husain *et al.* [8]	/		
8.	Omar *et al.* [9]	/		
9.	Chairani *et al.* [10]	/		
10.	Omar *et al.* [11]	/		
11.	Omar *et al.* [12]	/		
12.	Kaprawi *et al.* [13]	/		
13.	Rodzalan *et al.* [14]	/		
14.	Jagannathan *et al.* [15]	/		
15.	Hearn *et al.* [16]	/		
16.	Ruzita *et al.* [17]	/		
17.	Ibrahim and Nashir [18]	/		
18.	Vasanthi and Basariya [19]	/		
19.	Yamauchi *et al.* [20]	/		
20.	Narantuya and Baatarsuren [21]	/		
21.	Vincent and Rajasekhar [22]	/		
22.	Pastore and Pompili [23]	/		
23.	Muchira *et al.* [24]	/		
24.	Silva and Garcia [25]	/		
25.	Wotschack *et al.* [1]		/	
26.	Beaudry and Perry [26]		/	
27.	Brockmann and Smith [27]		/	
28.	Ogata *et al.* [28]			/
29.	Duchetto and Hanheide [29]			/
30.	Hassan *et al.* [30]			/
31.	Marchant *et al.* [31]			/
32.	Dogara *et al.* [32]			/
33.	Avitia-Carlos *et al.* [33]			/
34.	Gimba Dogara *et al.* [34]			/
35.	Aguelo *et al.* [35]			/

4.1. Adaptation of OJT to modern technologies and IR 4.0

IR 4.0, known alternatively as smart, intelligent industry, or smart manufacturing, was introduced in 2011 to enhance Germany's manufacturing competitiveness. This revolutionary idea rapidly gained worldwide recognition and implementation, with major nations such as Japan, France, the USA, and the UK launching significant initiatives. Figure 2 shows IR 4.0 transition as a thorough industrial revamp within an integrated framework, merging physical and digital worlds via cyber-physical systems [20]. It includes IoT-facilitated environments linking people, processes, and services, allowing networked data sharing to develop innovative, collaborative smart systems. This shift signifies the digitization of various sectors, utilizing embedded sensors, extensive cyber-physical systems, and advanced analytics. IR 4.0 rise has normalized the use of robots, simulations, and automation, enhancing efficiency, performance, and productivity [21]. Studies show that successful adaptation to IR 4.0 involves a learning-focused culture,

advanced managerial development, practical learning experiences, and strong links with educational and training bodies through OJT and upskilling programs [22]. However, this research mainly reflects high-performing firms experienced in IR 4.0, suggesting more inclusive future studies. A broad agreement exists among various stakeholders, including governments, industries, unions, and educators, about the key factors for transitioning to IR 4.0. Industries are encouraged to develop comprehensive capability strategies, not just focusing on new technology acquisition but also on extensive job training, nurturing innovative work cultures, and sustaining solid educational partnerships [10]. The study also addresses the wider societal impacts of IR 4.0 technologies like robotics and AI, recognizing their potential to transform existing job sectors.

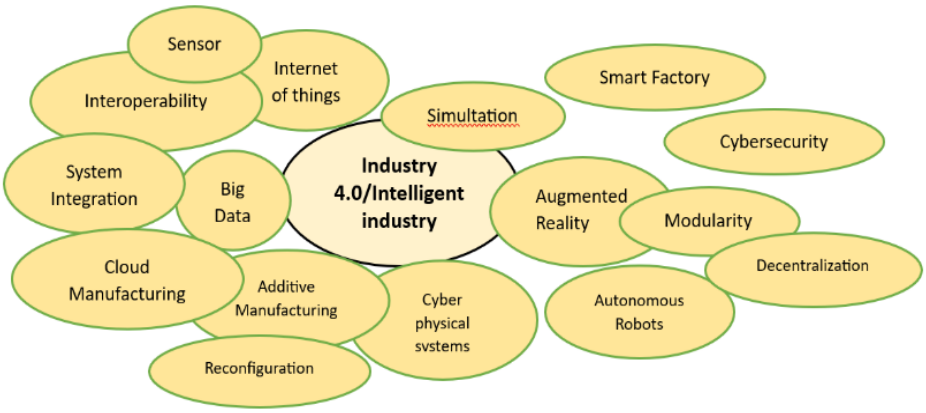

Figure 2. Pictorial representation of IR 4.0 [36]

The findings suggest that while some technologies may lead to job displacement, others can create opportunities for upskilling, product and process innovation, and cross-sector employment [23]. In a similar vein, the study examines the social cognitive career theory to assess the TVET institutions' curricula in Kenya, recognizing the potential for Africa to harness its demographic dividend by investing in a young workforce. The research identifies a disparity in the coverage of soft and technical skills and points to barriers such as inadequate resources, outdated equipment, and a lack of practical training in the curriculum, which hamper students' employability. To mitigate these issues, the paper recommends fostering partnerships between TVET institutions and industry to ensure that the training provided aligns with labor market needs. Such alliances can inform the enhancement of OJT, scale up successful models, and cultivate a workforce adaptable to the changing labor landscape [24]. Furthermore, the paper analyzes the Norwegian Introduction Program's impact on female immigrants' labor market participation.

While the program led to a slight increase in employment for female immigrants from Asia or Africa, it did not improve their earnings, suggesting that the initiative may have had a displacement effect rather than enhancing language proficiency and employability skills [25]. Nonetheless, when viewed as an exploration of an entire manufacturing ecosystem, our study underscores a remarkable consensus among government, industry, labor unions, and education stakeholders regarding the fundamental factors that drive the transition to IR 4.0 [26]. These technologies could produce stark differences between efficiency versus innovation-oriented adoption strategies. Whilst the former could displace workers, the latter can open pathways for upskilling, product and process innovation and cross sector employment. Through the ecosystem level case approach, multiple stakeholder perspectives provide triangulated insights into advanced manufacturer's education, skills and training strategies, uncovering four learning principles that underpin the approach of manufacturers successfully transitioning to IR 4.0 [27].

4.2. OJT and labor market inclusion

Within the framework of the 11th Malaysia Plan, several challenges have been identified, with a prominent one being the deficiency in skills among instructors involved in TVET. The inadequacy of skills within TVET institutions highlights a disconnect between the competencies possessed by employees and those essential for effective job performance. This issue has been recognized as a significant impediment to the efficacy of OJT programs in aligning with industry requirements. Moreover, subpar skills within the industrial sector can result in adverse consequences such as economic and social deprivation, diminished tax revenues, underutilization of human capital investments, reduced job satisfaction, decreased employment opportunities, and suboptimal job search behaviors [28]. These repercussions underscore the pressing need

for further research on bridging the skills gap, especially considering the pivotal role of teachers and the quality of their instruction in shaping both general educational excellence and specific job competencies.

Previous research findings indicate that, on average, respondents possess the requisite abilities and capabilities to perform their designated tasks. Furthermore, respondents express satisfaction with various aspects of their work, including the content of their job responsibilities, their compensation, and the assurance of job security. Figure 3 shows transforming TVET to meet industry demand, 10th Malaysia Plan. The focus is on transforming TVET, which is a type of education and training system designed to equip individuals with practical skills and knowledge required for specific trades, professions, or industries. TVET programs are crucial because they provide the workforce with the technical and vocational skills needed to meet the demands of various industries, such as manufacturing, technology and construction.

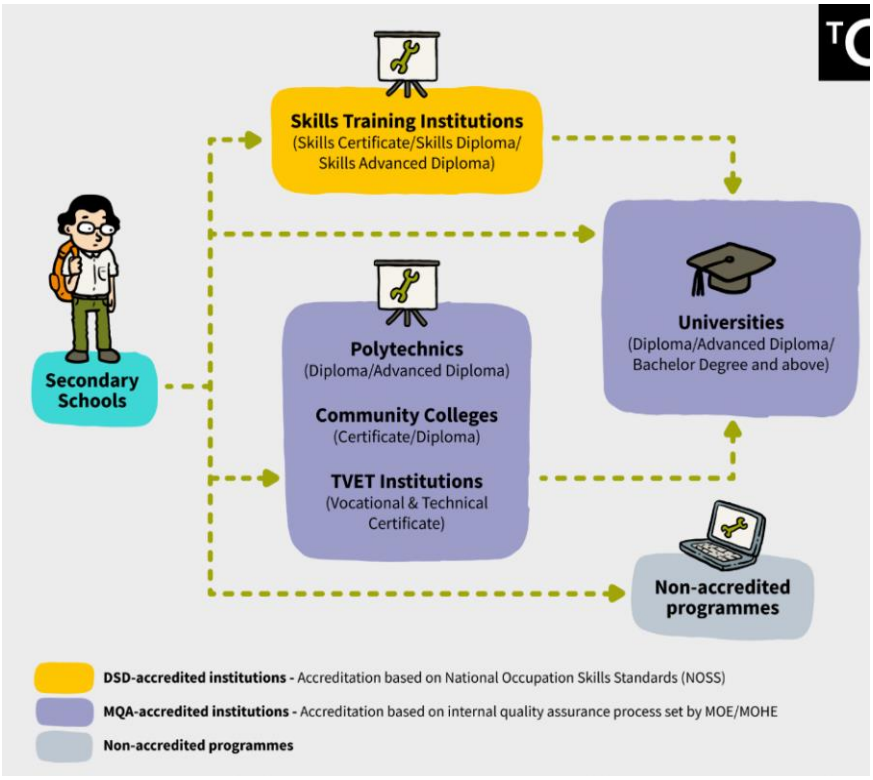

Figure 3. Strategy paper 9-transforming TVET to meet industry demand, 10th Malaysia Plan and UNESCO-UNEVOC International Centre [37]

These outcomes form a robust foundation for further exploration into the skills gap, given the pivotal role that teachers and their quality play in shaping both the overall educational excellence and the specific job competencies. The research findings indicate that the average participants exhibit the requisite abilities and aptitude to perform their tasks effectively. Furthermore, the participants expressed contentment with their job content, salary packages, and the assurance of employment stability. Remarkably, the findings also reveal that respondents have no intentions of retiring from their roles as TVET instructors [29]. By identifying a roster of generic skills necessary for succeeding in an IR 4.0 work milieu, irrespective of industry type, these skills can be seamlessly integrated into the TVET curriculum, catering to the training needs of TVET trainees at the entry-level of competence, from certificate levels 1 to 3 (Malaysian skills certificate). This approach is particularly beneficial because the technological proficiency required is not industry-specific. The introduction of a TVET curriculum enriched with IR 4.0 skills can also serve as a template for other industries to develop their own tailor-made TVET curricula, thereby generating a pool of job-ready graduates and elevating the competencies of existing workers to excel in an IR 4.0 work setting.

By pinpointing the enablers for IR 4.0 integration into the TVET curriculum, TVET training institutions can design and establish a conducive IR 4.0 training environment, equipping TVET trainees with the requisite skills [30]. TVET has long been regarded as instrumental in a nation's development. Structured questionnaires were disseminated to human resource managers within listed companies in Malaysia that

employ technical graduates. This approach enables HEIs to take corrective measures and initiate initiatives to enhance the attributes considered vital in producing marketable technical graduates, thereby contributing to the nation's goal of becoming a developed nation by the year 2020 [31].

4.3. Innovative training practices and competency development

Unemployment is one of the problems faced by many countries. A gap between the skills required by employers and possessed by graduates is one of the factors affecting unemployment. In such situations, it is important to investigate whether life and career skills are embedded by higher education institutions, especially regarding technical and vocational education since they provide a semi-skilled and skilled workforce to compete in the global labor market. Previous research shows various departments have their own way of embedding their teaching and learning process for their students. This study may be used to promote and assist in higher education, specifically polytechnics and industries to improve and enhance TVET programs. Students should be provided with training and skills to survive and thrive in the real working environment [32].

This study aims to determine the readiness and understanding of TVET lecturers in the implementation of IR 4.0. A total of 203 TVET lecturers in Malaysia were involved in this study, which also used descriptive and inferential statistics. Findings reveal a high level of readiness, understanding and implementation of IR 4.0 amongst the TVET lecturers. A significant relationship likewise exists amongst readiness, understanding and implementation of IR 4.0. Findings also show that the TVET lecturers' understanding is a mediator of the relationship between readiness and implementation of IR 4.0. Lastly, results imply that the lecturers can further enhance their effort in implementing IR 4.0 to achieve the Mission of 2020 [33]. As shown in Figure 4, complex thinking goes beyond traditional rote learning and memorization and instead focuses on cultivating higher-order thinking skills that are crucial in an era of rapid technological advancements and complex global challenges.

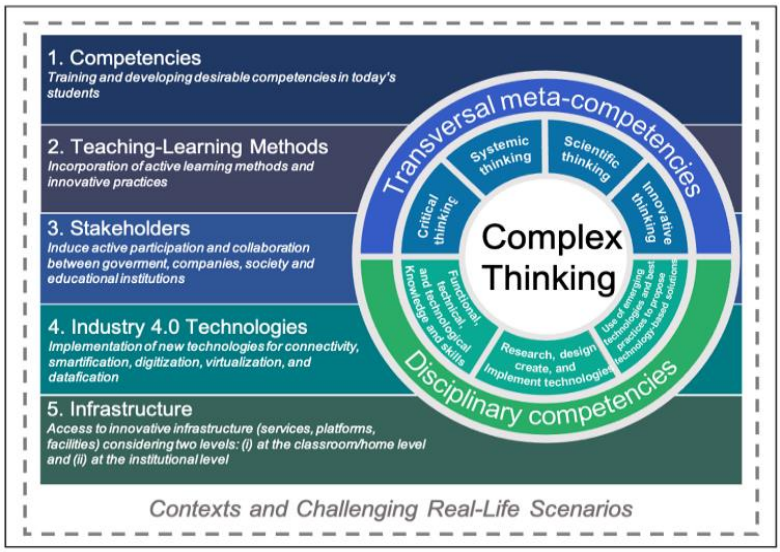

Figure 4. Complex thinking in Education 4.0 [38]

The 11th Malaysia plan highlights several challenges, particularly the skills deficit among TVET teachers. This skills gap within TVET institutions signifies a disconnect between the competencies possessed by employees and those required for effective job performance [34]. Such a disparity poses a significant barrier to the effectiveness of training programs in meeting industry demands. Additionally, inadequate skills within the workforce lead to economic and social disadvantages, including diminished tax revenues, wasted investments in human capital, lower job satisfaction, reduced employment opportunities, and ineffective job search behaviors. These consequences underscore the urgent need for further research into the skills gap, especially considering the crucial role of teachers and their quality in shaping overall education standards and specific job competencies [35]. Previous studies indicate that average respondents possess the ability to perform their tasks effectively and express satisfaction with their job content, remuneration, and employment security. Interestingly, these respondents do not intend to retire from their positions as TVET instructors. This study critically evaluates the Malaysian government's initiatives from 2010 to 2021 aimed at enhancing

industrial engagement within the TVET system. Five key government policies have been identified from a review of 231 relevant literature sources, each proposing strategies to strengthen collaboration between industry and TVET. The report notes that these initiatives adopted a corporatist approach to promote corporate involvement in the national TVET framework by offering various incentives such as tax breaks, training grants, and subsidies. Recommendations have been made to enhance the industry-TVET partnership by imposing certain obligations on related industries to contribute to national human resource development, drawing inspiration from Germany's dual apprenticeship model [36].

4.4. Equity, access, and effectiveness of OJT

Preparing our students for future work roles is a critical component of any work-based learning like the TVET and cooperative education (COE) program. The supervisor's role, the location and atmosphere of the training site, interpersonal relationships, and a variety of other factors all contribute to a student's training program's effectiveness. Studies shows students had a positive workplace learning in terms of the COE procedure, the environment and accessibility of the site, their cognitive, behavioral, and social learning experiences, their attitude toward their supervisor and coordinator, and their evaluation of training, according to the findings [39]. The findings suggest that the training institution can provide high-quality and satisfactory training programs for undergraduate students. Curriculum review and pre-service seminars were proposed as interventions. The needs for highly skilled manpower could be achieved through the active industry involvement in TVET. The Malaysian industry have indicated their interest in supporting the TVET sector, however, the strength of actual collaboration between the industry and TVET agency is still weak and need to be improved [40]–[42].

The aim of this paper is to provide an overview on the level of industries participation in the Malaysia's TVET system. Some issues regarding the TVET system that lead to the industry engagement also been highlighted including the government initiatives to attract the involvement of industries. Certain measures and recommendations were suggested to reinforce strategic TVET agency-industry relationship and cooperation in order to rationalize it into more efficient approach that matches the government needs [37]. The teaching profession in Malaysia remains highly esteemed, thanks to the unwavering dedication and commitment of educators who strive to enhance educational outcomes for future generations. This profession has evolved into a recognized benchmark for the nation's vision of developing human capital. However, despite this acknowledgment, teachers face significant challenges in delivering high-quality educational services. Numerous studies have highlighted various issues within the teaching profession and its environment, including severe depression, anxiety, demotivation, and behavioral problems [43]. These challenges often lead to teachers leaving the profession, whether voluntarily or due to pressures from the educational system. To address this concern, this study investigates the reasons behind teachers' departures and, more importantly, the factors that contribute to job satisfaction and retention. The research focuses on Malaysian training instructors at TVET institutions through a survey. Descriptive and correlational methods were utilized to assess job satisfaction among TVET instructors and identify factors influencing their job satisfaction and retention. The findings reveal that while most instructors express satisfaction with their teaching roles, many struggle to cope with overwhelming issues stemming from current workloads, student disciplinary challenges, and unclear expectations from key stakeholders within the TVET system [18].

A nation's progress in innovation, social engagement, employment opportunities, and economic growth hinges on the strength of its educational and research systems. In the pursuit of sustainable development goals, interdisciplinary, comprehensive, and long-term TVET research is imperative. This attempt should be integrated with other research fields like social sciences and education. To bolster the TVET sector sustainably, an effective research policy is pivotal, complemented by a robust institutional framework, skilled personnel, collaboration, and sustained financial support from the government, industries, and development partners. Regional and global networks such as SEAMEO-VOCTECH, CPSC, and UNESCO-UNEVOC provide valuable support through training, workshops, and skill exchanges to enhance departmental research capacity [40]. Offering research opportunities and educational resources to teachers and aspiring researchers is vital for their professional growth. Additionally, students pursuing master's and doctoral programs in TVET must receive adequate support, including funding for research proposals and publications. Promoting a virtual research community and leveraging ICT-based TVET research within TVET institutions is crucial [38]. TVET programs should prioritize hands-on experiences over theoretical aspects to equip graduates with practical knowledge, skills, and attitudes for specific workplaces. It is imperative to draw lessons and best practices from both developing and developed nations to foster growth in the TVET research and development sector. Embracing an all-inclusive and comprehensive approach involving all stakeholders is essential for the sustainable development of a country, as a one-size-fits-all approach is inadequate for TVET system [44].

5. DISCUSSION

The scientific question addressed in this study is "What are the challenges and opportunities associated with OJT programs within TVET institutions, and how can these programs be optimized to meet the evolving demands of the modern workforce?" The key finding is that effective OJT programs in TVET institutions require continuous adaptation to modern technologies and IR 4.0, strong industry-academia collaborations, innovative training practices, and equitable access to training opportunities [45]. These elements collectively enhance the alignment of OJT programs with industry demands, thereby improving employment outcomes and labor market inclusion for graduates. The results have significant implications for the field of TVET and the broader community by providing evidence-based recommendations for enhancing OJT programs, ensuring they are relevant and effective in preparing students for the modern workforce. Highlighting the need for continuous curriculum updates and strong industry partnerships, which are critical for aligning training with industry needs and technological advancements [46].

TVET institutions, which focus on equipping students with practical skills and preparing them for specific trades or professions, see OJT as essential in bridging the gap between theoretical knowledge and real-world application. However, implementing effective OJT programs involves several challenges. Recent researches [47] shows that, there is the need to align training with ever-evolving industry requirements, as rapid technological advancements necessitate regular updates to curricula. Maintaining quality and consistency across various training contexts is another significant hurdle, especially given the diverse industries and evolving technological landscapes involved. Resource allocation poses a major challenge as well, with effective OJT programs often requiring substantial funding, equipment, and skilled personnel. Developing objective and effective assessment tools to evaluate student performance in practical settings adds to the complexity. Furthermore, forging and maintaining robust industry-academia collaborations is crucial for the success of OJT programs. Such partnerships ensure that training remains relevant and provides mutual benefits, but establishing and nurturing these relationships can be challenging [48]. Additionally, previous researches [49], ensuring compliance with educational and industry standards and regulations is necessary, which involves continuous monitoring and adjustments to training programs.

To navigate these complexities, TVET institutions must adopt best practices such as collaborating with industry experts in curriculum development, providing regular training for instructors, incorporating innovative teaching methods, focusing on student-centered learning, implementing continuous evaluation and feedback mechanisms, and establishing strong industry connections for internships and placements. Additionally, leveraging technology, such as online platforms, e-learning tools, and virtual or augmented reality, can significantly enhance the effectiveness of OJT, providing immersive and flexible learning experiences that complement traditional training methods [50]. The cornerstone of effective OJT lies in establishing a robust framework that aligns closely with industry requirements. This begins with the development of a curriculum that is not only comprehensive but also adaptable to the rapid changes in industry standards and technologies. Collaboration with industry experts is essential in this regard, as it ensures that the training provided is relevant and up-to-date. This partnership can extend beyond curriculum development to include guest lectures, workshops, and site visits, which provide students with valuable insights into real-world applications of their skills [51]. Additionally, a strong liaison between TVET institutions and industries facilitates smoother transitions for students from the classroom to the workplace, enhancing their employment prospects. It also opens doors for internships and apprenticeships, offering students the invaluable opportunity of learning while working, which is a key aspect of effective OJT.

The quality of OJT is heavily dependent on the instructors and the teaching methodologies employed [52]. Instructors should not only possess extensive knowledge and experience in their respective fields but also need to be trained in effective teaching strategies. This includes being adept at integrating theoretical knowledge with practical skills and using innovative teaching methods that cater to varied learning styles [53]. Additionally, adopting a student-centered approach in OJT ensures that the training is tailored to meet individual learning needs and career aspirations. This approach can include personalized learning plans, mentorship programs, and providing students with a choice in selecting their OJT placements, thereby fostering a more engaging and relevant learning experience [54]. Involving students in decision-making processes related to their training also encourages greater investment and ownership of their learning journey. Ultimately, these practices not only enhance the quality of OJT but also contribute to the development of a skilled, confident, and industry-ready workforce, which is the ultimate goal of TVET programs.

6. CONCLUSION

Stressing the necessity of equitable access to training opportunities ensures that all students can benefit from high-quality OJT programs. Informing policy and institutional frameworks supports the successful implementation of these programs. Additionally, it is essential to consider the global perspective of the study, recognizing both the universal and local challenges and strategies in TVET. Lifelong learning

and continuous skill development are crucial to stay competitive in an ever-changing job market. Integrating technology, such as VR and AR, enhances the effectiveness of OJT programs. The implications of these findings are wide-ranging, impacting policy development, curriculum enhancement, industry collaboration, educational equity, and future research.

Policymakers can use these insights to create frameworks that support dynamic and adaptive OJT programs tailored to industry needs. TVET institutions can keep their curricula current by incorporating new technologies and industry trends, ensuring students acquire the most relevant skills. Strengthening partnerships between industries and educational institutions can provide students with practical and relevant training experiences. Efforts to ensure equitable access to quality training can help bridge employment and skill gaps among diverse populations. The findings can also guide future research into new training methods, technological integrations, and policy impacts on OJT effectiveness. Further research and the implementation of advanced technologies can provide immersive and effective learning experiences. Sharing best practices and collaborating internationally can improve the quality and effectiveness of OJT programs globally. Developing sustainable and scalable OJT models adaptable to various industries and regions will be crucial for long-term success. Addressing these areas can significantly improve OJT programs within TVET institutions, ultimately benefiting the broader community by producing a skilled and adaptable workforce.

As we conclude, it is essential to reflect on the critical role that effective OJT in TVET plays in preparing a skilled and adaptable workforce for the modern job market's challenges. Effective OJT in TVET is a dynamic and comprehensive process. It requires a blend of industry-aligned curriculum, quality instruction, soft skill development, technological integration, real-world exposure, and strong mentorship and support systems. By adopting these best practices, TVET institutions can equip students not just with the technical skills required for their careers but also with the soft skills, adaptability, and lifelong learning mindset needed to thrive in an ever-evolving job market. Ultimately, the goal is to provide a holistic training experience that prepares students to be competent, confident, and well-rounded professionals, ready to make meaningful contributions in their respective industries.

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AUTHOR CONTRIBUTIONS STATEMENT

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C : **C**onceptualization
M : **M**ethodology
So : **So**ftware
Va : **Va**lidation
Fo : **Fo**rmal analysis
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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest to report regarding the present study.

DATA AVAILABILITY

The authors confirm that the data supporting the findings of this study are available within the article. List of articles, details and methods used in the analysis available within the article to any researcher for purposes of reproducing the results.

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