Journal of Current Science and Research Review
Volume 1 Issue 5, October (2023) ISSN: 2961-0869
https://jcsrr.org/index.php/jcsrr **ORIGINAL ARTICLE**

Revolutionising Delivery in TVET for Industry 4.0: Strategies from the Field– NGT and ISM Approach

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Abstract
Digital technologies and changing job market demands have brought significant changes to education and training. Industry 4.0, marked by advanced technologies and widespread digitisation, has transformed traditional industrial processes, creating entirely new job roles. As a result, new entrants to the workforce need fresh skills for this digital era. Integrating digital technologies into Technical and Vocational Education and Training (TVET) is crucial for preparing individuals for Industry 4.0. The COVID-19 pandemic emphasises the vital role of digitalisation in TVET. However, these changes have also revealed digital divides, showing limitations in traditional teaching methods and offering an opportunity for innovation. This research explores instructional strategies to transform the delivery and enhance the quality of TVET in Malaysia. The model, developed through the NGT and ISM approach, involves nine experts with over a decade of experience in mechanical and manufacturing-related diploma programmes from both public and private TVET institutes in Malaysia. Experts represented various portfolios related to learning and teaching and TVET management. The findings revealed seven delivery strategies prioritised and to be focused on. These strategies are clustered into three themes: technology-mediated learning environments, industry-simulated TVET settings and contextualised learning experiences. The strategies highlight the evolving roles of technical TVET instructors, which include facilitator of online or remote learning, curator of digital content, learning architect and technology integrator, as well as industry liaison and strategic partnership promoter. Originality/value - The study offers a practical solution for technical TVET instructors' reference in integrating technology in physical and remote learning environments.

***Keywords*—** TVET, Delivery Strategies, Industry 4.0, ISM, NGT

1 Introduction

In today's rapidly changing world, various crises, including geopolitics, climate change, digitalisation, and sustainability, are reshaping industries. Malaysia has taken proactive steps in response to these challenges by introducing the New Industrial Master Plan (NIMP) 2030, aimed at revitalising the manufacturing sector and related services, playing a pivotal role in the country's economic growth. It is expected to generate employment opportunities for a significant portion of the workforce (MITI, 2023).

Globally, TVET is undergoing a profound evolution driven by complex work processes and the rapid advancement of technology (Stolte, 2021). In Malaysia, the 11th Malaysian Development Plan (2016-2020) was designed to enhance labour market efficiency, align TVET programs with industry demands, promote lifelong learning, and elevate training quality. The Twelfth Malaysia Plan (2021-2025) is aligned with these objectives and places a strong emphasis on talent development and technology adoption (Economic Planning Unit).

The swift progress of technology, particularly in the era of Industry 4.0, necessitates a highly skilled workforce capable of managing intricate processes (MBOT, 2021; Spöttl, 2020). However, challenges such as competency gaps, limited technology accessibility, infrastructure constraints, and digital literacy among instructors persist (UNESCO, 2017; Broadband Commission, 2017; Liu et al., 2020). To address these challenges, integrating digital technologies into TVET has become imperative (Ronzhina et al., 2021; Bejinaru, 2019; Petrova et al., 2020; Mbanga & Mtembu, 2020; Rotas & Cahapay, 2020). The outbreak of the COVID-19 pandemic further accelerated the digital transformation in education, prompting TVET institutions to transition from on-site to remote learning, a shift that notably impacted hands-on courses (Shay & Pohan, 2021).

The advent of Industry 4.0 has not only reshaped the composition of the workforce but also influenced the types of skills demanded by companies to maintain competitiveness (Ismail & Hassan, 2019; Spöttl, 2019). The dynamic nature of the workforce, characterised by constantly evolving skill requirements for future jobs, presents a formidable challenge (Acemoglu & Restrepo, 2018). Consequently, there is a growing demand for a higher level of competency and a skilled workforce capable of addressing technological challenges. This demand has necessitated the creation of new job profiles, as these changes influence all job roles, given the intensified work processes and increased data networking inherent in Industry 4.0 (Spöttl, 2020).

Industry 4.0 is characterised by the integration of cyber and physical with the aim of creating smart processes and systems. The infusion of advanced technologies with the Internet of Things (IoT), artificial intelligence (AI), and digitalisation into the physical and biological systems in manufacturing and industry helps to increase efficiency, reduce costs, and improve product quality. Digitalised content, such as 3D models, digital twins, virtual reality simulations, and other digital representations of physical assets, plays a critical role by enabling the creation of smart factories and the efficient management of production processes. This digitalisation allows for greater automation and connectivity in the manufacturing process, leading to increased efficiency and improved quality control. It is expected to lead to job displacement but also the development of new job skills that require competence qualification (Zulnaidi et al., 2020; Schröder, 2019; Spöttl, 2017).

In line with increased automation, digitalisation of work processes, and artificial intelligence (AI), there are new emerging technologies and new competencies to be developed. Various authors have presented ways to cluster competencies. Spöttl, Parvikam, and Paryono (2021) highlighted the new cluster of competencies as broad competencies or new basics, context-specific competencies, and abstract competencies. AI-driven generative technologies are changing the design process of the manufacturing industry, thus shifting the focus towards critical thinking, empathy, and creativity, abstract competencies.

TVET focuses on providing students with the competencies needed for specific trades or industries. The International Labour Organization (ILO-UNESCO, 2020) reported that institutions drive innovation in digital TVET. TVET provides the skilled workforce needed to operate and maintain the advanced technology used in Industry 4.0. TVET helps to prepare workers for the changing job market and the new skills that will be required in Industry 4.0. The relationship between the world of work and TVET institutions suggests that changes in the industry and the job market have a significant impact on the training provided at these institutions (Ismail & Hassan, 2019; Spöttl & Windelband, 2021; Spöttl, Parvikam & Paryono, 2021). Cooperation between the two is necessary for producing graduates who are well-suited for the job market and who can directly influence the practice of the industry since progress can only be achieved when theory is directly linked to practice.

The lack of adequate skill sets to expedite the movement towards Industry 4.0 in Malaysia is a challenge (Saipudin & Suhairom, 2021; Ismail & Hassan, 2019). Additionally, TalentCorp Critical Occupations List 2022/2023 reported that too few applicants or no applicants at all, applicants lack the required credentials or certification/qualification, or lack the required skill of quality checking for niche products. These various sources highlighted a lack of awareness of the concept of Industry 4.0 and its benefits, curricula of courses offered by local higher learning institutions are not up to date with current industry practices, and graduates lack the required technical and soft skills to succeed in these critical roles. Additionally, technical TVET instructors are not fully ready and do not really understand how to apply elements of Industry 4.0 in Malaysia and ASEAN member states (Saipudin & Suhairom, 2021; Zulnaidi et al., 2020; Ismail & Hassan, 2019).

It is important to establish a culture of innovation and collaboration to respond to the demands of digital transformation effectively. Understanding the requirements of Industry 4.0 and what skills will be needed to succeed is a top Industry 4.0 investment priority for organisations, which will enhance the technical TVET instructors' readiness and develop talent for future workforce performance (Zulnaidi et al., 2020). This culture of innovation and collaboration can be achieved by involving all stakeholders, particularly the technical TVET instructors, updating curriculum content, improving delivery methods, and effectively utilising technology. Technology, on the other hand, as suggested by Jonassen (1994), should be used as a cognitive tool that relies on the learner to provide intelligence.

Technical TVET instructors play multifaceted roles that demand pedagogical, technical, and digital competence (Tucker, 2021). Professional development of instructors is critical in introducing and advancing these technologies, as they are central to the performance, effectiveness, and overall quality of TVET programs (Stolte, 2021). TVET institutions play a vital role in providing the industry with a skilled workforce, but they encounter challenges in keeping pace with technological advancements and global shifts (MBOT, 2021; Spöttl, 2020). These dynamic changes necessitate adjustments in the attributes of the future workforce (Schröder, 2019). To maintain the quality of education and training, TVET institutions must prioritise instructors' continuous professional development (Tucker, 2016). Digitalising TVET settings brings flexible and remote learning opportunities, expanding access to education and training prospects (Schröder, 2019). Integrating digital technology into TVET provides avenues for interactive and immersive learning experiences (Harasim, 2017), equipping students with essential digital skills for future employment (Spöttl, 2020). These digital competencies are vital in preparing students for the demands of a digitalised and rapidly changing workplace. Furthermore, technical TVET instructors can enhance engagement, stimulate critical thinking, and facilitate hands-on experience with state-of-the-art technologies (MBOT, 2021). The adoption of Digital TVET addresses the challenges posed by technological advancements, ensuring that instructors and graduates are well-prepared for the digital economy and can contribute effectively to the growth and competitiveness of industries (Tucker, 2021).

Incorporating innovative delivery strategies is essential for improving student learning outcomes and enhancing the overall quality of TVET education and training. In a learning environment where students have more control, instructors' roles shift towards creating assignments and providing guidance through questions (Höpfner, 2009). Meanwhile, students assume greater responsibility for independently planning and presenting their information. This transition fosters a sense of proactivity and self-reliance in students' learning endeavours. Technical TVET instructors' extensive experience and expertise are invaluable in creating such a model, which can significantly boost students' learning achievements and, consequently, have a substantial impact on the overall quality of TVET graduates. However, in Malaysia, there is currently a lack of practical references to guide technical TVET instructors in effectively navigating the challenges of day-to-day teaching and learning in the context of digital and industry-relevant TVET. The pressing need to address Industry 4.0, the evolving job landscape, digital disparities, and the absence of mandated guidelines or strategies for enhancing the quality of TVET instruction has led to the development of a comprehensive and practical guide tailored to support technical TVET instructors in managing the teaching and learning process within a digital and industry-relevant framework.

1.1 Problem Statement

In the pursuit of revolutionising TVET delivery in Malaysia to align with the demands of Industry 4.0 and the digitalised workplace (Spöttl & Windelband, 2021), several critical challenges have emerged. These challenges encompass the digital divide among technical TVET instructors Saipudin & Suhairom, 2021; Zulnaidi et al., 2020; Ismail & Hassan, 2019, the unavailability of comprehensive guidelines for TVET instructors (Stolte,2021), and the pressing need for a dynamic learning environment that prepares students for technology-driven industries (Spöttl, Parvikam & Paryono, 2021). Additionally, there is a notable absence of established strategies to bridge these gaps and effectively integrate digital technologies into the TVET teaching and learning process.

The COVID-19 pandemic further accentuated these challenges by necessitating rapid digital transformation and highlighting the importance of digital skills among instructors and students. Moreover, the evolving workplace landscape demands higher-order thinking, advanced technology integration, and the development of competencies aligned with digitalisation. Despite various efforts and initiatives by ministries and institutions, there remains a lack of standardisation in digital technology integration within TVET and a dearth of practical references to guide technical TVET instructors effectively.

Consequently, there is an imperative to address these challenges comprehensively to enhance the quality of TVET delivery in Malaysia, prepare students for the digital workplace, and bridge the digital divide among instructors. The development of a practical and adaptable model is needed to guide technical TVET instructors in managing the teaching and learning process within a digital and industry-relevant framework. This model should incorporate strategies for content selection, technology integration, innovative teaching methods, and competency-based assessments, effectively shaping the quality of TVET for the future workforce.

The guiding research questions are as follows:

RQ 2.1 What are the proposed strategies according to experts' consensus to revolutionise delivery in TVET?

RQ 2.2 Which of the proposed strategies, according to experts' consensus, should be prioritised to revolutionise delivery in TVET?

2 Literature Review

The subheadings below discuss and position technology as a transformative tool. The adaptability of TVET programmes to emerging digital pedagogical approaches, the integration of diverse digital tools, and the reconsideration of traditional practices in favour of innovative learning methodologies collectively contribute to the ongoing revolution in TVET delivery in Malaysia. The discussion aligns with the imperatives of Industry 4.0, ensuring that TVET remains a cornerstone in preparing learners for the evolving demands of the workforce.

2.1 Leveraging on Technology Adaptation

The dynamic nature of the industry exerts a profound influence on the TVET ecosystem, shaping critical aspects of the Learning and Teaching (L&T) process, including curriculum, delivery, and assessment (Spöttl, 2017). The advent of cutting-edge learning technologies has ushered in a new era in education, introducing innovative platforms such as Massive Open Online Courses (MOOCs), Personalised Learning Environments (PLEs), and Adaptive Learning Systems (ALS). These developments underscore a fundamental shift towards individualised, networked, and Artificial Intelligence (AI)--managed learning approaches, reflecting the evolving needs of the industry and the demands of the Fourth Industrial Revolution.

The implications of these advancements are not confined to theoretical concepts but extend to transformative changes in instructional methods. The integration of flipped classrooms, learner-driven assignments, and diverse media, including video and digital applications, has revolutionised the teaching process, rendering it more engaging and effective for contemporary, time-efficient learners (Al-Murshidi, 2020; Sumardi & Nugrahani, 2020).

In response to the COVID-19 pandemic, the educational landscape witnessed accelerated changes, with scholars such as Code et al. (2020) noting a significant impact on pedagogical approaches. Blended learning, personalised, and individualised instructional methods emerged as resilient strategies to provide flexible and tailored learning experiences in challenging times. The imperative to adapt to these changes showcases the resilience and flexibility inherent in TVET programmes.

Furthermore, the integration of online activities, interactions, materials, and assessments, as advocated by Juhary (2020), represents a pivotal shift in the TVET paradigm. Collaborative technologies play a crucial role in replicating face-to-face interactions within the online learning environment, adapting TVET to the realities of the digital era (Nguyen & Nguyen, 2019). In leveraging and integrating these technologies, technical TVET instructors have a unique opportunity to enhance the L&T experience (Grenčíková et al., 2021) and promote student-centred learning (Höpfner, 2009), particularly in the delivery of theory-based content.

The digital resources available to TVET instructors are diverse, ranging from Learning Management Systems (LMS) that facilitate comprehensive course management to multimedia resources, interactive whiteboards, educational apps, virtual labs, and social media. Each tool contributes uniquely to visual and interactive content delivery, gamified and interactive learning experiences, hands-on experiential learning, and collaborative project work, respectively (Nguyen & Nguyen, 2019).

The debate surrounding the efficacy of online labs, as explored by Brinson (2015) and Stoeckel (2020), challenges traditional preferences for hands-on experiences in TVET. These discussions provide nuanced insights, suggesting that online labs can be as effective, if not more so, in terms of content knowledge attainment. The efficacy of online labs challenges the conventional narrative and opens avenues for exploring flexible and accessible learning arrangements without compromising learning outcomes.

2.2 Technology and TVET Instructor Competence

However, a critical analysis of the competency profile for vocational training officers reveals a minimal focus on digital competence and pedagogical digital competence (see Appendix A). Despite variations in their perspectives, scholars unanimously recognise the challenges and opportunities presented by online learning (Chuah & Mohamad, 2020; Sumardi & Nugrahani, 2020; Sepulveda-Escobar & Morrison, 2020) and stress the importance of support and collaboration among various stakeholders, including teachers, parents, and relevant authorities (Chuah & Mohamad, 2020; Kidd & Murray, 2020).

Blended learning approaches, incorporating both synchronous and asynchronous elements, are highlighted as essential for effective learning experiences. The scholars emphasise the need for flexibility and adaptability in teaching practices, particularly in the online learning environment. Teachers are encouraged to explore new ideas, mechanisms, and platforms to engage with students effectively (Sumardi & Nugrahani, 2020).

Divergent views among scholars exist. One focuses on technology education (Code et al., 2020) and another on Initial Teacher Education programmes (Sepulveda-Escobar & Morrison, 2020). Despite these differences, a common thread is the emphasis on the uncertain orientation of the future of education and the necessity for fundamental changes in the system (Kidd & Murray, 2020; Code et al., 2020).

The ASEAN region discusses the limitations of the current online teaching approach, emphasising the need for reinforcement and reflection (Chuah & Mohamad, 2020) and stresses the importance of academic collaboration and knowledge sharing for enhancing teaching strategies advocating for systematic and effective online education through diverse activities and interactive learning (Juhary, 2020). The advocates for the flipped classroom model cite advantages like increased interest and time efficiency (Sumardi & Nugrahani, 2020). These insights collectively underscore the challenges, opportunities, and necessary adaptations in online learning and teaching.

The crucial aspect of investing is in teacher quality to realise technology's benefits fully (Tucker, 2016). The literature discussed lays emphasis which aligns with Tucker's (2016) on the evolving competency profile of technical TVET instructors and the importance of bridging the gap in digital and pedagogical competence.

The impact of advanced technology has necessitated a shift in occupational profiles, requiring educators to focus on procedural, cognitive, emotional, and social skills (Spöttl, 2020). Educators must adapt their teaching strategies to integrate technology, ensuring students acquire the skills necessary for success in the media-powered environment.

2.3 Technology and Delivery in TVET

The landscape of online learning sees technology playing a pivotal role in delivering instructional content (Majumdar et al., 2021; Harasim, 2017). Amidst the COVID-19 pandemic, the swift adoption of digital transformation in the L&T process, facilitated through technologies and the Internet, has been noted (Gan & Sun, 2021). Synchronous and asynchronous learning situations have taken the lead, offering a platform for simulations and shared resources.

Scholars present contrasting views on the role of technology in instructional delivery. Some emphasise technology substituting teachers, while others point to the successful adaptation of digital transformation through the L&T process. However, a consensus exists on the potential of internet-mediated learning to efficiently prepare students for future industries and multidisciplinary technologies, emphasising practicality and industry relevance.

While remote learning is deemed suitable for theoretical courses, practical courses involving real or ideal practices pose challenges (Assunção Flores & Gago, 2020). Motivation and human factors, however, can overcome these limitations (Herrera et al., 2006; Nickerson et al., 2007). stress the crucial role of human and social factors in remote experimentation, advocating for higher motivation and lower scepticism to enhance the educational value of remote learning experiences.

Although the configurations for participant groups, interaction tools, and activity-supporting tools for the implementation of remote experiments have been outlined (Herrera et al., 2006), the lower-ability students tend to rate remote labs more effectively, suggesting they may be particularly suitable for students with visual or flexible learning styles (Nickerson et al. (2007). On the same note, the effectiveness of a lab, regardless of its form, with active teacher involvement is crucial in online classrooms (Stoeckel, 2020).

The online learning environment presents challenges such as limited internet connectivity and reduced interaction, particularly in asynchronous distance learning (Bagley et al., 2015). Students' expectations, often rooted in traditional learning strategies, need careful consideration when designing online learning strategies (Carter et al., 2020; Sumardi & Nugrahani, 2021). Instructors must adapt instructional methods to meet student expectations and support learning needs, recognising the differences between traditional and online settings.

Digitalisation in TVET necessitates a substantial shift in the learning and training process, emphasising technology-integrated delivery. Challenges, including limited internet connectivity and the need for adaptations to evolving instructional methods, underscore the practical difficulties students may face in the online learning process. The shift to online learning also demands a re-evaluation of assessment strategies and cultural adaptations to ensure the effective integration of technology in TVET.

3 Methodology

The identification of the strategies conducted used the nominal group technique (NGT) and interpretive structural modelling (ISM) assisted by software. NGT and ISM were deployed in this study based on the design and development research model development by Rita C. Richey and James D. Klein (2014). The NGT uses a hybrid session while the ISM is done remotely.

The first method employed in this investigation is the NGT technique, which involved consulting nine technical TVET instructors specialising in mechanical and manufacturing-related diploma programmes. The experts are briefed on the objective of the discussion and the expected outcomes by an appointed facilitator.

3.1 Nominal Group Technique (NGT)

NGT is a systematic tool used to determine a group's shared viewpoints on a certain subject. The application of these instruments can be seen in the works of many scholars. NGT is a systematic tool used to elicit a group's collective opinions and insights on a particular subject (Potter et al., 2004; Harvey & Holmes, 2012). Its versatile application extends across various academic domains, including mental health (Mahmud & Mustapha, 2022; Mustapha et al., 2022), heat energy (Rade et al., 2017), submarine operations (Moelyanto et al., 2021), safety management (Khan et al., 2017), showcasing its application versatility and effectiveness in various research disciplines.

Introduced in the 1960s, NGT originally served as a method for conducting group discussions aimed at generating information to address specific issues (Potter et al., 2004; Harvey & Holmes, 2012). Over time, it has gained recognition and adoption by scholars from diverse fields, including consumer groups, health, medical sciences, and social work. The method's appeal lies in its cost-effectiveness and efficiency, making it an attractive choice for researchers (Potter et al., 2004).

One of NGT's key strengths is its capacity for idea generation and clarification, ensuring that every participant's perspective is not only heard but also acknowledged (Wiggins et al., 2020; Harvey & Holmes, 2012). This collaborative approach facilitates a comprehensive exploration of topics, making it a valuable tool for researchers and professionals seeking to harness the collective wisdom of a group while efficiently addressing complex issues.

The NGT has been used by scholars across disciplines because it is a cost-effective and time-efficient method for data collection. The merits of the application based on articles reviewed using NGT include:

1. Provides equal opportunity for all members to have a voice in contributing their ideas and opinions.
2. Facilitates the generation of a substantial number of ideas in a relatively short amount of time.
3. Encourages members to critically evaluate the clarity, strengths, and weaknesses of each idea.
4. Allow participants to contribute their perspectives and ensure each voice is heard.
5. Promotes group decision-making among group members.
6. Effective data collection, valuable information generation and clarification in response to specific issues through group discussions.
7. Prioritisation of information, which allows participants to prioritise and discuss the generated information, ensuring that the most important ideas are given appropriate attention.
8. Interdisciplinary applicability

The facilitator posed the stimulus question to a group of 9 experts, a recommended size by Harvey and Holmes (2012). The TVET experts These experts have over ten years of experience in manufacturing and mechanical-related diploma programmes and portfolios related to assessment, management, curriculum development, and innovation. During the idea generation, the participants respond individually to each stimulus question and write their solutions independently. The ideas were recorded and shared with the group to avoid a single train of thought. These idea statements were reviewed and refined collectively in the group to increase clarity. The group reached a consensus on the proposed idea statement by voting. The voting score is based on a 5-point Likert scale. Each expert indicated their level of agreement with each statement using 1 = Strongly disagree, 2 = Disagree, 3 = Not sure, 4 = Agree, 5 = Strongly agree. Statements that reached 70% of expert consensus or more, according to Deslandes et al. (2010) and Dobbie et al. (2004), are identified as *suitable* strategy ideas. Based on the percentage of the scores, the statements are ranked in descending order. The NGT process was completed according to schedule, and quick decision-making was avoided. The output of the NGT is a list of 23 *suitable* strategy statements.

3.2 Interpretive Structural Modelling (ISM)

ISM Concept Star is the licensed software used to build the relationship model. The four main input for the ISM software is the title, relation phrase, construct, and idea list. The ideas entered into a dialogue box are suitable strategy statements. Each strategy statement in the idea list was voted on. The same experts from the NGT process are involved in this process. The experts voted "yes" or "no", depending on their individual expert opinion on each of the strategy statements. The construct that is being used is "In managing day-to-day learning and teaching process. There are various challenges faced by TVET technical instructors in selecting content fit for Industry 4.0. The strategy is to ...." The relationship phrase used during the voting between the strategy statements is "This strategy is more significant than...". The defined construct and the relationship statement guide the experts.

Each expert voted "yes" if they agreed with the relationship and "no" if otherwise. The final decision regarding the relationship is made based on the majority count of the experts' votes. The output of the ISM is a relationship model.

4 Findings

This structured process of small-group discussion in NGT was used in the study to generate ideas from nine experts. Experts ranked all ideas by voting on the proposed strategy statements. All 16 strategy statements are identified as suitable according to expert consensus. These strategy statements are numbered from 1 to 16 in no specific order. The percentage of the score, rank priority and voter consensus for each strategy statement using Microsoft Excel software is displayed in Table 1.

Table 1 : Expert Consensus on Delivery Strategies

No	Strategy Statement	Percentage of Vote	Rank Priority	Expert Consensus
1	Confirm trainer competency in digital delivery.	98	1	Suitable
2	Prioritisation of the task to be carried out online (practical task online, theoretically based online).	96	2	Suitable
4	Implement a student-centred approach (Change the current approach to teaching and move away from a teacher-centred teaching method).	92	3	Suitable
16	An innovative learning approach that can be applied to prepare students for Industry 4.0.	92	3	Suitable
11	Create a small practical group of students to carry out learning tasks and activities to improve social interactions and teamwork among students.	90	4	Suitable
5	Do the real thing based on real work from industry (contextual learning).	88	5	Suitable
6	Use a problem-related industry/Problem-based learning approach using the 4 C elements (cognitive skills/ability, critical thinking, communication, collaboration, creativity).	88	5	Suitable
3	Differentiate trainers as subject matter experts but not in teaching methodology.	86	6	Suitable
13	Create a technical guidance team comprising experts from the institute and industry (field experts).	86	6	Suitable
14	Upgrade the existing system to accommodate hybrid mode (not to be very specific for the purpose).	86	6	Suitable
8	Upload a recorded video of the session.	82	7	Suitable
9	Assess learner level of understanding prior to topic/course to determine delivery strategies.	82	7	Suitable
7	Provide supplementary material on the virtual class, such as video.	78	8	Suitable
12	Send demo kit to students to demonstrate skills for lower level (theoretical online, practical on their own).	78	8	Suitable
15	Work with an institute or a technical centre in another location to support/ collaborate and ease practical training.	76	9	Suitable
10	Integrate Augmented Reality (AR)/Virtual Reality (VR) tools relevant to the content to create new training experiences.	70	10	Suitable

These suitable strategy statements are used as input in the ISM model. The manual process of developing a relationship model is often lengthy and time-consuming. However, the backend programming within the ISM Concept Star software streamlines this task by automatically identifying the relationships among various strategies. It efficiently pinpoints which strategies exert influence or drive the behaviour of the system under consideration. Additionally, the relationship model allows for the identification of the driving power and dependent power associated with each strategy. The relationship model is depicted in **Error! Reference source not found.** as follows.

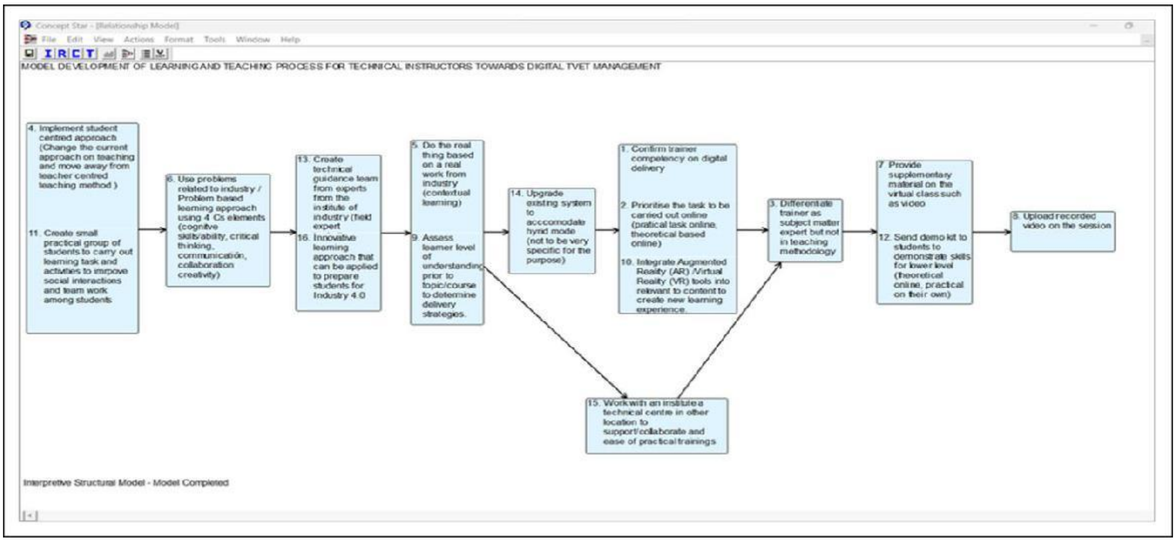

***Figure 1** : Delivery Strategies Relationship Model*

The Concept Star software generates a comprehensive relationship model, as illustrated in Figure 1. This relationship model serves as a valuable tool for the authors, aiding in their understanding of the connections between various strategy statements. In Figure 1, directional arrows indicate the driving factor, following the logical principle that if element A drives element B, and element B drives element C, then it can be inferred that element A drives element C. However, this logic does not hold in reverse. Element C depends on element B, and element B, in turn, depends on element A.

Specifically, in Figure 1, we observe that Strategy 4 and Strategy 11 drive Strategy 6. Strategy 6, in turn, influences Strategy 13 and Strategy 16, which then drives Strategy 14. Strategy 14 subsequently influences Strategy 1, Strategy 2, and Strategy 10, which collectively drive Strategy 3. Strategy 3, in its role as a driver, influences Strategy 7 and Strategy 12 and drives Strategy 8. Therefore, it can be concluded that Strategy 4 and Strategy 11 collectively drive Strategy 8.

The terms "driving power" and "dependent power," which will be utilised in the subsequent discussion of the Reachability Matrix, are closely tied to this logic. To provide a visual representation of the intricate interconnections between these strategies, a reachability matrix is generated. **Error! Not a valid bookmark self-reference.**2 displays this matrix, and it is derived directly from the relationship model., is derived from the relationship model.

Table 2 : *Reachability Matrix for Delivery Strategies*

Idea	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	Driving Power
1	1	1	1	0	0	0	1	1	0	1	0	1	0	0	0	0	7
2	1	1	1	0	0	0	1	1	0	1	0	1	0	0	0	0	7
3	0	0	1	0	0	0	1	1	0	0	0	1	0	0	0	0	4
4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16
5	1	1	1	0	1	0	1	1	1	1	0	1	0	1	1	0	11
6	1	1	1	0	1	1	1	1	1	1	0	1	1	1	1	1	14
7	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	3
8	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1
9	1	1	1	0	1	0	1	1	1	1	0	1	0	1	1	0	11
10	1	1	1	0	0	0	1	1	0	1	0	1	0	0	0	0	7
11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16
12	0	0	0	0	0	0	1	1	0	0	0	1	0	0	0	0	3
13	1	1	1	0	1	0	1	1	1	1	0	1	1	1	1	1	13
14	1	1	1	0	0	0	1	1	0	1	0	1	0	1	0	0	8
15	0	0	1	0	0	0	1	1	0	0	0	1	0	0	1	0	5
16	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	16
Dependent Power	11	11	13	3	7	4	15	16	7	11	3	15	5	8	8	5	

The values "0" and "1" are derived from Figure 1 using the following rule. "i" and "j" are the strategies. Input (i, i) is marked as "1" because i drive i

Input (i,j) is marked as "1", because i drive j

Input (j, i) is marked as "0" because i is not driven by j.

The interconnections between the driving power and dependent power for each strategy are important to categorise the strategies. It is further discussed under the sub-heading MICMAC Diagram. The result of the partitioning is shown in Table 3 below. The hierarchy consists of ten levels representing the sixteen strategies, with Level 1 denoting the lowest and Level 10 the highest. The placement of characteristics within this hierarchy is determined by their relative importance and their impact on other characteristics. The most crucial characteristics, which exert the greatest influence, are positioned at the top of the hierarchy. The strategies are organised in descending order to establish their hierarchy of importance. The characteristics are partitioned from the highest to the lowest, with Strategy Ideas 4 and 11 placed at Level 10, while Level 1, the lowest level, starts with Strategy Idea 8.

Table 3 : Partitioning of Reachability Matrix

Idea	**Strategy Statement**	Level
4	Implement a student-centred approach (Change the current approach to teaching and move away from a teacher-centred teaching method).	10
11	Create a small practical group of students to carry out learning tasks and activities to improve social interactions and teamwork among students.	10
6	Use a problem-related industry/Problem-based learning approach using the 4 C elements (cognitive skills/ability, critical thinking, communication, collaboration, creativity).	9
13	Create a technical guidance team comprising experts from the institute and industry (field experts).	8
16	An innovative learning approach that can be applied to prepare students for Industry 4.0.	8
9	Assess learner level of understanding prior to topic/course to determine delivery strategies.	7
5	Do the real thing based on real work from industry (contextual learning).	7
14	Upgrade the existing system to accommodate hybrid mode (not to be very specific for the purpose).	6
10	Integrate Augmented Reality (AR)/Virtual Reality (VR) tools relevant to the content to create new training experiences.	5
2	Prioritisation of the task to be carried out online (practical task online, theoretically based online).	5
1	Confirm trainer competency in digital delivery.	5
15	Work with an institute or a technical centre in another location to support/ collaborate and ease practical training.	4
3	Differentiate trainers as subject matter experts but not in teaching methodology.	3
7	Provide supplementary material on the virtual class, such as video.	2
12	Send demo kit to students to demonstrate skills for lower level (theoretical online, practical on their own).	2
8	Upload the recorded video of the session.	1

The purpose of the MICMAC diagram is to analyse the drive power and dependence power of factors (Attri et al., 2013). The MICMAC diagram is obtained by using the values of the x (dependence power) and y (driving power) axes as (x, y) coordinates in a Cartesian graph. The x and y values are identified and presented in Table 4 below. The coordinate is marked by using the strategy number. By using these values as the coordinate points in a Cartesian graph, each strategy is categorised into a specific quadrant. Each quadrant denotes a specific characteristic for the driving and dependent power, as shown in Table 5.

Table 4 : Driving power and Dependence power

Idea	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
x	11	11	13	3	7	4	15	16	7	11	3	15	5	8	8	5
y	7	7	4	16	11	14	3	1	11	7	16	3	13	8	5	16

The Cartesian graph or MICMAC diagram is given in accordingly.

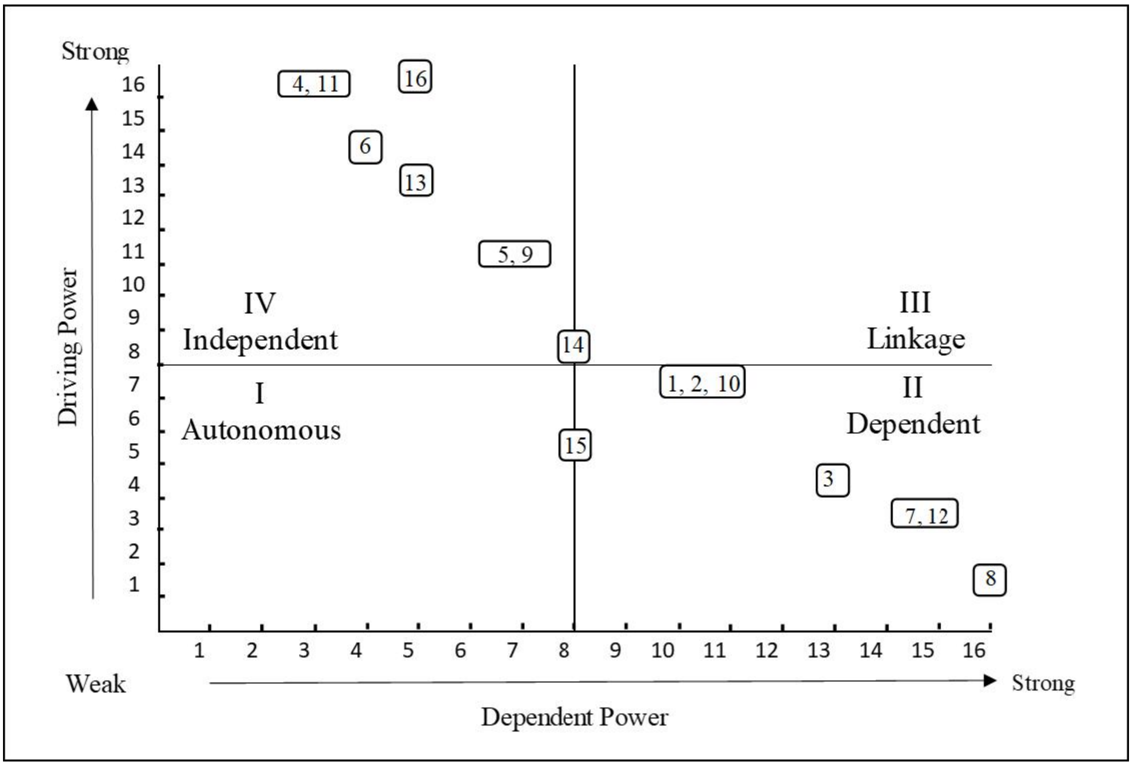

***Figure 2** : MICMAC diagram*

Based on the driving power and dependent power, the strategies are categorised into four quadrants. The description of the characteristics of the strategies according to each quadrant is given in Table 5 below.

Table 5 Characteristics of Quadrant

Quadrant	I	Autonomous. Strategies have weak drive power and weak dependence power. The strategies that enter this quadrant are generally not related to the system and may have little relationship even though the relationship can be strong. There is no strategy for this characteristic in this study.
Quadrant	II	Dependent. weak driver-strongly dependent strategies. The strategies in this quadrant are dependent on the independent strategies.
Quadrant	III	Linkage. Strong driver-strongly dependent strategies. Strategy 13 must be addressed carefully because the relationship between the strategies is unstable.
Quadrant	IV	Independent. Strong driver-weak dependent strategies. Strong strategies that drive the system.

Therefore, the quadrants to be addressed are Quadrant IV, Quadrant II, and Quadrant III. By referring, seven independent strategies have strong driving powers. These strategies are shown in Table 6 as follows.

Table 6 : Independent Strategies

Strategy	Statement
4	Implement student student-centred approach (Change the current approach to teaching and move away from the teacher-centred teaching method),
11	Create a small practical group of students to carry out learning tasks and activities to improve social interactions and teamwork among students.
16	An innovative learning approach that can be applied to prepare students for Industry 4.0
6	Use problem-related to industry/Problem-based learning approach using 4 Cs elements (cognitive skills/ability, critical thinking, communication, collaboration, creativity)
13	Create a technical guidance team from experts from the institute of industry expert (field expert)
5	Do the real thing based on real work from industry (contextual learning)
9	Assess learner level of understanding prior to topic/course to determine delivery strategies.

There are six strategies independent strategies, as shown in **Error! Reference source not found.** and six dependent strategies, as shown in **Error! Reference source not found.** as follows.

Table 7 : Dependent Strategies

Strategy	Statement
1	Collect feedback from students immediately after every session.
2	Prioritisation of the task to be carried out online (practical task online, theoretically based online).
10	Integrate Augmented Reality (AR)/Virtual Reality (VR) tools relevant to the content to create a new training experience.
3	Differentiate trainers as subject matter experts but not in teaching methodology.
7	Provide supplementary material in the virtual class, such as video.
8	Upload recorded video on the session.
15	Work with an institute or a technical centre in another location to support/ collaborate and ease practical training.

These prioritised delivery strategies were evaluated using FDM. The experts rated the characteristics as suitable, suggesting that they address instructional delivery methods, strategies, and techniques to revolutionise TVET delivery in Malaysia. The delivery strategies, in general, are ranked second' and the focused strategies are ranked third.

5 Discussion

Characteristics that exhibit high driving power and are independent of other characteristics. The characteristics listed are as follows.

- Idea 4 Implement student student-centred approach (Change the current approach to teaching and move away from the teacher-centred teaching method),
- Idea 11 Create a small practical group of students to carry out learning tasks and activities to improve social interactions and teamwork among students,
- Idea 16 Innovative learning approach that can be applied to prepare students for Industry 4.0,
- Idea 6 Use problem-related to industry/Problem-based learning approach using 4 Cs elements (cognitive skills/ability, critical thinking, communication, collaboration, creativity),
- Idea 13 Create a technical guidance team from experts from the Institute of Industry expert (field expert),
- Idea 5 Do the real thing based on real work from industry (contextual learning) and
- Idea 9 Assess the learner's level of understanding prior to the topic/course to determine delivery strategies.

Additionally, characteristics that exhibit high driving power and are independent of other characteristics are listed as follows.

- Idea 4 Implement student student-centred approach (Change the current approach to teaching and move away from the teacher-centred teaching method).
- Idea 11 Create a small practical group of students to carry out learning tasks and activities to improve social interactions and teamwork among students.
- Idea 16 Innovative learning approach that can be applied to prepare students for Industry 4.0.
- Idea 6 Use a problem related to industry/Problem-based learning approach using 4 C elements (cognitive skills/ability, critical thinking, communication, collaboration, creativity).
- Idea 13 Create a technical guidance team from experts from the Institute of Industry expert (field experts).
- Idea 5 Do the real thing based on real work from the industry (contextual learning)
- Idea 9 Assess the learner's level of understanding prior to the topic/course to determine delivery strategies.

Some of the strategies proposed can be grouped or clustered together since they represent similar ideas. The three core themes derived from these characteristics are technology-mediated learning environments, industry-simulated TVET settings and contextualised learning experiences.

i. Technology-mediated learning environments

This theme centres around leveraging technology to create effective and engaging learning environments. It aligns with the demands of Industry 4.0, where technology plays a crucial role. Idea 4 emphasises implementing student-centred approaches through technology, such as online platforms, interactive multimedia, and digital resources. Idea 11 complements this theme by suggesting small practical groups in virtual settings, where students can collaborate and interact through video conferencing and online collaboration tools. By adopting technology-mediated learning environments, instructors can facilitate flexible, interactive, and personalised learning experiences for learners.

ii. Industry-simulated TVET settings

This theme focuses on creating learning environments that simulate real-world industry settings. Idea 16 highlights the importance of innovative learning approaches that prepare students for Industry 4.0. The innovative learning approach can include the integration of industry simulations, virtual laboratories, and case studies replicating authentic workplace scenarios. Idea 6 further supports this theme by advocating for problem-based learning approaches, where learners tackle industry-related challenges using cognitive skills, critical thinking, communication, collaboration, and creativity. By incorporating industry simulations and problem-based learning, instructors can enhance learners' practical skills and ability to apply theoretical knowledge in real-world contexts.

iii. Contextualised learning experiences

This theme emphasises contextualising learning experiences to make them relevant and meaningful for learners. Idea 13 suggests the involvement of industry experts as part of a technical guidance team, who can provide insights and real-world perspectives. Idea 5 promotes contextualised learning by incorporating real work from the industry, allowing learners to apply their knowledge and skills directly. This theme also aligns with idea 9, highlighting the significance of assessing learner levels of understanding to tailor delivery strategies accordingly. By providing contextualised learning experiences, technical instructors can bridge the gap between theory and practice, enhancing learners' industry-specific knowledge and skills.

By focusing on these three core themes of technology-mediated learning environments, industry-simulated TVET settings, and contextualised learning experiences, TVET institutions can effectively manage the delivery of sessions in different learning environments. These themes align with the demands of Industry 4.0 and Digital TVET by leveraging technology, simulating industry settings, and contextualising learning to prepare learners for the digital era. The delivery dimension featured characteristics such as problem-centred learning, industry-based learning, and the use of AR/VR tools, directly addressing challenges related to connectivity, engagement, and technical proficiency. These ideas resonated with users, emphasising infrastructure upgrades, interactive teaching methods, and technology utilisation for flexible learning.

Characteristics that exhibit strong dependency on other characteristics, such as integrating Augmented Reality (AR)/Virtual Reality (VR) tools relevant to the content (Idea 10) or differentiating trainers as subject matter experts (Idea 3), play fundamental roles in shaping the landscape of modern L&T practices. These ideas underscore the strong need for technology integration and specialised expertise within the learning environment. For instance, integrating AR/VR tools requires a robust technological foundation and expertise to harness the potential of these immersive technologies effectively. Likewise, differentiating trainers and acknowledging them as subject matter experts emphasises the need for instructors who possess in-depth knowledge of their respective fields. However, the transformative potential of these characteristics is most pronounced when they are coupled with characteristics that exhibit high driving power and independence, such as one that can navigate in technology-mediated environments.

On the flip side, characteristics with high driving power and independence, such as implementing a student-centred approach (Idea 4) or creating small practical groups of students for collaborative tasks (Idea 11), represent catalysts for innovation and pedagogical change. These ideas go beyond the foundational aspects and encourage dynamic learning experiences. For example, implementing a student-centred approach empowers learners to take ownership of their learning and fosters adaptability by tailoring learning to individual needs. Similarly, creating small practical groups promotes collaboration, teamwork, and problem-solving skills independently.

The synergy between these two types of characteristics is where genuine revolutionising and transformation flourish. Characteristics that exhibit strong dependency serve as a solid foundation, setting the stage for collaboration, adaptability, and technology integration—critical components of the modern education and training landscape. Integrating AR/VR tools and differentiating instructors' competence pave the way for characteristics with high driving power to make a significant impact. Together, these characteristics create a holistic and forward-thinking L&T environment, one that not only leverages technology and promotes industry relevance but also tailors learning to the diverse needs of students. This collaborative and synergistic approach results in a well-rounded learning journey perfectly aligned with the demands of the digital world and thoroughly prepares learners for success in a rapidly evolving world. The investment in technology will only yield significant returns if it is accompanied by a revolutionary transformation in the delivery of education and training (Tucker, 2016). Upgrading the existing system to create a collaborative and hybrid learning environment should be tailored to meet the specific needs and goals of this transformation (Idea 14).

The strategies from the field introduce integrating technology-mediated learning environments, which signifies a pivotal transformation within the didactics and pedagogical domain. Educational theory encourages active collaboration (Harasim, 2017) and interaction by forming small practical groups to foster a student-centred (Höpfner, 2009). Furthermore, embracing problem-based learning approaches prepares students to meet the dynamic challenges inherent in the contemporary world of work diligently. These can be effectively employed by leveraging technology.

The competence and skills of technical TVET instructors play a vital role in introducing and seamlessly integrating innovative technologies into the TVET teaching and learning process (Grenčíková et al., 2021). In the era of Industry 4.0, preparing students for the workforce necessitates innovative approaches. Integrating industry simulations, virtual laboratories, and case studies into the curriculum is a robust strategy. The recommended strategies for an industry-simulated TVET setting or hybrid setting not only narrow the digital divide but also equip learners with practical skills and insights relevant to the contemporary job market. Collaborating with industry experts to provide contextualised learning experiences further enhances the authenticity and industry alignment of the educational journey, thus promoting industry partnership.

Technology integration opens up opportunities for the roles of technical TVET instructors to evolve, and new role emerges. The study introduces technical TVET instructors as learning facilitators. One who is the subject matter expert and facilitates the learning by meaningful content engaging activities to bring about the desired outcomes amongst students and prepare for a conducive and supportive environment. Thus, the technical TVET instructor's evolving role in the context of revolutionising delivery in TVET is as follows.

i. Facilitator of Online or Remote Learning

With the increasing adoption of online learning platforms and digital tools, technical TVET instructors can assume the role of facilitators in the virtual learning environment. They can guide and support students through online discussions, collaborative projects, and interactive activities. In this role, instructors would ensure students have access to resources, provide timely feedback, and foster a sense of community among learners.

ii. Curator of Digital Content

As the digital landscape expands, technical TVET instructors can curate and develop digital content that aligns with industry demands and the learning objectives of their programmes. They can source, evaluate, and customise digital resources to enhance the instructional materials available to students. Instructors would play a vital role in selecting relevant content, ensuring its quality, and adapting it to meet the diverse needs of learners.

iii. Learning Architect and Technology Integrator

In the era of Industry 4.0, integrating technology into TVET programmes is crucial. Instructors can become technology integrators, exploring and incorporating emerging technologies such as virtual reality, augmented reality, simulations, and online learning platforms into their teaching practices. They would guide students in using these technologies to develop practical skills and gain industry-relevant experience. The strategies raise the changing dynamics and evolution of the instructor's role, as discussed by Höpfner (2009). Previously, instructors were often seen as the primary source of information, while students played passive roles. However, the model promotes a learner-centred approach, where instructors become facilitators of learning. This shift resonates with the idea that learning should take precedence over teaching, echoing the insights of Tawil et al. (2012).

iv. Industry Liaison and Strategic Partnership Promoter

Technical TVET instructors are key in fostering partnerships and collaborations with industry stakeholders, bridging the gap between institution and industry. They can establish connections with employers, industry associations, and professional bodies to facilitate work-based learning opportunities, industry projects, and internships for students. Instructors would act as intermediaries, ensuring that the TVET programmes align with the needs and expectations of the industry.

6 Conclusion

The authors recognised that the educational and training landscape is on an irreversible trajectory towards digitalisation. This transformation is expected to persist, emphasising the need for strategies that align with this digital shift. Furthermore, the infusion of advanced technologies and evolving work profiles, catalysed by practices like Industry 4.0, fundamentally reshapes the job market. The experiences gained during the COVID-19 pandemic have highlighted the adaptability of technical TVET instructors to leverage technology in the learning process, affirming the need for digital integration.

The of technical TVET instructors is indicative of their adeptness in applying and integrating technology. As technology continues to advance, it is imperative to consider how instructors can equip students for success in an increasingly technology-driven world. Instructor development on pedagogical digital competence and innovative strategies for L&T need to be addressed instantly. Additionally, embracing technology and fostering industry partnerships are pivotal for both technical TVET instructors and institutions. This approach allows TVET institutions to cultivate practical skills, technical expertise, and industry-relevant knowledge, effectively bridging the gap between training and the demands of Industry 4.0.

While technology adaptation and integration are vital, it is essential to focus on students' needs and, at the same time, provide practical, career-oriented training briding the institutions and industry. Recognising that technology accessibility and availability, while necessary, may not be sufficient underscores the significance of instructor digital competence. Preparing technical TVET instructors is the first step in guiding students to navigate the digital landscape and meet Industry 4.0 demands.

Adapting to the requirements of hybrid learning environments is crucial, and the integration of digital and physical settings can create dynamic and flexible learning experiences. TVET institutions continue to serve as cornerstones of a thriving and future-ready workforce. Within this context, technical TVET instructors play evolving and crucial roles that support the effective functioning of the system. Their expertise in content knowledge, pedagogical competence, pedagogical digital competence, delivery and evaluation skills, and access to necessary resources collectively contribute to fostering an effective and conducive learning environment. It is imperative to invest in instructor development, as the foundation for shaping quality learning begins in the classroom.

Authors contributions

This study is a co-authored article. Raihan Tahir conceptualised the study and wrote the initial draft under the supervision of Zuraidah Abdullah, who provided critical feedback and edited the manuscript to comply with the requirements of the publisher. Ramlan Mustapha validated the information based on the model generated. All authors have read and approved the final manuscript.

Declaration of conflicting interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

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APPENDIX A

Author/s	Chuah & Mohamad	Sumardi & Nugrahani	Sepulveda-Escobar & Morrison	Quezada et al.	Assunção Flores & Gago	Whittle et al.	Juhary	Kidd &Murray	Code et al.
Year	**(2020)**	**(2020)**	**(2020)**	**(2020)**	**(2020)**	**(2020)**	**(2020)**	**(2020)**	**(2020)**
Title	Emergency Remote Teaching Scenarios, Struggles and Soundboxes: A Case Study on Malaysian Teachers	Adaptation to Emergency Remote Teaching: Pedagogical Strategy for Pre-Service Language Teachers Amid Covid-19 Pandemic	Online Teaching Placement During the COVID-19 Pandemic in Chile: Challenges and Opportunities.	From Bricks and Mortar to Remote Teaching: A Teacher Education Programme's Response To COVID-19	Teacher education in times of COVID-19 pandemic in Portugal: national, institutional, and pedagogical responses	Emergency Remote Teaching Environment: Conceptual Framework for Responsive Online Teaching in Crises	Emergency Remote Teaching during COVID-19 Pandemic: Roles of Educators in Malaysia	The Covid-19 Pandemic and its Effects on Teacher Education in England: How teacher educators moved practicum learning online.	Pandemic Designs for The Future: Perspectives of Technology Education Teachers During COVID-19
Target	Graduate trained teachers	Pre-service Language Teachers	Student teacher	Graduate Teacher Education Programme	Teacher Educators	K-12 teachers and professional instructional designers	Academic staff	Teacher Educators	Technical education teachers
Remarks	The absence of reinforcement and reflection, which are common in face-to-face teaching. not able to provide reinforcement and reflection after the quizzes.	With the flipped classroom, the instructional practices are more interesting and time-efficient, students are more independent, and the instruction is more effective.	Provided an opportunity to expand the traditional professional knowledge and skills in ITE programmes; loom for new ideas and mechanisms to engage with students actively.	Adjustments were made to class session formats based on teacher candidates' feedback. Modifying the syllabus to account for new dates and timelines.	The challenges and disruptions caused by school and university closures may also be seen as opportunities to learn and reshape traditional roles and practices.	Synchronous education was ideal. Asynchronous learning presents a valuable opportunity for many circumstances.	Where students are still required to learn online, so does the teaching practice continue online. Offer systematic and effective online education.	Nationally and internationally, the future remains deeply uncertain. Universities plan mixed-mode teaching (that is, both synchronous and asynchronous	Technology education teachers refer to knowledge-based concepts as 'theory', which many reported they successfully transitioned online. However, the 'hands-on' or 'doing' aspects

Table 2.9 Continued

Author/s	Chuah & Mohamad	Sumardi & Nugrahani	Sepulveda-Escobar & Morrison	Quezada et al.	Assunção Flores & Gago	Whittle et al.	Juhary	Kidd &Murray	Code et al.
Year	(2020)	(2020)	(2020)	(2020)	(2020)	(2020)	(2020)	(2020)	(2020)
	Relevant authorities to invest time and effort in understanding on-the-ground issues faced by teachers, parents, and students.	The instructional process becomes more interesting because of various instructional media, such as videos or digital applications. Real-time synchronous interactions and a wide variety of asynchronous engagements are important principles	None of the sessions was aimed at how to deal with online teaching. Despite not being ready, the new context encourages them to learn new things. Key supporting factors: relationship, communications, and care from school cooperating teacher and their university supervisor. Provide technical and emotional support.	Provide feedback on their lessons and reflections that need to be completed with their classroom students. Some faculty even simulate lesson planning and delivery with experts from the field and their peers.		Opportunities were identified to engage students in activities that could not be explicitly achieved in the classroom's time-constrained environment. Learner-driven assignments provide the ability to pursue learning in their own homes and at their own pace might allow teachers to engage students in topics and approaches of particular interest, instead of being limited	Include online activities, learning, and teaching interactions, materials and assessments. Redesign and revamp the curricula, as some L&T activities cannot be executed online; thus, other platforms and strategies must be chosen and applied to give students the knowledge, exposure, and experience that they need. Comparing what happened during the	Online learning with a limited number of students physically present on campus. While the new spaces were 'forced' into existence, they were embraced, sometimes leading to improved and innovative practices. What is unclear, though, is what will happen to these new spaces and pedagogical innovations.	of the curriculum, especially in the more specialised context (machining and welding), were incredibly challenging. Although faced with many challenges, the pandemic also revealed significant opportunities for schooling. Technology Education is 'essential' in the education of the next generation. The renewed pandemic transformed pedagogical approaches,

			The new academic			to lessons and	teaching		incorporating.