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Preparing STEM-Ready TVET Graduates:
Insights from Malaysia's Construction Context

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ABSTRACT

Technical and Vocational Education and Training (TVET) play an essential role in preparing graduates with practical, technical, and professional competencies required for rapidly evolving STEM-related industries. However, persistent gaps between institutional training and contemporary industry expectations continue to challenge graduate preparedness. This study examined contractors' perspectives to generate evidence for strengthening TVET education in Malaysia's construction context. A quantitative survey was conducted involving 59 G7 contractors in Klang Valley using a structured questionnaire, and the data were analyzed using descriptive statistics in SPSS. The findings indicate that contractors generally recognized TVET graduates' practical skills and problem-solving abilities but express concerns regarding graduates' digital competencies, exposure to emerging construction technologies, and workplace communication skills. The findings also highlight the need for stronger curriculum relevance, closer industry–institution collaboration, greater integration of technology-oriented learning, and expanded work-integrated learning opportunities. This study contributes to the continuous improvement of TVET education by demonstrating how industry perspectives can inform curriculum enhancement and competency development to better prepare STEM-ready graduates for future professional practice.

Keywords: *Technical and Vocational Education and Training (TVET); STEM Education; Graduate Competencies; Industry–Education Collaboration; Curriculum Enhancement*

INTRODUCTION

Technical and Vocational Education and Training (TVET) play a critical role in Malaysia's workforce development by supplying skilled labour for industries such as construction, manufacturing, and engineering (Azmi & Salleh, 2021). Offered through MOE, MOHE, and MOHR, TVET programs at certificate and diploma levels support the nation's vision of becoming a high-income, innovation-driven economy (Economic Planning Unit, 2021). Historically, TVET was perceived as a secondary option for students with weaker academic backgrounds (Yusoff, 2020). To overcome this stigma, reforms have rebranded TVET as a viable career pathway through vocational certifications, apprenticeships, and stronger industry linkages (Ridzuan, 2022). Current initiatives emphasise practical training, international collaboration, green skills, sustainability, and lifelong learning. Proposals such as the establishment of the Malaysia Research Institute for Vocational Education and Training (MyRIVET) further highlight efforts to centralise governance and improve curriculum design (Salleh & Sulaiman, 2020).

The construction sector is a key driver of Malaysia's economic growth, contributing 3–5% of GDP and improving living standards while ranking second in ASEAN for competitiveness under the Construction 4.0 Strategic Plan (CIDB, 2020; Khan, 2014). To sustain this growth, Technical and Vocational Education and Training (TVET) has been

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promoted as a crucial initiative to provide industry-relevant, hands-on skills, a role it has played since the establishment of the Kuala Lumpur Trade School in 1926 (Dahar Minghat, 2022).

Despite its importance, TVET faces persistent challenges including skill mismatches, limited technological exposure, social stigma, and weak industry linkages (Saibon, 2019; Zid, 2020; Zainudin, 2024). In the context of Industry 4.0, deficiencies in digital literacy and communication further limit graduates' employability (Halik Bassah & Mohd Noor, 2023). One major issue is the mismatch between skills taught in TVET institutions and industry demands, caused by limited collaboration and outdated curricula (Kamaruzaman, 2024; Rahmat et al., 2022). Resource constraints, such as outdated equipment and insufficient instructor training, further weaken program delivery (Yunos et al., 2021). The shortage of qualified educators with relevant industry experience also reduces teaching quality, resulting in graduates who lack practical exposure and workplace readiness (Anwar & Mohamad, 2022; Alias, 2020). Many instructors have limited opportunities for professional development, preventing them from keeping pace with technological advancements (Ismail, 2021). Weak partnerships between TVET institutions and industries contribute to graduates entering the workforce without essential technical and soft skills. Formalized collaborations, including advisory boards, joint certification, and teacher immersion programs, have been suggested to reduce this gap (Zainuddin & Ismail, 2021). Social stigma further undermines TVET's effectiveness, as it is often viewed as inferior to academic education and associated with low-skilled, low-paying "3D jobs" (Yusoff, 2020). This perception limits student enrolment and employer recognition, reducing career opportunities for graduates (Mohd Rokeman & Che Kob, 2024). Other barriers include limited understanding of apprenticeship programs among employers, which weakens practical training opportunities (Zainudin, 2024).

These challenges highlight the need to strengthen curriculum relevance through closer alignment between TVET institutions and contemporary professional practice. TVET has strong potential to strengthen Malaysia's construction industry by aligning curricula with industry needs, fostering collaboration, and equipping graduates with both technical and soft skills. Partnerships with contractors through internships, mentorships, and joint training ensure graduates are job-ready, digitally literate, and adaptable to new technologies such as BIM and project management tools (Sh Said & Mohd Yussof, 2023). At the same time, integrating sustainable practices into training—such as green materials, energy efficiency, and circular constructions supports national environmental goals (Ruslan et al., 2023). Hands-on learning and work-integrated training enhance problem-solving and teamwork, while industry involvement in curriculum design ensures relevance (Majid, 2024). Overall, TVET contributes to employment creation, economic growth, and competitiveness by producing a skilled workforce capable of driving innovation, efficiency, and sustainable development in construction (Hashim, 2019).

Research Objectives

Given the importance of curriculum relevance and industry engagement in TVET, perspectives from construction contractors provide valuable evidence for informing the continuous improvement of TVET education. Therefore, this study aims to:

1. examine contractors' perceptions of the competencies demonstrated by TVET graduates,
2. identify the educational and competency gaps between current TVET provision and industry expectations, and
3. propose strategies for strengthening TVET education through curriculum enhancement and industry collaboration.

METHODOLOGY

This study employed a quantitative survey design to examine industry perspectives on TVET graduates in the Malaysian construction sector. Primary data were collected using a structured questionnaire administered to contractors, while secondary data were obtained through an extensive review of relevant literature. The questionnaire consisted of four sections covering respondents' background, contractors' perceptions towards TVET graduates, challenges faced by TVET graduates, and strategies to enhance the marketability and employability of TVET graduates in the Malaysian construction industry.

Simple random sampling was adopted to select the respondents. The sample focused on G7 contractors located in the Klang Valley area, as these organizations represent major contractors with substantial involvement in construction projects. A total of 180 questionnaires were distributed through email and other social media platforms.

Of the questionnaires distributed, 59 completed responses were received, representing a response rate of 32.8%. The responses were considered sufficient for descriptive analysis because the study aimed to explore contractors' perceptions and identify key issues related to TVET graduates rather than to develop predictive or causal models.

The collected data was analyzed using SPSS Statistics, which provides comprehensive capabilities for data management, statistical analysis, plotting, reporting, and presentation. A five-point Likert scale was used for all perception items, and the analysis focused on descriptive statistics to summarize respondents' views regarding the competencies of TVET graduates, the challenges encountered by graduates, and potential strategies for strengthening TVET education in the Malaysian construction context.

RESULTS AND DISCUSSION

This section represents the findings obtained from the respondent's feedback and was analysed using SPSS software and displayed in a tabulation forms. Table 1 shows the years of experience of people working in the construction industry based on a survey. It includes four categories: 1 to 4 years, 5 to 7 years, 7 to 10 years, and more than 10 years. Each category lists how many people fall into it and what percentage they represent. Most respondents (32.2%) have 5 to 7 years of experience. The 7 to 10 years group makes up 23.7%, while both the 1 to 4 years and more than 10 years groups account for 22.0%. There were 59 valid responses in total, meaning all data was complete and used in the analysis. This data helps us understand the level of experience of construction workers in the survey. It shows a good mix of new and experienced workers, which is useful for planning training, hiring, and managing projects.

Table 1. Years of experience

Descriptions	Percent	Percent
1 to 4 years	13	22.0
5 to 7 years	19	32.2
7 to 10 years	14	23.7
More than 10 years	13	22.0
Total	59	

Table 2 indicated the percentage of current workforce for TVET graduates in the Malaysian construction industry. Each response is grouped into four categories: 0–25%, 26–50%, 51–75%, and 76–100%. The first range (0–25%) had the highest number of responses, with 18 people (30.5%) rating their experience at the lowest level. The second range (26–50%) had 12 responses (20.3%), showing a smaller group with below-average views. The 51–75% range was chosen by 15 people (25.4%), suggesting more positive opinions, while the highest range (76–100%) had 14 responses (23.7%), indicating a good number of people were very satisfied. This breakdown helps give a clearer picture of the overall sentiment, which is useful for understanding the survey results and planning future actions or improvements.

Table 2. Percentage of TVET graduates current workforce in construction industry

Percentage of current workforce of TVET graduates		Frequency	Percent
Valid	0%-25%	18	30.5
	26%-50%	12	20.3
	51%-75%	15	25.4
	76%-100%	14	23.7
	Total	59	100.0

Contractors' Awareness and Perception of TVET Graduates

This section analyses how industry stakeholders perceive the competency, employability, and overall contribution of TVET graduates within the Malaysian construction sector. Table 3 presented the awareness and

perceptions of respondents toward TVET graduates working in the construction industry. The highest-rated statement was that TVET graduates possess the technical skills required for construction projects, with a mean score of 3.85, ranked first. This shows that many respondents believe TVET graduates do have important technical knowledge to perform well on construction tasks. Following closely, TVET graduates contribute significantly to improve productivity on construction projects, with a score of 3.64, sharing the second rank.

Also scoring 3.64 was the workers with TVET qualifications are preferred in the recruitment process, which means TVET graduates were seen as valuable when companies were hiring them. In fourth place was the TVET graduates demonstrate sufficient problem-solving skills on-site, with a mean of 3.59, showing a good level of confidence in their ability to handle challenges during work. However, the scores also suggest some areas for improvement. For example, the perception that TVET programs were well known in the construction industry received a mean score of 3.4, ranked fifth. Similarly, the idea that TVET programs were very popular in the industry scored 3.36, ranked sixth, showing that while some awareness exists, TVET still needs stronger recognition and acceptance.

Lastly, the statement that TVET graduates show good adaptability to the fast-paced environment of the construction industry received a score of 3.34, ranked seventh. This indicated that employers may still have some doubts about whether graduates can adjust quickly to the pressure and pace of real construction projects. Overall, the results reflect a generally positive but cautious view of TVET graduates. Respondents believe TVET students have strong technical skills and can help with productivity, but there is still room to improve in areas such as adaptability, problem-solving, and industry recognition. Strengthening these aspects could help increase confidence and acceptance of TVET graduates in the construction sector.

Table 3. Contractors' awareness and perception of TVET graduates

Code	Description	N	Mean	Std. Deviation	Rank
B1	TVET programs are very popular in the construction industry	59	3.36	1.09486	6
B2	TVET programs in the country are well known in the construction industry	59	3.4	1.19075	5
B3	Workers with TVET qualifications are preferred in the recruitment process.	59	3.64	1.09486	3
B4	TVET graduates possess the technical skills required for construction projects	59	3.85	1.27054	1
B5	TVET graduates demonstrate sufficient problem-solving skills on-site.	59	3.59	1.0524	4
B6	TVET graduates show good adaptability to the construction industry's fast-paced environment.	59	3.34	1.30794	7
B7	TVET graduates contribute significantly to improving productivity on construction projects	59	3.64	1.04655	2

Challenges Encountered by TVET Graduates in Entering Construction Industry

The information in Table 4 showed some challenges that TVET graduates faced when trying to join the construction job market. One of the main challenges was lack of practical experience, with a mean score of around 3.19. This indicated that many employers feel graduates were not well-prepared to work on real construction sites because they have not had enough hands-on practice. As a result, they take longer to adjust and rely more on learning through experience after they start working. Another big concern was the lack of technical skills among graduates, with an average score of about 3.47.

This showed that many employers think graduates do not have the right technical knowledge and skills needed in today's construction industry, especially in using new technology, following safety rules, and handling modern work

processes. Also, problems related to the gap between what were taught in school and what were needed in the industry had a common concerned. This included limited interaction between training centres and industry players, with scores between 3.44 and 3.58. This means the training content may not fully prepare graduates for real job tasks.

Besides, respondents believed that traditional academic paths were still seen as better than vocational training, with a mean score of around 3.51. It showed that there was still a doubt about the value of TVET, and more work need to be done to improve its image and importance. Overall, these problems suggest that TVET programs need serious improvements. This includes giving students more practical training, updating the curriculum to include new technology, and working more closely with industry experts to make sure students are learning the right skills. These changes can help graduates to be more ready for work and improve the trust of employers in TVET graduates.

Table 4. Challenges encountered by TVET graduates

Code	Description	N	Mean	Std. Deviation	Rank
C1	TVET graduates face challenges due to a lack of practical experience when entering the construction industry	59	3.19	1.19589	7
C2	Insufficient technical skills among TVET graduates are a major concern for employers in the construction industry.	59	3.47	1.02311	3
C3	The training provided by TVET institutions adequately prepares graduates for the use of modern technologies in construction.	59	3.44	1.13367	4
C4	The training imparted in TVET programs align with industry requirement	59	3.58	1.11731	1
C5	Lack of collaboration between TVET institutions and industries	59	3.44	1.19296	5
C6	Traditional academic path better than vocational training	59	3.51	1.23697	2
C7	Lack and weakness of government support to TVET graduates	59	3.39	1.232	6

Strategies to Enhance he Marketability and Employability of TVET Graduates in Construction Industry

Referring to table 5, the highest ranked solution with a mean score of 4.58, was the establishment of formal alliances or advisory boards between TVET schools and industry players. This indicated the need to have continuous industry feedback to update curricula to remain relevant and aligned to meet real needs. These partnerships are viewed as essential to effective curriculum reform, innovation, and making graduates acquire skills that were in line with contemporary industry needs.

Besides, the respondents emphasized the importance of curriculum updates and technological developments, as evident in an average rating from around 3.69 to 3.80. They believed that training materials should be revised periodically to include modern equipment, software, and tools being used in the construction industry. The focus of such initiatives was to compensate for the imbalances between academic performance and industry requirements, thereby ensuring that students gain the appropriate skills from the beginning. Moreover, there were pervasive support for practical training elements, including industrial attachments, internships, and apprenticeships, which were viewed as essential for learning through practice and gaining skills.

In addition, participants call for greater training of instructors and the availability of industry-specific facilities to facilitate this modernisation initiative. These investments should improve the quality of training programs, thereby increasing the image and prestige of TVET in the eyes of learners and employers. Overall, these suggestions were tending toward an integrated system with an emphasized-on industry collaboration, flexibility of curriculum, upgrading of technology, and on-the-job training. The application of these strategies was expected to deliver a more

competent and employment-capable workforce, improve industry confidence in TVET graduates, and ultimately propel the sustainable development of the construction sector.

Table 5. Strategies to enhance the marketability and EMPLOYABILITY of TVET graduates

Code	Description	N	Mean	Std. Deviation	Rank
D1	Mandatory industrial training, internships, or apprenticeships	59	3.66	1.06042	6
D2	Revise and upgrade the curriculum regularly with industry input to match current technologies and practices	59	3.69	1.26292	5
D3	Modern equipment, software, and industry-relevant tools, and conduct regular training for instructors	59	3.8	1.09512	4
D4	Formal partnerships or advisory boards between TVET institutions and industry	59	4.58	6.77013	1
D5	Enhance the image and recognition of TVET through public awareness campaigns	59	3.93	1.01479	2
D6	Stronger policy support from the government, for companies to hire TVET graduates	59	3.86	1.12123	3

CONCLUSION

This study examined industry perspectives on the competencies demonstrated by TVET graduates in the Malaysian construction context to provide evidence for strengthening TVET education. The findings indicate that contractors generally recognize the practical skills, technical capabilities, and problem-solving abilities demonstrated by TVET graduates. However, the findings also suggest that graduates require stronger preparation in digital competencies, emerging construction technologies, and workplace communication to meet contemporary industry expectations.

The study further identified several educational and competency gaps that continue to influence graduate preparedness. These include the mismatch between institutional training and industry requirements, limited exposure to current technologies, insufficient industry collaboration, and the continuing perception of TVET as a less prestigious educational pathway. Collectively, these challenges indicate that curriculum relevance remains a critical issue in preparing graduates for evolving professional practice.

Based on these findings, the study highlights the importance of strengthening TVET education through closer collaboration between educational institutions and industry, regular curriculum enhancement, greater integration of technology-oriented learning, and expanded opportunities for work-integrated learning. Industry-informed curriculum development, supported by government initiatives and stronger stakeholder engagement, can contribute to improving graduate competencies while ensuring that TVET programs remain responsive to technological advancement and changing professional expectations.

Overall, the findings demonstrate that industry perspectives provide valuable evidence for the continuous improvement of TVET education. Rather than serving solely as an evaluation of graduate employability, this study contributes to understanding how industry feedback can support curriculum development and competency enhancement, thereby strengthening the role of TVET in preparing future STEM-oriented professionals for an increasingly technology-driven environment.

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