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Development and Validation of the CBT-Triple Helix Hybrid Training Model in TVET

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ADDIE, competency-based training, content validity, training model, triple helix, TVET

Abstract

This study aims to develop and validate a competency-based training model integrated with the triple-helix principle, which emphasizes collaboration among academia, industry, and government. The research employed a development design based on the ADDIE model, encompassing the stages of analysis, design, development, implementation, and evaluation. The training model was structured into seven systematic phases: needs analysis, curriculum design, training, mentoring, collaboration and networking, certification and evaluation, and a continuous cycle if required. Validation was conducted by two academic experts and two field practitioners, with the results analyzed using Aiken's V formula. The findings indicate that the model achieved a high validity index. More specifically, academic experts rated the model at 0.97, categorized as very high, while practitioners rated it at 0.93, which is also considered high. These results demonstrate that the developed training model is not only conceptually sound but also feasible for practical implementation in vocational education. The CBT-Triple Helix Hybrid Model offers a strategic framework to enhance the relevance, quality, and sustainability of vocational training and holds significant potential as a reference for both practical implementation and future policy development.

1. Introduction

The Indonesian labor market is facing complex structural challenges, ranging from the mismatch between graduates' skills and industry needs to low labor productivity. The Asian Development Bank report highlights the skills gap between worker qualifications and market demands, labor market segmentation that disadvantages youth, women, and rural populations, the dominance of short-term contracts, disproportionate wages, and limited access to upskilling or reskilling training (Allen, 2016). Furthermore,

in the 21st century, the growing urgency of digital skill demands underscores the necessity of enhancing competencies through equitable access to training (Gayatri et al., 2022). The two main issues that have emerged are the disparity in graduate competencies and limited access to training for competency development. This condition narrows the opportunities for the workforce to enter more productive and competitive sectors.

This situation underscores the urgency of strengthening the Technical and Vocational Education and Training (TVET) system as a strategy to prepare a competent, adaptable workforce relevant to labor market dynamics. TVET is considered strategic in bridging the gap between the education and industry worlds, particularly through the provision of competency-based training that meets the real needs of the job market (Jamalludin et al., 2022; Yusoff et al., 2024; Omar & Kamaruzaman, 2024; Ridzwan et al., 2017). However, the implementation of TVET training in Indonesia still faces several obstacles, such as the use of conventional, less contextual training models and the minimal involvement of key stakeholders. Zhon and Juwaherr (2024) emphasize that developing digital competencies in the context of TVET requires a whole-institution approach, which integrates the roles of leaders, educators, and learners. Without institutional integration, training tends to be partial and decontextualized. Similar points were raised by Wickramasinghe and Wickramasinghe (2024), who identified structural barriers in the implementation of Industry 4.0 competencies due to weak collaboration with the industrial sector. These findings underscore the urgency of reforming the TVET training model to be more contextual and collaborative as a prerequisite for improving the effectiveness and relevance of vocational education.

Competency-Based Training (CBT) is widely recognized as a dominant pedagogical approach in Technical and Vocational Education and Training (TVET), as it focuses on equipping learners with practical and job-relevant competencies that respond to workforce demands. Mgaya et al. (2022) found that most trainers at vocational training centers do not yet have adequate technical or pedagogical competencies to effectively implement CBT. Limited industry involvement and low access to professional training for instructors further widen the gap between the training curriculum and the realities of labor market needs. Anwar and Mohamad (2022) also revealed that the main challenges in implementing CBT include learning methods, inadequate infrastructure, and non-contextual materials. These findings indicate that TVET training reforms require a more comprehensive approach, including curriculum updates, strengthening trainer competencies, and active partnerships with the industry.

CBT is a results-based training system that allows participants to acquire and demonstrate competence through flexible learning directly connected to labor market needs (Mulder & Winterton, 2017). CBT is based on three main principles: competency mastery, competency-based assessment, and adaptive modular learning design (Ahmed et al., 2022a; Masran et al., 2025). Synergy between various actors, including academics, industry/business, and government, is necessary to support the effectiveness of this training. This collaboration is known as the triple-helix approach, which emphasizes the importance of cross-sector cooperation in developing adaptive and innovative human resources.

Capilla et al. (2020) developed a triple-helix model based on the GIGAKU philosophy, which integrates the roles of universities, industry players, and government in human resource development through technology centers such as Techno Park. Wawak et al. (2024) extended the application of this concept to higher education within the context of Quality 4.0, highlighting the importance of cross-sectoral collaboration to strengthen digital capacity and human resource innovation. Meanwhile, Hailu (2024) showed that the formal relationship between universities, industry, and government plays an important role in technology transfer and the creation of market-oriented human resources. Based on these studies, it can be concluded that universities serve as centers for innovation and curriculum design, industry contributes to the development of needs-based curricula, and the government acts as a guarantor of policies, regulations, and incentives. The three of them together form a market-oriented learning ecosystem.

Previous studies in the development of TVET training models show a trend towards a competency-based approach, modularisation, and technology integration. The study of Malik et al. (2018) focuses on the application of the Competency-Based Training (CBT) model as an approach to improve the pedagogical and professional competence of teachers. In contrast to this approach, Hailu (2024) developed a training model based on triple helix theory that integrates the roles of universities, industry, and government through the framework of University–Industry Linkages (UILs). This model emphasises the process of technology transfer and innovation, in which universities and industry play a dynamic role in the exchange of resources, skills, knowledge, innovation, networking, productivity, and market access. Meanwhile, Olojuolawe et al. (2022) proposed a competency-based retraining model for workshop technicians and engineering laboratories that focuses on strengthening five key competencies, namely leadership, professionalism, management, innovation, and automation. Ahmed et al. (2022) further highlight the challenges of CBT implementation in supporting institutional and trainer readiness during the COVID-19 pandemic by emphasising face-to-face, online, and e-learning approaches as adaptive strategies.

Although the studies of Malik et al., Olojuolawe et al., and Ahmed et al. consistently adopt the CBT approach in the development of training models, the approach still focuses on the pedagogical and technical dimensions separately. In contrast, Hail's research emphasises triple helix collaboration to improve institutional productivity and competitiveness but does not explicitly integrate it into competency-based training designs. Thus, although the four studies have made significant contributions to the development of training in the TVET sector, there is no model that systematically integrates CBT training design with triple helix collaboration in a single integrated training framework. This gap underscores the need for the development of a TVET training model that is not only orientated towards the mastery of individual competencies but also institutionally integrated through strategic collaboration between education, industry, and government.

CBT approach is needed to ensure that each trainee masters skills in a measurable, relevant, and work-standard-compliant manner. On the other hand, technical and strategic training requires the involvement of three main actors: academics as curriculum providers and training facilitators, industry as the source of real needs, and the government as the guarantor of regulations, incentives, and quality policies. Integrating the triple-helix approach is key to guaranteeing that the training model is institutionally relevant and sustainable in supporting the transformation of vocational human resources. This research aims to develop and validate a competency-based training (CBT) model integrated with the triple-helix principle in the context of vocational education and training suitable for the Indonesian context. This research provides a theoretical contribution to the literature on collaborative vocational training models that is beneficial for training providers, industry, and government in designing programs for workforce competency development. Therefore, this research will provide implementable recommendations for national vocational human resource development policies based on partnerships.

2. Literature Review

Developing a Competency-Based Training (CBT) model integrated with the triple helix framework requires a strong theoretical foundation and a systems-oriented perspective. CBT focuses on achieving specific skills aligned with industry standards, thereby addressing real-world demands. This approach emphasizes that training should be based on measurable and validated competencies derived from actual labor market needs. CBT approach prioritizes the attainment of specific competencies according to field requirements (McClelland, 1973) and ensures that participants not only understand concepts theoretically but can also apply them in practical contexts (ILO, 2015). However, training cannot operate effectively in isolation without support from other sectors, making the synergy of the triple helix essential.

The triple helix framework integrates the roles of academia (as facilitators of science and innovation), industry (as users of training outcomes and drivers of market needs), and government (as policymakers and infrastructure providers) (Etzkowitz & Leydesdorff, 2000). This synergy enables the creation of evidence-based policies, institutional strengthening, and the transfer of knowledge and technology (Nutley et al., 2007). The triple helix model emphasizes that innovation emerges not from the efforts of a single actor but from mutually reinforcing cross-sectoral collaboration. Higher education institutions contribute through curriculum research and development, industry provides insights into market needs and practical applications, and government facilitates the process by creating supportive policies and providing access to funding and infrastructure. Such interactions do not occur in a vacuum; they are influenced by the social, economic, and cultural contexts of each region.

Integrating CBT theory with the triple helix approach can enhance the design of innovative training models by incorporating diverse contextual factors and institutional logics (Cai, 2015b). Within the framework of open innovation, the triple helix serves as a foundation for developing regional innovation systems, where boundary-spanning intermediaries play a crucial role in connecting various actors (Kerry & Danson, 2016). Consequently, this training model should facilitate cross-sectoral collaboration and foster open innovation. Furthermore, recent developments have led to the integration of the triple, quadruple, and quintuple helix models, resulting in the concept of a neo-triple helix that considers the dynamics of innovation, social structures, and environmental sustainability (Amaral & Cai, 2022). This evolution highlights the importance of involving not only academia, industry, and government but also civil society and environmental considerations within the innovation ecosystem.

By adopting this integrated perspective, the proposed training model can strengthen systemic innovation that adapts to social and environmental changes while contributing to regional and national economic development (Figueiredo et al., 2023). A deep understanding of this systems approach is crucial for training designers to produce human resources who are competent, innovative, and globally competitive. This approach goes beyond technical competencies, encompassing the development of social and entrepreneurial skills. CBT also allows for structured and measurable assessments such as portfolios

and practical examinations to evaluate the extent to which participants can apply their knowledge in real-world contexts.

Aligned with the evolution of the triple helix concept, Amaral and Cai (2015a) argue that the relationships among the three actors operate within multilevel and multi-mechanism frameworks, where interactions occur not only at formal institutional levels but also through informal networks, local communities, and individual actors. This is critical because the success of training implementation depends on how well the model adapts to the local social, cultural, and economic characteristics of the area. In the context of open innovation, Kerry & Danson (2016) also emphasize the importance of boundary-spanning intermediaries individuals who connect various actors and create cross-border innovation spaces. Such roles may be undertaken by training institutions or industries that actively link trainees to real-world work settings, enriching their learning experience while accelerating innovation.

Through the integration of CBT and the triple helix framework, training is expected to produce a workforce that is not only technically proficient but also innovative, adaptable to change, and capable of driving human resource development to compete in global markets while contributing to sustainable economic growth.

3. Methodology

This study aims to develop and validate a triple-helix integrated CBT training model, so the research design is research and development (R&D) using the ADDIE development model. This model was chosen because it is easy to implement and its stages are comprehensive, covering initial analysis to evaluation. The ADDIE model, developed in the 1970s, consists of five design stages: Analysis, Design, Development, Implementation, and Evaluation (Branch, 2009).

Model validation was conducted through expert judgment from four experts: a content expert in the field of vocational education, a training model design expert, and a field practitioner. The validation instrument uses a Likert scale validation sheet and comes with an open comment field. The validation sheet includes two indicators: content validity and construct validity. Content validity includes the purpose of the model and the theoretical foundation. Meanwhile, the validity of the construct includes the syntax of the model, social system, reaction principle, support system, direct (instructional), and indirect impact. The rating scale consists of 5 categories: very feasible (score 5), feasible (score 2), fairly feasible (score 3), less feasible (score 2), and very poor (score 1). Then at the end of the validation column there are 3 categories of results conclusions: suitable for use, suitable for use with revision, and not suitable for use.

Expert validation is accumulated using Aiken's V formula with the following equation (Aiken, 1985):

$$V = \frac{\sum s}{n\,(c-1)} \tag{1}$$

Explanation:
V : Expert agreement index regarding item validity
s : r – l
r : Number given by the expert
l : Lowest validity assessment score
n : Number of experts
c : Highest validity assessment score

After being accumulated, the calculation results are considered valid if they meet the criteria according to Aiken's index. This study involved 4 raters or experts and used a 5-point rating scale on the validation sheet, making 0.88 the minimum threshold for being considered valid.

4. Result and Discussion

4.1 Product Development Process

The model development began with an analysis phase to map the needs of vocational education, which still faces serious challenges regarding the relevance of graduate competencies to industry needs. Various studies and surveys indicate that TVET graduates in Indonesia are often not yet prepared for the needs of the world of work. Some companies assess that the technical skills, problem-solving, and communication abilities of graduates are still low, at approximately 50% and 35%, respectively (Populix & KitaLulus, 2024). On the other hand, the formal TVET curriculum, particularly in the field of information technology, still focuses on basic skills such as computational thinking and early programming, even though the industry

demands more advanced digital competencies, including mastery of cutting-edge devices and analytical reasoning (SMERU Research Institute, 2022). Additionally, the teaching-centered learning approach continues to effectively limit the development of practical skills and digital literacy (Maknun & Marwiah, 2022). This condition is exacerbated by limited practical facilities in many vocational institutions, which hinders the optimal development of students' performance skills. This situation confirms the existence of a fundamental gap between learning achievements and the demands of the practice-based world of work. Based on this, needs analysis becomes an important foundation for designing a competency-based training model that emphasizes real-world performance according to industry standards.

An analysis was also conducted on the characteristics of the participants and the mapping of the roles of the triple helix actors, namely the government, industry, and educational institutions. Vocational training participants generally have diverse backgrounds, ranging from varying learning motivations and technical readiness to different work experiences, necessitating a flexible yet standardized training model to accommodate this diversity. The government has promoted vocational education through the link and match policy in Presidential Instruction Number 9 of 2016 concerning the Revitalization of Vocational High Schools (SMK), but implementation in the field is often hampered by limited real collaboration with the industrial sector. The industrial world itself demands a workforce that not only possesses technical skills but also problem-solving abilities, technological adaptability, and a strong work ethic. Meanwhile, educational institutions are required to continuously innovate to ensure that curricula and teaching methods remain relevant to changes in the job market. Field findings from interviews with relevant government agencies also emphasize the importance of continuous mentoring, as stated:

> "*We also feel that the patterns we need to implement in our efforts to empower my actors are like that. So, it's not just stopping at training, but there is mentoring involved. That's why it's not just about gathering once and then teaching this training and then leaving. We carry out continuous mentoring, and if it's incubated, we do it for up to 6 months. So, it's very beneficial and impactful*."

This statement confirms that vocational training models are not sufficient in the short term but must be supplemented with continuous mentoring mechanisms. Therefore, the analysis results confirm the urgency of developing a CBT-Triple Helix Hybrid training model (Fig.1) that can meet the interests and integrate the needs of all parties sustainably.

Fig. 1 *CBT-Triple Helix Hybrid model design*

The Capability Transformation Model (CBT-Triple Helix Hybrid Model) offers a conceptual framework for strengthening individual and institutional capacity through an integrated approach. The Capability Transformation Model (CBT-Triple Helix Hybrid Model) is designed to strengthen individual and institutional capacity through four main dimensions: competency development, skill application, multi-stakeholder collaboration, and sustainability through certification and evaluation. This approach combines competency-based training with the triple helix framework (academia–industry–government), resulting in

a learning ecosystem that emphasizes not only theoretical aspects but also practical application and needs-based orientation.

The competency development stage focuses on curriculum, training, and ability measurement, but it is crucial to be aware of any gaps with the real needs of the business world. Similarly, during the incubation and mentoring stages, which are important as a platform for practice, there is a potential for dependency if they are not accompanied by a sustainability strategy. Triple helix collaboration is key to bridging cross-actor needs, but it often faces the issue of interest asymmetry, which demands transparent collaboration governance.

Ultimately, ensuring sustainability requires certification, standardisation, and systematic competency evaluation, as these elements are essential for sustaining capability transformation in the long term. However, certification should not be a mere administrative formality; it should provide real added value to participants and enhance their competitiveness. Thus, while the CBT-Triple Helix Hybrid Model offers a comprehensive framework, its success is highly dependent on its suitability to the local context, fair governance mechanisms, and a commitment to sustainability principles.

After the CBT–Triple Helix Hybrid Model was designed, a systematic training flow was formulated to organise the training process into seven core stages (Fig.2), beginning with needs identification and culminating in continuous evaluation.

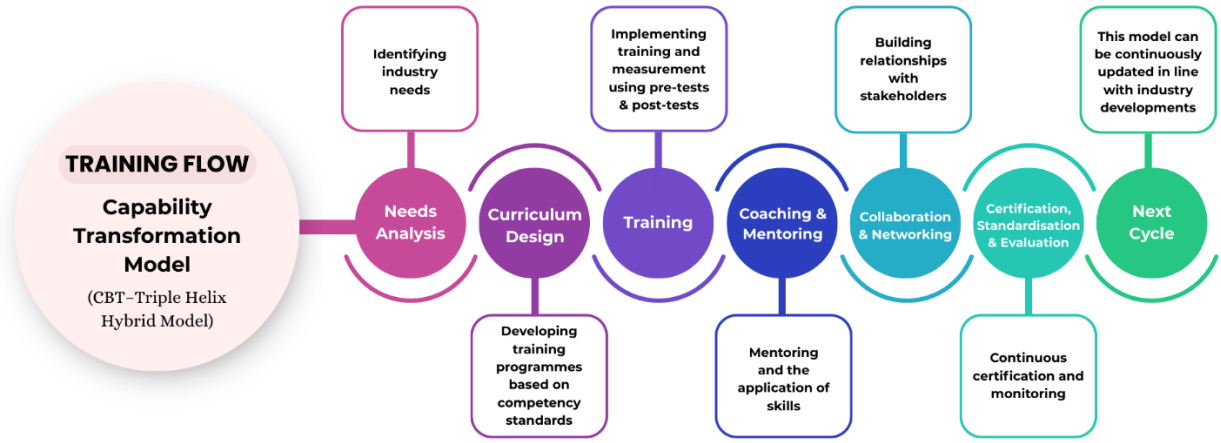

Fig. 2 *Training flowchart for the CBT-Triple Helix Hybrid model*

The training stages in the model above can be described as follows:

4.1.1 Needs Analysis

The first stage is to identify the needs of the industry and the edutourism ecosystem. This analysis is important to ensure that training programs align with labor market dynamics and global trends. Its weakness is that this stage is often hampered by data limitations and communication gaps between the education and business world**s**.

4.1.2 Curriculum Design

Based on the need analysis results, the curriculum is designed with measurable competency standards. The curriculum should not only be oriented toward technical skills but also be flexible to change. The criticism that has emerged is that normative curricula are still frequently found and are not responsive enough to contextual needs.

4.1.3 Training

After the curriculum design stage, the training implementation phase focuses on delivering competency-based training, with learning outcomes assessed using pre-test and post-test measures. This evaluation

provides an overview of the participants' improved abilities. However, purely quantitative measurements risk overlooking soft skills dimensions such as creativity and collaboration abilities.

4.1.4 Mentoring & Incubation

As a follow-up to the training program, participants subsequently enter a mentoring phase that emphasizes ongoing guidance and the direct application of acquired skills within real-world business settings. The challenge is to prevent participants from becoming dependent on mentors so that their independence is maintained.

4.1.5 Collaboration & Networking

The success of training and mentoring initiatives is highly dependent on effective collaboration and networking with relevant stakeholders to ensure sustainability and broader impact. This stage emphasizes building networks with cross-sectoral stakeholders. Strategic collaboration within the triple helix framework strengthens business and innovation opportunities. Nevertheless, there is often a dominance of industrial interests, making fair collaborative governance necessary.

4.1.6 Certification, Standardization & Evaluation

Participant competence is then legitimized through certification and standardization. Continuous evaluation ensures skills remain relevant to market needs. The risk to avoid is making certification a mere administrative formality without providing real added value.

4.1.7 Next Cycle

The final stage is to cyclically update the model based on the evaluation results. Thus, the training program remains adaptable to industry changes and global developments. This process confirms that capability transformation is an ongoing agenda, not a one-time project.

4.2 Product Validation and Development Results

Once the CBT–Triple Helix Hybrid model had been rigorously developed and equipped with a systematic training flow, the next step was expert validation involving both practitioners and academics. One of the validators is a professor from the Faculty of Vocational Studies, Yogyakarta State University; then a lecturer from the Department of Information Management at Amikom University Yogyakarta; and two practitioners in the fields of education and tourism. In the validation process, experts assess the completeness of the model structure, the relevance of the content, its applicability in the local context, and the innovation of the learning approach. In addition to evaluating the content of the developed model, the experts also provided some input and suggestions to improve the model's quality. The validator suggests adding a digital post-training monitoring and evaluation mechanism for more structured mentoring and progress tracking. Also ensuring that all instruments, including modules and SOP, are available in a digital format that is easily accessible. To meet this, models and materials for training purposes are available and can be accessed through the website.

Following the completion of the expert validation process, the validity of the instrument was analyzed using Aiken's V, which is suitable for use when involving a number of experts (raters) to assess the relevance of instrument items to the construct being measured. In this study, the number of raters involved was four experts, with a scoring range of 1 to 5, where a score of 1 indicates the lowest rating and a score of 5 indicates the highest rating. The results of the Aiken's V index calculation are in the range of 0 to 1, where being closer to 1 indicates higher content validity. Interpreting the V value refers to the following criteria.

The interpretation of the Aiken’s V index can be categorized into three levels of validity. A value below 0.40 indicates low validity, values between 0.40 and 0.80 indicate moderate validity, and values equal to or greater than 0.80 indicate high validity. This classification has been widely applied in educational and social research to assess the content validity of instruments (Retnawati, 2016).

Thus, an instrument can be considered to have high validity if the V value falls within the ≥ 0.8 category. Conversely, if the V value is still in the moderate or low category, the instrument item needs to be improved or revised based on feedback from experts. The validation results show that this model guide obtained an Aiken's V value of 0.95, which means the model has "high" validity. This indicates consistency in the experts' assessment of the quality and relevance of the developed training model. The Aiken's V value from academics reaches 0.97, which means it falls into the "high" category. Meanwhile, the assessment from practitioners also shows a strong value of 0.93, which, although slightly lower than academics, still falls into

the "high" category. Overall, these findings indicate that the developed instrument has received strong content validity support from both academic and practical perspectives, making it suitable for further use in the research implementation stage.

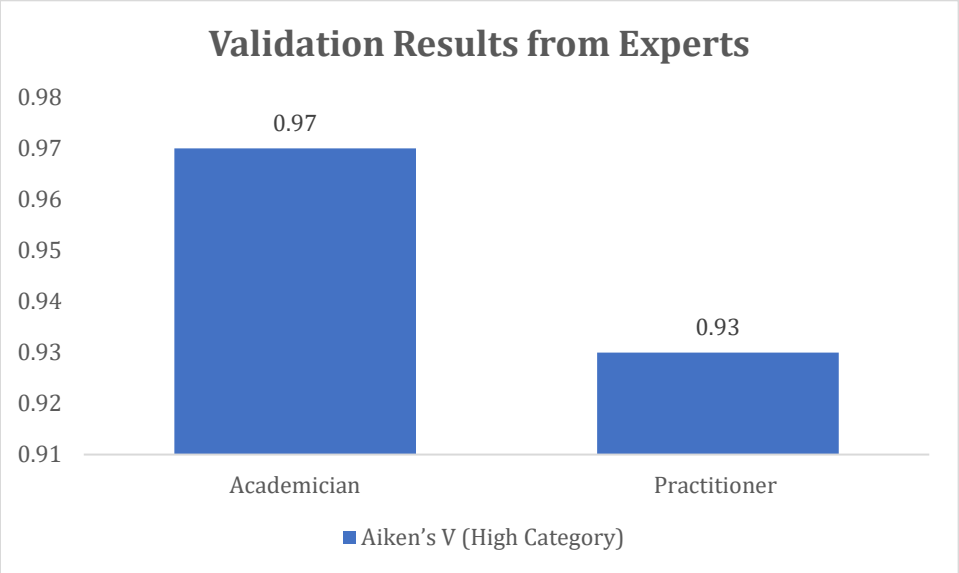

Fig. 3 *Expert validation results (N=4)*

According to the outcomes of the expert validation, the main strength of the model, according to experts, is the integration between a community-based local approach and the support of key actors in village development. Some feedback from training participants also indicates that this model is capable of practically addressing their needs, although there were suggestions to increase the number of real-life case studies and strengthen the local business digitalization module.

The entire validation results indicate that the developed training model has met the content feasibility standards academically and practically. This reinforces that the model is suitable for use as a capacity-building reinforcement training model that supports the formation of technical competencies and behavioral development. Additionally, this validation also serves as the foundation for ensuring that the transformation process being built is not only focused on increasing knowledge but also leads to the achievement of success indicators across the board.

More specifically, academic experts' validation results demonstrate that the CBT–Triple Helix model was highly rated, especially regarding the clarity of its development goals and its consistency with the theoretical foundations. This confirms that the developed model aligns with a robust academic framework and has clear achievements. Meanwhile, validation from practitioners also received high scores, particularly in terms of syntax and instructional impact. These findings indicate that the CBT Triple Helix model is highly applicable and has a positive impact both directly and indirectly after training and community development. Overall, assessments from academics and practitioners confirm that the CBT Triple Helix model has strengths from both a conceptual and practical perspective, making it suitable for use and further development.

4.3 Discussion

The development of the CBT-Triple Helix Hybrid training model in this study makes a conceptual contribution to the TVET literature by offering a training framework that integrates competency-based approaches and multi-stakeholder collaboration operationally. The findings of this study show that the incorporation of CBT with the triple-helix mechanism not only strengthens the relevance of training to industry needs but also expands the role of educational institutions and governments in ensuring the sustainability of transformation. To further clarify the novelty of this contribution, it is necessary to situate the proposed model in relation to existing CBT-based training models within the TVET literature.

Compared to the CBT model developed by Malik et al., which only emphasises planning, implementation, and evaluation based on curriculum and literature review (Malik et al., 2018). The CBT-Triple Helix Hybrid training model is more contextual because it involves the role of industry actors,

academics, and governments in curriculum design to post-training mentoring to allow for alignment between competency standards, real work practices, and policy support. This approach provides a theoretical contribution to the development of TVET design that is not only orientated towards the achievement of individual competencies but also focused on strengthening the vocational training ecosystem institutionally. Given the integrative and ecosystem-oriented nature of the proposed model, ensuring its conceptual and structural validity becomes a critical methodological concern.

The results of expert validation showed that Aiken's V index of 0.95 indicates that the structure and substance of the training model have represented the constructed measured constructs consistently. Expert validation is a critical stage in model development because it determines which components are designed to be able to represent constructs before empirical implementation (Almanasreh et al., 2019). In line with the validation framework proposed by Almanasreh et al., this study has gone through the stages of initial design, quantification of expert assessment, and reconstruction of the model based on the suggestions obtained. The selection of Aiken's V as a technical analysis was considered appropriate because of its sensitivity in capturing the level of agreement between experts, particularly in the context of the development of vocational training models (Roebianto et al., 2023). Beyond confirming its structural validity, the model's strength also lies in how the triple-helix mechanism is operationalised within the training process.

The integration of the triple helix in this model places academics as knowledge creators and innovation agents, industry acts as knowledge users and practical mentors, and governments act as enablers and facilitators. This pattern is in line with the findings of Cheng et al., who underline that the integration of industry, universities, and government is capable of creating a sustainable innovation ecosystem (Cheng et al., 2024). However, as Wu et al. warn, the effectiveness of triple-helix collaboration is highly dependent on participatory and balanced governance. In this context, the CBT-Triple Helix Hybrid training model offers a more operational division of roles, thus potentially reducing the practice of symbolic collaboration (Wu et al., 2025). CBT-Triple Helix Hybrid model is able to address the gap in weak collaboration in vocational education in Indonesia with a proportional division of roles. This training model is capable of serving as a framework for collaboration in sustainable vocational training. This operational configuration resonates with, and is further supported by, a growing body of empirical evidence on competency-based education and triple-helix collaboration in TVET.

The findings of this study also reinforce previous empirical evidence that competency-based approaches (CBT/CBET) contribute to strengthening the quality of vocational education (Gerishom Wafula Manase & Elisha Nyamu, 2024; Misbah et al., 2020). Both studies confirm that the implementation of competency-based education (CBE/CBET) has proven to be relevant and effective in vocational education, although the level of implementation varies and the flexibility aspect is still a weakness. Dynamic curriculum support, trainer competencies, and industry partnerships contribute directly to improving job skills, job readiness, and competitiveness of graduates. On the other hand, the study confirms that the practic of the Triple Helix Model (THM) is a strategic framework to strengthen the relevance of vocational education while encouraging economic transformation (Diana Mulya Dewi et al., 2020; Godfrey G. Moshi et al., 2024; Nuryadin Eko Raharjo et al., 2025). Overall, the three findings confirm that THM has great potential to improve the quality of vocational graduates, narrow skills gaps, and promote sustainable economic development, but its success is largely determined by the consolidation of inter-stakeholder roles and continuous evaluation mechanisms. By integrating these two approaches in one integrated training design, the model developed in this study fills the literature gap related to the need for a TVET model that is able to link competency mastery with a cross-actor collaboration mechanism in a sustainable manner. Building upon these empirical insights, the present study translates the combined CBT and triple-helix principles into a structured seven-stage training model.

The seven-stage integrated training model that combines Competency-Based Training (CBT) principles with the Triple-Helix mechanism represents a relevant conceptual step in bridging competency-orientated curriculum design with the local innovation ecosystem. By operationally placing academia, industry, and government at the curriculum design, work practice, and continuous mentoring levels, this model not only follows the helix theory's recommendation for coordinated cross-sector collaboration but also addresses the empirical call for intentional cross-actor coordination to enable partnerships to drive real social learning and innovative capacity (Cai & Lattu, 2022; Mudde et al., 2025; Zakaria et al., 2023). The competency-based approach combined with the triple-helix mechanism allows for modules and assessments that are directly related to job tasks, thereby increasing the potential for transfer to practice (Sultan et al., 2025). An additional feature of this integrated design concerns the mode of training delivery adopted within the model.

This model combines online and in-person training; the hybrid approach increases flexibility of access and continuity of training, but its effectiveness is highly dependent on instructional design, infrastructure,

social interaction, and measurable learning objectives (Meng et al., 2024). Taken together, these design features position the CBT–Triple Helix Hybrid model as both theoretically grounded and practically oriented.

Thus, this CBT-Triple Helix Hybrid model not only responds to the needs of vocational training innovation but also offers an operational framework proven to align with current international trends and empirical findings. This research is expected to contribute to the literature on vocational training model development and provide practical guidance for implementing competency-based training for TVET. This CBT-Triple Helix Hybrid training model is expected to support the government's link and match strategy, strengthen collaboration among stakeholders, and produce graduates ready to meet the demands of the world of work. One notable limitation of this research lies in the lack of empirical validation through real-world implementation of the CBT–Triple Helix Hybrid model, thereby opening avenues for future experimental and longitudinal investigations.

5. Conclusion

This research successfully developed and validated a seven-stage CBT Triple-Helix Hybrid training model, consisting of needs analysis, curriculum design, training, mentoring, collaboration and networking, certification and evaluation, and a follow-up cycle if required. Validation results indicated a very high level of validity, with an overall index of 0.95, supported by assessments from academic experts (0.97) and practitioners (0.93), confirming the model's robustness from both conceptual and practical perspectives. These findings are consistent with prior studies on the effectiveness of competency-based education in vocational training while extending the discourse by demonstrating that triple-helix integration enhances both academic rigor and practical relevance in training models. The primary contribution of this study is the provision of empirical evidence that the CBT Triple-Helix Hybrid Model is not only feasible for implementation but also has significant potential as a reference framework to strengthen innovation and sustainability in vocational education. Future research should examine broader applications and long-term impacts to generate strategic insights for policymakers and stakeholders.

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Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of the paper.

Author Contribution

The authors are responsible for the study conception, research design, data collection, data analysis, result interpretation and manuscript drafting.

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