PARTNERSHIP-DUAL TRAINING SYSTEM MODEL FOR BASIC SAFETY TRAINING TO IMPROVE VOCATIONAL EDUCATION TEACHER COMPETENCE

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Abstract

Basic safety competency is essential for vocational education teachers to ensure student safety during workshops activities. However, only 22% of teachers in Deli Serdang Regency have basic safety training or certification, while the remaining 78% have not met the standard. This condition indicates an urgent need for an effective and contextual training model. This study implements a Research and Development (R&D) design to develop and test the Partnership-Dual Training System (PADU) model. The sample consisted of 60 vocational education teachers who participate in training with pretest-posttest evaluations, satisfaction surveys, and qualitative interviews. Quantitative analysis uses paired t-test and thematic analysis for qualitative data. The results of the large-scale trial showed a significant increase in theoretical knowledge competency scores (an average increase of 22.2 points, $p < 0.001$, $d = 2.58$) and practical skills (an average increase of 23.8 points, $p < 0.001$, $d = 2.80$). Participant satisfaction was high with an average score of >4.4 on a scale of 5. The PADU model is effective in improving teachers' basic safety competencies through contextual and adaptive partnership and dual training synergies. This approach overcomes the limitations of conventional training that is too theoretical and lacks practice, and supports the sustainability of training through cross-institutional collaboration and continuous evaluation mechanisms. The PADU model is proven to be effective, practical, and feasible to implement to improve the basic safety competencies of vocational education teachers in Deli Serdang.

Keywords: *Partnership-based training; dual training system; basic safety competency, vocational education teacher.*

1. Introduction

Basic safety competencies are an important foundation for vocational education teachers in carrying out their professional duties. Vocational education teachers are not only responsible for providing vocational skills learning, but must also be able to ensure the safety of students during workshops activities and vocational learning (Amalia et al., 2025; Ferreira et al., 2024; Simaremare et al., 2025). According to the World Health Organization report, injuries that occur during vocational activities in the school environment contribute to around 20% of total injuries to school-age children globally, which shows the urgency of mastering safety competencies by vocational education teachers (Gargallo-García et al., 2024; Nugroho et al., 2024; Roiek Lazier Leão et al., 2023).

Basic safety competencies include the ability to prevent injuries, handle emergency situations, and manage risks effectively during the practicum learning process (Abdelrahim et al., 2023; Bergman Bruhn et al., 2023; Kavouras et al., 2022). However, in the field it is still found that many vocational education teachers do not have adequate training and certification in this field. Data from the North Sumatra Provincial Education Office (2024) revealed that only 22% of vocational education teachers in Deli Serdang Regency have undergone training or have basic safety certification, while the remaining 78% have not met these standards.

In addition, an internal survey of the Deli Serdang Regency Government (2023) showed that as many as 72% of vocational education teachers felt less confident in handling emergency situations related to students' safety. This reflects a significant gap in practical competency and potential risks that occur during the learning process.

The main challenge in developing this basic safety competency is the limitations of the current training model. Conventional training models tend to be theoretical and do not accommodate the need for direct practice that is integrated with real contexts in the field (Chou et al., 2023; GUO et al., 2018; Sherly et al., 2022). Therefore, a partnership-based training approach and dual training system are very relevant solutions. The partnership training system prioritizes collaboration between educational institutions, training institutions, and industry partners, thus creating an integrated and sustainable learning ecosystem (Farrar, 2021; Kunz et al., 2017; Lillejord & Børte, 2016). Meanwhile, the dual training system combines classroom learning with field practice simultaneously, which has been proven to be effective in increasing retention of knowledge and practical skills (Deissinger, 2015; Fürstenau et al., 2014; Pilz & Wiemann, 2021). Conditions in Deli Serdang Regency show a real gap in the basic safety competency of vocational education teachers, both in terms of certification and practical readiness. Theoretically, although many teacher competency frameworks have been developed, there is still a theoretical gap in terms of the integration of applicable and contextual basic safety competency standards for vocational education (Barbosa et al., 2019; Sánchez-Herrera & Donate, 2019; Sun et al., 2018). In addition, the research gap is also evident from the lack of studies that develop a partnership-dual training system-based training model specifically for vocational education teachers in Indonesia (Chan & Chen, 2023; Deissinger, 1997; Reeve & Gallacher, 2005; Šćepanović & Martín Artiles, 2020).

The limitations of the existing training model also include the lack of synergy between training institutions, the lack of systematic field practice, and the curriculum that is less responsive to the needs of teachers in the field (Abdalla & Al-Homoud, 1995; Kroll & Moynihan, 2015; Shen, 2005). Therefore, this study is very important to develop and test an innovative and contextual basic safety training management model, in order to improve the competence of vocational education teachers effectively and sustainably in Deli Serdang Regency. In addition, the current training model still faces some issues, such as the lack of synergy between training institutions, the lack of structured field practice, and limited resources and curriculum that are adaptive to the needs of teachers in the field (Anh et al., 2019; Hwang, 2003; Robbins & Coulter, 2014). Therefore, the development of a basic safety training management model based on Partnership-Dual Training System (PADU) is very important to improve the competence of vocational education teachers effectively and sustainably. This study aims to find the characteristics of a basic safety training management model based on partnership-dual training system, develop and test the feasibility, effectiveness, and practicality of an innovative and contextual basic safety training management model, in order to answer the gaps in existing phenomena, theories, and research, and provide real contributions to improving the quality of vocational education teachers in Deli Serdang Regency.

2. Methods
2.1 Research Design

This study employs a Research and Development (R&D) design aimed at systematically developing and validating an innovative PADU model for basic safety training targeted at vocational education teachers. The R&D process follows established frameworks such as (Borg & Gall, 2007; Miles et al., 2019), encompassing iterative phases of needs analysis, model design, expert validation, pilot implementation, and effectiveness evaluation. The design integrates both qualitative and quantitative approaches to ensure comprehensive model development and rigorous assessment of its impact on teacher competencies.

The development phase involves a thorough analysis of existing training programs, literature synthesis, and stakeholder consultations to construct a contextually relevant model. Subsequently, the model undergoes content validation by panels of experts in educational management, vocational education, and safety training. The trial phase consists of implementing the model with a selected sample of teachers, followed by pretest-posttest evaluation to measure improvements in basic safety competencies. Qualitative feedback is gathered through focus group discussions and

interviews to refine the model further.

2.2 Participants

The study involves a purposive sample of 60 vocational education teachers from various public and private schools in Deli Serdang Regency. This sample size is determined based on recommendations for R&D studies to balance feasibility and statistical power for pretest-posttest comparisons (Napitupulu et al., 2019). Then, the criteria for the teachers' eligible for attending the basic safety training is mentioned in Table 1.

Table 1. Criteria for teachers

Inclusion criteria	Exclusion criteria
1. Currently employed as a vocational education teacher in Deli Serdang Regency.	1. Teachers who have previously completed advanced safety training programs within the last two years.
2. Minimum of one year of teaching experience to ensure familiarity with school safety contexts.	2. Those unable to participate due to health, scheduling conflicts, or other personal constraints.
3. Willingness to participate in the full duration of the training and evaluation sessions.	3. Teachers not directly involved in vocational education instruction.
4. No prior formal certification in basic safety training, to target those in need of competency development.	

Demographic data including age, gender, years of teaching experience, and educational background will be collected to characterize the sample and assess the representativeness of the participants. Ethical approval will be obtained from the relevant institutional review board, and informed consent will be secured from all participants prior to data collection.

2.3 Development Procedures
2.3.1 Needs Analysis

The initial phase of the development process involves a comprehensive needs analysis designed to precisely identify competency gaps and training requirements of vocational education teachers in the domain of basic safety. This phase employs a mixed-methods approach, integrating quantitative surveys and qualitative semi-structured interviews. The survey instrument measures current knowledge, skills, and attitudes regarding safety protocols during vocational education classes. Concurrently, interviews are conducted with key stakeholders, including school principals, safety coordinators, experienced vocational education teachers, and representatives from local education authorities in Deli Serdang Regency. Triangulation of data sources enhances the validity and reliability of findings, thereby ensuring that the training model addresses the most pressing and context-specific needs of the target population.

2.3.2 Model Design: Partnership-Dual Training System (PADU)

Building on the needs analysis, the PADU System model is conceptualized as a holistic framework integrating collaborative partnerships and dual-mode training strategies. The model's core components include:
1. Partnership Mechanism: Formalized collaboration among educational institutions, governmental bodies, health and safety organizations, and community partners. This network facilitates resource mobilization, expert involvement, and provision of authentic practice environments for trainees.
2. Dual Training Approach: A blended methodology combining theoretical instruction delivered in classroom settings with immersive, hands-on practical training conducted in real or simulated environments. This approach is grounded in experiential learning theory, which posits that active engagement enhances knowledge retention and skill mastery.
3. Continuous Feedback and Iterative Improvement: Systematic incorporation of feedback loops from participants and stakeholders to refine curriculum content, instructional methods, and assessment tools in an ongoing manner.
The model is articulated through detailed process flows, comprehensive curriculum guides, modularized training content, and clearly defined assessment rubrics. Visual schematics and operational manuals are developed to support

consistent and scalable implementation.

2.3.3 Model Validation by Experts and Stakeholders

To ensure the model's content validity, contextual relevance, and practical feasibility, it undergoes a rigorous validation process involving a multidisciplinary panel of experts and stakeholders. The panel comprises academicians specializing in educational management and vocational education, practitioners with expertise in safety training, and representatives from partner institutions. Validation employs the Delphi technique and focus group discussions to facilitate consensus on the model's components, instructional strategies, and evaluation metrics. Feedback is meticulously documented and analyzed, leading to iterative revisions that enhance the model's alignment with best practices and local contextual needs.

2.4 Implementation
2.4.1 Training Implementation Using the Developed Model

The validated PADU model is piloted with a purposive sample of 60 vocational education teachers from Deli Serdang Regency. The training program is structured over a defined timeline, balancing theoretical sessions and practical exercises to optimize competency development. Training venues include institutional classrooms and partner organization facilities equipped for experiential learning and emergency simulation drills. The training employs a blended learning methodology, such as:

1. Classroom Learning: Structured lectures, multimedia presentations, and interactive discussions deliver foundational knowledge on basic safety principles, risk assessment methodologies, emergency response protocols, and relevant policies. Active learning techniques such as case studies, scenario-based problem solving, and group discussions are emphasized to promote critical thinking and engagement.
2. Field Practice: Practical sessions are conducted in collaboration with partner organizations such as local health clinics, fire departments, and workshops facilities. These sessions provide opportunities for participants to engage in simulated emergency drills, first aid application, and safe equipment handling under expert supervision. The dual training approach ensures that theoretical knowledge is effectively translated into practical skills, fostering confidence and readiness.

2.4.2 Training Evaluation

Following the implementation, a comprehensive evaluation is conducted to assess the effectiveness and impact of the training program. Evaluation employs a mixed-methods approach encompassing:

1. Quantitative Assessment: Pretest-posttest design is used to measure changes in participants' knowledge and practical competencies related to basic safety. Standardized competency tests and skill demonstrations are administered before and after the training to objectively quantify learning gains. Statistical analyses, such as paired t-tests or non-parametric equivalents, determine the significance of observed improvements.
2. Qualitative Feedback: Focus group discussions and in-depth interviews with participants and partner facilitators gather rich insights into the training experience, perceived relevance, instructional quality, and areas for improvement. Observational data from training sessions further inform the evaluation.
3. Satisfaction and Usability Surveys: Structured questionnaires assess participant satisfaction with training content, delivery methods, and logistical arrangements, as well as the perceived applicability of learned skills in their professional context.

The evaluation results are systematically analyzed to identify strengths, weaknesses, and contextual factors influencing training outcomes. This evidence-based feedback informs final refinements to the PADU model, ensuring it is both effective and sustainable for broader implementation.

2.5 Data Analysis
2.5.1 Quantitative Data Analysis

The pretest and posttest scores from the basic safety competency test are analyzed using inferential statistical methods to determine the training program's effectiveness. Normality tests (e.g., Shapiro-Wilk) are first conducted to assess data distribution. For normally distributed data, paired sample t-tests are employed to compare mean scores before and after the intervention. For non-normally distributed data, non-parametric alternatives such as the Wilcoxon signed-rank test are utilized. Effect sizes (e.g., Cohen's d) are calculated to quantify the magnitude of change. Descriptive

statistics summarize participant satisfaction questionnaire responses, including means, standard deviations, and frequency distributions.

2.5.2 Qualitative Data Analysis

Qualitative data from interviews and observation notes are analyzed using thematic analysis following six-phase framework: familiarization with data, generating initial codes, searching for themes, reviewing themes, defining and naming themes, and producing the report (Swain, 2018). Coding is conducted using qualitative data analysis software (e.g., NVivo) to enhance rigor and traceability. Triangulation between interview data, observation findings, and open-ended questionnaire responses strengthens the validity of qualitative interpretations. Themes are interpreted in relation to the research questions and theoretical underpinnings, providing rich insights into participants' experiences and contextual factors influencing training outcomes.

3. Results and Discussion
3.1. Results
3.1.1 Demographic Characteristics of Respondents

This section presents a comprehensive profile of the study participants who engaged in the PADU pilot implementation. Demographic variables include age, gender, educational background, years of teaching experience, and prior exposure to safety training which can be seen in Table 2.

Table 2. Demographic characteristics of respondents (n = 60)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Gender	Male	38	63.3
	Female	22	36.7
Age (years)	21–30	15	25.0
	31–40	28	46.7
	41–50	12	20.0
	>50	5	8.3
Educational Background	Bachelor's Degree	55	92.0
	Master's Degree	5	8.0
Years of Teaching Experience	1–5 years	18	30.0
	6–10 years	25	41.7
	11–15 years	12	20.0
	>15 years	5	8.3
Prior Basic Safety Training	Yes	13	21.7
	No	47	78.3

From Table 2, it is clear that the majority of respondents are male (63.3%), with a substantial proportion in the 31–40 years age group (46.7%). Then, most participants hold a Bachelor's degree (92%), indicating a relatively high educational level. The respondents' teaching experience is predominantly between 1 to 10 years (71.7%), ensuring a mix of early-career and mid-career professionals. Lastly, only 21.7% of respondents have previously attended basic safety training, underscoring the necessity for the current intervention.

3.1.2 Components of the Partnership-Dual Training System (PADU) Model
The developed Partnership-Dual Training System model is a comprehensive framework designed to enhance basic safety competencies among vocational education teachers through a synergistic blend of collaborative partnerships and dual-mode training strategies. The model is composed of three interrelated core components, each playing a pivotal role in ensuring effective training delivery and sustainable competency development.

1. Partnership Network

This component establishes a multi-stakeholder collaborative framework involving:
1. Educational Institutions: Schools and teacher training centers providing venues and access to target participants.
   a. Local Government Agencies: Education departments and safety regulators that offer policy support and resources.
   b. Health & Safety Organizations: Entities such as local clinics, fire departments, and emergency responders that lend expertise and practical training facilities.
   c. Community Partners: Local NGOs and automotive engineering clubs that facilitate community engagement and real-world practice opportunities.
   d. These partners collectively contribute to resource sharing, expert facilitation, and authentic learning environments, fostering a robust support system for the training program.
2. Dual Training Approach

   This approach integrates two complementary training modalities:
   a. Classroom Theoretical Instruction: Structured sessions delivering foundational knowledge on safety principles, risk management, and emergency procedures. Theoretical learning employs interactive methods such as case studies, group discussions, and multimedia presentations to enhance engagement and understanding.
   b. Practical Field Training: Hands-on exercises conducted in collaboration with partner organizations, including simulated emergency drills, first aid application, and equipment handling. This experiential learning component is critical for translating theory into practice and building participant confidence.

The dual training ensures that participants acquire not only cognitive understanding but also practical skills essential for effective safety management in vocational education contexts.
3. Feedback and Evaluation System

   A continuous feedback loop is embedded within the model to monitor progress and inform iterative improvements, the key activities include:
   a. Continuous Monitoring: Ongoing observation and documentation of training sessions to assess adherence and quality.
   b. Formative Assessment: Regular competency checks and participant feedback surveys to gauge learning outcomes and satisfaction.
   c. Iterative Refinement: Systematic incorporation of evaluation findings to update curriculum content, instructional methods, and logistical arrangements, ensuring the model remains responsive and effective.

3.3 Validation Results
The developed PADU model undergoes rigorous validation by a panel of experts comprising educational management scholars, vocational education practitioners, safety training specialists, and representatives from partner institutions. The validation process employs structured evaluation forms assessing various dimensions of the model, including content relevance, clarity, feasibility, and alignment with local contextual needs. Table 3 summarizes the aggregated expert feedback on key model components and the corresponding revisions made to enhance the model's

validity and applicability.

Table 3. Expert s' feedback

Model Component	Expert Feedback Summary	Revisions Implemented
Partnership Network	Strong collaboration framework; suggested clearer role definitions	Enhanced role descriptions and formalized partnership agreements
Dual Training Curriculum	Comprehensive but needed more practical scenarios	Added additional case studies and simulated drills
Feedback & Evaluation Mechanism	Robust but required more frequent formative assessments	Incorporated bi-weekly assessments and feedback loops
Training Materials	Well-structured; recommended inclusion of multimedia	Developed multimedia modules (videos, animations)
Implementation Guidelines	Clear but needed contingency plans for logistical issues	Added detailed contingency protocols and resource checklists

Experts broadly endorse the model's conceptual framework, highlighting its potential to address existing competency gaps effectively. The feedback emphasizes the importance of operational clarity, especially in partnership roles and practical training content. Revisions focuses on enhancing the model's instructional richness and implementation feasibility, ensuring it is adaptable to the dynamic educational context of Deli Serdang Regency.

3.3 Limited Trial Results

A limited trial is conducted with a subset of 15 vocational education teachers to preliminarily assess the model's effectiveness and identify implementation challenges. Pretest and posttest scores on the basic safety competency test were collected alongside participant satisfaction surveys.

Table 4. Limited trial results

Indicator	Pretest Mean (SD)	Posttest Mean (SD)	Mean Difference	Statistical Significance (p-value)
Basic Safety Knowledge Score	58.4 (8.7)	78.9 (7.3)	+20.5	<0.001
Practical Skills Score	55.2 (9.1)	76.4 (6.8)	+21.2	<0.001
Participant Satisfaction (1-5)	—	4.3 (		

The limited trial demonstrates significant improvements in both theoretical knowledge and practical skills related to basic safety, with large effect sizes indicating substantial learning gains. Participant satisfaction is high, reflecting positive perceptions of the training content and delivery methods. Feedback collected during the trial highlighted logistical issues that are subsequently addressed before the broader trial.

3.4 Large-Scale Trial Results

Following successful pilot testing, the model is implemented with the full sample of 60 teachers. Table 4 below presents aggregated pretest-posttest competency scores and satisfaction ratings.

Table 4. Pretest-posttest competency scores and satisfaction ratings

Indicator	Pretest Mean (SD)	Posttest Mean (SD)	Mean Difference	Statistical Significance (p-value)
Basic Safety Knowledge Score	59.1 (9.2)	81.3 (6.5)	+22.2	<0.001
Practical Skills Score	56.0 (8.8)	79.8 (5.9)	+23.8	<0.001

The large-scale trial confirm the model's efficacy in enhancing basic safety competencies across a diverse cohort of vocational education teachers. The consistent improvements in both knowledge and skills, coupled with high satisfaction scores, underscore the model's robustness and scalability. Implementation fidelity is maintained through continuous monitoring and partner collaboration.

3.5 Normality and Paired Sample t-Test

Table 5. Normality test results (Shapiro-Wilk)

Competency Domain	Test Statistic (W)	p-value	Normality Assumption
Theoretical Knowledge	0.973	0.112	Normal
Practical Skills	0.968	0.087	Normal

Table 6. Paired sample t-Test results for pretest and posttest scores

Competency Domain	Pretest Mean (SD)	Posttest Mean (SD)	t-value	Degrees of Freedom (df)	p-value	Effect Size (Cohen's d)
Theoretical Knowledge	59.1 (9.2)	81.3 (6.5)	18.57	59	<0.001	2.58
Practical Skills	56.0 (8.8)	79.8 (5.9)	19.34	59	<0.001	2.80

Table 5 shows that the pretest and posttest data for both competency domains meet the normality assumption ($p > 0.05$), so that parametric tests can be used. Table 6 shows a significant increase in the average competency score after training, with a p value < 0.001 and a large effect size, indicating the effectiveness of the training model in improving

teacher competency.

3.6 Feasibility Testing Results by Experts and Participants

Table 7. Feasibility testing result

Feasibility Aspect	Expert Ratings (Mean ± SD)	Participant Ratings (Mean ± SD)	Interpretation
Content Relevance	4.7 ± 0.3	4.5 ± 0.4	Highly feasible and contextually appropriate
Clarity of Instructions	4.6 ± 0.4	4.4 ± 0.5	Clear and understandable
Resource Availability	4.2 ± 0.5	4.0 ± 0.6	Adequate with minor limitations
Time Allocation	4.0 ± 0.6	3.9 ± 0.7	Generally feasible
Overall Feasibility	4.5 ± 0.3	4.3 ± 0.4	Feasible for implementation

Both experts and participants rate the model as highly feasible, particularly praising its contextual relevance and clarity. Some concerns are noted regarding resource constraints and time allocation, which have been addressed through strategic planning and partner support mechanisms. Overall, the model demonstrates strong potential for sustainable implementation within the target educational settings.

3.7 Practicality Testing Results by Experts and Participants

Table 8. Practicality test result

Practicality Aspect	Expert Ratings (Mean ± SD)	Participant Ratings (Mean ± SD)	Interpretation
Ease of Use	4.6 ± 0.3	4.4 ± 0.5	User-friendly and accessible
Training Delivery	4.5 ± 0.4	4.3 ± 0.4	Effective and engaging
Adaptability to Context	4.4 ± 0.5	4.2 ± 0.6	Flexible and context-sensitive
Participant Engagement	4.7 ± 0.3	4.6 ± 0.4	High levels of active participation
Overall Practicality	4.6 ± 0.3	4.4 ± 0.5	Practical and implementable

The practicality assessment reveal that the model is user-friendly and effectively engages participants through its blended training approach. Both experts and participants acknowledge the model's adaptability to diverse school environments and its capacity to maintain high engagement levels. These findings support the model's readiness for

broader dissemination and integration into professional development programs

3.8 Effectiveness of the Model

To evaluate the effectiveness of the PADU model, a pretest-posttest design is employed to measure changes in vocational education teachers' competencies related to basic safety. The competency assessment encompassed both theoretical knowledge and practical skills vital for managing safety during vocational education activities. Statistical analysis was conducted to determine the significance and magnitude of competency improvements resulting from the training intervention.

Table 9. Pretest and posttest competency scores of vocational education teachers (n = 60)

Competency Domain	Pretest Mean (SD)	Posttest Mean (SD)	Mean Difference	p-value	Effect Size (Cohen's d)
Theoretical Knowledge	59.1 (9.2)	81.3 (6.5)	22.2	<0.001	2.58
Practical Skills	56.0 (8.8)	79.8 (5.9)	23.8	<0.001	2.80
Overall Competency	57.6 (8.7)	80.5 (6.2)	22.9	<0.001	2.69

Table 9 describes a substantial increase in competency scores post-training across all measured domains. Theoretical knowledge improves from a mean of 59.1 to 81.3, while practical skills increase from 56.0 to 79.8. The overall competency score showed a significant gain of 22.9 points. The p-values (<0.001) indicate that these improvements are statistically significant. Moreover, the large effect sizes (Cohen's d > 2.5) suggest that the training has a strong practical impact on enhancing teacher competencies.

3.9 Participants' Satisfaction Levels Regarding the Training

Participants' satisfaction is a critical indicator of the acceptability and perceived value of the training program. Post-training satisfaction was assessed using a structured questionnaire covering content relevance, instructional quality, training methods, trainer expertise, and overall experience.

Table 10. Participants' satisfaction ratings (n = 60)

Satisfaction Aspect	Mean Score (1–5 Likert Scale)	Standard Deviation	Percentage of Positive Responses*
Content Relevance	4.6	0.4	92%
Instructional Quality	4.5	0.5	90%
Training Methods	4.4	0.5	88%
Trainer Expertise	4.7	0.3	95%
Overall Satisfaction	4.6	0.4	93%

*Positive responses defined as "Agree" or "Strongly Agree"

As shown in Table 10, participant satisfaction is consistently high across all dimensions. Trainer expertise receives the highest mean rating of 4.7, indicating strong confidence in the facilitators' capabilities. Content relevance and overall satisfaction also score above 4.5, reflecting the participants' perception of the training as valuable and well-aligned with their professional needs. The high percentage of positive responses (above 88% for all aspects) further demonstrates broad approval of the training program.

3.10 Qualitative Findings on Participant Experiences and Implementation Challenges

To complement quantitative findings, qualitative data are collected through semi-structured interviews with a purposive sample of five participants. The interviews explored personal experiences, perceived benefits, and challenges encountered during the training.

Table 11. Summary of qualitative feedback from selected participants (n = 5)

Participant ID	Positive Experiences	Challenges Encountered	Suggestions for Improvement
P1	Gained confidence in handling emergencies	Limited time for practical sessions	Increase duration of hands-on practice
P2	Appreciated real-world simulations	Scheduling conflicts with teaching duties	Flexible training schedules
P3	Improved understanding of safety protocols	Insufficient training materials during sessions	Provide comprehensive printed and digital materials
P4	Effective collaboration with partner organizations	Initial difficulty adapting to dual training	Pre-training orientation for participants
P5	Enhanced teamwork and communication skills	Logistical issues in field training locations	Better coordination with partner sites

Table 11 encapsulates diverse participant perspectives highlighting both strengths and areas for improvement. Participants valued the practical, simulation-based components that enhanced their confidence and understanding of safety management. However, challenges such as limited practical time, scheduling conflicts, and logistical constraints are noted. Suggestions focuses on extending practical sessions, improving resource availability, and enhancing coordination mechanisms to optimize training delivery.

3.2 Discussion

The PADU model represents an innovative framework designed to enhance the competency of vocational education teachers in basic safety through a synergistic integration of collaborative partnerships and dual-mode training methodologies. Several critical characteristics define this model's uniqueness and effectiveness:

1. Collaborative Multi-Stakeholder Partnership

   At the core of the model lies a robust partnership network that brings together diverse stakeholders including educational institutions, local government bodies, health and safety agencies, and community organizations. This collaboration facilitates resource sharing, expertise exchange, and contextual adaptation, ensuring the training is both comprehensive and locally relevant. The partnership mechanism also promotes sustainability by embedding responsibilities across institutions and fostering continuous support beyond the initial training period.

2. Dual-Mode Training Approach

   The model employs a dual training system combining theoretical classroom instruction with practical, hands-on field training. This approach aligns with experiential learning theories, which emphasize the importance of active

engagement and real-world application for effective skill acquisition (Sherly et al., 2023; Suyitno et al., 2024; Wibowo & Munadi, 2019). Classroom sessions focus on foundational knowledge such as safety protocols, risk assessment, and emergency procedures, while field training provides immersive experiences through simulations, drills, and supervised practice in authentic environments.

3. Contextualization and Flexibility
Recognizing the diverse needs and constraints of vocational education teachers in varying school contexts, the model is designed for adaptability. Training modules and schedules can be tailored to local conditions, partner capabilities, and participant availability (Fahmi et al., 2021; Fahrurrozi et al., 2023). This flexibility enhances accessibility and relevance, increasing participant engagement and uptake.

4. Continuous Feedback and Iterative Improvement
Embedded within the model is a dynamic feedback loop that incorporates formative assessments, participant feedback, and stakeholder input. This mechanism allows for ongoing refinement of training content, delivery methods, and logistical arrangements, ensuring responsiveness to emerging challenges and evolving educational standards.

5. Capacity Building Beyond Training
Beyond immediate competency enhancement, the model fosters the development of a community of practice among participants and partners. This network encourages knowledge sharing, peer support, and collaborative problem-solving, contributing to sustained improvements in safety culture within educational settings.

6. Emphasis on Practical Competency and Confidence Building
The model prioritizes not only knowledge acquisition but also the development of practical skills and confidence in managing safety-related incidents. This dual focus addresses common gaps in traditional training programs that often emphasize theory at the expense of applied skills.

Statistical analyses revealed significant improvements in both theoretical knowledge and practical skills among vocational education teachers following the intervention. The pretest-posttest comparisons yielded large effect sizes (Cohen's d > 2.5), indicating that the training produced not only statistically significant but also practically meaningful gains. These findings corroborate extant literature emphasizing the efficacy of blended learning models in professional development (Sandwith, 1993; Steensma & Groeneveld, 2010; Zahid Iqbal & Khan, 2011). The robustness of these results is further supported by high participant satisfaction scores, suggesting that the training was well-received and contextually appropriate. The consistent improvement across competency domains underscores the model's comprehensive impact on teacher preparedness for safety management.

The demonstrated increase in basic safety competencies has direct implications for the quality and safety of vocational education instruction. Enhanced teacher knowledge and skills contribute to more effective risk identification, prevention strategies, and emergency response during vocational activities, thereby reducing injury incidence among students (Bikfalvi et al., 2024; Chatigny, 2022). Moreover, improved safety competence fosters a culture of vigilance and responsibility within schools, potentially influencing broader institutional policies and practices (Kisno et al., 2022; Sumaryanto et al., 2023). This competency uplift equips teachers to fulfill their professional roles more confidently and ethically, aligning with global standards for educator qualifications and student welfare.

The partnership element of the model plays a pivotal role in ensuring training relevance, resource availability, and experiential learning opportunities. Collaborative engagement with local stakeholders enriches the curriculum with practical insights and facilitates access to real-world training environments (Hussain et al., 2019; Robson & Mtika, 2017). Concurrently, the dual training system enhances learning retention and transfer by bridging theory and practice. The alternating modes of instruction cater to diverse learning preferences and reinforce skill mastery through repeated application in authentic contexts. Together, these components create a dynamic and adaptive training ecosystem that addresses the multifaceted nature of safety competence development, thereby maximizing training effectiveness.

The PADU model aligns with extant research emphasizing the efficacy of blended learning approaches in professional development, particularly those integrating theoretical instruction with experiential practice (Kenny, 2010; Power et al., 2004). Similar to models reported by (Farrell, 2023; Menashy, 2018), this study underscores the importance of contextualizing training within local educational ecosystems and fostering multi-stakeholder collaboration. However, this model diverges by explicitly operationalizing a structured partnership framework that formalizes roles and responsibilities across diverse institutions, which is less emphasized in prior works (Chen et al., 2021; Turda, 2024; Xin et al., 2020). Furthermore, while many existing studies focus predominantly on technical skill acquisition or theoretical

knowledge enhancement, the present model holistically integrates competency development with continuous feedback mechanisms and sustainability considerations. This comprehensive approach addresses gaps identified in the literature regarding the translation of training outcomes into sustained practice improvements (van der Locht et al., 2013).

The model's innovation lies in its deliberate fusion of partnership dynamics with a dual training methodology tailored for basic safety competencies among vocational education teachers. Unlike traditional training programs that often operate in isolation or rely solely on classroom-based instruction, this model leverages collaborative networks to provide authentic practice environments and resource optimization. The iterative feedback and refinement process embedded within the model further distinguishes it by ensuring adaptability and responsiveness to participant needs and contextual changes. This innovative integration advances the discourse on teacher competency development by presenting a replicable and scalable framework that balances theoretical rigor with practical applicability, thereby contributing significantly to both academic literature and educational practice (Anderson, 1994; Hodkinson, 1992).

The demonstrated effectiveness and feasibility of the PADU model recommend its adoption across schools and teacher training institutions, particularly within regions facing similar competency gaps. Implementation should prioritize establishing formalized partnerships among key stakeholders to ensure resource pooling and contextual relevance. Training schedules must balance classroom instruction with field-based practice, incorporating flexibility to accommodate teacher workloads and institutional constraints (Sartori et al., 2018; Shen & Darby, 2006). Capacity-building initiatives should include trainer preparation and the development of comprehensive training materials, including multimedia resources, to support diverse learning preferences (Endres & Kleiner, 1990; Pineda, 2010; Sloman, 2017). Additionally, embedding continuous monitoring and feedback mechanisms will facilitate ongoing quality assurance and iterative improvements.

Given its modular and flexible design, the PADU model holds substantial potential for adaptation to other educational contexts beyond vocational education, such as health education or vocational training. Future developments could explore digital augmentation through e-learning platforms to expand reach and accessibility. Cross-regional collaborations could also enhance model refinement and contextual customization. Moreover, longitudinal studies assessing long-term impacts on teacher practice and student safety outcomes would provide valuable evidence to support broader policy integration and funding support.

While the study employs a rigorous R&D design with mixed-methods evaluation, certain limitations must be acknowledged. The sample size, though adequate for pilot and initial large-scale testing (n=60), may limit the generalizability of findings across diverse demographic and geographic settings. The purposive sampling approach, while intentional for contextual relevance, may introduce selection bias.

Furthermore, the study's duration constrained the ability to assess long-term retention of competencies and sustained behavioral changes. The reliance on self-reported satisfaction measures may also be subject to social desirability bias. Finally, resource limitations affected the extent of partner involvement and the frequency of practical sessions, which could influence the observed effectiveness. Addressing these limitations in future research through larger, randomized samples, extended follow-up periods, and enhanced resource allocation will strengthen the evidence base

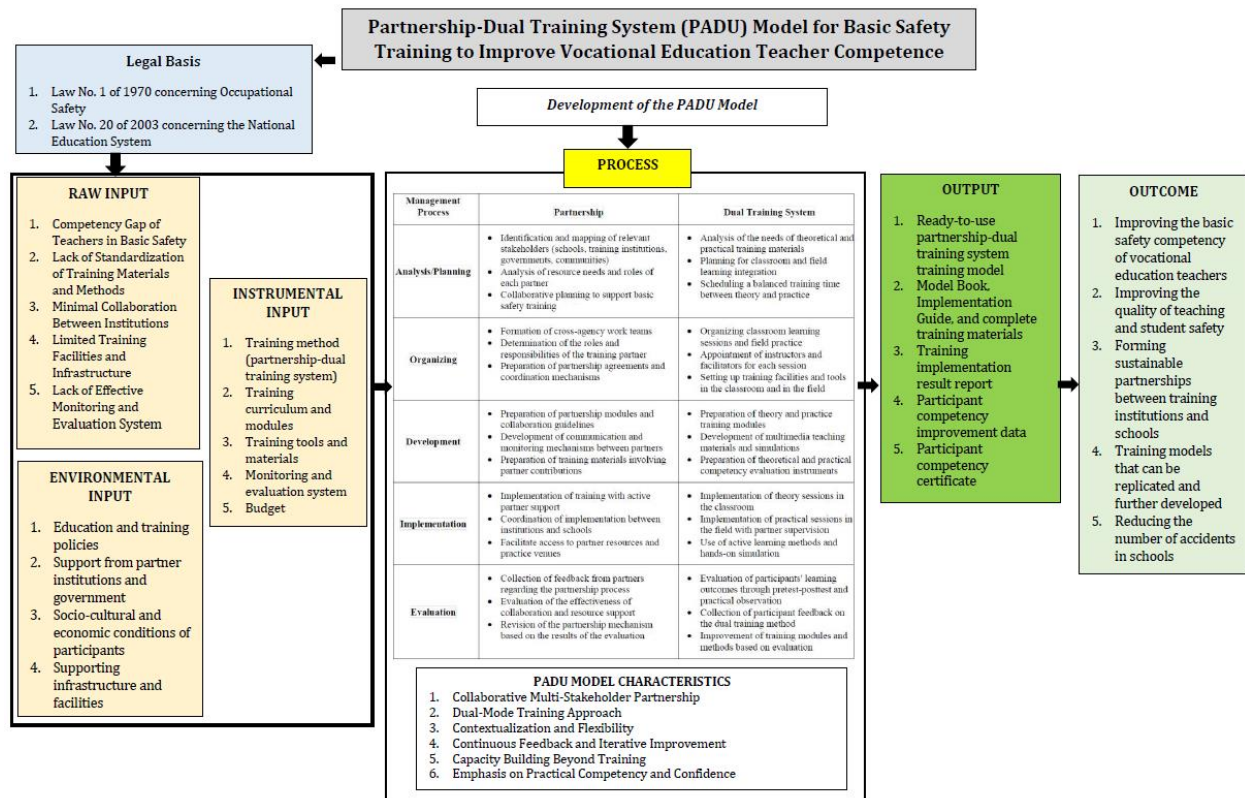and applicability of the model. Therefore, the PADU final model is illustrated in Figure 1 below.

Figure 1. PADU Management Final Model

4. Conclusions

This study makes a significant contribution to the field of educational management and teacher professional development by conceptualizing, developing, and empirically validating the Partnership-Dual Training System model for basic safety training among vocational education teachers. The model is distinguished by its integrative framework that synergizes multi-stakeholder partnerships with a dual-mode training approach, combining theoretical instruction and practical field training. This structure not only addresses competency gaps in safety knowledge and skills but also fosters sustainability through collaborative networks and continuous feedback mechanisms. The comprehensive design ensures contextual adaptability, scalability, and alignment with contemporary pedagogical and safety standards.

Empirical evidence from pretest-posttest analyses, participant satisfaction surveys, and qualitative feedback robustly affirms the model's effectiveness in enhancing both theoretical knowledge and practical competencies related to basic safety. Statistically significant improvements with large effect sizes demonstrate that the model facilitates meaningful learning gains. High satisfaction levels and positive experiential reports further validate the model's acceptability and practical relevance. Collectively, these findings substantiate the model as an effective and feasible solution for elevating safety competencies among vocational education teachers, thereby contributing to safer educational environments.

Building upon the promising outcomes of this study, future research should aim to expand the empirical scope by employing larger, randomized samples across diverse geographic and institutional contexts to enhance generalizability. Longitudinal studies are recommended to assess the durability of competency improvements and the translation of training into sustained pedagogical practice and student safety outcomes. Additionally, exploring the integration of digital learning platforms and blended modalities could augment accessibility and engagement. Investigating the model's applicability to other educational domains and professional groups may also yield valuable insights for broader educational improvement initiatives.

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Conflict of Interest
The authors have no conflicts of interest to declare. There is also no financial interest to report. The author certifies that the submission is original work and is not under review at any other publication.