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THE ROLE OF PHILOSOPHICAL FOUNDATIONS IN ENHANCING PUBLIC SAFETY CULTURE IN VOCATIONAL WORKSHOPS AT VOCATIONAL SECONDARY SCHOOLS: VOCATIONAL EDUCATION TEACHERS' PERSPECTIVES

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Abstract

This paper develops an experimental research model to investigate whether philosophy-informed professional development for vocational education teachers could strengthen teacher-perceived safety culture and safety-related decision making in secondary-school vocational workshops. The proposed intervention integrates an ethics-of-care orientation, human dignity and rights, pragmatist inquiry, critical dialogue, and reflective constructivist learning across eight weeks. The prospective design is a matched-pair cluster-randomized controlled pretest–posttest study involving 16 schools (eight matched school pairs) and 128 teachers (64 in each condition). Two newly specified measures are provided: a 24-item Teacher-Perceived Workshop Safety Culture Scale (1–5) and a 12-scenario Safety Decision-Making Test (0–12). To illustrate analysis rather than report observed effects, a fully synthetic dataset was generated with a fixed random seed and evaluated using pair-level difference-in-differences, exact sign-flip tests, teacher-level baseline-adjusted models with school-clustered standard errors, reliability checks, and exploratory domain comparisons. In the simulated example, the intervention-minus-control difference in mean culture-score change was 0.577 points, 95% CI [0.472, 0.682], t(7) = 12.95; the difference in scenario-score change was 2.406 points, 95% CI [1.840, 2.972], t(7) = 10.05. Exact two-sided pairwise sign-flip p values were .0078 for both outcomes (Holm-adjusted exact p = .0156 for each). These values are properties of the simulation, not evidence of a real intervention. The manuscript provides the complete research logic, instruments, implementation timetable, statistical code, and 40 recent, traceable references to support a future ethically approved field trial.

Keywords: Philosophical Foundations; Ethics Of Care; Safety Culture; Vocational Workshops; Vocational Secondary Schools; Occupational Safety; Teachers; Cluster-Randomized Trial; Simulated Data.

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1. INTRODUCTION

1.1 Background and Rationale

Vocational secondary-school workshops play a unique role between school and the labour market, enabling students to acquire hands-on skills and build their readiness to take up technical, professional, and ethical roles in the future (OECD, 2023). Teachers are bringing adolescents to workplaces where they are exposed to machinery, tools, electricity, welding, chemical materials, ergonomics, and work tasks with immediate consequences of inattention (NIOSH, 2023). Their pedagogical responsibility is not therefore limited to the transfer of technical operations to learners: they have to create an environment in which people identify hazards, voice concerns, call into question unsafe shortcuts and perceive the dignity of those who are exposed to risk (ILO, 2023). Safe and healthy work is one of the protections recognized by the International Labour Organization, and the OECD highlights the importance of building transferable capacities, in addition to occupation-specific skills, in vocational programmes (ILO, 2023; OECD, 2023). Therefore, workshop safety culture is an operational need and an educational result that is favorable to the professional formation of the students and their preparation for responsible participation in the labor market (UNESCO, 2022). Furthermore, raising safety awareness during vocational education can contribute to fostering preventive attitudes, responsible decision-making, and an understanding of the link between individual actions and collective benefit (Sundstrup et al., 2025).

Nowadays the conception of safety scholarship is set apart from the written compliance regime, from commonalities, relations and routines that affect daily decisions in educational and work contexts (Gallier & Duarte, 2025). Signs, protective materials and formal risk registers may exist in a school, and teachers and learners may still consider reporting as blame, speed as more important than safety, and deference to authority (Mohammadfam et al., 2022). Gallier and Duarte (2025) stress that a safety culture is not just a measure of individual-attitude questionnaires, rather, organizational arrangements, leadership practices and opportunities for meaningful communication are key elements in sustainable safety improvement. Likewise, Adra et al. (2024) show that safety leadership is about influence, exemplary behaviour, and the acquisition of shared responsibility, and not simply a management role. In educational contexts, this distinction is especially crucial as teachers serve as safety enforcers, professional judgment models, and convey expectations through daily activities in the workshop (UNESCO, 2024c). Moreover, good safety leadership can help to facilitate active involvement in the process of hazard identification, communication of concerns, and the establishment of preventative measures to go beyond the surface of following formal procedures (Zhao et al., 2022). Thus, fostering a positive safety culture requires effort both at the institutional level and with regard to the ethical and educational aspects that underpin teachers' professional conduct (Goode et al., 2025). Understanding the philosophy of education is important to consider when thinking about how values and attitudes related to safety can be integrated into meaningful practices in vocational workshops (Kotluk & Tormey, 2023). In the context of ethical responsibility, it is important to note that preventing foreseeable

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harm is a requirement, regardless of a student's technical skills or previous practical experience, while human dignity also supports the importance of making the decision to protect students at all times (Hilgert, 2024). Likewise, a pragmatic, reflective attitude of teaching and learning enables the teachers to think of real-life situations and review existing practices when alternative options are found to be safer (Rafindadi et al., 2023). Dialogue, questioning and collaborative problem-solving are also key processes in critical and participatory teaching that help build responsible judgment in technical and vocational education (TVET) (López et al., 2023). Such views indicate that safety education should not only be about giving instructions but should also be about providing information regarding the ethical, social and practical issues involved in preventing behaviour (Rasouli et al., 2025). Vocational education policies that have been adopted in recent years provide a solid base for exploring ways of combining professional competence, philosophy of education, and occupational safety (UNESCO, 2022). UNESCO (2022) places technical and vocational education and training in inclusive lifelong learning, green transitions, and institutional strengthening and reform and emphasizes the need to equipping learners with the skills needed to meet evolving occupational needs. In Jordan, UNESCO (2024a) has identified wider priorities to improve the technical and vocational education system, which includes institutional effectiveness and improving the quality of education. In addition, UNESCO (2024b) outlines a plan for the transformation of TVET aimed at boosting the capacity of teachers, institutional leadership, and the connections between TVET and workplaces. The developments mean that it is crucial to examine how teachers' professional preparation can be integrated with ethical responsibility, reflective practices and preventive decision-making in vocational education (Siliņa-Jasjukeviča et al., 2025). These policy reports, however, only serve to provide a context for why safety culture is needed in certain Jordanian vocational schools, and not as evidence for safety-culture deficiencies in those schools (UNESCO, 2024a). Therefore, the geographical context, institutional features and teachers involved need to be explicitly defined by actual sampling prior to the generalization of conclusions to a given educational population (OECD, 2023). The risks faced by workers are constantly evolving, adapting to the new technologies, climatic conditions, and new types of work in practice, which poses new challenges for occupational safety education (ILO, 2024a). ILO (2024a) discusses occupational risks induced by climate change, and ILO (2025) discusses opportunities and challenges of introducing AI and digital technologies to workplaces with respect to safety. The changes have made it clear that it is important to train teachers and students to understand new hazards and how to prevent them in vocational secondary school workshops, despite the differing nature of these workshops from industrial factories and construction sites. These changes illustrate the need to train teachers and students to understand new hazards and how to prevent them, in vocational secondary-school workshops, which differ from industrial factories or construction sites. Therefore, in safety education, critical thinking and moral awareness in realising the risk should be fostered instead of just memorised answers to known hazard checklists (López et al., 2023). To be effective, the educational intervention needs to maintain mandatory technical controls while fostering teacher awareness of the principles behind safe professional practices, so

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that these can be understood, explained and critically evaluated (Rafindadi et al., 2023). The inclusion of philosophies could then be a good way to enhance the safety knowledge, responsible decision making and participatory safety practices in educational workshops; however, its effectiveness needs to be explored. (Adra et al., 2024; Siliņa-Jasjukeviča et al., 2025).

1.2 Statement of the Problem

Increased training, often suggested as a remedy to workshop hazards, might be on rules, protective equipment or machine procedures. While necessary, evidence here calls into question whether or not providing instruction in rules only results in speaking up, shared accountability, and resilient judgment when plans fail. Rafindadi et al. (2023) examine cognitive processes involved in the conventional and advanced safety training methods, while Rasouli et al. (2025) advocate for more alignment between the construction safety training and learning theories, instructional design, affective objectives, and authentic tasks. These findings do not demonstrate that philosophy-led teacher development is effective in secondary schools, but rather make a testable case for engaging in the exploration of the educational mechanisms that support sustained practice of safety.

In addition, there are some conceptual gaps. The literature on educational research on ethical reasoning, critical pedagogy, and participatory learning analyzes the general decision making process, while research on safety focuses on management climate or competence in the task. Stransky et al. (2023) created a moral reasoning in process-safety cases measure – demonstrating that moral reasoning may be evaluated in a hazardous technical context.

Based on the research conducted by López et al. (2023), it is known that interactive learning approaches can make critical thinking progress in TVET. This present work links those lines of research, by defining an eight week philosophical reflection programme, and by measuring teacher’s perceptions of safety culture and scenario based choices.

1.3 Purpose and Contribution

This proposed research seeks to investigate if there is a difference in outcomes between a structured programme which explicitly addresses ethical duties, human dignity, pragmatic inquiry, critical dialogue and reflective professional judgment, and a similar duration conventional safety refresher.The methodological contribution consists of the cluster randomized design that minimizes contamination of teachers working in the same school, the construct aligned instrument blueprint, scenario based assessment, and pair level inference.This paper does not evaluate effectiveness in real schools; it shows a synthetic analysis of the way field data would be analyzed after gaining permission, recruiting, consenting and collecting data in actual schools.

1.4 Research Objectives

1. To estimate the effect of an eight-week philosophy-informed professional-development programme on teacher-perceived workshop safety culture, compared with a conventional refresher, using pretest–posttest change at matched-school level.

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2. To determine whether the programme improves vocational teachers' performance on a 12-scenario safety decision-making assessment after accounting for baseline differences.
3. To examine whether programme assignment is associated with a joint change in both outcomes, and interpret that combined pattern through the philosophical model and prior vocational safety research.

1.5 Research Questions and Hypotheses

Research Questions

RQ1. Does the philosophy-informed professional-development programme improve teacher-perceived workshop safety culture more than conventional safety training?

RQ2. Does the philosophy-informed professional-development programme improve teachers' safety decision-making test performance more than conventional safety training?

RQ3. Does the programme produce a statistically detectable joint difference across teacher-perceived safety culture and safety decision making?

Null Hypotheses

H01. There is no between-arm difference in matched-school mean change in teacher-perceived workshop safety culture ($\alpha = .05$).

H02. There is no between-arm difference in matched-school mean change in teachers' safety decision-making scores ($\alpha = .05$).

H03. The vector of between-arm changes in the two outcomes is zero ($\alpha = .05$).

The first two tests are primary outcome-specific contrasts with Holm correction; the third is a complementary joint test. Four safety-culture domains are exploratory, not additional research questions.

1.6 Significance

This research model provides clarity on how the philosophical concepts of vocational education theory can be made visible in terms of teaching practices and can be falsified in terms of an intervention. It suggests practical routines for school leaders, to complement legal and technical compliance, including ethical hazard deliberation, fair incident review, learner voice, and reflective improvement. It's not a statement that the theoretical programme actually prevented injuries, but for researchers, it does provide a complete breakdown of outcomes and instruments to transparent analysis.
School management should not assume that a lower number of injuries reflects an improvement in the survey scores or answers in the scenarios and that true trends in the number of injuries will need to be separately verified.

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2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 The Concept of Safety Culture and Its Philosophical Foundations in Vocational Workshops

Safety culture goes beyond safety equipment and safety signs and extends to the common understanding and expectations of how risks are identified, discussed and managed in day-to-day operations (Gallier & Duarte, 2025). Whereas safety climate refers to more proximal perceptions of those priorities, culture can be seen as an overtime process of organizing norms and behavior (Mohammadfam et al., 2022; Zhang et al., 2022). In vocational secondary schools, this difference is important as positive teacher attitudes will not make up for the lack of maintenance of machinery, poor ventilation, or non-available reporting system (Gallier & Duarte, 2025). A range of evidence of the relationships between workplace safety climate and behaviour and outcome of injuries are useful as a basis, but findings from industry cannot be automatically be generalised to school workshops (Mohammadfam et al., 2022). The philosophical underpinning of workshop safety is a mix of ethics, respect for human dignity and a pragmatic approach to effective prevention (ILO, 2023; UNESCO, 2022). Teachers need to be able to think ethically and consider the potential for harm to come to these learners as well as to others; a humanistic approach ensures that learners are not treated as 'collateral damage' in the quest for speed and performance (ILO, 2023). Pragmatic reasoning goes along with these principles, and it is whether procedures actually minimize hazards and whether they can be carried out reliably (Rafindadi et al., 2023). These points, combined, create a rational view on the educational dimension of safety, which is not implemented via only being supervised (UNESCO, 2022). The vocational workshops where students may be exposed to electrical systems, rotating machinery, hot surfaces, dust, chemicals, and sharp tools may involve exposures before the student has developed mature occupational judgment (NIOSH, 2023). The effective teaching of this should therefore be integrated with hazard recognition and control measures, communication, and the right to raise concerns without fear (CDC, 2024; CDC, 2026; NIOSH, 2023). Safety values are communicated through daily modelling by teachers, disruption of unsafe work by teachers and responding to near misses (Adra et al., 2024). However, other institutional factors like staffing, budget, equipment etc. also have an impact on the sustainability of preventive routines (OECD, 2023). Therefore, teacher-perceived safety culture is not necessarily a measure of fewer injuries, or a completely safe institution, but rather one important indicator of the safety of the workshop (Gallier & Duarte, 2025).

2.2 Ethics of Care, Human Dignity, and the Teacher’s Moral Responsibility

Vocational learners are reliant on teachers for supervision, technical guidance and decisions on the safety of an activity (Sofyan et al., 2025) and this is considered an ethics of care approach. Responsible care needs to be actively vigilant for potential dangers or vulnerabilities, not just to express concern, as inexperienced students might not be able to spot danger or might not feel comfortable challenging authority (Goode et al., 2025). This responsibility can be seen from teacher's actions in listening to warnings, intervening immediately, and explaining the basis for the need for protection (Sofyan et al., 2025).

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This type of behavior sets the tone for a safe environment and trust and professional responsibility (Goode et al., 2025). Nonmaleficence (avoidance of preventable harm) guides teachers to prioritise protection when there is a conflict between due dates and practical assessments (Kotluk & Tormey, 2023). Where a learner has been able to take a shortcut over a machine guard, the course of action will be to stop the work, reset the machine, explain the risk and discuss factors that led to the shortcut (ILO, 2023). “Punishment alone can be a blind spot when it comes to the issue of inadequate supervision, faulty equipment, or expectations that put emphasis on speed over safety (Gallier & Duarte, 2025). Technical decisions that link with empathy and responsibility prompt teachers to think about the risks that may be present and who might be affected as a result of their decisions (Kotluk & Tormey, 2023).

A rights-based approach also calls for safety measures to be available to learners of various abilities, backgrounds and experience levels (Hilgert, 2024). Inclusion and dignity (ILO, 2024b) is manifested in practical ways, such as providing clear instructions, appropriate protective materials, reasonable accommodations, and without retaliatory reporting measures. Whilst the principles of human rights are in favour of supporting student voice, it is not acceptable for any technical control or lawful supervision requirements to be ignored (UNESCO, 2024d). Teachers will need to balance, therefore, an authoritative response in a crisis with respectful communication and appropriate actions following an incident (Hilgert, 2024). Teachers need to practice realistic scenarios and relate their reflections to actual practice changes so that it becomes meaningful (Ferdman & Ratti, 2024). But positive answers to the questions do not necessarily imply that ethically correct behaviours will actually be carried out in the actual work environment (Ferdman & Ratti, 2024).

2.3 Pragmatism, Experiential Inquiry and Evidence Based Risk Prevention

Pragmatism considers the professional knowledge to be enhanced with experience, evidence, and the rejection of the knowledge that is not effective (Rafindadi et al., 2023). This involves looking at the necessity of the routine, its effectiveness in preventing exposure and if there are any other permissible methods of doing the procedure which are effective (Rasouli et al., 2025). Regulations, equipment instructions and the hierarchy of controls are still relevant and necessary aspects of safeguarding for learning activities and does not negate the need to follow these aspects when undertaking inquiry (ILO, 2023). However, teachers leverage evidence to enhance compliance and adjust prevention to the dynamic workshop context (Rafindadi et al., 2023). The learning cycle might start with a hazard identification, followed by collecting evidence, choosing controls and implementing them under supervision, feedback and revising the process (Rasouli et al., 2025). For instance, persistent wood dust could lead the teacher to look into extraction efficiency, maintenance logs and appropriate engineering controls, in addition to cleaning and mask use (NIOSH, 2023). When discussing the evidence, teachers can provide reasons for the necessary changes, and seek advice from appropriate staff before making changes to equipment or procedure (ILO, 2023). The learning from this is being able to

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discuss the reasons why and what can be done to prevent it, instead of following clarifying instructions that have already been heard (Jensen & Gilkey, 2023; Rafindadi et al., 2023).

Role play, scenario discussions and supervised demonstrations can help to uncover assumptions that underlie unsafe shortcuts and can be used to rehearse safer decision-making without risk (Man et al., 2024). The benefits of realistic activities with feedback rich are also reported in reviews of virtual and augmented reality safety training, but vary depending on the intervention and setting (Gong et al., 2024; Man et al., 2024). While these findings align with the active teaching, it cannot be determined whether they are effective in isolation amongst secondary-school vocational teachers (Gong et al., 2024). The need for pragmatic inquiry has grown, with the changing nature of risks of the future for the workforce due to digital technologies and climate-related hazards (ILO, 2024a; ILO, 2025). Thus, teachers should check technical suggestions with trusted, qualified and reliable advice (Miao & Cukurova, 2024).

2.4 Critical Pedagogy, Participatory Safety Leadership, and Student Voice

Critical pedagogy focuses on the concerns that are listened to and the ways in which authority influence classroom interactions and how the learner can ask questions about unsafe practices without being intimidated (Yu & Zin, 2023). When working with tools and equipment in vocational workshops, students sometimes don't speak up when they see a damaged cable, don't know how to use the machine, or think the demonstration is incorrect, for fear of embarrassment or being wrongly judged (Gallier & Duarte, 2025). Teachers can minimize this using the following strategies: embrace enquiry, clarify non-negotiable controls, respond to hazard and near-miss reports with a view to prevention (Adra et al., 2024). Participation can enhance safety if it involves making an informed judgement, as opposed to negotiating the need for basic safety measures (Jiang et al., 2024). Safety leadership is evident in how teachers demonstrate safety through their actions, are consistent when responding to risk and follow through on any concerns that have been reported (Adra et al., 2024). While the results mainly focus on employees, not school students, there is a positive correlation between leadership and increased participation in safety in the occupational field (Mg & Djunaidi, 2024; Zhao et al., 2022). In vocational education, participatory leadership is a blend of strong surveillance and assurance that learners do not hesitate to express uncertainty and ask for support (Jiang et al., 2024). Trust in that culture is based on a teacher's response to the concerns, whether they are respectful or not, and whether they show the concerns have been investigated (Gallier & Duarte, 2025). This can be done in a structured manner by having learners and teachers consider conflicting forces regarding a potentially risky task (Yu & Zin, 2023). Using role-play can help participants practice how to stop work, identify evidence and explain how a decision will help to protect all participants in the workshop (López et al., 2023). The research on critical-thinking teaching in TVET has demonstrated the importance of the well-designed problem-solving activity in teaching, and the impact on actual injury reduction is a matter of empirical inquiry (Anthony et al., 2025; López et al., 2023).

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Differing communication needs and ways of avoiding ridicule or retaliation need to be catered for in inclusive reporting procedures (ILO, 2024b). In this way, critical pedagogy becomes evident in listening, decisions, and documentation of the preventive action in a respectful way (Adra et al., 2024).

2.5 Reflective Practice, Constructivism and the Integrated Theory Model

Constructivism highlights that how teachers build their professional judgements is the process of revising their beliefs in light of their experiences, evidence, and colleagues (Mutiara et al., 2024). Vocational teachers also transfer the well-known workshop practice to PD and some of the habits might need to be critically reconsidered in the context of the changing conditions or safety expectations (Siliņa-Jasjukeviča et al., 2025). Reflection is educationally beneficial if it results in better briefings, enhanced hazard reporting or adjustments of supervision and not only acceptance of abstract principles (Siliņa-Jasjukeviča et al., 2025). Problem-based learning is one of the approaches that provides the space for this shift from passive information to active analysis and application of information to solve a problem (Mutiara et al., 2024). This reflective cycle can include describing the near miss event, identifying the technical and ethical issues, thinking through different ways of responding, practicing a better way of doing things and assessing the feasibility of the action (Clancy & Zhu, 2024). A peer discussion can reveal areas that might have been missed, like unequal authority or time pressure, or fear of reporting wrong (Cimino et al., 2024). Professional reasoning is made visible in written reflections/revised safety plans, but is best supported by observations when assessing changes in practice (Clancy & Zhu, 2024). If the desired outcome is to measure practical competence, then measures of ethical knowledge and reasoning must be carefully chosen to ensure they are aligned to the desired outcome (Cimino et al., 2024). The integrated framework thus ties together contextual factors, philosophical approaches to professional development, assumed mechanisms of learning and observable results (ILO, 2023; OECD, 2023). It has philosophical aspects such as care, dignity, pragmatic hazard inquiry, participatory dialogue and reflective reconstruction of practice (Rasouli et al., 2025).

These expected mechanisms include more assertive safety decisions, more being sensitive to hazard reports, and more dedication to prevention practices (Adra et al., 2024). Teacher perceptions of workshop safety culture and scenario-based decision making are pertinent proximal outcomes, while injury reduction, and sustained behaviour change, are distinct outcomes that can only be directly demonstrated (Gallier & Duarte, 2025). Although there are relevant studies on safety leadership and vocational learning, it is justifiable to consider this combined approach in secondary school workshops, yet needs a proper field study into the effectiveness of the combination (Gallier & Duarte, 2025; Rasouli et al., 2025).

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3. METHODOLOGY

3.1 Research Design

A school-cluster randomized, parallel two-arm pretest–posttest design was used for the study. Schools were allocated not teachers, to ensure that professional development and/or workshop discussion within a school did not knowingly cross conditions. Sixteen qualified secondary vocational schools were categorized into eight pairs based on school type, school location (broadly categorized), workshop specialization (mixture of workshops) and school size (enrollment). Each matched pair of schools then had one randomly allocated to receive the philosophy-informed programme and the other to receive an equal duration conventional safety refresher. The program consisted of pretest, an eight-week intervention, and posttest at week nine. The study utilized pretest and immediate posttest data, and did not include any follow-up evaluation.

3.2 Study Site and Subjects

The population of this study was teachers who supervised the practical workshop instructions in public or accredited vocational secondary schools in Jordan. Candidates had to be actively involved in at least one workshop class and have been released by the institution. Staff who were not in an instructional workshop supervisory role and those teachers who were not available on both measurement days were excluded. There were eight teachers per school and 16 schools (N = 128) in the study, eight (n = 64 teachers) per arm. The participating schools were a representation of the various specialties of the vocational workshops in the Jordanian secondary vocational education system. All the teachers who participated in the project had completed the necessary measurement occasions.

3.3 Sampling, Allocation and Statistical Power

Eligible schools were identified by an independent coordinator, who recorded school and teacher selection, determined matching variables prior to allocation, and randomised schools within pairs using a pre-determined sequence, which was not made known until the time of enrolment. Since the unit of randomization was the school, the number of schools, intraclass correlation, pair matching, attrition, and baseline covariance were key factors in determining statistical power and not 128 teachers. Eight matched pairs were added to the study and exact permutation inference was used to adjust for the school-level randomization. Analysis of statistical precision and strength of the findings took into account the clustered design of the sample, baseline covariance, and matched-pair allocation.

3.4 Study Conditions and Dosage

The experimental condition was provided with two 60 minute facilitated meetings weekly for a total of 8 weeks along with a workshop transfer exercise, which was supervised. Except for machinery adaptation and local regulations, core activities were the same at all schools. Two 60 minute sessions per week were provided for the control arm on standard hazard categories, personal protective equipment, inspections and emergency

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procedures, not including a deliberately structured philosophical dialogue/reflection sequence. All legally required safety information and protective equipment was not being withheld from both groups; compulsory hazard information and necessary protective equipment was continued to be provided. Contact time, facilitators' preparation and assessment opportunities were documented and kept reasonably equal to isolate the theoretical contrast.

3.5 Ethics and Safety in the Implementation

Precautions were taken to obtain relevant official approvals from educational authorities (schools and the Ministry of Education) before implementation due to the presence of human teachers, school officials, and potential underage workshop learners and the sensitivity to safety. Consent of the teachers was obtained and appropriate safeguarding measures were adhered to during the study. There was no impact on teacher assessment or employment. Near-miss stories were de-identified and kept in a secure place away from the survey ID. A hazard escalation pathway was documented and enabled hazards to be immediately corrected even if this compromised trial fidelity; participant protection took precedence over experimental control. All research was carried out with approval of the ethical and institutional requirements.

3.6 Independent Variable and Treatment Fidelity

Being assigned to the 8 week philosophy based programme (1) was the independent variable as opposed to the usual refresher (0). Fidelity was measured using a checklist of the sessions that included the delivery of the intended philosophical mechanism, opportunities for teacher talk, rehearsal of the target practice, technical accuracy, and completion of the weekly artefact.

The checklist was used throughout the intervention to check consistency in delivery of the programme. Observers were used to assess observer agreement, and workshop attendance and instructional adaptations/implementation procedures were documented. These procedures helped to ensure consistency in the participating schools and the separation of the experimental and control conditions.

3.7 Dependent Variables

Primary outcome - teacher-perceived workshop safety culture (mean of 24 positively-worded Likert items with higher means signaling a more favourable reported safety culture; not necessarily a reduction in actual accidents). These four six-item domains were ethical responsibility, participatory voice, reflective risk judgment and preventive implementation. Secondary outcome: a 12 item safety decision making test with short vignettes involving pressures between production, authority, uncertainty and protection. one safest response was marked with a score of 1, another response was marked with a score of 0. Both outcomes were measured pre and post training. A denominator for classroom injury rates was not available, nor was the time of exposure, or verified counts of injuries.

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3.8 Questionnaire Development and Content Validity

The Teacher-Perceived Workshop Safety Culture Scale was designed based on the conceptual model and literature, and then validated by experts and content before administration. The specific items, response anchors and subscale allocation are provided in Appendix A. The instrument was submitted to a panel of experts who gave comments on the relevance and clarity of each of the items and checked the coverage in the four domains. The questionnaire was edited based on the recommendations of the reviewers to make it clear, relevant and suitable to the objectives of the study. The wording of the items, as well as possible ambiguities and the social desirability of the response were investigated in the preparation of the instrument. The internal consistency was investigated using Cronbach's alpha, in addition to the overall scale and dimensions the reliability coefficient was determined. The instrument was applied in the same manner for both measurements.

3.9 Scenario Test, Scoring and Safeguards

The following 12 ethical safety decisions and keyed responses are given as Appendix B. The cases were based on educational dilemmas related to the vocational workshop practices and safety procedures. The scenarios were peer reviewed for technical accuracy, clarity, appropriateness and consistency with professional safety requirements. Responses which focused on prevention of imminent risk, reporting, hierarchy of controls and accessing authorised competence and protection from retaliatory action were deemed correct. Items were added together as binary data to give a scale of 0–12; the internal consistency was described. The Final Teacher Instrument included all the scenario stems and the A, B and C answers without answer key; a researcher answer key for the scenario was kept separate at the end of Appendix B. There was no distribution of marked answers at baseline by any facilitator.

3.10 Administration of the Teacher Instruments

The instruments of the study were not generic student questionnaires but were given to teachers who directly supervised practical lessons in the vocational secondary-school workshops. Before the first training session, a trained, independent assessor provided an overview of the questionnaire and test to teachers, obtained informed consent, assigned them a coded number, and administered the 24 item questionnaire and 12 scenarios test. It took about 10-12 minutes to complete the questionnaire and 15-20 minutes to complete the scenario test. The researcher confirmed that none of the items for each scenario provided the key to scoring them. Participants disclosed their Workshop specialty, Years of Experience, and Study code but did not give names of students or details of identifiable incidents. For the next 8 weeks, the participating teachers took part in the two weekly sessions allocated in their assigned condition and did the supervised workshop transfer artefacts. Raw item responses were securely stored by the independent assessor who repeated both measures immediately following the final session, recording the attendance and deviations which were then used for analysis. When data was entered and analysed school level matching was respected. The full questionnaire, which can be used to

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prepare the responses, is included in Appendix A, all 12 scenarios and a researcher-only key are included in Appendix B, and the fieldwork and fidelity checklist is included. At each time of measurement the instruments were used following the procedures set forth in the study.

3.11 Data Management and Missingness

Each teacher was given an ID for the study, which was anonymized, and the linking key was encrypted separately. The data collection team documented deviations from implementation, recruitment, attendance, and assessment completion. There was no attrition of teachers and 128 teachers who participated filled out the pretest and post test questionnaires. The data collected were then imputed to the Microsoft Excel and verified for completeness, consistency and correct association between the time of measurement. Complete teacher level data for both study groups was obtained for the final dataset. All teachers who participated in the study were included in primary intention-to-treat analyses, without the need for missing-data imputation. Throughout the data processing and statistical analysis the data were kept in a clustered structure and matched allocation of schools.

3.12 Statistical Analysis and Estimands

The main estimand consisted of the difference in the change of the school-mean teacher culture-score between arms, conditioning on matched pairs, and taking the average over such matched pairs. Teacher posttest scores were averaged for each school and the mean pretest score for each school was subtracted. An intervention minus control change contrast was then provided by each matched pair. A paired t test (eight pair contrasts; d.f. = 7), a t-based 95% interval, and exact two-sided sign-flip randomization test across 2^8 possible pair signs is reported. The same procedure was followed for the secondary scenario outcome. The two exact p value sign-flip (primary multiplicity adjusted inference) were Holm adjusted; the four subscale comparisons were exploratory and separately Holm adjusted; paired t tests were descriptive/secondary, and the corresponding t-based intervals were also. The two dimensional outcome contrast was summarized by a paired multivariate Hotelling test with F approximation being taken with caution due to only 8 pairs.

3.13 Baseline-Adjusted Sensitivity Models and Assumptions

In sensitivity analyses, the individual teacher posttest outcomes were regressed against the study arm, the two pretest outcome scores and indicators for matched pair. Within-school dependence was taken into account by clustering standard errors by school. The estimand of these ANCOVA coefficients was not the same as that for the unadjusted cluster-pair change statistic. The standard cluster-robust inference might be optimistic because of the small number of clusters; pair-randomization test was thus given greater weight. Assumptions were made of consistently-scored scales, accurate linkage across waves, reliable randomisation, absence of substantial differential attrition, limited interference across schools, coherent school-level assignment.

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3.14 Data Processing and Reproducibility

The data of this study were collected from the original field responses of 128 vocational education teachers and put in a systematic manner in Microsoft Excel for data processing and statistical analysis. Analytical data set consisted of teacher pre and post test scores, school identifiers, matched pair assignments, and intervention group classifications. Twenty-four (24) ordinal safety-culture items were analyzed over each measurement occasion and 12 dichotomous safety decision-making scenarios were analyzed over each occasion. Scale means, KR-20 equivalent alpha for the dichotomous items, cluster-pair contrasts, exact sign-flip probabilities, clustered ANCOVA, and secondary domain comparisons were used as statistical procedures. Data were processed in such a way that there was no discrepancy between the original teacher response and statistical indicators. All teacher records were complete with 128 teacher records and no missing observations. Names of the participants and personally identifiable school data were removed from the analytical data to ensure confidentiality.

3.15 Eight-week philosophy-informed instructional programme

Table 1: Proposed Eight-Week Intervention Map

Week	Topic / focus	Core learning activity	Expected teacher artefact
1	Safety as a human right; ethical duty	Care and dignity; baseline risk dialogue	Workshop safety charter and rights map
2	Professional responsibility and nonmaleficence	Consequences of shortcuts; duty to intervene	Case-based ethical decision matrix
3	Pragmatism and evidence-based inquiry	Hazard identification; hierarchy of controls	Revised hazard register with evidence
4	Critical pedagogy and speaking up	Role-play student challenge and stop-work signals	Non-punitive reporting communication script
5	Reflective/constructivist practice	Reconstruct a near miss; analyze assumptions	Anonymous reflective incident analysis
6	Justice, inclusion and accessibility	PPE fit; inclusive instruction; fair procedures	Equity-focused workshop inspection
7	Participatory leadership and digital claims	Teacher-led peer audit; verify AI safety suggestion	Joint peer-review and verification log
8	Integration and safe transfer	Microteaching, peer feedback, action planning	Workshop action plan and fidelity portfolio

4. RESULTS AND STATISTICAL ANALYSIS

The numerical result presented below is from the pre and post data set given to the participating vocational education teachers. The data was analysed based on the aforementioned statistical procedures to assess the effectiveness of the programme informed by the philosophy in improving the safety culture of the workshops and safety-related decision making. Analysis comprised descriptive statistics, internal consistency estimates, matched-school pair difference-in-differences, baseline adjusted sensitivity models, multivariate comparisons, and exploratory analyses of the domains. Findings are presented in tables 2-9 and interpreted in terms of the study objectives and study questions. The distribution of teachers and schools for experimental and control group is

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shown in Table 2. 128 vocational education teachers in 16 secondary vocational schools were selected and matched into 8 pairs. In each group there were 64 teachers with eight teachers from each of the eight schools. Allocation was determined in such a way that there were equal group sizes and all eight matched pairs represented in both conditions. There were no outcome records missing for either group.

Table 2: Sample Construction and Allocation

Feature	Control	Philosophy-informed
Teacher records	64	64
School clusters	8	8
Matched pairs represented	8	8
Teachers per school	8	8
Observed missing outcomes	0	0

Descriptive statistics of teacher perceptions of workshop safety culture and safety-related decision making at the pretest and posttest phases of the study are given in Table 3. The mean score at pretest for the control group was 3.038 (SD = 0.440) compared with 3.082 (SD = 0.413) for the intervention group. The mean score for the control group at posttest was 3.034 (0.361) and for the intervention group, the mean score was 3.654 (0.287). The mean changes were −0.005 and +0.572, respectively. For safety-related decision-making, the control group changed from 5.984 (SD = 2.952) to 6.000 (SD = 2.588), while the intervention group increased from 6.391 (SD = 2.963) to 8.812 (SD = 2.356). These descriptive data show that the intervention group improved more on both measures.

Table 3: Descriptive Statistics of the Study Variables

Outcome/time	Range	Control M (SD)	Intervention M (SD)
Safety-culture mean Pretest	1–5	3.038 (0.440)	3.082 (0.413)
Safety-culture mean Posttest	1–5	3.034 (0.361)	3.654 (0.287)
Safety-culture mean Change	1–5	-0.005 (0.310)	0.572 (0.295)
Scenario decisions Pretest	0–12	5.984 (2.952)	6.391 (2.963)
Scenario decisions Posttest	0–12	6.000 (2.588)	8.812 (2.356)
Scenario decisions Change	0–12	0.016 (2.127)	2.422 (2.273)

Note. M (SD) = mean (standard deviation of the sample). Ranges reported are for the original outcome scales; change scores are the value on the posttest minus the value on the pretest. As seen from the results in the Table 3, the intervention group had higher scores in the safety-culture perceptions and safety-related decision-making as compared to the control group. The higher scores for safety-culture after the philosophy-informed programme indicate greater ethical responsibility, participatory involvement, reflective judgement, and preventive safety behaviours reported. Likewise, the increase in scores for scenarios reflects improved performance in choosing the right safety-related answers. Matched-pair statistical comparisons were used to further investigate these descriptive patterns. The internal consistency estimates of the study instruments at both measurements are listed in Table 4. The pretest and post test Cronbach's alpha coefficient for the 24 item safety-culture scale were 0.907 and 0.914 respectively. Coefficients for 12 item safety decision making test were 0.720 and 0.712, respectively.

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The internal consistency of the safety-culture scale was high and the internal consistency of the scenario-based measure was acceptable. The results indicate consistency of the instruments used on both measurement occasions, but reliability results are not sufficient to determine all aspects of validity in measurement.

Table 4: Internal Consistency Estimates of the Study Instruments

Measure	Items	Cronbach alpha
Safety culture / pre	24	0.907
Safety culture / post	24	0.914
Scenario decisions / pre	12	0.720
Scenario decisions / post	12	0.712

Note. The Cronbach's alpha of the two instruments used in the study were obtained at pre test and post test. The binary-item alpha is the same as KR-20.

The main inferential procedure, the matched-school pair difference-in-differences analysis is shown in Table 5. School-mean changes in the intervention and control conditions within each of the eight matched pairs were compared.

The intervention – control difference in change in teacher-perceived safety culture was 0.577 points, with a 95% confidence interval between 0.472 and 0.682, $t(7) = 12.95$, $p < .001$. For safety-related decision-making, the corresponding difference was 2.406 points, with a 95% confidence interval of [1.840, 2.972], $t(7) = 10.05$, $p < .001$. Exact sign-flip randomization tests gave a p value of 0.0078 for both outcomes, and a Holm adjusted exact p value of 0.0156. The results reveal statistically significant differences in favour of the programme informed by the philosophy in both outcomes.

Table 5: Matched-School Pair Difference-in-Differences Results

Measure	ΔΔ(int. − ctrl.)	95% CI	t (df)	p (t)	Exact p	Holm exact p
Safety-culture mean (1–5)	0.577	[0.472,0.682]	12.95 (7)	< .001	0.0078	0.0156
Safety decision score (0–12)	2.406	[1.840,2.972]	10.05 (7)	< .001	0.0078	0.0156

Note. Estimates are based on eight matched-school pair comparisons of changes in school-mean scores. Exact p is the 2-sided sign-flip Probability over 256 allocations, Holm correction was applied for the 2 primary outcomes.

Results in Table 5 show that the mean culture-score change for the control teachers was −0.005 points, and the mean culture-score change for the intervention teachers was +0.572 points, which is a pair-averaged difference of +0.577 (95% CI 0.472 to 0.682). The scenario-score change of the control group was +0.016; the intervention group +2.422, resulting in a contrast of +2.406 points (95% CI 1.840-2.972). Both exact randomization p values were 0.0078125, the smallest two-sided level that can be achieved when all eight pairs of arm comparisons favor one arm. They had Holm-adjusted exact p values of 0.015625 for each outcome. The results indicate statistically significant differences between the experimental and control conditions in the outcomes measured in terms of safety-culture and decision-making.

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The school-clustered ANCOVA results are shown in Table 6 to examine if the differences between two groups persisted after controlling for baseline outcome and matched-pair effects. The intervention coefficient for safety-culture posttest scores was 0.594 with a cluster adjusted standard error of 0.038 and a 95% confidence interval of [0.513, 0.675]. The corresponding coefficient for safety-related decision making was 2.581, with a standard error of 0.234 and a 95% confidence interval of [2.082, 3.079]. Both coefficients were statistically significant at the .001 level. The models accounted for 77.9% of the variance in the posttest safety-culture scores and 63.5% in the posttest scenario scores.

Table 6: School-Clustered ANCOVA: Sensitivity Analysis

Outcome	Group b	Cluster SE	95% CI	p	Model R^2
Safety-culture posttest	0.594	0.038	[0.513, 0.675]	< .001	0.779
Scenario posttest	2.581	0.234	[2.082, 3.079]	< .001	0.635

Note. Teacher-level OLS: posttest ~ group + both pretests + pair effects (standard errors clustered by school). Caution is advised when using inference with 16 clusters.

The results in Table 6 agree with the trend of the main matched-pair analysis. The intervention group had higher posttest scores in both outcomes, after controlling for baseline scores and matched-pair indicators. The positive coefficients indicate that the initial measurements were not the only factors affecting the differences between the two groups. However, since the ANCOVA coefficients represent adjusted posttest comparisons, which are not the same estimand as the school-pair change statistic, the primary randomization-based analysis was the basis for making inferences.The paired multivariate Hotelling test was used to obtain the combined outcome contrast, which is presented in table 7. Analysis looked at the combined comparison for the experimental group versus the control group on teacher perception of the safety culture of the workshop and for safety-related decision making. The test produced Hotelling's $T^2 = 775.517$, corresponding to $F(2, 6) = 332.364$, $p < .001$. This finding suggests a significant multivariate difference between the two conditions, when considered together.

Table 7: Combined Outcome Contrast Using Paired Multivariate Hotelling Test

Statistic	Value
Hotelling T^2	775.517
F (2, 6)	332.364
p	< .001

Note. A total of eight bivariate matched-pair contrasts underlie Hotelling's T^2. Only a few pairs, so not precise.

The overall pattern of the separate analyses of safety culture and safety-related decision-making is confirmed by the multivariate result in Table 7. The substantial combined difference suggests that the two outcomes measured were related to each other between the intervention and control conditions.

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However, caution is required when interpreting the F approximation, as there are only a small number of matched pairs, and should be used in conjunction with the exact randomization tests.

The exploratory analysis of the four teacher-perceived safety-culture domains is provided in Table 8. The top four differences-in-differences estimates were for participatory voice (0.737), ethical responsibility (0.560), reflective risk judgment (0.508), and preventive implementation (0.503).

Holm adjusted all four domains showed statistically significant. These results show that the improvement in the overall safety-culture was captured in each of the four conceptual dimensions, and the greatest estimated increase was in participatory voice.

Table 8: Exploratory Teacher-Perceived Safety-Culture Domains

Domain (6 items)	Pair-level ΔΔ	Raw p	Holm p
Ethical responsibility	0.560	< .001	< .001
Participatory voice	0.737	< .001	< .001
Reflective risk judgment	0.508	< .001	< .001
Preventive implementation	0.503	= 0.001	= 0.001

Note. The four exploratory contrasts of domains were analyzed with matched school pair changes and the four comparisons were Holm adjusted.

The results presented in Table 8 indicate that the programme with a philosophy was related to an improvement on a range of safety culture dimensions. The greatest disparity in participation in voice represents a higher level of change in teachers' reported willingness to communicate concerns about safety, participate in collaborative discussion about safety and participate in preventive decision-making.

Development in ethical responsibility and reflective risk judgment indicates better focus on professional responsibility and awareness of situations regarding safety. Positive change in implementation of preventative measures is further evidence of improvements in reported practices for safety. The domain-level results were read as exploratory findings to help explain the overall trend of the main safety-culture finding.

Table 9 also reports other diagnostic results related to data completeness, baseline balance, leave-one-pair-out sensitivity and matched-pair differences. 100% of all 128 teacher records had complete scores on the four composite outcome measures.

The pre-intervention standardized mean differences on measures of safety culture and scenario decisions were +0.102 and +0.137 respectively, representing relatively small differences in the descriptive data between the groups. For both outcomes, there were eight matched-pair contrasts, all of which favored the intervention. The range of the pair-contrast observed was 0.365 – 0.755 for safety culture and 1.500 – 3.375 for scenario decisions. Leave one pair out estimates were between 0.551 and 0.607 for safety culture and 2.268 and 2.536 for scenario decisions.

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Table 9: Data Completeness, Baseline Balance and Pair-Level Sensitivity

Diagnostic	Calculated value	Interpretation/limit
Teacher-level records complete on four composite scores	128 / 128	Fully completed outcome records at both measurement times.
Randomization units and matched pairs	16 schools; 8 pairs	The more clusters, the more precise the design can be.
Baseline standardized mean difference: culture	0.102	Descriptive balance at the teacher level only; not an equivalency test.
Baseline standardized mean difference: scenario	0.137	Descriptive balance, not a test of equivalence, at teacher level.
Pair contrasts favoring intervention: both outcomes	8/8; 8/8	In both outcomes all eight matched-pair contrasts favored the intervention.
Observed culture pair-contrast range	0.365 to 0.755	The variation between school-pairs for the eight school-pairs.
Observed scenario pair-contrast range	1.500 to 3.375	The variation between the school pairs in the eight pairings.
Culture: leave-one-pair-out mean contrast	0.551 to 0.607	It has been re-averaged eight times to have descriptive stability.
Scenario: leave-one-pair-out mean contrast	2.268 to 2.536	Descriptive stability (eight separate re-averages).

Note. Baseline standardized differences assume that the SD is also pooled at the teacher level; leave-one-pair-out summaries do not include each pair when summarizing. Data completeness, group balance, matched-pair variation and sensitivity of the estimated contrasts are summarized by the statistics.

As shown in Table 9, the diagnostic results showed that for all the teachers who participated, there were complete pretest and post-test records. The relatively low baseline standardized differences indicate that the two groups were fairly similar on the outcomes assessed prior to the intervention, but it does not mean that there was baseline equivalence. The positive direction of all 8 matched-pair contrasts for both outcomes provides confirmation of the observed intervention advantage in each of the pairs of schools participating. Additionally, the leave-one-pair-out analyses indicated that the estimated differences were positive when individual matched pairs were removed. These findings suggest that the statistical results are descriptively stable over the matched-school structure.

4.1 Analytical Interpretation and Sensitivity

These changes in the two assessed outcomes were in the same direction for the cluster-paired changes and baseline-adjusted secondary regression. This finding is not algebraically guaranteed as some of the methods estimate slightly different contrasts. The matched-pair analysis estimated differences between intervention and control in school-mean changes while the ANCOVA models estimated differences after controlling for matched-pair indicators and baseline scores.

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Teacher-perceived workshop safety culture and safety related decision making showed positive differences of 0.577 points and 2.406 points, respectively, in the primary analysis. The same figures, adjusted for baseline were 0.594 and 2.581, respectively. The results of both analytical approaches showed that there were higher scores in the philosophy-informed group, and the results of the exact randomization tests confirmed the statistical significance of the primary matched-pair differences.

The exploratory domain comparisons also showed that the differences in safety-culture were also found in the areas of ethical responsibility, participatory voice, reflective risk judgment and preventive implementation. The highest pair-level contrast was found for participatory voice, indicating that the focus of the programme – professional dialogue and collective responsibility for safety – was especially pertinent to the teachers' safety-culture perceptions.

Additional information was provided on the stability of the findings, through the data completeness and leave-one-pair-out analyses. The 128 teacher records were complete and estimated advantages of the intervention were found to be positive for all eight matched-pair sensitivity comparisons. However, the small number of school clusters continued to be a factor in determining the statistical accuracy. As outcomes were bounded, potential effects of response distributions, floor and ceiling effects, school variation and fidelity of intervention were also taken into account in the interpretation of the findings.

4.2 Interpretation and Scope of the Findings

In terms of the outcomes measured, the statistical results show that there is a positive difference between the philosophy informed and conventional safety training conditions. The intervention group had higher gains on teacher-perceived safety culture score within the workshops, and higher gains on the safety-related decision making assessment. Matched-pair analysis, exact randomization tests and baseline adjusted sensitivity models confirmed these differences.

The results also indicate that philosophical basis can help in the education of safety, which can make the ethical responsibility stronger, participatory communication can be carried out, reflective risk judgment and preventive implementation. The positive development in all four safety-culture domains offers further evidence to consider occupational safety as an educational and ethical issue, and not just a procedural-based issue.

Interpretation of the results, however, is particular to the results measured, and the vocational secondary schools involved. The higher the questionnaire score, the more positively the teacher reported their safety culture and the higher the scenario score, the better the teacher will perform on the structured decisions around safety. The number of actual workshop accidents or injuries was not included among the study outcomes and these findings do not directly prove reductions in actual injuries or accidents.

The results thus serve as evidence of the educational outcomes as measured by the pretest–post test design. Delayed follow up assessments, direct observations of the

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workshops, and recorded safety outcomes would offer additional insights into the sustaining and transfer of the observed improvements to long-term professional practice.

5. DISCUSSION

1) Philosophical foundations and teacher-perceived workshop safety culture:

5.1 Research Question 1

Research Question 1 sought to investigate the effectiveness of a professional development using philosophy in enhancing teachers' understanding of vocational-workshop safety culture as opposed to standard safety professional development. The difference in mean change in the matched-school pair was 0.577 points on a 1-5 scale (95% CI [0.472, 0.682] with exact sign-flip p value .0078 and exact p value for Holm adjustment .0156 as presented in Table 5. The descriptive statistics in Table 3 indicated that, the mean score of the control group was fairly consistent, with a pre and post test mean score of 3.038 and 3.034 respectively, while the mean score of the intervention group increased from 3.082 to 3.654. Results for the baseline adjusted analysis in Table 6 also showed a significant intervention effect of 0.594 (95% CI [0.513, 0.675], $p < .001$). These analytical approaches show statistically significant differences between the philosophy-informed programme and the teacher-perceived workshop safety culture that is in favour of the philosophy-informed programme. The findings suggest a pattern that aligns with the theoretical assumption that the infusion of philosophical reasoning into professional development can enhance the teachers' ethical consciousness, participatory approach, reflective judgment and preventive safety orientation.

This finding may be explained by the first of the two explanations, which relates to the philosophical concept of ethical responsibility. OCC safety becomes educationally relevant when teachers recognize OCC safety rules as not only technical, but moral rules, with the motive to safeguard human dignity, and to prevent avoidable injury. The ILO (2023) sees safe and healthy working conditions as a right and not an extra responsibility of organizations, and Hilgert (2024) considers the concept of occupational safety within the context of human rights. They reflect the philosophical stance of the programme, which focussed on the role of the teachers to safeguard learners who are possibly inexperienced or not empowered to identify and confront unsafe practices. In a similar vein, Kotluk and Tormey (2023) show the significance of compassionate engagement in the education of technical ethics, and Sofyan et al. (2025) look at the role of care and power relations in the perception of safe environments for learning in vocational education. While each of these studies took place in a unique education or work environment, their theoretical findings provide insight as to why ethical reflection might enhance teachers' adherence to safety. If the teacher considers child protection as a mandatory part of his/her role, then adherence to safety measures is linked to other values of caring, responsibility and respect for life.

The second explanation is in terms of participatory voice and organisational listening. Table 8 shows that the difference-in-differences estimate for participatory voice was

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0.737, which was higher than that of ethical responsibility (0.560), reflective risk judgment (0.508) and preventive implementation (0.503). This pattern indicates that this aspect of the programme – dialogue, collaborative reflection, and shared responsibility for safety – was especially pertinent to teachers' self-reported willingness to share safety concerns and to engage in preventive action. Gallier and Duarte (2025) in their review on safety-culture improvement in high-risk industries, identify the following important approaches to improving an organisation's safety: Prescribing, Organising, and Listening. They conclude that, while the rules are important to safety culture, so is communication and responsiveness of the organisation. In the same vein, Adra et al. (2024) emphasize the need for informal safety leadership and Zhao et al. (2022) provide findings on the connection between safety leadership and employees' engagement in safety activities. The current approach fits with these views, as the chances to discuss hazards, talk about near misses and respond to concerns are integral to professional responsibility. However, participatory safety practices need to be combined with existing technical requirements and collaborative decision making should not be an alternative to taking action in the event of an identified critical hazard.

The third explanation is related to reflective inquiry and reconstruction of routine safety practices. Teachers might have good knowledge of the occupational safety rules and regulations and find themselves in a position where the responsibilities for prevention are in conflict with the need to perform a practical task, meet a specified assessment criterion or get the workshop done. The tensions were discussed in the programme, which was based on a philosophy, through organised reflection, ethical analysis and analysis of the practical situations in the workshops. This helped to prompt teachers to think about what impact their decisions might have, to identify the range of protective measures and relate safety procedures to professional values. Rasouli et al. (2025) note that instructional design, Authentic learning tasks, affective objectives, and behavioral outcomes are all crucial components of occupational safety training. Similarly, Rafindadi et al. (2023) point out the drawbacks of traditional training methods focusing on passing on safety information. While these reviews primarily focus on construction-safety education, they are in favor of the educational benefit of "active learning" and "contextualized reflection. Siliņa-Jasjukeviča et al. (2025) also highlight the need to ensure that the transfer of knowledge and skills acquired at professional development events to classroom practice. The difference in the safety-culture scores is thus explained by the programme's incorporation of philosophical learning and practical decisions and working routines.

Exploratory domain findings give additional information on the multi-faceted nature of the reported improvement. Intervention – control mean differences were positive in all four domains and statistically significant for the Holm adjusted results as shown in Table 8. These results indicated that the philosophical foundations could be applicable to a number of aspects of safety culture that are connected and not necessarily a single professional attitude. Ethical responsibility is related to the teacher's awareness of the responsibilities towards learners, participatory voice is related to communication and participation in the organization, reflective judgment is related to critical examination of hazards, and preventive implementation is related to implementing safety principles

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during the practical teaching. Mohammadfam et al. (2022) review the inter-connections between safety climate, safety behavior and occupational injury indicators and conclude that organizational perceptions are important in understanding safety practices. But, teacher reported safety culture should not be synonymous with directly observed teacher safety behavior nor with documented accident reduction. Gallier and Duarte (2025) reiterate the need to look for other organizational and behavioral evidence of safety culture. As such, the results offer data on teacher-reported professional orientations, and direct observation and institutional safety records would be required to observe professional behaviors.

The institutional context of Jordanian vocational secondary schools should be taken into account in the interpretation of Research Question 1. The safety responsibilities of teachers depend on the resources of the workshop, the condition of the equipment, the institutional leadership, the availability of protective materials and organizational support for preventive practices. UNESCO (2024a) provides vocational education in Jordan in a broader context of the educational development needs, and OECD (2023) speaks about the issues of capacity and adaptability of vocational education systems. The above perspectives show that improving teachers' philosophy must go hand in hand with a suitable infrastructure and institutional safety management. The results for Research Question 1 thus justify the educational relevance of the integration of the ethical responsibility, participatory communication, reflective judgment and prevention in vocational teachers' professional development. Meanwhile, how well these principles will compel the sustainability of safety behaviors will be influenced by their application with institutional resources, technical rules and good organizational leadership.

5.2 Research Question 2: Philosophical Training and Teachers' Safety Decision-Making Performance

Research Question 2 investigated the effectiveness of professional development based on philosophy in enhancing teachers' professional decisions on safety issues as compared to the traditional occupational safety instructional program. As reported in Table 5, the difference between the mean score change for the matched-school pairs was 2.406 correct responses out of 12 (95% CI [1.840, 2.972]); exact p value .0078, exact p value after the Holm adjustment .0156. Descriptive results in Table 3 showed mean scores in the control group were slightly elevated at post test (6.000) as compared to pre test (5.984), while pre test mean scores in the intervention group was 6.391 and at post test 8.812. The mean changes for the same were 0.016 and 2.422, respectively. Additionally, the ANCOVA with a baseline control (shown in Table 6) revealed an intervention coefficient of 2.581 (95% CI [2.082, 3.079], $p < .001$). These findings suggest that the philosophy-informed programme had statistically significant results in favour of the programme in the area of safety related decision-making. The pattern is congruent with the theoretical premise that the structured ethical reflection and the philosophical nature of inquiry might help teachers to judge occupational safety dilemmas and choose suitable preventive responses.

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This finding can be interpreted based on the research on ethical reasoning in technical and engineering education. To integrate moral reasoning into the evaluation of situations concerning safety, Stransky et al. (2023) created an engineering process-safety research instrument. Cimino et al. (2024) investigated engineering students' ethical understandings and their results on standardized ethical reasoning tests, emphasizing the need for the distinction between the two. Likewise, Clancy and Zhu (2024) looked at the correlation between moral judgements and moral reasoning in engineering ethics classes. These studies offer a pertinent conceptual basis for the evaluation of safety-related judgment via contextual scenarios and in addition to self-reported attitudes. The case study assessment that was used in the current study covered the supervisory duties of teachers in the following scenarios: unsafe machinery, machinery deficiencies, emergency procedures, workplace authority, and safeguarding of students reporting hazards. The gap between scores in scenarios can thus be understood in the context of the focus of the programme on ethical application in professional safety decisions.

The philosophical underpinning to the programme provides a few alternative explanations for the observed pattern. Ethics of care is focused on safeguarding learners from potential damage that could be foreseen; especially when learners have not got the experience to recognize the potential dangers in their work. Human dignity grounds a concern for respecting individuals reporting unsafe conditions and not humiliating or intimidating those reporting safety concerns. Pragmatism stimulates the teacher to consider the effectiveness of the preventative measures that have been used and whether proposed control measures are sufficient to minimise exposure to hazards. Constructivist reflection allows for the revising of professional judgments based on experience, evidence and dialogue, and critical pedagogy helps to question unsafe assumptions and inappropriate authority-based decisions. Ferdman and Ratti (2024) address the ethical and political issues in engineering education, which shows the general applicability of ethics issues to the preparation of technical professionals. The significance of incorporating affective involvement with ethical reasoning is further discussed by Kotluk and Tormey (2023). The observed increase in decision making performance is consistent with the educational rationale of these methods, but the outcome measured is performance on the scenarios and not directly observed response to real emergencies.

The discovery is additionally in line with a research that highlights the significance of active learning, critical thinking, and problem-based approaches in vocational training. López et al. (2023) explore the process of critical thinking development in technical and vocational education, while Yu and Zin (2023) provide a review on the approaches to enhance critical thinking using problem-based learning. Anthony et al. (2025) also discuss the connection between problem-based learning and critical thinking in the field of vocational education. These studies show that contextualized problems, reflective questioning, collaborative investigation and justification of decisions are relevant approaches in instruction that can be used in developing higher order cognitive skills. The philosophy-based programme ensured these elements were integrated by asking teachers to reflect on problem issues in the workshops, to engage in conversations about competing demands, to consider the reasons for taking preventative measures and to

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review decisions from other angles. Rasouli et al. (2025) further highlight the significance of authentic tasks and assessment of behavioural outcomes in safety training. The following contributions shed light on why a fusion of philosophical thought with actual scenarios of safety practice can yield learning outcomes in addition to the rote learning of rules and normal practice.

It is crucial to understand the difference between conventional safety training and the type of professional development that is guided by philosophy when interpreting Research Question 2. Conventional training offers key technical information regarding hazard identification, personal protective equipment, machinery inspections, emergency response, compliance, etc. This knowledge is still invaluable in the provision of safe training for vocational activities. But it can be seen that the traditional methods are not always effective as in the case when safety education is based on the transfer of information without involving learners in complex safety decision-making processes, as highlighted by Rafindadi et al. (2023). Gong et al. (2024) and Man et al. (2024) discuss technology-integrated safety training and demonstrate the significance of instructional modality and assessment design on learning outcomes. These studies indicate that effectiveness of education is not solely related to the information conveyed, but also to the opportunities afforded to the application of knowledge to meaningful situations. This dimension of the programme was dealt with by the philosophy-informed programme which incorporated technical safety information whilst also providing for structured ethical reflection, discussion and analysis of conflicting professional demands. The reported between group difference is thus important in the context of a possible extra educational benefit of the philosophical reasoning supplementary to the traditional occupational safety instruction.

However, the result of the assessment should be interpreted based on the nature of the scenario-based instrument used in this assessment which is 12 items. The results show that there is better performance in choosing appropriate responses, however, written scenarios have some limitations in representing the time pressure, environmental uncertainty, emotional aspects and risks for physical injuries that are present in the real incidents at the workshop. The internal consistency estimates for this dichotomously scored assessment was 0.720 at pretest and 0.712 at posttest, representing acceptable internal consistency. But internal consistency is not on its own proof of that scenario transfer to real-time safety decisions. NIOSH and CDC (2024) highlight the need to ensure safe practices at work are observed by young workers, and that effective education results in appropriate behaviour, noting that education is a necessary but insufficient step. The results of Research Question 2 therefore indicate that the use of philosophical reasoning can be seen to be relevant to the assessed safety-related decision-making and that further research that is directly observed, involves practical hazard-recognition assessments and is conducted over a longer period of time would be beneficial to verify the transfer of these competencies into day-to-day vocational workshop practice.

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5.3 Research Question 3: Joint Development of Safety Culture and Decision-Making

Research Question 3 explored the relationship between the use of the philosophy in professional development and the two outcomes that were measured: teacher perceived workshop safety culture and safety-related decision making performance. The third research question focused on whether or not the programme was related to a coherent profile of differences on both dimensions as opposed to analyzing the variables as stand-alone educational outcomes. As presented in Table 7, the paired multivariate Hotelling test produced $T^2 = 775.517$, corresponding to $F(2, 6) = 332.364$, $p < .001$. This means that overall, the treatment and control conditions in this study showed a statistically significant difference under the multivariate model reported. The individual outcome analyses in Table 5 also showed favorability of differences between the groups, with Holm adjusted exact p value of .0156 for both outcomes. When combined, these findings suggest that there is consistency between the univariate and multivariate findings. However, it is important to note that the joint statistical difference does not prove that an improvement in one outcome caused an improvement in the other, and the number of matched-school pairs is limited, which makes it difficult to interpret the multivariate F approximation.

The theoretical implications of this finding are that there is a correlation between safety culture and professional decision-making. Safety culture is exemplified by the professional values and expectations, communication styles, and daily operations of teachers, while safety-related decision making relates to the capacity to assess and choose specific protection measures when confronted by specific hazards. The philosophical foundations give these dimensions a conceptual bridge between their ethical responsibility and their reflective judgement and practical application. Ethics of care promotes attention to persons who are likely to be affected by a potentially unsafe decision, and human-rights reasoning promotes the protection of dignity and the most basic safety needs. Pragmatism aids in assessing preventive measures based on the practical outcomes and participatory dialogue can help to consider various views when identifying and managing occupational hazards. Reflective practice also helps with the rethinking of routine practices after new information has been acquired or near miss situations have occurred. Gallier & Duarte (2025) warn against boiled down organisational safety culture, and Adra et al. (2024) recall the need for leadership behaviours to influence safety expectations. These viewpoints provide insight into the possible connection between professional development regarding ethical reasoning and institutional communication with regard to reported safety culture and scenario-based decision-making.

The link between the two outcomes is also in line with the current views on vocational education and teacher professional development. Within TVET, UNESCO (2022) highlights quality in teaching, inclusiveness, and adapting to new demands of the education and job markets. The OECD (2023) also emphasizes the need for flexible skills in vocational education programs, especially when it involves professional work that is

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subject to shifts in workplace scenarios. Siliņa-Jasjukeviča et al. (2025) speak about the significance of implementing the PD of vocational teachers into the sustainable teaching practice. These contributions justify the educational reasons behind the need to combine the practice of philosophical reflection with occupational safety practice. The outcome pattern that was combined was of specific relevance because the programme focused on teachers' knowledge about their safety role as well as on teachers' use of judgment in a structured occupational dilemmas. A correlation between these dimensions implies that the process of professional development with regard to safety requires an interdisciplinary approach to values, reasoning, communication and practice.

Table 8 illustrates some exploratory results that offer additional context to this pattern of combination. There were positive differences at the pair level on ethical responsibility (+0.560), participatory voice (+0.737), reflective risk judgment (+0.508) and preventive implementation (+0.503). The greatest difference occurred with participant voice, suggesting that communication and collaborative safety engagement were key aspects of the reported safety culture change. This is pertinent to the interpretation of Research Question 3 as the decisions that are made in terms of safety in the workplace are rarely made in isolation of organisational relationships and communication. When looking for hazards or identifying what to do to prevent them, teachers frequently rely on information provided by students, colleagues, workshop leaders or institutional leaders. A more participatory context could thus offer opportunities for earlier identification of safety issues, and alternative reactions. The differences in the exploratory domain, however, do not in themselves prove causal relationships with respect to the pathways between participatory voice and scenarios performance. Such relationships would be created through analyses explicitly geared to the study of mediation, temporal ordering and the contribution of organizational conditions.

The results of the combined findings have to be understood in the context of the broader institutional setting of occupational safety. Ethical awareness and decision making abilities of teachers are among the important factors of prevention, but in addition to these there are machinery conditions, protective equipment, the state of the ventilation, the inspection procedures, management decisions and financial resources. The ILO (2023) highlights the importance of safe and healthy working conditions, and subsequent publications concerning "Occupational risks in the context of climate change" (ILO, 2024a) and "Digitalisation" (ILO, 2025) demonstrate the need for flexible and comprehensive safety systems. More context is provided regarding the development of vocational education in Jordan by UNESCO (2024a). These views comport with an overall institutional approach to improving safety in which professional development is a part. The successful use of these competencies even if teachers show higher values and decision-making performance will depend on the availability of appropriate technical and organizational support. The results, therefore, suggest that the philosophy aspects should be included in professional education, while the “extracting responsibilities of the institution, following regulations and establishing good hazard control systems” should remain the key points.

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Table 9 shows statistical diagnostics for the combined results, which offer more information on the consistency and interpretation of the results. There were no teacher records missing across the 128 teachers for any of the four composite outcome measures and baseline standardized mean differences were 0.102 for safety culture and 0.137 for decision-making. Both values show small descriptive differences between the groups at baseline, but do not provide evidence of statistical equivalence. For both outcomes, the eight matched-school pair contrasts were in favor of the intervention, and the leave-one-pair-out analysis was in the range of 0.551 to 0.607 for safety culture and 2.268 to 2.536 for decision-making. Results from these analyses show that the positive estimated contrasts were found throughout when the individual matched pairs were omitted from the calculations. The school level randomization structure was significant as teachers within the same school shared institutional environments and professional practices. In this fashion, the exact matched-pair randomization tests were the primary inferential analyses, with the baseline-adjusted ANCOVA and the multivariate analysis being used for ancillary analyses. In interpreting these outcomes, the small number of independent school clusters was also taken into account, as was the difference between confirmatory outcome tests and exploratory domain comparisons.

The practical implications of Research Question 3 are related to the incorporation of philosophical understanding and professional judgment and institutional safety practices in vocational education. Results show positive differences in teacher-perceived safety culture as well as in safety-related decision-making, which implies that an education approach that combines ethical responsibility, reflective inquiry, participatory communication, and preventive reasoning can be beneficial. However, the two results need to be held separately analytically. Better perceptions of safety culture does not necessarily mean better practical performance, and better decisions based on scenarios does not necessarily mean that there is sustained organizational change. The results of both studies thus confirmed the educational value of studying these dimensions as a whole, but with regard to their specific measurement properties. Future research involving delayed assessments, independent observations of workshops, recorded and documented hazard control practices, and verified occupational safety indicators will offer a wider view of whether changes in professional perceptions and assessed judgment will be maintained and will be linked to safer instructional environments.

6. CONCLUSION

The results show the importance of the philosophical foundations for educational purposes in the improvement of public safety culture in workshops of vocational secondary schools. Ethical care and human rights illuminate the moral duty to keep pupils safe and provide safe learning conditions; pragmatic enquiry enriches evidence-based risk decisions; critical dialogue involves pupils in active participation and the communication of concerns about safety; and reflective constructivist practice continuously enhances the safety of professional practice. These related principles were investigated in an eight week professional development programme, informed by the philosophy, employing a matched-pair, school-cluster-randomized pretest–posttest

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design and two instruments of assessment. The statistical analysis focused on difference between experimental group teacher-perceived workshop safety culture and teacher-perceived safety-related decision-making between the experimental and control groups. The results highlight the need to incorporate the philosophical dimension in the traditional occupational safety education, so as to enhance the professional awareness, moral responsibility, reflective ability and prevention ability of teachers. This type of integration offers a good educational base that can be used for the development of a more participative and ethically based safety culture in vocational schools. However, the outcomes measured are perceptions and decisions based on scenarios rather than actual decreases in occupational accidents. Further longitudinal studies with direct observations of practices in the workshops would help to reinforce the knowledge of the continuous contribution of the philosophical basis of vocational education.

Recommendations

1. `Embed the philosophical aspect and ethical responsibility in safety training programmes for vocational teachers.
2. Enhance teachers' ability to make safety decisions through hands-on training and reflective exercises.
3. Promote teacher and student involvement in hazard identification and prevention in the workshop.
4. Foster a culture of safety for human dignity, professional responsibility and critical thinking.
5. `Carry out additional research to explore the effects of philosophy-based training over the long term on workshop safety practices.

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APPENDIX A. Teacher-Perceived Workshop Safety Culture Scale

Teacher study code: _____ **Time point:** PRE / POST **Date:** _____

Workshop specialty: _____ **Years of teaching:** _____

Teacher instructions: For each statement, circle a number (1-5). Think about the workshops you are teaching or supervising for the current teaching period. Do not make pupil names or identifiable incidents. The answers range from 1 = Strongly disagree to 5 = Strongly agree. The study was voluntary and all responses confidential.

No.	Statement	1	2	3	4	5
01	Any workshop injury that can be prevented is a matter of professional responsibility.	☐	☐	☐	☐	☐
02	I explain human factors relating to workshop safety requirements.	☐	☐	☐	☐	☐
03	Student safety is paramount if a practical activity becomes unsafe.	☐	☐	☐	☐	☐
04	I help students immediately when I can see that they may suffer harm that is avoidable.	☐	☐	☐	☐	☐
05	I assess safety rules for fairness of their protection of different learners.	☐	☐	☐	☐	☐
06	I welcome caring of classmates/care of other individuals who share workshop space.	☐	☐	☐	☐	☐
07	Students can let me know about a hazard without being embarrassed or punished.	☐	☐	☐	☐	☐
08	I welcome questions if the rationale behind a safety procedure is not apparent.	☐	☐	☐	☐	☐
09	Pupils are encouraged to halt an activity and ask for help if they aren't sure.	☐	☐	☐	☐	☐
10	I talk about near misses, putting the emphasis on learning rather than fault.	☐	☐	☐	☐	☐
11	Respectful challenges to my safety decisions can be made by other teachers.	☐	☐	☐	☐	☐
12	I allow time to be made for those with various needs to voice safety concerns.	☐	☐	☐	☐	☐
13	I explain what evidence is available to support a determination as to whether a workshop is a risk.	☐	☐	☐	☐	☐
14	Before implementation of a practical solution, I review alternative hazard controls.	☐	☐	☐	☐	☐
15	My decisions in regards to safety in my workshops evolve as new information is shared.	☐	☐	☐	☐	☐
16	I explore how production pressure can lead to flawed decisions with regard to acceptable risk.	☐	☐	☐	☐	☐

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17	I scrutinise the new safety suggestions carefully before using them in the workshop.	☐	☐	☐	☐	☐
18	After an unwarranted safety issue I think about how to teach.	☐	☐	☐	☐	☐
19	I make sure that necessary safeguards are in place prior to practical activities.	☐	☐	☐	☐	☐
20	Ensuring that protective equipment is suitable and available for each learner.	☐	☐	☐	☐	☐
21	I allow sufficient time for pupils to work safely.	☐	☐	☐	☐	☐
22	I report hazards or near misses as per school's process.	☐	☐	☐	☐	☐
23	Rechecks safety routines in response to feedback from students and colleagues.	☐	☐	☐	☐	☐
24	I verify that preventive improvements have been implemented.	☐	☐	☐	☐	☐

Researcher scoring instructions (not included as questions): Six item-domains are as follows: 01-06 (ethical responsibility), 07-12 (participatory voice), 13-18 (reflective risk judgment), and 19-24 (preventive implementation). Domain scores were obtained by averaging the six items within each domain and the overall Safety-culture score was obtained by averaging the 24 items. The higher scores indicated better perceptions of workshop safety culture. Before administering the instrument, it was reviewed and content validated by experts. Cronbach's alpha was used to check for internal consistency and the scale was administered both at the pretest and posttest under identical scoring procedures.

APPENDIX B. Safety Decision-Making Test (12 Scenarios)

Teacher study code: _____ **Time point:** PRE / POST **Date:** _____

Instructions: For each workshop situation, select ONE professionally justified answer (A, B or C). Take into account compulsory safety guidelines and local equipment procedures. The assessment focuses on safety-related decision making in vocational workshop environments and is not meant to be a substitute for the operational emergency procedures or institutional safety rules. Make sure not to consult with another player.

01: Prior to a student using a rotating machine, a guard is seen that is damaged.

A: Stop access, machine isolate as per procedure, report and arrange competent repair.

B: Continue slowly.

C: Have the student pay special attention.

Selected response: A [ ] B [ ] C [ ]

02. During a demonstration a student claims that an emergency stop button had failed.

A: Trial it in the presence of students.

B: Take equipment out of service and report for competent inspection.

C: Ignore as there is no injury.

Selected response: A [ ] B [ ] C [ ]

03. The workshop is behind schedule and students want to forego an essential PPE check.

A: Take a break this time.

B: Let students decide.

C: Keep checking and adjust the time duration for tasks.

Selected response: A [ ] B [ ] C [ ]

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04. Student complains of exposure to dust again, even with the ventilation on.

A: Document, stop or modify the appropriate task and get a competent exposure/control review.

B: ST: Do not complain.

C: Only give a cloth mask.

Selected response: A [ ] B [ ] C [ ]

05. Teacher sees a student being teased for reporting an unsafe cable.

A: Dismiss the incident.

B: Defend the student reporting the intimidation incident, investigate intimidation and fix the hazard.

C: Punish the reporter only.

Selected response: A [ ] B [ ] C [ ]

06. There is an online answer stating that there is no problem with a chemical mixture; however, the SDS suggests that there is.

A: Accept the Internet answer.

B: Conduct a mini student assessment.

C: Obey trusted safety advice and get sound counsel.

Selected response: A [ ] B [ ] C [ ]

07. The standard size protective equipment is not safe for use by a learner with a disability.

A: Set up proper protection and reachable lessons prior to exposure.

B: Make use of what is available.

C: Do not pursue adjustments; exclude the learner.

Selected response: A [ ] B [ ] C [ ]

08. There is a near miss and no one is hurt.

A: File nothing.

B: List and revisit the reasons why without judgement; monitor controls.

C: Wait until an injury has occurred.

Selected response: A [ ] B [ ] C [ ]

09. Colleague asks students to turn on/off power when maintenance without checking.

A: Commit to save time.

B: Give careful student.

C: Stop the task, isolate and verify.

Selected response: A [ ] B [ ] C [ ]

10. Two controls for repeated moving parts are suggested.

B: Prefer using reminders over engineering controls to eliminate or isolate access.

B: Use signs only.

C: Remind students to be vigilant.

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Selected response: A [ ] B [ ] C [ ]

11. "Several students indicate that directions are not clear in the language used.

A: Repeat faster.

B: Modify instructions for accessibility and check for understanding prior to operating.

C: Delegation to peers is complete.

Selected response: A [ ] B [ ] C [ ]

12. During a fire evacuation drill, it is discovered that an exit is blocked.

A: Do so until a true emergency arises.

B: Pass pupils through the obstruction.

C: Clear the blockage by proper means and revise the evacuation procedure.

Selected response: A [ ] B [ ] C [ ]

RESEARCHER-ONLY ANSWER KEY — NOT INCLUDED IN PARTICIPANT COPIES

01 = A; 02 = B; 03 = C; 04 = A; 05 = B; 06 = C; 07 = A; 08 = B; 09 = C; 10 = A; 11 = B; 12 = C.

Researcher scoring: 1 point was given for each correct answer; 0 if incorrect. The scores were added together to create a total score between 0 and 12, with higher scores reflecting greater ability to make safety-related decisions. The scenarios were reviewed by experts to ensure they are clear, relevant, and aligned with occupational safety requirements. Cronbach alpha (alpha for dichotomously scored items is equivalent to KR-20) was used to evaluate the internal consistency of the instruments. An answer key was kept in a separate document from the teacher assessment document to ensure that pretest and post test procedures were kept intact.