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Analysis of Occupational Safety and Health Culture Through Students' Awareness of Workplace Hazards: A Study of Clause 7.3 of ISO 45001:2018

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ABSTRACT

Laboratory environments in higher education institutions present significant occupational hazards, yet systematic safety management remains largely underdeveloped, particularly in specialized facilities such as the Highway Engineering Laboratory. This study aims to analyze the safety culture through the level of OSH awareness among Civil Engineering students at the Highway Engineering Laboratory of Universitas Lampung based on Clause 7.3 of ISO 45001:2018. A quantitative descriptive method was employed, with data collected from 150 students of the 2023 cohort using a total sampling technique and an 11-item Likert-scale questionnaire across five dimensions: OSH policy awareness, contribution to OSH, benefits of OSH performance, implications of non-conformance, and SOP observance. The results indicate an overall mean awareness score of 2.41 (*Low*), with the lowest scores recorded in OSH Policy Awareness (2.11) and SOP Observance (2.19), attributable to the confirmed absence of a formal OSH policy and documented SOP in the laboratory. These findings conclude that the laboratory has not fulfilled the foundational requirements of ISO 45001:2018, necessitating immediate development of formal safety documentation and structured OSH orientation programs.

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1. INTRODUCTION

Occupational Safety and Health (OSH) has become a fundamental concern in both industrial and academic settings worldwide. The increasing complexity of work environments, including those found in educational institutions, has heightened the need for systematic safety management frameworks. Globally, workplace accidents continue to impose significant human and economic costs, underscoring the urgency of establishing robust safety cultures at every level of work activity (Azizi, 2024; Bora et al., 2025). In Indonesia, the implementation of OSH in higher education laboratories remains a critical yet often overlooked domain, as most regulatory attention has historically been directed toward the industrial sector (Mahendra 2025; Rengkuan et al., 2024). Laboratories within universities, despite hosting complex and potentially hazardous activities, frequently operate without standardized safety management systems, creating conditions that are conducive to preventable accidents. The integration of OSH principles into academic laboratory

environments is therefore not only a matter of regulatory compliance but also a foundational step toward cultivating a long-term safety culture among future professionals (Alfafa, 2024; Sholeha, 2025).

Empirical evidence consistently demonstrates that laboratory environments in educational institutions are not immune to occupational hazards and accidents. Studies conducted across various types of academic laboratories in Indonesia have documented recurring safety violations, inadequate use of personal protective equipment (PPE), and insufficient hazard communication practices (Purnomo & Saputro, 2023; Sulistiyowati et al., 2023). In engineering and vocational laboratories, evaluations have revealed that students and laboratory staff are routinely exposed to physical, chemical, and ergonomic hazards without adequate protective measures in place (Dodie et al., 2025; Ratu et al., 2025). The consequences of such exposures range from minor injuries to potentially life-threatening incidents, all of which are largely preventable through systematic hazard identification and risk control (Bora et al. 2025; Mahendra et al., 2025). These findings collectively highlight a systemic gap in OSH governance within academic laboratory settings, particularly in Indonesian polytechnics and universities where practical training constitutes a significant portion of the curriculum.

Among the various types of academic laboratories, the Highway Engineering Laboratory (*Laboratorium Jalan Raya*) presents a distinctive and relatively underexplored risk profile. This type of laboratory involves the use of heavy equipment, high-temperature materials such as asphalt bitumen, abrasive aggregates, and mechanical testing machines that generate significant levels of noise, dust, and heat (Mahendra, 2025; Soehardi et al., 2025). Unlike chemistry or biology laboratories, where hazard profiles are more widely documented, the Highway Engineering Laboratory combines physical, chemical, and mechanical hazards in a single workspace, making comprehensive risk management particularly challenging (Mahendra, 2025; Mahendra et al., 2026). The operational activities conducted in this environment — including Marshall test procedures, aggregate sieve analysis, and bitumen penetration testing — require direct student interaction with hazardous materials and equipment, often under time-constrained practical session conditions (Soehardi et al., 2025). Despite this complex risk landscape, dedicated OSH evaluations of Highway Engineering Laboratories remain scarce in the Indonesian academic literature, representing a significant gap that warrants targeted investigation.

Students who participate in laboratory practicum activities occupy a particularly vulnerable position within the occupational safety hierarchy. Unlike trained industrial workers, students typically lack formal occupational experience and possess limited familiarity with workplace hazard recognition and risk mitigation procedures (Purnomo & Saputro, 2023). Their engagement in laboratory activities is often task-oriented and performance-driven, which may cause them to deprioritize safety protocols in favor of completing experimental procedures within allotted time frames (Dodie et al., 2025; Sulistiyowati et al., 2023). Furthermore, the role of Laboratory Education Technicians (*Pranata Laboratorium Pendidikan*/PLP) in supervising and enforcing safety standards during practicum sessions has been found to be inconsistently applied, leaving students with insufficient guidance on proper safety behavior (Mahendra et al., 2026; Sholeha, 2025). This combination of limited personal experience, inadequate supervision, and insufficient safety education creates a structural vulnerability that significantly elevates the risk of occupational incidents in academic laboratory settings.

Within the framework of ISO 45001:2018, Clause 7.3 specifically addresses the requirement for *awareness* as a critical component of an effective Occupational Health and Safety Management System (OHSMS). This clause mandates that all workers — and by extension, laboratory users — must be aware of the organization's OSH policy, their contribution to the effectiveness of the OHSMS, the implications of non-conformance, and the specific hazards and risks associated with their work activities (Azizi, 2024; Soewardi et al., 2026). Awareness, in this context, transcends mere knowledge acquisition; it constitutes an active, internalized understanding that shapes behavioral responses to occupational hazards and serves as the cognitive foundation of a sustainable safety

culture (Soewardi et al., 2026; Thressia, 2025). Research has consistently demonstrated that the level of OSH awareness among laboratory users is a reliable predictor of safety behavior compliance, accident frequency, and the overall maturity of an organization's safety culture. Therefore, measuring student awareness through the lens of Clause 7.3 ISO 45001:2018 provides a theoretically grounded and practically meaningful instrument for diagnosing the state of safety culture in academic laboratory environments (Azizi, 2024; Fitri et al., 2026).

Despite the existence of internationally recognized OSH management standards such as ISO 45001:2018, a substantial implementation gap persists between regulatory frameworks and actual safety practices in Indonesian university laboratories. Several studies have reported that many academic institutions have not formally adopted OHSMS frameworks, relying instead on informal safety guidelines that lack systematic hazard identification, risk assessment, and corrective action mechanisms (Azizi, 2024;Mahendra, 2025)). Where OSH evaluations have been conducted, the findings consistently reveal deficiencies in safety training, inadequate provision of personal protective equipment, and an absence of documented safety procedures accessible to laboratory users (Alfafa, 2024; Mulyadi et al., 2023). The gap is particularly pronounced in the domain of safety awareness, where students and laboratory personnel demonstrate limited understanding of their roles and responsibilities within the broader OSH management system. This disconnect between formal standards and lived laboratory practice suggests that the adoption of ISO 45001:2018 in Indonesian university settings remains aspirational rather than operational, necessitating evidence-based interventions grounded in context-specific empirical research (Mahendra, 2025; Soewardi et al., 2026)

Against this background, the present study aims to analyze the safety culture in the Highway Engineering Laboratory (*Laboratorium Jalan Raya*) at Universitas Lampung through the lens of student awareness (*tingkat kepedulian*) as defined by Clause 7.3 of ISO 45001:2018. By systematically assessing students' awareness of OSH policies, occupational hazards, risk implications, and their individual roles within the safety management system, this study seeks to provide an empirical portrait of the current state of safety culture in this specific laboratory context. The findings are expected to contribute to the growing body of literature on OSH implementation in Indonesian higher education, while also offering practical recommendations for laboratory managers, academic institutions, and policymakers responsible for advancing safety governance in educational environments. Furthermore, this study responds to the broader call for the integration of ISO 45001:2018 into academic laboratory management systems as a structured pathway toward the development of a proactive and sustainable occupational safety culture. Ultimately, improving student awareness is not merely a compliance objective but a transformative educational goal that prepares future engineers to uphold the highest standards of occupational safety in their professional careers.

2. RESEARCH METHOD

This study was conducted at the Highway Engineering Laboratory (*Laboratorium Jalan Raya*) of the Civil Engineering Department, Faculty of Engineering, Universitas Lampung, which serves as the primary practical training facility for undergraduate students enrolled in road and pavement engineering courses. The laboratory was selected as the research site due to its distinct operational characteristics, which involve direct student interaction with hazardous materials and heavy testing equipment, including asphalt bitumen, aggregate specimens, and mechanical compaction machines, thereby presenting a complex and representative OSH risk environment within an academic setting. The selection of this specific laboratory is further justified by the limited availability of dedicated OSH awareness studies targeting Highway Engineering Laboratories in Indonesian higher education institutions, making it a contextually significant and academically relevant research site. Data collection was carried out during the active practicum period of the 2024/2025 academic year, coinciding with the scheduled laboratory sessions of the 2023 cohort students, ensuring that all

respondents had recent and direct experience with the laboratory environment at the time of the survey.

This study employed a quantitative descriptive research design to systematically measure and analyze the level of OSH awareness among students at the Highway Engineering Laboratory in relation to the requirements of Clause 7.3 of ISO 45001:2018. A quantitative approach was selected because it enables the numerical measurement and statistical analysis of awareness levels across a defined population, thereby producing objective and reproducible findings regarding the current state of safety culture in the laboratory environment. The descriptive dimension of this design focuses on portraying the existing condition of student awareness without manipulating any variables, making it appropriate for evaluating the degree to which the four core dimensions of Clause 7.3 — namely OSH policy awareness, individual contribution, benefits of OSH performance, and implications of non-conformance — have been internalized by laboratory users. This methodological approach is consistent with previous quantitative descriptive studies that have been applied to evaluate OSH implementation and awareness in academic and technical laboratory settings across Indonesia.

Data were collected through a structured self-administered questionnaire distributed to all research respondents during their scheduled laboratory practicum sessions. The questionnaire comprised 11 items organized across five dimensions derived from Clause 7.3 of ISO 45001:2018, namely OSH policy awareness (*kebijakan K3*), individual contribution to OSH (*kontribusi terhadap K3*), benefits of OSH performance (*manfaat kinerja K3*), implications of non-conformance (*implikasi ketidakpatuhan*), and SOP observance (*observasi terkait SOP*), each of which reflects a distinct cognitive and behavioral component of occupational safety awareness in the laboratory context. Each item was measured using a five-point Likert scale ranging from 1 (*Strongly Disagree*) to 5 (*Strongly Agree*), which enables the quantification of awareness intensity and facilitates meaningful comparison across dimensions and respondent groups. A total sampling technique was applied, whereby all 150 students from the 2023 cohort of the Civil Engineering Department who had previously completed practicum activities at the Highway Engineering Laboratory were included as respondents, eliminating sampling error and maximizing the representativeness of the collected data. Prior to full-scale distribution, the questionnaire underwent content validation through expert review and reliability testing using Cronbach's Alpha to ensure that the instrument produced consistent and valid measurements of the targeted awareness dimensions.

The preparation phase of this study involved several sequential stages designed to ensure the methodological rigor and contextual relevance of the research instrument and data collection process. The initial stage consisted of an in-depth review of ISO 45001:2018, particularly Clause 7.3, as well as a systematic review of existing literature on OSH implementation in academic laboratories in Indonesia, which provided the theoretical and empirical foundation for the development of the questionnaire dimensions and items. Following the literature review, the questionnaire instrument was constructed by operationalizing the four awareness requirements of Clause 7.3 into measurable indicators, with an additional dimension specifically addressing students' awareness and observance of standard operating procedures (*SOP*) applicable to the Highway Engineering Laboratory, given the unique hazard profile of this facility. The instrument was subsequently submitted for expert validation involving OSH specialists and academic laboratory practitioners to assess its content validity, clarity, and alignment with the ISO 45001:2018 framework, after which revisions were made based on the feedback received. Administrative preparations were also completed during this phase, including the coordination of research permits with the laboratory management, scheduling of questionnaire distribution sessions in alignment with practicum timetables, and the briefing of respondents regarding the voluntary nature of their participation and the academic purpose of the study.

3. RESULTS AND DISCUSSIONS

Result

The results of this study present the descriptive statistical analysis of OSH awareness levels among 150 Civil Engineering students of the 2023 cohort who had completed practicum activities at the Highway Engineering Laboratory of Universitas Lampung. Awareness was measured across five dimensions derived from Clause 7.3 of ISO 45001:2018, comprising 11 questionnaire items scored on a five-point Likert scale. The scoring categorization applied in this study follows a standard interval conversion, whereby scores ranging from 1.00 to 1.79 are classified as Very Low, 1.80 to 2.59 as Low, 2.60 to 3.39 as Moderate, 3.40 to 4.19 as High, and 4.20 to 5.00 as Very High. The dimension-level results are presented in Table 1.

Table 1. OSH Awareness Score by Dimension (Clause 7.3 ISO 45001:2018)

No.	Dimension	Items (n)	Mean Score	Category
1	OSH Policy Awareness (Kebijakan K3)	2	2.11	Low
2	Contribution to OSH (Kontribusi terhadap K3)	2	2.38	Low
3	Benefits of OSH Performance (Manfaat Kinerja K3)	2	2.53	Low
4	Implications of Non-conformance (Implikasi Ketidakpatuhan)	2	2.67	Moderate
5	SOP Observance (Observasi terkait SOP)	3	2.19	Low
	Overall Mean Score		2.41	Low

As presented in Table 1, the overall mean awareness score across all five dimensions was 2.41, placing the student population in the Low category and indicating that the majority of students have not adequately internalized the OSH awareness requirements mandated by Clause 7.3 of ISO 45001:2018. Among the five dimensions, OSH Policy Awareness recorded the lowest mean score of 2.11 (*Low*), followed by SOP Observance at 2.19 (*Low*), Contribution to OSH at 2.38 (*Low*), and Benefits of OSH Performance at 2.53 (*Low*). The only dimension that reached the Moderate category was Implications of Non-conformance, with a mean score of 2.67, suggesting that students possess a slightly higher level of awareness regarding the personal consequences of safety violations compared to their understanding of institutional OSH policies and procedural requirements. The predominance of Low-category scores across four of the five measured dimensions confirms that the safety culture at the Highway Engineering Laboratory remains critically underdeveloped, particularly in relation to policy communication and SOP documentation — two foundational pillars of an effective OHSMS under ISO 45001:2018. The item-level breakdown of scores across all 11 questionnaire items is presented in Table 2 to provide a more granular analysis of the specific awareness deficiencies identified within each dimension.

Table 2. Item-Level OSH Awareness Score

Item	Statement	Mean Score	Category
Dimension 1: OSH Policy Awareness (Kebijakan K3)			
1.1	I am aware of the existence of a formal OSH policy in this laboratory	1.97	Low
1.2	I understand the OSH objectives applicable to practicum activities in this laboratory	2.25	Low
Dimension 2: Contribution to OSH (Kontribusi terhadap K3)			
2.1	I understand my role in contributing to OSH effectiveness during laboratory practicum	2.31	Low
2.2	I actively report unsafe conditions or potential hazards I observe in the laboratory	2.45	Low
Dimension 3: Benefits of OSH Performance (Manfaat Kinerja K3)			
3.1	I believe that implementing OSH procedures improves the overall safety of laboratory activities	2.48	Low
3.2	I perceive that good OSH performance benefits both individual students and the laboratory institution	2.58	Low
Dimension 4: Implications of Non-conformance (Implikasi Ketidakpatuhan)			
4.1	I understand that violating OSH procedures can result in accidents or injuries during practicum	2.89	Moderate
4.2	I am aware that non-compliance with OSH rules may lead to	2.45	Low

	institutional sanctions or academic consequences		
Dimension 5: SOP Observance (Observasi terkait SOP)			
5.1	I follow a written Standard Operating Procedure (SOP) during every practicum session in this laboratory	2.03	Low
5.2	I have been provided with a copy or access to the official SOP for laboratory activities	2.11	Low
5.3	I understand the step-by-step safety procedures for each experiment conducted in this laboratory	2.43	Low

The item-level analysis presented in Table 2 reveals several critical findings that warrant detailed interpretation. Within Dimension 1 (OSH Policy Awareness), Item 1.1 — which assessed students' awareness of the existence of a formal OSH policy in the laboratory — recorded the lowest score of the entire instrument at 1.97 (*Low*), indicating that the vast majority of students were unaware of any formally documented safety policy governing their practicum activities. Item 1.2 (mean = 2.25, *Low*) similarly reflected students' inadequate understanding of specific OSH objectives applicable to their laboratory work. Within Dimension 2 (Contribution to OSH), both items fell in the Low category, with Item 2.1 (mean = 2.31) and Item 2.2 (mean = 2.45) collectively suggesting that students neither understood their individual safety responsibilities nor engaged in proactive hazard reporting behaviors during practicum sessions. In Dimension 3 (Benefits of OSH Performance), Item 3.1 (mean = 2.48) and Item 3.2 (mean = 2.58) indicate that students have not fully recognized the value of OSH compliance, though the scores approach the upper threshold of the Low category, suggesting a marginally higher level of awareness in this domain relative to policy knowledge.

Dimension 4 (Implications of Non-conformance) produced the most divergent item scores across the entire instrument: Item 4.1 (mean = 2.89, *Moderate*) — addressing awareness that OSH violations can cause physical harm — was the highest-scoring item overall, while Item 4.2 (mean = 2.45, *Low*) — addressing awareness of institutional sanctions — remained considerably lower, revealing that students' consequence awareness is confined primarily to personal physical risk and does not extend to institutional or procedural dimensions. Finally, within Dimension 5 (SOP Observance), Items 5.1 (mean = 2.03) and 5.2 (mean = 2.11) both registered among the lowest scores in the instrument, a finding that is directly attributable to the confirmed absence of a formally documented Standard Operating Procedure in the Highway Engineering Laboratory, which structurally prevents students from accessing, referencing, or adhering to written safety protocols during their practicum activities. Item 5.3 (mean = 2.43, *Low*) further confirms that students lack a systematic understanding of step-by-step safety procedures for the experimental activities conducted in this laboratory.

Discussion

The overall mean awareness score of 2.41 (*Low*) obtained in this study reflects a concerning deficit in OSH awareness among Civil Engineering students at the Highway Engineering Laboratory of Universitas Lampung, a finding that is consistent with patterns documented in comparable academic laboratory environments across Indonesia. Mahendra (2025), in an evaluation of the same laboratory, identified significant shortcomings in OSH implementation, including the absence of formal safety documentation and insufficient hazard communication to students. Similarly, Thressia (2025) and Alfafa (2024) reported low OSH awareness and inadequate safety culture in university-level basic and engineering laboratories, suggesting that this deficit is systemic rather than institution-specific. The low overall score observed in the present study indicates that the requirements of Clause 7.3 of ISO 45001:2018 — which mandates that all laboratory users possess internalized awareness of OSH policy, individual contribution, performance benefits, and non-conformance implications — have not been adequately fulfilled in the study context.

The OSH Policy Awareness dimension recorded the lowest mean score among all five dimensions at 2.11, with the lowest individual item score of 1.97 corresponding to students' familiarity with the existence of a formal laboratory OSH policy. This finding indicates that the majority of students were entirely unaware of any institutionally documented safety policy governing their

practicum activities, a condition that fundamentally undermines the foundational requirement of Clause 7.3 ISO 45001:2018, which stipulates that workers must be aware of the OSH policy and its relevance to their work (Azizi, 2024; Mahendra, 2025). The absence of a communicated and accessible OSH policy in the Highway Engineering Laboratory is corroborated by findings from Mulyadi et al., (2023) dan Dodie et al., (2025), both of whom identified the lack of formal safety policy documentation as a recurring deficiency in Indonesian educational workshop and laboratory settings. Without a clearly communicated policy, students cannot reasonably be expected to align their behavior with organizational safety expectations, rendering the development of a safety culture practically impossible.

The SOP Observance dimension yielded the second lowest mean score of 2.19, a result that takes on additional significance in light of field observations conducted concurrently with this study, which confirmed that the Highway Engineering Laboratory of Universitas Lampung does not currently possess a formally documented and institutionally endorsed Standard Operating Procedure for student practicum activities. The absence of a written SOP directly explains the low item scores for statements regarding students' access to SOP documents (mean = 2.11) and their adherence to written safety steps during practicum sessions (mean = 2.03), as students cannot observe procedures that do not formally exist in documented form (Mahendra, 2025; Soehardi et al., 2025). This finding is particularly alarming given the complex hazard profile of the Highway Engineering Laboratory, which involves high-temperature asphalt materials, heavy compaction equipment, and abrasive aggregate handling — all of which require detailed step-by-step safety protocols to mitigate accident risk. The absence of an SOP represents a structural gap that not only contributes to low student awareness but also constitutes a direct non-conformance with the requirements of ISO 45001:2018 (Azizi, 2024; Fitri et al., 2026).

The Contribution to OSH and Benefits of OSH Performance dimensions both recorded mean scores in the Low category (2.38 and 2.53, respectively), indicating that students had a limited understanding of both their individual roles in maintaining laboratory safety and the broader benefits associated with effective OSH performance. These findings align with Purnomo & Saputro (2023) dan Sulistiyowati et al., (2023), who similarly found that students in practicum settings tend to perceive OSH compliance as an external obligation rather than an internalized personal responsibility, a cognitive orientation that is antithetical to the development of a proactive safety culture. The relatively higher score observed in the Implications of Non-conformance dimension (mean = 2.67, *Moderate*) — driven primarily by students' general awareness that accidents can cause physical harm (mean = 2.89) — suggests that students possess some rudimentary understanding of safety consequences at a personal level, yet this awareness does not extend to institutional or procedural implications, as evidenced by the low score for the item addressing awareness of academic or institutional sanctions (mean = 2.45) (Dodie et al., 2025; Mulyadi et al., 2023).

Collectively, the findings of this study demonstrate that the safety culture at the Highway Engineering Laboratory of Universitas Lampung remains at an embryonic stage, characterized by the absence of formal OSH documentation, insufficient policy communication, and a student population whose awareness falls predominantly in the Low category across the dimensions stipulated by Clause 7.3 of ISO 45001:2018. These conditions underscore the urgent need for the laboratory management and the Civil Engineering Department to prioritize the development and formal adoption of a comprehensive OHSMS, beginning with the formulation of a written OSH policy and laboratory-specific SOPs as foundational instruments for awareness development (Mahendra, 2025; Soewardi et al., 2026). Furthermore, structured OSH orientation programs should be integrated into practicum curricula to systematically build student awareness prior to their first laboratory engagement, consistent with recommendations advanced by Mahendra (2025), Rengkuan et al., (2024), dan Sholeha (2025), who collectively emphasize the critical role of proactive safety education in cultivating a sustainable OSH culture within academic institutions.

4. CONCLUSION

This study demonstrates that the level of OSH awareness among Civil Engineering students of the 2023 cohort at the Highway Engineering Laboratory of Universitas Lampung is predominantly low, with an overall mean score of 2.41 based on the five dimensions of Clause 7.3 of ISO 45001:2018, namely OSH policy awareness, contribution to OSH, benefits of OSH performance, implications of non-conformance, and SOP observance. The most critical deficiencies were identified in the OSH Policy Awareness dimension (mean = 2.11) and the SOP Observance dimension (mean = 2.19), both of which are directly attributable to the confirmed absence of a formally documented OSH policy and Standard Operating Procedure in the laboratory — a structural gap that prevents students from developing informed and consistent safety behavior regardless of their individual disposition toward safety. The only dimension approaching a moderate level was Implications of Non-conformance (mean = 2.67), suggesting that students possess a basic instinctive awareness of physical harm risk, yet lack the institutional framework necessary to translate this awareness into systematic safety compliance. These findings collectively indicate that the Highway Engineering Laboratory has not yet fulfilled the foundational requirements of ISO 45001:2018, and therefore the immediate development of a formal OSH policy, laboratory-specific SOPs, and a structured safety orientation program integrated into the practicum curriculum is strongly recommended as a prerequisite for cultivating a sustainable occupational safety culture within the laboratory environment.

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