

Analysis of the Stop Work Authority (SWA) Program and Development of a Microlearning Training Module for Construction Workers

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Abstract

Introduction: Construction projects with high risk levels require strong occupational safety and health systems, yet the implementation of the Stop Work Authority program often faces challenges such as uneven risk understanding, ineffective communication, limited training, and weak safety culture. **Objective:** This study aims to evaluate the influence of risk understanding, Stop Work Authority understanding, communication, and training on safety compliance, and to develop microlearning-based electronic learning media to enhance program effectiveness. **Method:** A quantitative descriptive cross-sectional survey was conducted involving construction workers, supervisors, and safety officers in a building project at Universitas Gadjah Mada, with 84 respondents selected from a population of 106. Data were collected using a validated and reliable Likert-scale questionnaire, supported by observations and interviews, and analyzed using descriptive statistics and multiple linear regression with classical assumption testing. **Result and Discussion:** The findings show that all variables are in good to very good categories, and all independent variables have a significant positive effect on safety compliance. Strengthening these aspects contributes to improved worker behavior and program implementation. **Conclusions:** Enhancing risk understanding, communication, and structured training supported by microlearning-based electronic learning is essential to improve safety compliance and strengthen safety culture in construction projects.

Introduction

Occupational accidents continue to pose a significant challenge across industrial sectors, particularly in construction, which is characterized by high-risk activities and complex work environments. Occupational Health and Safety (OHS) is designed as a preventive framework to reduce workplace accidents and protect workers health through the application of safety standards and supervision (Khoirunnisa *et al.*, 2023). However, despite regulatory efforts in Indonesia, accident rates remain high, showing gaps between policy and field implementation. Construction work involves hazardous tasks such as working at heights, operating heavy machinery, and adapting to dynamic site conditions, all of which increase accident risk. These conditions show that accident prevention is not solely dependent on regulations, but also on how safety practices are implemented at the operational level. Therefore, addressing occupational accident problems requires not only compliance with standards but also strengthening workers' proactive safety behavior.

The regulatory framework for OHS in Indonesia, including Law No. 1 of 1970 and Government Regulation No. 50 of 2012, provides a structured foundation for ensuring workplace safety through systematic risk management and worker involvement. These regulations emphasize continuous improvement and organizational responsibility in maintaining safe working conditions. However, the persistence of occupational accidents shows that regulatory compliance alone is insufficient to ensure effective safety performance. One of the main difficulties is translating formal policies into practical actions that can be consistently implemented in daily operations. This gap shows the importance of operational safety mechanisms that empower workers directly in hazard identification and response. One such mechanism is the Stop Work Authority (SWA), which serves as a practical tool to bridge the gap between policy and real-time safety action.

Empirical data further reinforce the urgency of addressing occupational accidents in Indonesia. From January to December 2024, there were 462,241 recorded occupational accident cases, with approximately 8,600 cases occurring in the construction sector based on claims data and participation proportions. These figures illustrate the magnitude of safety challenges faced by the construction industry, which involves high mobility, multi-stakeholder coordination, and hazardous exposures. In response, the government and industry stakeholders have promoted various safety initiatives, including the implementation of the Stop Work Authority (SWA) program (Bahtiar *et al.*, 2019). SWA provides workers with the formal right and responsibility to stop work when unsafe conditions are identified, thereby positioning workers as active agents in accident prevention. This approach shifts safety from being management-driven to participatory and behavior-based.

Despite its strategic importance, the implementation of SWA is influenced by various factors that affect workers compliance and effectiveness in practice. Research by Bahtiar *et al.* (2019) shows that limited understanding and lack of practical skills hinder workers from exercising their authority to stop unsafe work. Additionally, organizational factors such as poor communication, lack of coordination between contractors, and inconsistent policy dissemination contribute to implementation gaps. Cultural aspects, including hierarchical work structures and reluctance to confront unsafe practices, further discourage workers from intervening. Moreover, Liu *et al.* (2021) found that risk perception significantly influences workers safety behavior, where higher awareness leads to better compliance and safer decision-making. These findings show that SWA

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effectiveness is not solely determined by policy availability but also by cognitive, behavioral, and organizational factors.

Communication and leadership influence how workers comply with SWA policies in practice. Studies show that transformational leadership and effective supervisory communication significantly enhance safety awareness and encourage proactive safety behavior (Havinga *et al.*, 2021). A supportive work environment that fosters trust and open dialogue enables workers to report hazards and intervene without fear of negative consequences. Conversely, ineffective communication leads to hesitation and underreporting of unsafe conditions. Previous studies have explored SWA implementation across sectors, showing diverse influencing factors such as knowledge, motivation, and organizational culture (Bahtiar *et al.*, 2019; Havinga *et al.*, 2021; Manurung and Sukwika, 2021; Weber *et al.*, 2018; Sihombing, 2022; Murtasiyah and Halim, 2025a). These studies collectively show that while SWA is widely recognized, its effectiveness depends on how well supporting factors are managed. Thus, improving compliance requires an integrated approach that addresses behavioral, organizational, and communication aspects simultaneously.

Given the identified challenges, there is a clear need for innovative approaches to enhance workers understanding and compliance with SWA. Traditional training methods are often less effective in dynamic construction environments due to time constraints and limited engagement. Therefore, this study proposes the development of an interactive microlearning-based e-learning platform that incorporates video tutorials, quizzes, and real-life case studies. Microlearning offers short, focused, and accessible learning modules that are more suitable for construction workers' needs and work conditions. This approach is expected to improve knowledge retention, practical skills, and safety awareness more effectively. Based on this background, this study aims to analyze factors influencing SWA implementation, evaluate the role of risk perception and communication in safety compliance, and assess the effectiveness of training interventions. Ultimately, this research seeks to contribute to improving occupational safety performance through innovative and practical training solutions.

Method

This study used a quantitative descriptive design to examine the effect of the Stop Work Authority (SWA) program on safety compliance among construction workers. The approach was chosen to measure the relationship between SWA understanding, risk perception, communication, and training with safety compliance in a structured and testable way. Data were collected using a cross-sectional survey to reflect actual conditions at one point in time. The study also applied a program evaluation perspective to assess both the implementation process and its outcomes. Data collection methods included questionnaires, field observations, and interviews with HSE officers and supervisors to capture supporting and limiting factors of SWA implementation. The research was conducted at PT XYZ on a seven-story construction project at Universitas Gadjah Mada (UGM), Yogyakarta, which represents a high-risk work environment. The study was carried out from January to June 2026 and involved workers, supervisors, and HSE personnel who had at least three months of experience in SWA implementation. Sampling was conducted using the Slovin method, and the variables examined included SWA understanding, risk perception, communication, and training as factors influencing safety compliance.

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The population of this study consisted of 106 personnel, including workers, supervisors, and HSE staff involved in the construction project. The sample size was determined using the Slovin formula as (1):

$$n = \frac{N}{1+Ne^2} \quad (1)$$

where n represents the sample size, N is the population size, and e is the margin of error (0.05). Based on the calculation used (1):

$$n = \frac{106}{1+106(0.05)^2} = \frac{106}{1+0.265} = \frac{106}{1.265} = 84 \quad (2)$$

Thus, a total of 83 respondents were selected proportionally and randomly from the eligible population. This sampling approach ensures representativeness and minimizes sampling bias. The use of proportional random sampling allows each subgroup within the population to be adequately represented.

This study includes independent and dependent variables with clearly defined indicators. The independent variables consist of SWA understanding, risk perception, communication, and SWA training, while the dependent variable is safety compliance. SWA understanding covers workers knowledge of rights, responsibilities, hazard identification, sanctions, and emergency conditions. Risk perception refers to the ability to identify hazards, assess risks, understand consequences, and respond through preventive actions or SWA intervention. Communication focuses on the clarity of information, two-way interaction, and communication processes related to safety. SWA training includes aspects such as training schedules, materials, and its impact on workers' behavior. Safety compliance is measured through indicators such as PPE use, adherence to rules, reporting unsafe conditions, and participation in safety programs. Data were collected using a structured questionnaire with a Likert scale from 1 (very poor) to 4 (very good), supported by observations and interviews. The instrument was developed based on relevant theories and previous studies and was tested for validity using Corrected Item-Total Correlation and reliability using Cronbach's Alpha. Descriptive statistics, including mean, standard deviation, minimum, and maximum values, were used to summarize the data.

To facilitate interpretation, variable scores were categorized into four levels using interval calculations based on the formula (3):

$$\text{Interval} = \frac{\text{Maximum Score} - \text{Minimum Score}}{4} \quad (3)$$

The classification of variables is presented in the Tables 1-5.

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Table 1
Risk Perception Variable Category

Category	Score Range	Description
Very Poor	8 -14	STB
Poor	14.1 -20	TB
Good	20.1 -26	B
Very Good	26.1 -32	SB

Table 2
SWA Understanding Variable Category

Category	Score Range	Description
Very Poor	8 -14	STB
Poor	14.1 -20	TB
Good	20.1 -26	B
Very Good	26.1 -32	SB

Table 3
Communication Variable Category

Category	Score Range	Description
Very Poor	7 -12.25	STB
Poor	12.26 -17.50	TB
Good	17.51 -22.75	B
Very Good	22.76 -28	SB

Table 4
SWA Training Variable Category

Category	Score Range	Description
Very Poor	8 -14	STB
Poor	14.1 -20	TB
Good	20.1 -26	B
Very Good	26.1 -32	SB

Table 5
Safety Compliance Variable Category

Category	Score Range	Description
Very Poor	5 -8.75	STB
Poor	8.76 -12.50	TB
Good	12.51 -16.25	B
Very Good	16.26 -20	SB

Before running the regression analysis, several assumption tests were conducted, including normality, multicollinearity, and heteroscedasticity. Normality was tested using the Kolmogorov-Smirnov test, where a significance value above 0.05 shows normal data distribution. Multicollinearity was checked using Tolerance and Variance Inflation Factor (VIF), with Tolerance values above 0.10 and VIF below 10 showing no multicollinearity. Heteroscedasticity was examined using scatterplots and the Glejser test. Multiple linear regression was then used to analyze both the simultaneous and partial effects of the independent variables on safety compliance. Hypothesis testing was carried out using the t-test, F-test, and the coefficient of determination (Adjusted R²) to evaluate the model's explanatory power. All data were analyzed using SPSS software to ensure accurate results. In addition, this study developed an interactive e-learning platform based on microlearning principles to improve workers understanding of SWA. The development process included needs analysis, content design, material development, and platform implementation. The platform provides short modules, videos, quizzes, and case studies to support engagement and knowledge retention. Microlearning was chosen because it

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delivers concise content that fits the limited time and dynamic conditions of construction work. This study also followed ethical principles, including informed consent, confidentiality, and voluntary participation, with all data used only for research purposes.

Result and Discussion

1. Result

This study produces an e-learning based SWA training package designed to improve workers understanding and safety compliance in construction projects. The development of this learning output is based on the statistical findings and field observations, particularly the significant influence of risk perception, SWA understanding, communication, and training on safety compliance. The training package consists of a microlearning-based module, instructional videos, and a post-test, all integrated into a single Google Sites platform to provide easy and centralized access for users. The SWA training module is developed as the main learning component using a microlearning approach, where materials are divided into short and focused units. Each unit includes learning objectives, key explanations, case examples, and summaries to help workers understand the material gradually. The content is directly aligned with the variables identified in this study, including hazard identification, risk assessment, SWA procedures, communication, and safety compliance.

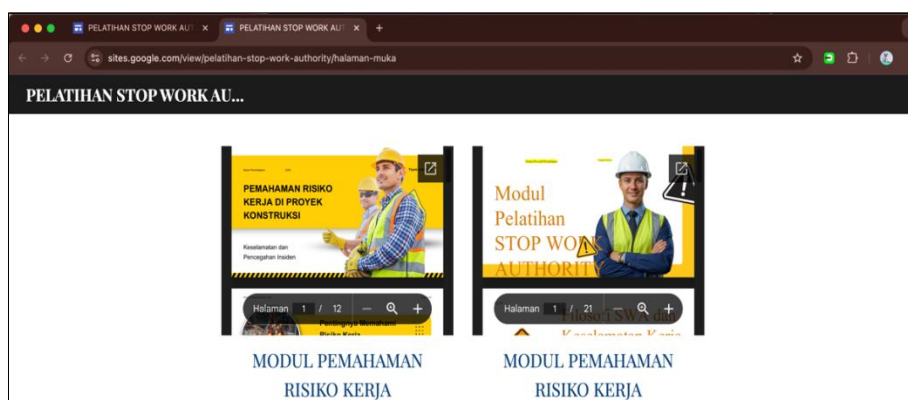


Figure 1. Microlearning-Based SWA Training Module Displayed

The module explains step-by-step procedures for implementing SWA, from recognizing hazards to reporting and resuming work after conditions are safe. It also emphasizes worker rights to stop unsafe work without fear of punishment, as well as their responsibility to report hazards properly. Communication aspects are included to address barriers such as hierarchical culture and hesitation to speak up. The module translates research findings into practical guidance that can be directly applied in the field. The instructional video is developed to strengthen understanding and connect theoretical concepts with real work situations. It presents messages such as recognizing unsafe conditions, as decisions to stop work, and following proper SWA procedures. The video is designed based on actual field conditions observed during the study.

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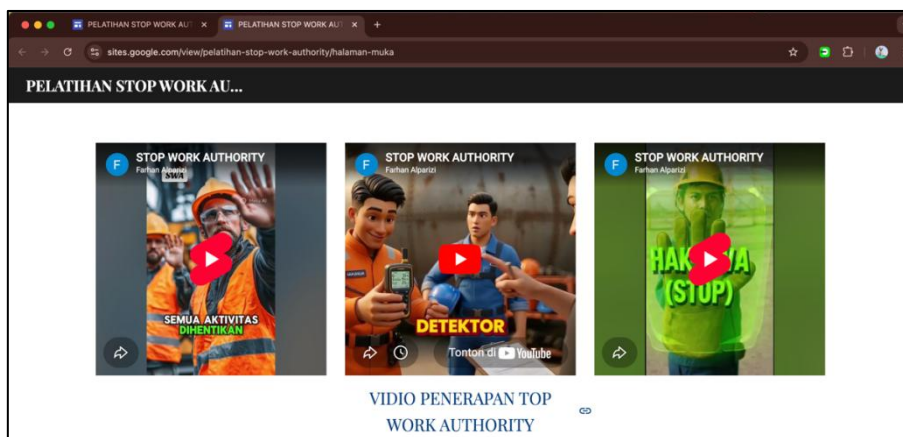


Figure 2. SWA Instructional Video

Each video has a short duration to match microlearning principles and accommodate workers limited time on site. The video is integrated into the same platform as the module, allowing a structured learning flow from reading to visual understanding. The post-test is designed to evaluate workers understanding after completing the learning materials. It is delivered through Google Forms and consists of multiple-choice questions based on the study variables, including risk perception, SWA understanding, communication, and safety compliance.

The validity test was conducted using the Corrected Item-Total Correlation (CITC) method, where an item is considered valid if the CITC value exceeds 0.30. The results of the validity test for the Risk Perception variable are presented in Table 6, All items (RK1-RK8) showed CITC values ranging from 0.394 to 0.698, which are all above the minimum threshold. This shows that each item has a sufficient correlation with the total score of the variable. Therefore, all items in the Risk Perception variable are considered valid and suitable for further analysis.

Table 6
 Validity Test of Risk Perception Variable

Statement	CITC	Description
RK1	0.589	Valid
RK2	0.509	Valid
RK3	0.394	Valid
RK4	0.698	Valid
RK5	0.542	Valid
RK6	0.519	Valid
RK7	0.504	Valid
RK8	0.581	Valid

Similarly, the validity test results for the SWA Understanding variable are presented in Table 7. The CITC values for all items (PEM1-PEM8) ranged from 0.449 to 0.662, exceeding the minimum criterion of 0.30. This shows that each item has a strong relationship with the total score and adequately reflects workers' understanding of the SWA program. Therefore, all items in the SWA Understanding variable are declared valid. The Communication variable also showed valid results, as presented in Table 8, with CITC values ranging from 0.383 to 0.488.

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Table 7
Validity Test of SWA Understanding Variable

Statement	CITC	Description
PEM1	0.449	Valid
PEM2	0.662	Valid
PEM3	0.557	Valid
PEM4	0.485	Valid
PEM5	0.455	Valid
PEM6	0.500	Valid
PEM7	0.498	Valid
PEM8	0.506	Valid

Table 8
Validity Test of Communication Variable

Statement	CITC	Description
KOM1	0.383	Valid
KOM2	0.488	Valid
KOM3	0.462	Valid
KOM4	0.478	Valid
KOM5	0.459	Valid
KOM6	0.435	Valid
KOM7	0.476	Valid

The validity test results for the SWA Training variable are shown in Table 9, where all items (PEL1-PEL8) have CITC values between 0.472 and 0.598, exceeding the minimum requirement. This shows that each item reliably represents the SWA training construct. Furthermore, the Safety Compliance variable also met the validity criteria, as shown in Table 10, with CITC values ranging from 0.500 to 0.618. These results confirm that all items used to measure safety compliance are valid and capable of capturing workers adherence to safety procedures consistently.

Table 9
Validity Test of SWA Training Variable

Statement	CITC	Description
PEL1	0.527	Valid
PEL2	0.530	Valid
PEL3	0.563	Valid
PEL4	0.486	Valid
PEL5	0.531	Valid
PEL6	0.598	Valid
PEL7	0.472	Valid
PEL8	0.498	Valid

Table 10
Validity Test of Safety Compliance Variable

Statement	CITC	Description
KEP1	0.500	Valid
KEP2	0.618	Valid
KEP3	0.595	Valid
KEP4	0.527	Valid
KEP5	0.556	Valid

Following the validity test, a reliability test was conducted using Cronbach's Alpha to evaluate the internal consistency of the instrument. A variable is considered reliable if the Cronbach's Alpha value exceeds 0.60. As shown in Table 11, all variables

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demonstrated strong reliability, with values ranging from 0.736 to 0.812. These results show that the questionnaire items consistently measure their respective constructs. Therefore, the instrument used in this study is both valid and reliable.

Table 11

Reliability Test Results

Variable	Cronbach's Alpha	Number of Items	Description
Risk Perception	0.812	8	Reliable
SWA Understanding	0.798	8	Reliable
Communication	0.736	7	Reliable
SWA Training	0.809	8	Reliable
Safety Compliance	0.781	5	Reliable

Descriptive statistical analysis was conducted to provide an overview of the data distribution, in Table 12. The results show that the average age of respondents is 29.65 years, with a range between 20 and 54 years, showing that most respondents are in the productive age group. The average work experience is 6.54 years, showing diverse levels of experience among participants. The mean score for risk perception is 27.49, showing a very good category. Similarly, SWA understanding has a mean score of 27.12, communication 24.19, and SWA training 27.29, all of which fall within the very good category. Safety compliance also shows a high mean score of 17.89, showing that workers generally demonstrate strong adherence to safety procedures.

Table 12

Descriptive Statistics

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Age	84	20.00	54.00	29.6548	8.05477
Work Experience	84	1.00	35.00	6.5357	6.97577
Risk Perception	84	22.00	32.00	27.4881	3.08707
SWA Understanding	84	20.00	32.00	27.1190	3.39881
Communication	84	12.00	28.00	24.1905	3.15265
SWA Training	84	18.00	32.00	27.2857	3.61580
Safety Compliance	84	14.00	20.00	17.8929	1.90761

The prerequisite tests included normality, multicollinearity, and heteroscedasticity tests. The normality test results in Table 13 show a significance value of 0.200, which is greater than 0.05, showing that the data are normally distributed. The multicollinearity test results in Table 14 show that all variables have tolerance values greater than 0.1 and VIF values less than 10, showing no multicollinearity. The heteroscedasticity test results in Table 4.15 show significance values greater than 0.05 for all variables, showing no heteroscedasticity.

Table 13

Normality Test (Kolmogorov-Smirnov)

Variable	Value
N	84
Test Statistic	0.079
Asymp. Sig.	0.200

Table 14
Multicollinearity Test

Variable	Tolerance	VIF
Risk Perception	0.483	2.070
SWA Understanding	0.384	2.606
Communication	0.402	2.490
SWA Training	0.408	2.451

Table 15
Heteroscedasticity Test

Variable	Sig.
Risk Perception	0.245
SWA Understanding	0.361
Communication	0.864
SWA Training	0.121

The multiple linear regression analysis results are presented in Table 16. The regression equation obtained is:

$$Y = 3.006 + 0.188X_1 + 0.114X_2 + 0.135X_3 + 0.123X_4 \quad (4)$$

Where Y represents Safety Compliance, X_1 represents Risk Perception, X_2 represents SWA Understanding, X_3 represents Communication, and X_4 represents SWA Training. All independent variables show positive coefficients, showing that increases in these variables lead to higher safety compliance. Each variable also shows a significance value less than 0.05, meaning all variables have a significant partial effect.

Table 16
Multiple Linear Regression Results

Variable	B	t	Sig.
Constant	3.006	2.676	0.009
Risk Perception	0.188	3.418	0.001
SWA Understanding	0.114	2.045	0.044
Communication	0.135	2.280	0.025
SWA Training	0.123	2.419	0.018

The F-test results in Table 17 show a significance value of 0.000, which is less than 0.05, showing that all independent variables simultaneously influence safety compliance. Furthermore, the coefficient of determination (R^2) in Table 18 is 0.698, meaning that 69.8% of the variation in safety compliance can be explained by the independent variables. The remaining 30.2% is influenced by other factors not included in the model. These findings show that the SWA program and its supporting factors have a strong contribution to improving safety compliance among construction workers.

Table 17
F-Test Results

F	Sig.
45.735	0.000

Table 18
Coefficient of Determination

R	R Square	Adjusted R Square
0.836	0.698	0.683

2. Discussion

Based on descriptive analysis, all variables were categorized as very good, showing that the foundational elements of the Stop Work Authority (SWA) program have been well established in the project. The multiple linear regression results confirm that all independent variables have a positive and significant effect on safety compliance. The simultaneous test shows an F-value of 45.735 with a significance level of 0.000, showing a strong collective influence. In addition, the coefficient of determination (R^2) of 0.698 implies that 69.8% of the variation in safety compliance can be explained by the four variables. This finding shows the critical importance of structured safety understanding and training in enhancing worker compliance (Aslam, 2024). Other studies also emphasize that the quality of SWA program inputs significantly shapes worker compliance behavior (Bahtiar *et al.*, 2019). Meanwhile, the remaining 30.2% is influenced by external factors such as safety culture, leadership, and production pressure (Havinga *et al.*, 2021).

The role of risk perception as a cognitive input is strongly supported by the regression results, which show a coefficient of 0.188 with a significance value of 0.001. This shows that improved understanding of workplace risks directly enhances safety compliance among workers. The high mean score (27.49) further suggests that workers generally possess a strong awareness of potential hazards in construction activities. Theoretically, risk perception involves the ability to identify hazards, evaluate probabilities, and assess the severity of potential consequences (Lestari *et al.*, 2020). In construction settings, this includes risks such as falling from heights, heavy equipment accidents, and electrical hazards (Gómez-Bull *et al.*, 2023). Empirical studies consistently show that higher risk awareness leads to safer behavior, including proper PPE usage and adherence to procedures (Liu *et al.*, 2021). Field observations align with these findings, as most workers showed safe practices and actively reported unsafe conditions. This reflects an increasing level of safety awareness that contributes to reduced accident rates and improved productivity (Putri Lestari *et al.*, 2025; Semnasti *et al.*, 2023).

However, it is important to note that high risk perception does not automatically guarantee safe behavior in all situations. Literature shows the phenomenon of hazard normalization, where repeated exposure to risks without incidents may reduce perceived danger (Mastrantonio *et al.*, 2024). This condition can lead to complacency and increased tolerance toward unsafe practices. Therefore, organizations must continuously reinforce risk awareness through strategies such as near-miss discussions, behavioral safety audits, and case-based learning (Gómez-Bull *et al.*, 2023; Mastrantonio *et al.*, 2024). In this study, risk understanding has gone beyond theoretical knowledge and is reflected in preventive actions observed in the field. Within the CIPP framework, risk perception is categorized as a cognitive input that must be continuously developed (Stufflebeam, 2014). Effective risk understanding also supports SWA implementation, as workers must recognize when conditions require work stoppage (Bahtiar *et al.*, 2019). Additionally, organizational support such as PPE provision and safety facilities further strengthens this relationship (Khoirunnisa *et al.*, 2023).

SWA understanding, as a normative input, also shows a significant positive influence on safety compliance, with a coefficient of 0.114 and a significance value of 0.044. The high average score shows that workers generally understand their rights and responsibilities related to SWA. Conceptually, SWA empowers workers to stop unsafe work without fear of punishment (Manuele, 2020). Field observations reveal that although workers often practice SWA principles, they do not always explicitly label their

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actions as SWA. This suggests that the concept has been internalized behaviorally, even if not formally expressed. Importantly, no sanctions were observed for workers raising safety concerns, aligning with the “no blame” principle (Steelworkers Health, Safety and Environment Department, 2022). However, psychological barriers remain, such as fear of delaying project progress or negative perceptions from supervisors (Weber *et al.*, 2018). This finding is consistent with previous studies showing cultural and hierarchical constraints (Bahtiar *et al.*, 2019).

From a CIPP perspective, SWA understanding serves as a bridge between formal policy and practical implementation (Stufflebeam & Coryn, 2014). Workers with better SWA understanding tend to show higher compliance, showing both awareness and appreciation of safety importance (Sihombing, 2022). To strengthen this input, continuous socialization and reinforcement are required, including real case discussions and success stories of SWA application (Muhammad Abdul Ghofur *et al.*, 2024). Management commitment must also be clearly communicated to ensure workers feel psychologically safe when exercising their rights (Steelworkers Health, Safety and Environment Department, 2022).

Communication plays an essential role as a relational input, with a regression coefficient of 0.135 and a significance value of 0.025. The high mean score shows effective safety communication practices within the project. Communication includes information exchange about hazards, procedures, and corrective actions among all stakeholders. Observations show that both formal (meetings, toolbox talks) and informal (WhatsApp groups) channels are actively used. This multi-channel approach facilitates rapid information flow and encourages worker participation (Sunyanti *et al.*, 2023). Effective safety communication has been shown to enhance risk awareness and engagement (Shen *et al.*, 2017). It also strengthens workers' perception of organizational commitment to safety, influencing their compliance behavior (Lyu *et al.*, 2025). In the context of SWA, clear communication reduces uncertainty and supports decision-making (Weber *et al.*, 2018).

Thus, communication can be viewed as a connecting element within the CIPP input framework. It links policies, training, and field practices into a cohesive system. Improvements in communication quality such as feedback mechanisms and supervisor training can further enhance safety compliance (Havinga *et al.*, 2021). The integration of digital communication tools also supports faster coordination and response.

SWA training, as a learning input, also significantly influences safety compliance, with a coefficient of 0.123 and a significance value of 0.018. The high average score shows that workers perceive training as effective, although some variability exists. Training activities include induction, toolbox meetings, and emergency drills. However, current methods are still dominated by verbal explanations, which may limit long-term retention. Research suggests that diverse learning media, including videos, improve understanding and engagement (Aulia *et al.*, 2024). Therefore, the development of microlearning-based e-learning platforms is highly relevant. Microlearning allows flexible, focused, and accessible training delivery (Shail, 2019). It complements traditional training and enhances knowledge retention. Within the CIPP framework, training is a strategic input that transforms policy into practical competence (Stufflebeam & Coryn, 2014). The significant regression results justify further investment in innovative training methods.

Conclusion

The quality of SWA program inputs plays a important role in shaping workers safety compliance behavior. The multiple linear regression analysis shows that work risk understanding, SWA understanding, communication, and SWA training simultaneously have a positive and significant effect on safety compliance, as showed by an F-value of 45.735, a significance level of 0.000, and a coefficient of determination (R^2) of 0.698, meaning that 69.8% of the variation in safety compliance is explained by these variables. Partially, work risk understanding has the strongest influence, showing that workers ability to recognize hazards, assess risks, and take preventive actions is a fundamental cognitive basis for safe behavior. SWA understanding also significantly contributes by reinforcing workers awareness of their rights and responsibilities to stop unsafe work, thereby strengthening adherence to safety procedures. In addition, effective communication among management, supervisors, HSE personnel, and workers enhances the dissemination of safety information and supports consistent implementation of safety practices. SWA training significantly improves compliance by equipping workers with the necessary knowledge and practical skills to identify unsafe conditions and respond appropriately. However, 30.2% of the variation in safety compliance is influenced by other factors outside the model, such as safety culture, leadership style, production pressure, and incentive systems, showing the need for a more comprehensive and integrated approach to safety program development.

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