Engineering Students' Awareness, Understanding, and Perception of TIA and RSA in Malaysia Construction Industry

Muriatul Khusmah Musa[1], Mohamad Zain Hashim[2*]

[1]Akademi Pengajian Bahasa, Universiti Teknologi MARA Cawangan Pulau Pinang, Pematang Pauh Campus, 13500 Pulau, Pinang, Malaysia

[2]Faculty of Civil Engineering, College of Engineering, Universiti Teknologi MARA Cawangan Pulau Pinang, Pematang Pauh Campus, 13500 Pulau, Pinang, Malaysia

***Corresponding Author**

DOI: https://dx.doi.org/10.47772/IJRISS.2025.909000126

Received: 26 August 2025; Accepted: 05 September 2025; Published: 01 October 2025

ABSTRACT

Traffic Impact Assessment (TIA) and Road Safety Audit (RSA) are critical tools in ensuring traffic efficiency, infrastructure sustainability, and road user safety in construction and urban development. However, limited research has been conducted to evaluate the awareness and understanding of these tools among engineering students who are future industry practitioners. This study investigates the impact of a technical briefing on students' awareness, understanding, and perception of TIA and RSA. A quantitative survey was administered to 77 undergraduate engineering students using a structured questionnaire that assessed self-rated knowledge before and after the online webinar, as well as their awareness and perception of TIA and RSA. The results revealed a statistically significant improvement in students' understanding following the session, with high levels of awareness (M = 4.17) and positive perceptions (M = 4.31) across all key indicators. Reliability analysis showed excellent internal consistency (Cronbach's $\alpha > .92$), and independent samples t-tests indicated no significant gender differences across awareness, understanding, or perception. While students expressed confidence in their conceptual grasp of TIA and RSA, their moderate confidence in applying these tools in professional settings suggests the need for enhanced experiential learning. The study concludes that while technical briefings are effective, integration of TIA and RSA into engineering curricula through hands-on training and case-based learning is essential to bridge the gap between theory and practice.

Keywords: Traffic Impact Assessment, Road Safety Audit, Engineering students, Awareness, Perception, Technical briefing, Infrastructure planning

INTRODUCTION

In recent years, the growth of infrastructure and urban development in Malaysia has intensified the need for strategic transportation planning and safety auditing processes [1]. Among the critical tools employed in addressing these needs are Traffic Impact Assessment (TIA) and Road Safety Audit (RSA). These instruments serve to ensure that infrastructure development projects are not only functionally efficient but also safe and sustainable. TIA is a technical evaluation that assesses the potential impact of new developments on the existing transportation system, helping planners anticipate and mitigate adverse traffic conditions [2]. RSA, on the other hand, is a formal safety performance examination of existing or future road infrastructure by an independent and multidisciplinary team, aimed at identifying potential safety issues and recommending improvements [3]. The increasing complexity of urban transportation systems, coupled with rising traffic volumes, necessitates the incorporation of TIA and RSA at all stages of project planning and development. In Malaysia, the implementation of these tools is governed by technical guidelines issued by regulatory bodies such as the Department of Town Planning and JKR, which emphasize the importance of conducting TIA for developments generating significant traffic and of applying RSA throughout the road design lifecycle [4]. These procedures are consistent with national objectives to alleviate congestion, enhance road safety, and

advance sustainable urban development. Yet, despite regulatory frameworks and heightened emphasis on these assessments, the degree of awareness and understanding of Traffic Impact Assessment (TIA) and Road Safety Audit (RSA) among engineering students remains uncertain. As future engineers, planners, and safety auditors, these students must be equipped with both theoretical knowledge and practical competence in TIA and RSA. Previous studies suggest that there is often a disconnection between academic training and industry expectations in civil and transportation engineering [5]. Engineering curricula tend to focus heavily on technical design and calculations, with limited emphasis on policy instruments and safety auditing procedures, such as those required in TIA and RSA applications [6].

Furthermore, although technical briefings and seminars are often organized to bridge this gap, there is limited empirical evidence assessing their effectiveness in enhancing students' knowledge and readiness [7]. Evaluating the students' awareness, understanding, and perception of TIA and RSA post-briefing is essential to determine whether these interventions contribute meaningfully to their preparedness for future professional roles. As highlighted by [8], exposure to practical tools and real-world processes through briefings and field studies significantly improves students' cognitive engagement and application capabilities. This study addresses an educational gap by evaluating engineering students' perceptions and comprehension of Traffic Impact Assessment (TIA) and Road Safety Audit (RSA) following technical briefings. In alignment with Malaysia's Road Safety Plan 2022–2030, which seeks a 50% reduction in road accidents, the effective application of RSA is particularly significant [9]. Likewise, the increasing prevalence of mixed-use and high-density developments underscores the importance of TIA as a preventive traffic management tool. Equipping engineering students with a sound understanding of these concepts is essential for producing graduates who are technically proficient and socially responsible. By examining the extent to which technical exposure influences students' knowledge of TIA and RSA, this study contributes to engineering education and infrastructure planning. The findings are expected to inform curriculum design, enhance briefing practices, and strengthen the integration between academic instruction and professional practice.

Problem Statement

The application of Traffic Impact Assessment (TIA) and Road Safety Audit (RSA) in infrastructure development has become increasingly significant due to rising concerns over traffic congestion, road safety, and sustainable urban growth in Malaysia [10]. These tools provide a structured methodology to evaluate transportation impacts and safety considerations in the planning and design stages of construction projects. Malaysian authorities such as the Department of Town Planning and Jabatan Kerja Raya (JKR) have mandated their implementation in various development scenarios [4][3]. While notable progress has been achieved in embedding TIA and RSA within national policy frameworks, a clear mismatch remains between policy advancement and educational preparedness, as significant concerns persist regarding the ability of future engineers, particularly civil engineering students, to adequately comprehend and effectively implement these procedures in professional practice[11].

Despite their critical relevance, TIA and RSA are often inadequately represented in university curricula, leaving a significant gap in the professional preparation of future engineers [12], [13]. The emphasis in engineering programs often remains on core technical competencies, with limited exposure to planning instruments and safety audit methodologies. While technical briefings and seminars are periodically conducted to enhance student awareness, the extent to which such efforts effectively translate into understanding and practical knowledge remains underexplored. Very few empirical studies have examined how students perceive and comprehend TIA and RSA after attending technical sessions. Consequently, there is a lack of data-driven insights into whether these educational interventions are sufficient to prepare students for real-world applications of traffic and safety assessment tools in the construction industry [14][5].

Insufficient awareness, understanding, and appreciation of TIA and RSA among future professionals may result in ineffective implementation or even non-compliance, with serious implications for traffic efficiency, road safety, and the sustainability of infrastructure development. Without proper training, engineering graduates may struggle to meet regulatory requirements, increasing the risk of design flaws, project delays, and safety oversights. A systematic evaluation of students' knowledge and perceptions of TIA and RSA, particularly following technical briefings is therefore essential. Such assessment can provide evidence-based

insights to support curriculum enhancement and guide industry stakeholders in aligning educational strategies with professional demands, thereby bridging the gap between academic preparation and practical application.

Research Objectives

This study aims to evaluate the effectiveness of a technical briefing on Traffic Impact Assessment (TIA) and Road Safety Audit (RSA) in enhancing engineering students' knowledge and preparedness for future professional application. Specifically, the research seeks to (1) assess students' awareness of the concepts, procedures, and significance of TIA and RSA; (2) evaluate their understanding of the key elements, objectives, and application requirements of these tools within construction and infrastructure contexts; and (3) examine their perceptions of the importance of implementing TIA and RSA in real-world practice, including their views on the integration of such topics into formal engineering education. These objectives collectively provide a comprehensive perspective on students' cognitive and perceptual responses to the technical session and are intended to guide improvements in curriculum development and industry-academic collaboration in the domains of transport planning and road safety.

LITERATURE REVIEW

Overview of Traffic Impact Assessment (TIA)

Traffic Impact Assessment (TIA) is a critical component of urban and transport planning that evaluates the effects of new developments on existing traffic conditions. It involves a systematic analysis of projected traffic volumes, intersection capacities, travel demand patterns, and parking requirements associated with a proposed development [10]. In the Malaysian context, TIA has been institutionalized through planning guidelines issued by [4], where it is mandated for developments that exceed a certain threshold in terms of trip generation or scale. The primary objective of TIA is to ensure that new developments are supported by adequate transportation infrastructure and that their implementation does not compromise the functionality, safety, or efficiency of existing road networks [4]. Furthermore, the recommendations produced through a TIA process assist decision-makers in determining the need for road upgrades, signalized intersections, traffic calming measures, or access modifications. Internationally, the implementation of TIA is considered a best practice in land-use and transport integration [15]. However, its effectiveness is highly dependent on the technical competency of the professionals involved, particularly in terms of traffic modelling, demand forecasting, and interpretation of results. In developing countries, including Malaysia, challenges such as limited technical expertise, inconsistent enforcement, and gaps in data availability often hamper the quality and reliability of TIA reports [5]. These challenges highlight the importance of equipping future civil engineers with adequate exposure to the TIA process during their academic training.

Road Safety Audit (RSA): Principles and Relevance

Road Safety Audit (RSA) is a proactive approach to road safety management that involves the systematic evaluation of road infrastructure projects by independent teams to identify potential safety issues before accidents occur [16]. RSA can be conducted at various stages of a project, including feasibility, detailed design, construction, and operation. It emphasizes user behaviour, road geometry, traffic signage, lighting, and other factors that influence safety performance. In Malaysia, RSA is mandated for major highway projects and is increasingly being applied to urban and rural roads in alignment with national road safety strategies [9]. Numerous studies have demonstrated the effectiveness of RSA in reducing crash rates and improving road user safety. According to [17], roads that undergo safety audits show a significant reduction in accident frequency and severity compared to those that do not. In the Malaysian context, however, the implementation of RSA has encountered practical limitations, including a shortage of trained auditors, low awareness among stakeholders, and inconsistent integration into early project planning stages [18]. These challenges again underscore the need for capacity building, particularly at the undergraduate level, where future practitioners can be introduced to the principles and applications of RSA through both theoretical and experiential learning.

Integration of TIA and RSA in Sustainable Infrastructure Planning

Both TIA and RSA contribute significantly to sustainable infrastructure development. TIA helps optimize traffic flow and reduce carbon emissions by ensuring that developments are compatible with transportation system capacities, while RSA enhances safety and reduces accident-related externalities [15]. When effectively integrated, these tools support the realization of Sustainable Development Goals (SDGs), particularly SDG 3.6 (halving road traffic deaths) and SDG 11.2 (providing access to safe, affordable, and sustainable transport systems). In Malaysia, the synergy between TIA and RSA is still evolving. While guidelines exist, the actual implementation in project workflows is often fragmented, partly due to the limited understanding of their complementary roles among practitioners and local authorities [19]. Therefore, embedding this integrated approach in engineering education is essential to foster a new generation of professionals capable of implementing holistic planning solutions that consider both traffic efficiency and user safety.

Educational Gaps and the Role of Technical Briefings

A recurring concern in engineering education is the misalignment between academic training and industry needs. Multiple studies have reported that Malaysian engineering students graduate with strong technical skills in structural analysis and design but lack exposure to planning, regulatory, and safety assessment tools such as TIA and RSA [6][11]. This gap not only affects their employability but also their ability to contribute meaningfully to multidisciplinary project environments where collaboration with urban planners, transport engineers, and safety auditors is essential. To address this gap, many institutions and government agencies have introduced technical briefings, site visits, and seminars as supplementary learning methods. According to [19], such experiential learning opportunities have shown positive impacts on students' understanding of real-world engineering processes, particularly when delivered through interactive formats. However, there remains limited empirical evidence evaluating the effectiveness of these interventions. Studies by [20] recommend that such briefings should be complemented with structured assessments to gauge knowledge retention and practical application readiness. Therefore, assessing student awareness, understanding, and perception of TIA and RSA following a technical session provides valuable insights into the learning outcomes and effectiveness of such educational strategies.

Summary of Literature and Research Gap

The literature clearly supports the importance of TIA and RSA in achieving efficient and safe infrastructure development. Regulatory frameworks and international best practices have established the theoretical and procedural foundations of these tools. However, in the Malaysian context, the practical implementation is still developing, and there are ongoing efforts to strengthen professional capacity, particularly among future engineers. Despite increasing efforts to expose students to TIA and RSA through briefings and seminars, there is insufficient research investigating the actual impact of such exposure on students' awareness, understanding, and perception. This gap provides a compelling rationale for the current study, which seeks to evaluate these cognitive dimensions in the context of a post-briefing survey among engineering students. The findings will not only contribute to educational practice but also support the larger agenda of preparing competent professionals for sustainable transport and road safety planning.

METHODOLOGY

Research Design

This study adopted a quantitative descriptive research design using a structured survey questionnaire to assess engineering students' awareness, understanding, and perception of Traffic Impact Assessment (TIA) and Road Safety Audit (RSA) following a technical briefing. A quantitative approach was selected due to its suitability for collecting standardized data from a large group of respondents, enabling objective measurement and statistical analysis of their cognitive and perceptual responses [21]. The study focused on students who had recently attended a briefing session on TIA and RSA, ensuring that their responses were directly influenced by the exposure to technical content.

Population and Sample

The target population comprised engineering students enrolled in a civil engineering program at a Malaysian public university. These students had participated in a structured technical talk organized by relevant industry practitioners and academic facilitators. As the survey was intended to be exploratory and diagnostic, purposive sampling was employed to ensure that only participants with prior exposure to the briefing were included in the study. A total of N = **77** valid responses were collected and analysed. The sample size was considered adequate for initial insight and descriptive analysis, especially within an academic institutional setting [22].

Research Instrument

The primary data collection instrument for this study was a self-administered questionnaire specifically developed to assess students' awareness, understanding, and perception of Traffic Impact Assessment (TIA) and Road Safety Audit (RSA). The questionnaire consisted of four sections. Section A captured general information, including gender as well as students' self-rated understanding of TIA and RSA before and after the technical talk using a 5-point scale. Section B focused on awareness and included five items measured on a 5-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree) to evaluate familiarity with the purpose, scope, and relevance of TIA and RSA. Section C addressed understanding and knowledge through five items that assessed the ability to differentiate between TIA and RSA, recognize their components and stakeholders, and evaluate readiness for industry application. Section D measured perception of importance and implementation, comprising five items that gauged students' views on the role of TIA and RSA in improving road safety, promoting infrastructure sustainability, and their integration into engineering education. The questionnaire was validated by two subject matter experts to ensure content relevance and clarity and was pilot-tested with a group of ten students. Based on their feedback, minor revisions were made to improve item clarity and sequencing.

Data Collection Procedure

Data were collected over one week immediately after the technical briefing to ensure recency and recall accuracy. The survey, administered in both physical and online formats, was voluntary, with confidentiality and anonymity guaranteed. Informed consent was obtained, and ethical approval was secured from the university's research ethics committee.

Data Analysis Techniques

The questionnaire data were coded and analyzed using SPSS (version 27). The analysis proceeded in three stages. First, descriptive statistics (frequencies, means, and standard deviations) were computed to summarize student responses on awareness, understanding, and perception. Second, reliability analysis using Cronbach's Alpha was performed for Sections B, C, and D, with $\alpha \geq 0.70$ considered acceptable. Third, a paired samples t-test was conducted to assess changes in students' self-reported understanding before and after the technical briefing (items A3 and A4). Where relevant, additional inferential tests—including independent samples t-tests (e.g., gender differences) and one-way ANOVA (e.g., demographic comparisons)—were carried out to identify significant group differences. All analyses were interpreted at the 95% confidence level ($p < 0.05$), and results were reported in tables and figures to support interpretation.

Results and Analysis

Demographic Profile of Respondents

The respondents in this study consisted exclusively of civil engineering undergraduates. Among the participants, 35 (45.5%) were male and 42 (54.5%) were female, indicating a relatively balanced gender distribution that permits comparative analysis between groups. Although engineering has traditionally been male-dominated, the higher proportion of female respondents in this sample points to a positive trend toward greater gender diversity in engineering education.

Self-Reported Understanding Before and After the Briefing

Respondents rated their level of understanding of Traffic Impact Assessment (TIA) and Road Safety Audit (RSA) on a 5-point scale, both before and after attending a technical briefing. The mean score before the briefing was 1.70 (SD = 0.97), while the mean score after the session increased to 4.29 (SD = 0.83). A paired samples t-test indicated that this difference was statistically significant, $t(76) = 18.79$, $p < .001$, suggesting that the technical briefing had a substantial positive effect on students' self-perceived understanding of the subject matter.

Table 1: Independent Samples Test across gender on before and after briefing

	Levene's Test for Equality of Variances		t-test for Equality of Means					
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Level of understanding the subject presented BEFORE attending technical talk.	Equal variances assumed	2.065	0.155	1.047	75	0.298	0.233	0.223
	Equal variances not assumed			1.019	61.306	0.312	0.233	0.229
Level of understanding the subject presented AFTER attending technical talk.	Equal variances assumed	0.677	0.413	0.831	75	0.409	0.157	0.189
	Equal variances not assumed			0.859	72.247	0.393	0.157	0.183

An independent samples t-test was conducted to examine gender differences in self-reported understanding of Traffic Impact Assessment (TIA) and Road Safety Audit (RSA) before and after attending a technical briefing. The results in Table 1 indicated no statistically significant difference in understanding before the briefing between male and female students, $t(75) = 1.05$, $p = .298$, with males (M = 1.83) and females (M = 1.60) reporting similar levels of prior knowledge. Similarly, no significant difference was found in understanding after the briefing, $t(75) = 0.83$, $p = .409$, indicating that both genders benefited equally from the technical session. These findings suggest that gender did not have a significant effect on students' perceived understanding either prior to or following the briefing.

Awareness of TIA and RSA (Section B)

Table 2: The mean scores and standard deviations for awareness-related statements

Item	Statement	Mean	SD
B1	I am aware of what is contained in the Traffic Impact Assessment (TIA).	4.09	0.61
B2	I am aware of the purpose and process of a Road Safety Audit (RSA).	4.10	0.66
B3	I understand the relevance of TIA in construction and infrastructure.	4.17	0.59
B4	I understand the importance of RSA in minimizing road safety risks.	4.25	0.63
B5	I was exposed to TIA and RSA procedures during the briefing sessions.	4.22	0.60

Results in Table 2 were calculated to assess students' awareness of Traffic Impact Assessment (TIA) and Road Safety Audit (RSA) following the technical briefing session. The results indicated generally high levels of agreement across all awareness-related statements on a 5-point Likert scale. Students reported strong awareness of the contents of TIA (M = 4.09, SD = 0.61) and the purpose and process of RSA (M = 4.10, SD = 0.66). They also demonstrated a clear understanding of the relevance of TIA in construction and infrastructure (M = 4.17, SD = 0.59) and recognized the importance of RSA in minimizing road safety risks (M = 4.25, SD = 0.63). Additionally, students agreed that they were adequately exposed to TIA and RSA procedures during the briefing (M = 4.22, SD = 0.60). These findings suggest a high level of awareness and effective delivery of key concepts during the technical session.

Understanding and Knowledge of TIA and RSA (Section C)

Table 3: Summarizes student responses related to knowledge and comprehension

Item	Statement	Mean	SD
C1	I can differentiate between the objectives of TIA and RSA.	4.04	0.68
C2	I understand when a TIA is required in a construction project.	4.04	0.68
C3	I understand the stages involved in conducting a RSA.	4.01	0.7
C4	I can identify key stakeholders in TIA and RSA processes.	4.09	0.67
C5	I believe my knowledge of TIA and RSA is sufficient for industry use.	4.05	0.71

Table 3 summarizes students' understanding of Traffic Impact Assessment (TIA) and Road Safety Audit (RSA), with consistently high mean scores across all items, reflecting a strong grasp of key concepts following the technical briefing. Students demonstrated the ability to differentiate between the objectives of TIA and RSA (M = 4.04, SD = 0.68), understood when a TIA is required in a construction project (M = 4.04, SD = 0.68), and reported familiarity with the stages of an RSA (M = 4.01, SD = 0.70). They also indicated the ability to identify key stakeholders in both processes (M = 4.09, SD = 0.67) and expressed confidence that their knowledge was sufficient for industry application (M = 4.05, SD = 0.71).

Perception of Importance and Implementation (Section D)

Table 4: Perception of Importance and Implementation

Item	Statement	Mean	SD
D1	TIA is crucial for managing traffic flow in developing areas.	4.21	0.73
D2	RSA helps prevent accidents and improve road safety.	4.26	0.68
D3	TIA and RSA should be mandatory in all major construction projects.	4.19	0.67
D4	The industry should provide more training for students on TIA and RSA.	4.31	0.65
D5	Implementing TIA and RSA improves infrastructure sustainability.	4.31	0.63

Students reported strong positive perceptions of the importance and implementation of Traffic Impact Assessment (TIA) and Road Safety Audit (RSA) in construction practice (Table 4). On a 5-point Likert scale, they agreed that TIA is essential for managing traffic flow in developing areas (M = 4.21, SD = 0.73) and that RSA is critical for accident prevention and road safety (M = 4.26, SD = 0.68). Respondents also supported making TIA and RSA mandatory in major projects (M = 4.19, SD = 0.67) and emphasized the need for more

industry training (M = 4.31, SD = 0.65). Moreover, they recognized that these practices contribute to sustainable infrastructure development (M = 4.31, SD = 0.63). Collectively, the findings indicate a high level of appreciation for the practical and strategic value of TIA and RSA in the engineering profession.

Reliability Analysis

Table 5: Reliability Analysis

	Reliability Statistics	
	Cronbach's Alpha	N of Items
Section B (Awareness)	0.925	5
Section C (Understanding)	0.940	5
Section D (Perception)	0.938	5

Reliability analysis in Table 5 was conducted to assess the internal consistency of the questionnaire items across Sections B (Awareness), C (Understanding), and D (Perception) using Cronbach's Alpha. The results indicated excellent reliability for all three sections. Section B (Awareness) yielded a Cronbach's Alpha of .925, Section C (Understanding) reported an alpha of .940, and Section D (Perception) produced an alpha of .938. All values exceed the commonly accepted threshold of .70 [23], indicating that the items within each section are highly consistent and reliable for measuring students' awareness, understanding, and perception of TIA and RSA.

Comparative Analysis

An independent samples t-test (Table 6) was conducted to examine gender differences in students' awareness, understanding, and perception of Traffic Impact Assessment (TIA) and Road Safety Audit (RSA). The results showed no statistically significant differences between male and female students across all three dimensions. For awareness, the difference between male (M = 4.15, SD = 0.56) and female (M = 4.18, SD = 0.54) students was not significant, t(75) = -0.18, p = .862. Similarly, no significant difference was observed in understanding scores between males (M = 4.02, SD = 0.63) and females (M = 4.07, SD = 0.61), t(75) = -0.31, p = .758. For perception, male (M = 4.23, SD = 0.58) and female (M = 4.28, SD = 0.62) students also did not differ significantly, t(75) = -0.38, p = .707. These findings indicate that gender did not have a significant effect on students' awareness, understanding, or perception of TIA and RSA following the technical briefing.

Table 6: Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means				
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Awareness	Equal variances assumed	0.109	0.742	-0.175	75	0.862	-0.022	0.125
	Equal variances not assumed			-0.174	71.513	0.862	-0.022	0.126
Understanding	Equal variances	0.184	0.669	-0.309	75	0.758	-0.044	0.142

	assumed							
	Equal variances not assumed			-0.308	71.360	0.759	-0.044	0.142
Perception	Equal variances assumed	0.188	0.666	-0.377	75	0.707	-0.052	0.139
	Equal variances not assumed			-0.379	73.967	0.705	-0.052	0.138

DISCUSSION

This study aimed to evaluate engineering students' awareness, understanding, and perception of Traffic Impact Assessment (TIA) and Road Safety Audit (RSA) following a technical briefing. The findings from Sections 6.1 to 6.6 demonstrate that the briefing had a significant positive effect on students' self-reported knowledge and perceptions, while also highlighting areas for further educational enhancement. Demographic analysis revealed a relatively balanced gender distribution among respondents, with 45.5% male and 54.5% female students. This composition allowed for gender-based comparisons in the analysis and reflects increasing female participation in engineering education an encouraging trend in a traditionally male-dominated field. The most substantial finding was the statistically significant improvement in students' understanding of TIA and RSA after the briefing. Before the session, students rated their understanding relatively low (M = 1.70, SD = 0.97), while after the session, the mean score rose markedly to 4.29 (SD = 0.83) on a 5-point scale. A paired samples t-test confirmed this improvement was highly significant, $t(76) = 18.79$, $p < .001$, indicating that the technical briefing effectively enhanced students' conceptual comprehension of the subject matter.

Students' awareness of TIA and RSA, as measured in Section B (Table 2), was also notably high. They reported strong agreement with statements regarding the content and purpose of TIA (M = 4.09, SD = 0.61) and RSA (M = 4.10, SD = 0.66), the relevance of these tools in construction and infrastructure planning (M = 4.17, SD = 0.59), and the importance of RSA in minimizing road safety risks (M = 4.25, SD = 0.63). Students also affirmed that the briefing adequately exposed them to procedural aspects of TIA and RSA (M = 4.22, SD = 0.60). These results suggest that the session successfully conveyed the foundational principles of both assessments.

In terms of technical understanding (Section C, Table 3), students exhibited high levels of knowledge across all items, with mean scores ranging from 4.01 to 4.09. They demonstrated the ability to differentiate between the objectives of TIA and RSA (M = 4.04, SD = 0.68), recognize when TIA is required (M = 4.04, SD = 0.68), and identify stakeholders in both processes (M = 4.09, SD = 0.67). However, the item reflecting confidence in applying this knowledge to industry settings (M = 4.05, SD = 0.71) suggests that while students felt knowledgeable, some uncertainty remained regarding practical implementation—an area that warrants further instructional focus.

Section D (Table 4) revealed strong perceptions of the importance of TIA and RSA. Students strongly agreed that TIA is crucial for managing traffic flow (M = 4.21, SD = 0.73) and that RSA is essential in preventing road accidents (M = 4.26, SD = 0.68). They supported making both assessments mandatory in major projects (M = 4.19, SD = 0.67) and expressed the need for industry-led training for students (M = 4.31, SD = 0.65). They also recognized the role of these assessments in improving infrastructure sustainability (M = 4.31, SD = 0.63). These findings suggest that students not only understood the technical function of TIA and RSA but also appreciated their broader impact on safety and sustainability.

Reliability analysis (Section 6.6, Table 5) confirmed the robustness of the instrument. All three dimensions: awareness ($\alpha = .925$), understanding ($\alpha = .940$), and perception ($\alpha = .938$),demonstrated excellent internal consistency, well above the .70 threshold recommended by Nunnally and Bernstein (1994). These results indicate that the questionnaire consistently and reliably measured the intended constructs. Independent samples t-tests revealed no significant gender differences in awareness, understanding, or perception. Male and female

students scored comparably across all dimensions, with p-values exceeding the .05 threshold. These findings suggest that the technical briefing was equally effective for both genders, underscoring its broad applicability and impact.

Taken together, the findings demonstrate that technical briefings are a powerful educational tool for enhancing student knowledge of critical infrastructure planning tools like TIA and RSA. However, the moderate level of confidence in applying this knowledge in real-world settings suggests that additional instructional interventions such as hands-on workshops, simulation exercises, or curriculum integration may be needed to bridge the gap between theoretical understanding and practical readiness.

CONCLUSION

This study evaluated engineering students' awareness, understanding, and perception of Traffic Impact Assessment (TIA) and Road Safety Audit (RSA) following their participation in a technical briefing. The findings clearly demonstrate the effectiveness of the briefing in enhancing students' self-reported understanding, with a significant increase in scores observed between pre- and post-session evaluations. Students also exhibited high levels of awareness and strong perceptions of the relevance and importance of TIA and RSA in real-world infrastructure planning and safety assurance. The high internal consistency of the measurement instrument further supports the reliability of the findings. Moreover, the lack of significant gender differences across awareness, understanding, and perception indicates that the briefing was uniformly impactful for all participants. However, while students demonstrated strong conceptual understanding, their moderate confidence in applying TIA and RSA in professional contexts suggests a need for deeper experiential learning. In conclusion, technical briefings are an effective method for introducing future civil engineers to essential tools such as TIA and RSA. Nevertheless, to ensure practical readiness, academic programs should consider integrating these topics into the core engineering curriculum through workshops, case-based projects, or simulation-based learning. This approach would not only reinforce conceptual knowledge but also build the applied skills necessary for students to contribute meaningfully to sustainable and safe infrastructure development upon graduation.

REFERENCE

1. Ministry of Transport Malaysia, "National Transport Policy 2019-2030," Minist. Transp. Malaysia, p. 70, 2019.
2. X. Zou, Z. Wang, L. Zheng, H. H. Dong, L. M. Jia, and Y. Qin, "Traffic impact analysis of urban construction projects based on traffic simulation," Proc. 2012 24th Chinese Control Decis. Conf. CCDC 2012, pp. 3923–3927, 2012.
3. Jabatan Kerja Raya Malaysia, Guidelines on Road Safety Audit Management. 2020.
4. J. K. R. Malaysia, Guidelines for Traffic Impact Assessment. 1994.
5. H. Muniappan, "The Disparity Between Engineering Education and Industry Application in Melaka," 2025.
6. J. Bin Ismail, C. T. Chik, and M. A. Hemdi, "TVET Graduate Employability: Mismatching Traits Between Supply and Demand," Int. J. Acad. Res. Bus. Soc. Sci., vol. 11, no. 13, pp. 223–243, 2021.
7. D. Vlachopoulos and A. Makri, "A systematic literature review on authentic assessment in higher education: Best practices for the development of 21st century skills, and policy considerations," Stud. Educ. Eval., vol. 83, no. November, p. 101425, 2024.
8. Brunhaver, S. R., R. F. Korte, S. R. Barley, and S. D. Sheppard, "Bridging the Gaps Between Engineering Education and Practice," Eng. a Glob. Econ., 2011.
9. Ministry of Transport Malaysia, "Malaysia Road Safety Plan 2022-2030," Minist. Transp. Malaysia, pp. 1–76, 2022.
10. L. W. May et al., "An overview of the practice of traffic impact assessment in Malaysia," Int. J. Eng. Adv. Technol., vol. 8, no. 5, pp. 914–921, 2019.
11. A. Ibrahim and I. M. Nashir, "Demand-supply Mismatch in TVET Academic Programmes: What Is It and What Should It Be?," J. Tech. Educ. Train., vol. 14, no. 2 SPECIAL ISSUE, pp. 177–189, 2022.
12. P. Zhang, S. G. Ma, Y. Sun, and Y. N. Zhao, "Investigating the Gaps between Engineering Graduates

and Quantity Surveyors of Construction Enterprises," Sustain. , vol. 16, no. 7, 2024.
13. M. A. Hazrat, N. M. S. Hassan, A. A. Chowdhury, M. G. Rasul, and B. A. Taylor, "Developing a Skilled Workforce for Future Industry Demand: The Potential of Digital Twin-Based Teaching and Learning Practices in Engineering Education," Sustain., vol. 15, no. 23, 2023.
14. Y. Alhammadi, A. M. Farouk, and R. A. Rahman, "Enhancing Construction Safety Education: Insights from Student Perspectives," Buildings, vol. 14, no. 3, pp. 1–18, 2024.
15. T. Litman, Evaluating Transportation Land Use Impacts: Considering the Impacts , Benefits and Costs of Different Land Use Development Patterns, vol. 1, no. 4. 2023.
16. Roads and Traffic Authority of New South Wales, Guidelines for Road Safety Audit Practices. 2011.
17. R. Elvik, "A comprehensive approach to evaluation of road safety policy," Traffic Saf. Res., vol. 6, pp. 1–14, 2024.
18. J. B. R. Souppez, "Engineering employability skills: Students, academics, and industry professionals perception," Int. J. Mech. Eng. Educ., vol. 53, no. 1, pp. 125–142, 2025.
19. O. Rompelman and J. De Vries, "Practical training and internships in engineering education: Educational goals and assessment," Eur. J. Eng. Educ., vol. 27, no. 2, pp. 173–180, 2002.
20. R. Yusof et al., "Assessing the Influence of Practical Training on Perceived Employability Among Public University Students in Malaysia," Asian Pacific J. Manag. Educ., vol. 7, no. 2, pp. 43–57, 2024.
21. J. W. Creswell, Research design: Qualitative, quantitative, and mixed methods approaches. SAGE Publications, Inc., 2009.
22. U. Sekaran and R. Bougie, Research Methods for Business: A Skill-Building Approach, vol. 34, no. 7. 2013.
23. J. Nunnally and I. Bernstein, Psychometric Theory 3rd edition (MacGraw-Hill, New York), vol. 1. 1994.