

A PSYCHOLOGICAL APPROACH TO ENHANCING ADOLESCENT ROAD SAFETY: INTEGRATING BEHAVIORAL THEORY AND DRIVING SIMULATION

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Article History:

Received: 11 Maret 2026

Revised: 30 Mei 2026

Accepted: 30 Mei 2026

Keywords: Theory of planned behavior, Driving simulator, Cognitive skill

Abstract: *This community service is a preventive program to address the serious issue of road accidents, which significantly affect young drivers in countries like Indonesia. Recognizing that human behavior is the main cause, a community program was launched for 36 high-risk, 17-year-old male students at SMK Negeri 7 Surabaya. The program used a dual approach: theoretical lessons based on the Theory of Planned Behavior and practical training with a driving simulator. This method aimed to improve their knowledge and skills, as well as their attitudes and confidence about safe driving. The results were a significant success. Before the program, students had low scores for their attitudes towards safe driving, social influence, and confidence in their skills. However, after the intervention, scores for all three areas improved dramatically. The most impressive gain was in self-confidence, which jumped from 28% to 72%. Post-program feedback also showed that the students found the lessons easy to understand and the driving simulator highly realistic and helpful. These findings prove that this combined approach is a very effective way to educate young drivers, providing a strong model that can be used to reduce accidents and save lives.*

Introduction

Road traffic injuries remain as a significant global health concern, though their burden is unevenly distributed across regions, with low- and middle-income countries experiencing a disproportionate impact. For instance, the Asia-Pacific region recorded over 694,000 road fatalities in 2021, constituting nearly 60% of the global total, with South-East Asia alone experiencing a high fatality rate of 20.7 deaths per 100,000 population (1). Beyond the significant human cost, the economic loss of these injuries are substantial, with estimated

costs exceeding 1% of the total Gross Domestic Product (GDP) in affected regions (2).

While numerous factors contribute to risky driving and traffic crash involvement, human behavior is accounted in approximately 95% of road traffic accidents. Therefore, gaining a comprehensive understanding of the psychological mechanisms that underlie driver behavior is critical for the development of effective, evidence-based interventions aimed at modifying such maladaptive behaviors (3). Within the field of international traffic psychology research,, two main domain of theoretical frameworks are widely recognized for explaining individual variations in risky driving behavior and traffic accident susceptibility: the personality trait approach and the social cognition approach (4).

Personality is commonly defined as a consistent pattern of emotions, thoughts, and behaviors that distinguish individuals from one another (5). The personality traits approach in traffic psychology seeks to identify enduring individual characteristics associated with risky driving behavior. This relationship can be traced back to the early 'accident proneness' theory, which expressed that certain personality dispositions may influence individuals to a higher likelihood of accident involvement (6). While the concept of "accident proneness" is largely considered conventional, internal driver-centric causal factors in traffic accident involvement have seen a renewal in research interest. Numerous studies, whether examining the influence of individual personality combinations of various personality dimensions, consistently demonstrate a weak yet noticeable association between personality traits and accident involvement (7, 8, 9).

Analysis of Indonesian traffic accident data reveals significant trends in fatalities and injuries. Records from the Indonesian National Traffic Police (10) indicate that between 2013 to 2018, motorcyclists and passenger vehicles consistently contributed to over 80-82% of traffic-related mortalities, with trucks accounting for approximately 10% or less. Moreover, motorcycles were implicated in more than 73% of all fatalities and severe injuries (AIS>3) during this period (11). When associated by age group, the highest incidence of motorcyclist-related accidents was observed among riders aged 17–25 years (12).

At the local level, the urgency of this program is reflected in the road safety situation in Surabaya. Previous studies reported that the number of traffic accidents in Surabaya showed an increasing trend between 2020 and 2022, with several districts such as Wonokromo, Gubeng, Genteng, and Tegalsari identified as accident-prone areas requiring greater traffic safety interventions (13). The urgency is further supported by national evidence indicating that children and adolescents account for approximately 20% of road traffic fatalities in Indonesia, while males are disproportionately affected compared with

females (14).

Considering that many students at the partner school regularly use motorcycles for daily travel, they are particularly vulnerable to unsafe driving behaviors and traffic crashes. Therefore, a structured road safety education program is needed to improve safe driving attitudes, strengthen perceived behavioral control, and promote responsible riding behavior among adolescents. Through a behavioral theory-based approach, the program aims to increase road safety awareness and ultimately contribute to reducing the incidence and severity of traffic accidents involving young motorcyclists, thereby minimizing both human and economic losses.

To achieve these targets, the initiative will deliver several actual outputs. These include the development and implementation of a comprehensive educational curriculum integrating behavioral theory principles with practical driving simulations, relevant specifically for adolescent students. Specific deliverables will include structured training sessions, educational modules and materials, and the deployment of driving simulator tools. Furthermore, the outputs will include quantitative data from pre- and post-intervention assessments to evaluate changes in knowledge, attitudes, and perceived behavioral control, beside qualitative feedback from participants to evaluate program satisfaction and inform future enhancements.

Method

This initiative was conducted by a team of lecturers from the Civil Engineering Department at Universitas Negeri Surabaya. The intervention's target demographic consisted of 36 students enrolled at the SMK Negeri 7 Surabaya. The methodology for achieving the program's objectives was a dual-component approach: (a) classroom-based theoretical instruction, which programmed with the Theory of Planned Behavior (TPB) to explain the principles of safe driving; and (b) hands-on virtual training conducted with a driving simulator to facilitate the practical application of safe driving protocols. Key supporting components, designed to ensure the program's success and long-term feasibility, involved the development of a comprehensive learning module for adolescent road safety education and the distribution of participation certificates to all attendees.

The application of this Community Service (PKM) program was structured into a series of distinct phases. The initial phase involved both internal and external coordination, where the team first defined implementation strategies, assigned duties, and prepared materials. Moreover, external collaboration with partners ensured the alignment on implementation logistics, scheduling, and expected outcomes. Thereafter, a training module was developed

in consultation with experts to establish solid and fundamental instructional structure. This was followed by a comprehensive preparatory phase, which included the finalizing all educational materials and securing necessary equipment.



Figure 1. Theoretical Delivering of Road Safety Among Adolescence

The main impementation, conducted at the SMK Negeri 7 Surabaya, consisted of delivering the theoretical content in the class as depict in Figure 1., administering practical driving simulations as depict in Figure 2., and conducting initial evaluations. Meanwhile, the Post-intervention, participants were assigned tests and questionnaires to engaged learning outcomes and requesting feedback from partners. The project concluded with the compilation of progress and final reports, which served to series of document and achievements throughout its implementation.



Figure 2. Traffic Simulation Session using Driving Simulator

Result

Based on the questionnaire that has been distributed to the students, the demographic analysis of the study cohort, as detailed in the first table, reveals a highly specific and relevant target population for road safety interventions. The sample was mainly dominated by male students (92%) aged 17 years (85%). More importantly, the data highlights a significant gap between self-reported driving experience and incident history. While a majority (82%) of

participants reported no prior experience driving cars or motorcycles, 88% admitted to having been involved in traffic incidents at least once a year, and 92% had received a ticket fines of traffic violation. This indicates a high-risk group that is exposed to and engaged in traffic-related activities despite a general lack of formal experience. A notable finding is the low rate of formal driving education, with 79% of participants having never received such training, highlighting a huge gap in existing safety education systems for this vulnerable demographic.

Table 1. Demographic result of respondents

Attributes	Category	Number
Age	15 years old	10%
	16 years old	5%
	17 years old	85%
Gender	Male	92%
	Female	8%
Trials driving cars or motorcycle	Yes	18%
	No	82%
Years on driving cars or motorcycles	< 1 year	81%
	1-2 years	12%
	> 2 years	7%
Involvement on traffic incidents	never	12%
	1-2	
	times/year	76%
	3-5	
	times/year	11%
Receiving tickets	> 5 times/year	1%
	Yes	92%
Receiving education on driving	Never	8%
	Yes	21%
	Never	79%

The results of the pre-test and post-test analysis demonstrate a significant positive impact of the intervention on key psychological constructs related to safe driving behavior, as measured by the Theory of Planned Behavior (TPB). As presented in the table, all three attributes—Attitude, Subjective Norms, and Perceived Behavioral Control—showed substantial improvements in the post-test scores compared to the pre-test scores.

Prior to the intervention, the average correct answers for Attitude, Subjective Norms, and Perceived Behavioral Control were 42%, 33%, and 28%, respectively. These baseline scores indicate a considerable need for targeted educational interventions, as they suggest that participants had a relatively weak foundation in positive attitudes toward safe driving, were less influenced by supportive social norms, and lacked confidence in their ability to perform safe driving actions.

Following the intervention, the average correct answers showed marked increases across the board. The score for Attitude improved from 42% to 58%, reflecting a positive shift in participants' personal evaluations of safe driving practices. The most significant gains were observed in Subjective Norms, which saw an impressive increase from 33% to 67%. This indicates that the program was highly effective in altering participants' perceptions of social pressure and the perceived approval from significant others regarding safe driving. The improvement in Perceived Behavioral Control from 28% to 72% is particularly noteworthy. This construct, often considered a strong predictor of actual behavior, suggests that the intervention successfully enhanced participants' self-efficacy and their confidence in their ability to perform safe driving behaviors even under challenging circumstances

Discussion

These substantial gains across all three TPB constructs are crucial. According to the theory, stronger positive attitudes, supportive subjective norms, and higher perceived behavioral control directly influence an individual's intention to perform a given behavior, and subsequently, the behavior itself. For adolescent drivers, these findings imply that the program successfully addressed the psychological foundations that are essential for developing and sustaining safer driving practices. The marked improvement in perceived behavioral control, in particular, points to a successful transition from merely understanding the importance of safety to feeling capable of implementing it on the road, which is a key step toward reducing traffic accidents.

Table 2. The pre- and post- test result of the community service

Attributes	Average correct answer Pre-test	Average correct answer Post-test
Attitude	42%	58%
Subjective norms	33%	67%
Perceived behavioral control	28%	72%

Beyond the quantitative gains in the Theory of Planned Behavior (TPB) constructs, the post-intervention survey provided crucial qualitative feedback on the program's perceived effectiveness and its impact on the participants' self-efficacy. As shown in the table, the results

consistently indicate a strong positive reception and high perceived value of the intervention components.

For the attribute, "The relevance of theoretical principles to practical driving," a combined 85% of participants rated it as 4 or 5, with 60% giving the highest score of 5. This overwhelmingly positive feedback suggests that the program was successful in bridging the gap between theoretical knowledge and real-world application, a common challenge in educational programs. Participants did not view the principles as abstract concepts but as highly relevant and directly applicable to their driving behavior.

The attribute "Level of comprehension" also received exceptionally high ratings, with 97% of participants scoring it as 4 or 5, and 62% giving a perfect score of 5. This result confirms that the instructional content was well-designed and delivered effectively, ensuring participants not only received information but also developed a strong and clear understanding of safe driving behaviors.

Furthermore, the integration of technology proved to be highly effective. The attribute "The applicability of simulated driving to real-world driving conditions" was rated 4 or 5 by 93% of participants. This finding validates the use of the driving simulator as a powerful tool for experiential learning, demonstrating that participants found the simulated scenarios to be realistic and a valuable preparation for actual driving contexts.

Finally, the survey assessed the program's impact on self-efficacy, a critical component for behavioral change. For "The perceived self-efficacy in real-world driving contexts," 76% of participants rated their improvement as 4 or 5. This indicates a substantial positive contribution to participants' confidence and belief in their ability to drive safely in the real world. However, the presence of 8% of participants rating this attribute as 1 suggests a degree of variability in this outcome. While the intervention successfully contributed to an enhanced sense of perceived self-efficacy for most, this outcome may require further reinforcement in future programs to ensure all participants feel equally capable.

Table 3. Evaluation of an Intervention to Enhance Safe Driving Awareness

Attributes	5	4	3	2	1
The relevance of theoretical principles to practical driving	60%	25%	15%	0%	0%
Level of comprehension regarding safe driving behaviors.	62%	35%	0%	3%	0%
The applicability of simulated driving to real-world driving conditions	52%	41%	7%	0%	0%
The perceived self-efficacy in real-world driving contexts.	51%	25%	16%	0%	8%

All in all, the combined theoretical and simulation-based program was highly effective. It successfully helped young drivers understand the practical relevance of safety rules and apply them in a simulated environment. While the intervention significantly boosted participants' self-confidence in their driving abilities, future programs should focus on reinforcing this confidence across all participants to ensure more consistent safe behaviors on the road.

Conclusion

The comprehensive analysis of the intervention highlights its significant success in addressing the core challenges of adolescent road safety. The study effectively targeted a highly vulnerable demographic—young male drivers with a history of incidents but limited formal training—and demonstrated a significant impact on the psychological factors that rules their driving behavior.

The pre- and post-test data, grounded in the Theory of Planned Behavior (TPB), shows that the program encouraged a substantial improvement in Attitude, Subjective Norms, and, most critically, Perceived Behavioral Control. The impressive increasing in participants' confidence and ability to perform safe driving actions, from a baseline of just 28% to 72%, is a powerful indicator that the intervention successfully moved beyond mere knowledge

transfer to develop a genuine sense of self-efficacy. This is further supported by the overwhelmingly positive feedback from the post-intervention survey, which validated the program's methodology. The high ratings for the relevance of theoretical principles and the applicability of the driving simulator confirm that the combined approach effectively connected the gap between classroom learning and practical, real-world application.

In sum, this intervention provides a compelling, evidence-based model for road safety education. The integration of behavioral theory with hands-on simulation proved highly effective not only in changing attitudes but also in equipping young, inexperienced drivers with the cognitive foundation and confidence necessary for responsible and safe behavior on the road. The findings offer a strong basis for replicating and scaling this model to mitigate the high-risk behaviors of this demographic and ultimately contribute to a reduction in traffic accidents.

Acknowledgements

The authors extend their sincere gratitude to the community service team, which included three engineering students and four supervising lecturers from the Civil Engineering Study Program, Universitas Negeri Surabaya, for their instrumental role in organizing this successful safe driving behavior awareness campaign. This initiative was made possible through the invaluable cooperation and contributions of SMK N 7 Surabaya, which served as the implementing partner. This activity was funded entirely by the implementing team, and the authors confirm the absence of any conflicts of interest with parties involved in the project.

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