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ENHANCING ADOLESCENT ROAD SAFETY THROUGH BEHAVIORAL THEORY AND DRIVING SIMULATION

PENINGKATAN KESELAMATAN BERLALU LINTAS REMAJA DENGAN PENDEKATAN TEORI PERILAKU DAN SIMULASI MENGEMUDI

Scope:
Applied Sciences

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A B S T R A C T

Background: *Indonesia experiences extremely high traffic accident rates, with motorcyclists and young drivers disproportionately affected due to prevalent human factors, insufficient safety education, and peer-influenced risky behaviors.* ***Objective:*** *In response, this community service initiative integrates comprehensive theoretical instruction with driving simulations to enhance road safety awareness and improve cognitive driving behaviors among adolescent students, specifically those at Sekolah Indonesia Kuala Lumpur.* ***Method:*** *This community service initiative employed a methodology that integrated theoretical instruction based on the Theory of Planned Behavior with virtual driving simulations, assessing its impact on adolescent drivers' road safety awareness through pre- and post-tests and participant satisfaction surveys.* ***Results:*** *The combined theoretical and simulation-based intervention was highly effective in enhancing adolescent drivers' perception of safety, as evidenced by a 32%, 32%, and 33% increase in their correct answer rates for Attitude, Subjective Norms, and Perceived Behavioral Control, respectively.* ***Conclusion:*** *The combined theoretical and simulation-based intervention effectively improved road safety attitudes, subjective norms, and perceived behavioral control among young, inexperienced male high school drivers with a history of incidents, consequently promoting cognitive and attitudinal shifts toward safer road behavior.*

A B S T R A K

Latar belakang: *Indonesia menghadapi tingkat kecelakaan lalu lintas yang sangat tinggi, dengan pengendara sepeda motor dan pengemudi muda yang terdampak secara tidak proporsional disebabkan oleh faktor manusia yang dominan, edukasi keselamatan yang tidak memadai, dan perilaku berisiko yang dipengaruhi oleh teman sebaya.* ***Tujuan:*** *Sebagai respons, inisiatif pengabdian kepada masyarakat ini mengintegrasikan instruksi teoretis komprehensif dengan simulasi berkendara untuk meningkatkan kesadaran keselamatan jalan dan memperbaiki perilaku mengemudi kognitif di kalangan siswa remaja, khususnya di Sekolah Indonesia Kuala Lumpur.* ***Metode:*** *Inisiatif pengabdian kepada masyarakat ini menggunakan metodologi yang mengintegrasikan instruksi teoretis berdasarkan Teori Perilaku Terencana dengan simulasi berkendara virtual, mengevaluasi dampaknya terhadap kesadaran keselamatan jalan pengemudi remaja melalui pre-test dan post-test serta survei kepuasan peserta.* ***Hasil:*** *Intervensi gabungan berbasis teori dan simulasi berhasil meningkatkan pemahaman pengemudi remaja terhadap prinsip keselamatan, dibuktikan dengan kenaikan tingkat jawaban benar sebesar 32%, 32%, dan 33% untuk faktor Sikap, Norma Subjektif, dan Kontrol Perilaku.* ***Kesimpulan:*** *Intervensi gabungan berbasis teori dan simulasi secara efektif meningkatkan sikap keselamatan jalan, norma subjektif, dan kontrol perilaku yang dipersepsikan di kalangan pengemudi SMA pria muda yang kurang berpengalaman dengan riwayat insiden, sehingga mengembangkan pergeseran kognitif dan sikap untuk perilaku jalan yang lebih aman.*

A R T I C L E I N F O

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BACKGROUND

Driven by economic development, Indonesia's high mobility demand (Manan and Várhelyi, 2015) is primarily met by affordable and accessible motorcycles and cars across the nation's 261-million-strong population. An analysis of Indonesian traffic accident data reveals significant trends in fatalities and injuries. Records from the Korlantas Polri (2024) indicate that between 2023 and 2024, motorcyclists and car drivers consistently accounted for over 76.42% of traffic-related fatalities. Furthermore, motorcycles were implicated in more than 73% of all fatalities and severe injuries (AIS > 3) from 2013 to 2018 (Fatmawati, 2019). When disaggregated by age group, the highest incidence of motorcycle accidents was observed among riders aged 17–25 years (Jusuf et al., 2017).

According to previous research, human factors represent the main cause of accidents, accounting for 95.23% of incidents, while road conditions contribute only 4.77% (Korlantas Polri, 2024). Furthermore, the purpose of driving experience is to develop the ability to control a vehicle in both routine and unexpected situations. It has been found that adolescents are more likely to be involved in traffic accidents (Aryatama, 2022), exhibiting the highest risk and comprising 51% of all crashes (Riskiansah and Zain, 2016). In fact, several studies have shown that these risky behaviors are correlated with drivers' accident risk in different ways depending on their age (De Winter et al., 2015).

Road safety is mainly influenced by driving behavior, driver risk perception, and driver experience (Farooq et al., 2020). Driving skills address motor abilities and information-processing capabilities, both of which can be improved through practice and training, thereby correlating with driving experience. Conversely, driving style refers to a driver's habitual manner of operating a vehicle, including decisions regarding speed and general attentiveness (Lucidi et al., 2019; Wåhlberg et al., 2015). More precisely, Lucidi et al. (2019) assessed the model's validity in predicting certain risky driving behaviors (violations, lapses, and errors) and in preventing traffic accidents among a large sample of young adolescent drivers, while also accounting for the impact of attitudes toward traffic safety. Moreover, Wulandari (2015) stated that the lack of comprehensive safety education systems and the strong influence of peer pressure toward risky behaviors are primary contributors to road safety issues among young adult riders in Indonesia.

In response to these issues, a community service initiative was developed to mitigate the incidence of traffic accidents among adolescent drivers. This program aims to increase awareness of safe driving practices and consequently reduce future collisions, specifically targeting Indonesian students at Sekolah Indonesia Kuala Lumpur. The project team provided students with theoretical foundations and cognitive driving training relevant to real-world conditions through a driving simulator.

METHOD

This community service (CS) program was designed for twenty students from Sekolah Indonesia Kuala Lumpur (SIKL). The course was initiated by a group of instructors from the Department of Civil Engineering, Universitas Negeri Surabaya, on July 16, 2025. To achieve the community service objectives, the program combined two primary approaches: a) theoretical instruction through lectures highlighting the Theory of Planned Behavior (TPB) to clarify safe driving concepts, and b) virtual hands-on training using a driving simulator designed to apply safe driving practices. To accomplish the program's goals and ensure sustainability, supporting components—such as certificates of participation for all community service participants and a comprehensive learning module to guide adolescent road safety education—were included as essential elements.

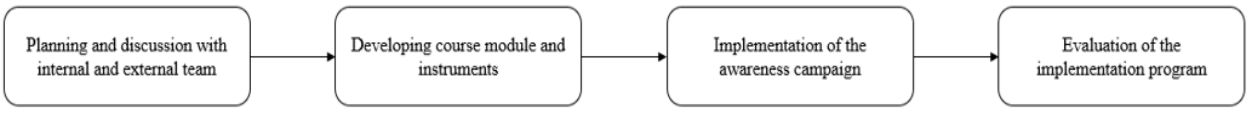

Figure 1. Flow Diagram for the Safety Driving Campaign Implementation Program

A set of preparation procedures, as shown in Figure 1, was implemented to carry out this community service program. To establish implementation plans, assign roles, develop technical protocols, produce guidelines and tutorials, prepare tools and resources, and determine participant targets that align with the expected outcomes, the internal team first collaborated internally. Moreover, the team also coordinated with external partners to address

implementation issues, timelines, and expected outcomes for the partner institution. Additionally, during the module preparation process, experts in road safety and transportation within the Faculty of Engineering were consulted to provide a concrete pedagogical foundation. Finalizing instructional materials—such as banners, booklets, complete learning modules, presentation slides, certificate drafts, and survey instruments—as well as acquiring all necessary auxiliary equipment, were key objectives of the training preparation phase. At Sekolah Indonesia Kuala Lumpur (SIKL), the instruction was delivered through theoretical sessions, realistic driving simulations, and preliminary activity evaluations, as shown in Figure 2. Tests and training questionnaires were administered after the intervention to evaluate learning outcomes and gather partner feedback. To document the progress and achievements of each stage of implementation, both progress and final reports were compiled as part of the community service documentation.

Figure 2. Safe Driving Behavior Awareness Campaign at Sekolah Indonesia Kuala Lumpur

The success indicators and impact evaluation strategy for this community service activity were measured across multiple dimensions. First, increased knowledge and skills were assessed through pre- and post-tests to quantify participants' improvement in understanding road safety principles and traffic regulations. These were complemented by demonstrations of safe driving techniques such as proper braking, body posture, and obstacle avoidance. The pre- and post-tests consisted of 50 questions related to safe driving behavior. Lastly, participant satisfaction was measured through post-training questionnaires and feedback mechanisms to identify areas for future program enhancement.

RESULT AND DISCUSSION

The analytical process was conducted in the Transportation Laboratory of the Department of Civil Engineering, Universitas Negeri Surabaya. An analysis of the demographic and behavioral characteristics of the participants is presented in Table 1. The age distribution indicates that 70% of participants were 16 years old, while 15-year-olds constituted 15% and 17-year-olds 10%. Regarding gender, males represented 62% of the cohort, while females comprised 38%.

According to Table 1, driving experience varied among participants: 45% reported having tried driving cars or motorcycles, while 55% had not. Of those with driving experience, a significant majority (75%) had less than one year of experience, with 20% having 1–2 years and only 5% having more than two years. Regarding involvement in traffic incidents, 83% reported 1–2 incidents per year, and 17% reported more than five incidents per year. An overwhelming 95% of participants had received traffic tickets, while just over half (55%) had received some form of driving education.

These findings suggest that the study population—mostly 16-year-old male high school students—has limited driving experience despite a high incidence of traffic violations and accidents. The data also highlight a considerable proportion of participants who have not received formal driving education, indicating a significant gap in current safety awareness programs for this age group.

Table 1. Demographic of The Participants

Attributes	Category	Number
Age	15 years old	20%
	16 years old	70%
	17 years old	10%
Gender	Male	62%
	Female	38%
Tried driving cars or motorcycles	Yes	45%
	No	55%
Years of driving experience (cars or motorcycles)	<1 year	75%
	1-2 years	20%
	>2 years	5%
Involvement in traffic incidents	never	0%
	1-2 times/year	83%
	3-5 times/year	0%
	>5 times/year	17%
Receiving tickets	Yes	95%
	Never	5%
Receiving education on driving	Yes	55%
	Never	45%

As for the results on how participants received information about the Safe Driving Awareness Campaign, findings reveal that the intervention positively impacted the key constructs of the Theory of Planned Behavior (TPB) related to safe driving awareness among adolescent drivers, as also evidenced by Lucidi et al. (2019). There are three key indicators in TPB that explain adolescent driving behavior: 1) Attitude – reflects positive or negative evaluations of engaging in safe driving practices; Subjective Norms – represent perceived social pressure from significant others to drive safely; and Perceived Behavioral Control (PBC) – signifies the individual's belief in their capability to perform safe driving behaviors considering both internal and external factors.

Table 2. The Result of Pre-test and Post-test of The Campaign

Attributes	Average Correct Answer Pre-test	Average Correct Answer Post-test
Attitude	51%	83%
Subjective norms	45%	77%
Perceived behavioral control	58%	91%

Prior to the intervention (pre-test), participants demonstrated an average correct answer rate of 51% for questions related to Attitude, 45% for Subjective Norms, and 58% for Perceived Behavioral Control (PBC). These baseline scores indicate moderate initial levels of positive attitudes toward safe driving, limited perceived social pressure (subjective norms) to drive safely, and a somewhat higher but still modest belief in their ability to control safety-related driving behaviors. Following the intervention (post-test), a notable improvement was observed across all TPB constructs. The average correct answer rate for Attitude rose significantly to 83%, Subjective Norms increased to 77%, and Perceived Behavioral Control reached 91%. These improvements

suggest that the intervention effectively enhanced adolescents' positive evaluations of safe driving, increased their perception of social support for safe driving behaviors, and strengthened their belief in their ability to perform such behaviors.

The substantial gains in these TPB constructs are noteworthy, as the theory posits that stronger positive attitudes, supportive subjective norms, and higher perceived behavioral control directly influence an individual's intention to perform a given behavior and, consequently, the behavior itself. For adolescent drivers, these findings imply that the program successfully addressed the psychological foundations essential for developing and sustaining safer driving practices. The significant improvement in Perceived Behavioral Control is particularly encouraging, as it indicates that participants not only understood the importance of safety but also felt more capable of practicing it on the road, which serves as a strong predictor of future safe behavior.

Regarding the post-test results used to evaluate the effectiveness of the training, an analysis of participant perceptions of the intervention—as summarized in Table 3—highlights key areas of impact on safe driving awareness among adolescent drivers. The evaluated attributes include the relevance of theoretical principles, level of comprehension, applicability of simulated driving, and perceived self-efficacy in real-world driving contexts.

Table 3. The Evaluation Result of Safety Driving Campaign Awareness

Attributes	5	4	3	2	1
The relevance of theoretical principles to practical driving	75%	15%	10%	0%	0%
Level of comprehension regarding safe driving behaviors	80%	10%	0%	5%	5%
The applicability of simulated driving to real-world driving conditions	75%	25%	0%	0%	0%
The perceived self-efficacy in real-world driving contexts	60%	5%	25%	0%	10%

A strong positive response was observed regarding the relevance of theoretical principles to practical driving, with 75% of participants rating it a "5", indicating it was highly relevant to practical driving, and an additional 15% rating it a "4". This proves that the theoretical material was perceived as highly relevant to real-world driving situations, which is important for translating knowledge into practical application. Furthermore, 80% of participants rated their comprehension level of safe driving behaviors as "5", and 10% rated it as "4", indicating a well-delivered and effective instructional outcome. This implies that the way the instruction was delivered successfully promoted comprehension of key safe driving concepts, creating a solid cognitive foundation for behavioral change.

Furthermore, most participants agreed that simulated driving activities were applicable to real-world driving scenarios, with 75% of respondents rating this aspect as a "5" and 25% as a "4". This high degree of agreement demonstrates how effectively the driving simulator bridged the gap between theoretical knowledge and the complexities of real-world driving, serving as an effective and practical teaching methodology. This finding is particularly significant for young drivers who may lack real-world experience and cognitive readiness, as the simulator provides a safe and realistic environment for skill development. Regarding perceived self-efficacy, 60% of participants rated themselves "5" (feeling very confident in their real-world driving ability), while 5% rated "4". Although 10% gave a rating of "1" and 25% rated "3", the majority of respondents still indicated that the simulation intervention increased their confidence and self-efficacy in their ability to drive safely in real-world situations. According to the Theory of Planned Behavior, this finding implies that the training enhanced participants' perceived control over safe driving practices, which is a key predictor of behavioral intention.

In summary, the results demonstrate that the combined theoretical and simulation-based intervention was highly effective in enhancing adolescent drivers' perception of the practical relevance of safety principles, their comprehension of safe driving behaviors, and the applicability of simulator-based training. While a notable

improvement in perceived self-efficacy was observed, future interventions could incorporate additional confidence-building activities or extended simulation practice to further strengthen this aspect across all participants, ultimately promoting more consistent safe driving behaviors in real-world scenarios.

CONCLUSION AND SUGGESTION

In conclusion, this study focused on a vulnerable group of young drivers—mostly 16-year-old male high school students with limited driving experience but a notable history of traffic incidents. This group, many of whom lacked formal driver's education, represented an ideal target for a structured safety intervention. The program, which combined theoretical instruction and simulation-based training, proved to be highly effective. This finding aligns with the research of Lucidi et al. (2019), which indicated that safety driving education can improve positive attitudes toward safe driving, strengthen the belief that safe driving is socially supported, and increase drivers' confidence in their ability to practice safe driving behaviors. These psychological improvements are essential because they are directly linked to a greater likelihood of engaging in safe driving practices in the future.

Beyond these measurable improvements, students found the safety principles to be highly relevant to real-world driving contexts. Through guided observation, participants were able to recognize safe driving behaviors and understand the strong connection between simulated and actual driving experiences. Although the program effectively enhanced participants' perceived confidence, the variation in confidence levels among students suggests that future initiatives should include additional reinforcement and extended simulation sessions. Overall, the study's success highlights that this integrated theoretical and simulation-based approach should be sustained and expanded, particularly for adolescent and novice drivers. It is therefore recommended that schools and government agencies integrate these evidence-based methods into standard driver's education programs, helping more young people develop a strong foundation for responsible and safe driving behavior.

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BIBLIOGRAPHY

Aryatama, F. zaini, 2022. Analisis Penyebab Kecelakaan Lalu Lintas di Jalan Empunala Kota Mojokerto. Jurnal Teknik Sipil: Rancang Bangun Vol. 8(2), Pp. 150-155. https://doi.org/10.33506/rb.v8i2.1805.

De Winter, J.C.F., Dodou, D., Stanton, N.A., 2015. A Quarter of A Century of The DBQ: Some Supplementary Notes on its Validity with Regard to Accidents. Ergonomics Vol. 58(10), Pp. 1745-1769. https://doi.org/10.1080/00140139.2015.1030460.

Farooq, D., Moslem, S., Tufail, R.F., Ghorbanzadeh, O., Duleba, S., Maqsoom, A., Blaschke, T., 2020. Analyzing The Importance of Driver Behavior Criteria Related to Road Safety for Different Driving Cultures. International Journal of Environmental Research and Public Health Vol. 17(6), Pp. 1893. https://doi.org/10.3390/ijerph17061893.

Fatmawati, A., 2019. Developing A Road Safety Framework for Indonesia. UHasselt.

Jusuf, A., Nurprasetio, I.P., Prihutama, A., 2017. Macro Data Analysis of Traffic Accidents in Indonesia. Journal of Engineering and Technological Sciences Vol. 49(1), Pp. 132-143. https://doi.org/10.5614/j.eng.technol.sci.2017.49.1.8.

Korlantas Polri, 2024. Kecelakaan Lalu Lintas di Indonesia Didominasi Oleh Kendaraan Roda dua. URL https://korlantas.polri.go.id/kecelakaan-lalulintas-di-indonesia-didominasi-oleh-kendaraan-roda-dua/ (accessed 10.6.25).

Lucidi, F., Girelli, L., Chirico, A., Alivernini, F., Cozzolino, M., Violani, C., Mallia, L., 2019. Personality Traits and Attitudes Toward Traffic Safety Predict Risky Behavior Across Young, Adult, and Older Drivers. Frontiers in Psychology Vol. 10(1). https://doi.org/10.3389/fpsyg.2019.00536.

Manan, M.M.A., Várhelyi, A., 2015. Exploration of motorcyclists' Behavior at Access Points of A Malaysian Primary Road – A Qualitative Observation Study. Safety Science Vol. 74(1), Pp. 172-183. https://doi.org/10.1016/j.ssci.2015.01.005.

Riskiansah, A., Zain, I., 2016. Analisis Pola Tingkah Laku Pengendara Sepeda Motor di Kota Surabaya dengan Driver Behavior Questionnaire (DBQ). Institut Teknologi Sepuluh Nopember.

Wåhlberg, A. af, Barraclough, P., Freeman, J.E., 2015. The Driver Behavior Questionnaire as Accident Predictor; A Methodological Re-Meta-Analysis. Journal of Safety Research Pp. 1-28. https://doi.org/10.1016/j.jsr.2015.08.003.

Wulandari, F., 2015. Pemahaman Pelajar Tentang Disiplin Berlalu Lintas Studi di SMK Kesehatan Samarinda. Journal Pembangunan Sosial Vol. 3(3), Pp. 52-64.