

ZEBRA CROSSING SAFETY FOR INDIVIDUAL WITH SPECIAL NEEDS: A MULTI-PERSPECTIVE STUDY

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Abstract: Zebra crossings, designed as safe passageways, often present unique challenges for children with special needs. Difficulties in hazard perception, attention, and decision-making make these everyday encounters with traffic far more complex and risky than for their peers. This study explores the issue through a multi-perspective approach, integrating public perceptions, professional insights, and driver behaviour. A mixed-method design was employed, combining an online questionnaire with university students, semi-structured interviews with lecturers in special education, and structured observations of driver compliance at a signal-controlled zebra crossing in Ipoh, Malaysia. Results revealed that university students expressed moderate confidence in their own safety but identified heightened risks for children with special needs, particularly in relation to inattentive drivers and inadequate infrastructure design. Lecturers emphasised systemic shortcomings, noting that current road environments and safety education programs insufficiently address the needs of vulnerable groups. Observational data confirmed frequent driver violations, with a notable proportion of vehicles failing to stop at red lights, thereby posing a direct risk to pedestrians. The discussion highlights the mismatch between road infrastructure assumptions and the capabilities of children with special needs, as well as the gap between public awareness and actual driver behaviour. The integration of perspectives underscores the importance of interdisciplinary collaboration between traffic engineering, special education, and public policy. In conclusion, the study demonstrates that zebra crossing safety for children with special needs is compromised by both environmental and behavioural factors. Addressing these risks requires targeted public education, enhanced teacher training, stricter enforcement of traffic laws, and inclusive infrastructure design.

Keywords: Individual with Special Needs, Driver Behavior, Pedestrian Safety, Public Perception, Zebra Crossings

INTRODUCTION

Pedestrian safety is not simply about painted lines or traffic signals; it is also about dignity, equity, and inclusion. Zebra crossings are intended to symbolize protection and order, yet for children with special needs, they often represent hesitation, uncertainty, and risk. Their unique cognitive, perceptual, and motor challenges make navigating traffic environments far more complex than for their peers. In Malaysia, inclusive education policies have expanded opportunities for independent travel among children with special needs. However, the mismatch between infrastructure design and the lived realities of these children has become increasingly evident. This study seeks to bridge that gap by integrating perspectives from university students, lecturers in special education, and direct observations of driver behaviour at signal-controlled zebra crossings. By triangulating these viewpoints, the research provides a holistic understanding of risks and proposes strategies for inclusive road safety.

RESEARCH BACKGROUND

The road traffic environment is a dynamic system requiring pedestrians to process multiple stimuli, make rapid decisions, and execute safe behaviours. For children with special needs, these demands are magnified. Studies show that such children often struggle with hazard perception, attention allocation, and decision-making, increasing their vulnerability to traffic injuries (Falemban et al., 2020). Malaysia's inclusive education initiatives have encouraged greater community participation by children with special needs, including independent travel. However, road infrastructure remains largely designed for standard adult users, neglecting the needs of individuals with disabilities (Hss, 2020). From the perspective of special education, safe and independent travel is a prerequisite for self-reliance, social participation, and future employment. Yet, curricula often emphasise safety education without addressing whether the physical environment supports the skills being taught. This mismatch creates systemic risks. Globally, urban planning has begun to embrace concepts such as child-friendly cities and universal design. Locally, however, empirical research in Malaysia remains limited. This study therefore integrates special education expertise, traffic engineering, and environmental psychology to identify risks and advocate for inclusive improvements.

PROBLEM STATEMENT

Despite growing awareness of inclusive design, Malaysia still lacks systematic research into the external factors influencing zebra crossing safety for children with special needs. Three critical gaps are evident (see Table 1). National statistics highlight the urgency of this issue. Between 2014 and 2023, an average of 434 children lost their lives in road accidents each year in Malaysia (Malaysian Institute of Road Safety Research [MIROS], 2025). Yet, strikingly, there is no data that specifically captures the experiences of children with special needs, leaving their vulnerabilities invisible in official records.

Table 1
External factors influencing zebra crossing safety

Gap	Description
Public Perception	University students, as future professionals and active road users, shape social norms around inclusivity. Yet their perceptions of pedestrian safety, particularly concerning special needs groups, are underexplored.
Professional Insights	Special education lecturers possess valuable expertise in identifying systemic risks, but their perspectives are rarely incorporated into traffic safety frameworks.
Driver Behavior	Violations at zebra crossings, such as failing to stop at red lights, pose direct threats to pedestrian safety. Localised empirical data on driver compliance in Malaysia is scarce.

OBJECTIVES

This study aims to:

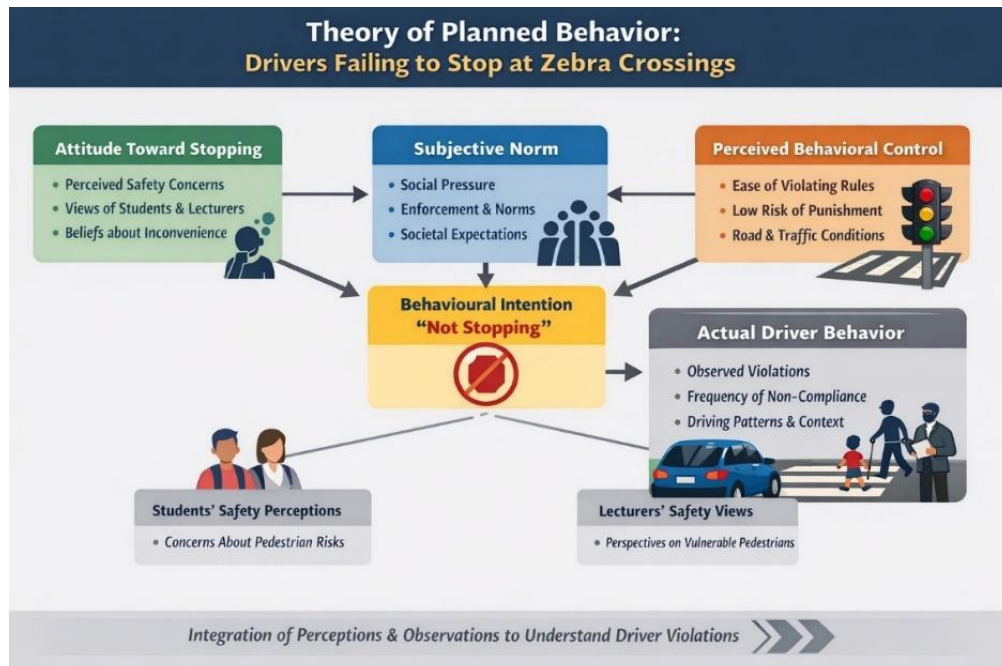
- i. Investigate students' perceptions of their own safety at zebra crossings.
- ii. Understand students' views on the safety risks faced by children with special needs.
- iii. Explore lecturers' perspectives on zebra crossing safety for special needs groups.
- iv. Observe and analyse driver behaviour at signal-controlled zebra crossings.

THEORETICAL FRAMEWORK

This study adopts the Theory of Planned Behavior (TPB) as the core framework to systematically analyse and predict the violation behaviour of drivers who fail to stop and yield at zebra crossings (see Figure 1). The TPB, developed by Ajzen (1991), assumes that an individual's behavioural intention is the most direct antecedent of their actual behaviour. Intention itself is shaped by three key psychological constructs: attitudes, subjective norms, and perceived behavioural control.

Figure 1

Theory of Planned Behavior: Drivers failing to stop at zebra crossings



In this study, the application of the theory is elaborated as follows:

- **Behavioural Attitude:** Drivers' evaluation of the act of stopping at a red light at a zebra crossing. This includes their personal assessment of safety, their perception of time delays, and their recognition of the vulnerability of children with special needs. A negative attitude (e.g., viewing stopping as inconvenient) increases the likelihood of violation.
- **Subjective Norms:** The social pressure drivers perceive from others. This study integrates the concern of university students for their own safety and the professional insights of special education lecturers as key social reference points. These perspectives help shape whether drivers feel compelled to comply with rules or whether social tolerance of violations weakens compliance.
- **Perceived Behavioural Control:** Drivers' perception of the ease or difficulty of stopping behaviour. This is influenced by road conditions, enforcement visibility, and the perceived convenience of violating rules. For example, if drivers believe enforcement is weak, they may feel confident in evading penalties.

Together, these three constructs interact to form the driver's behavioural intention of not stopping, which ultimately leads to observable violations such as failing to fully stop at zebra crossings.

This framework not only quantifies the frequency of violations but also explores the underlying social-psychological motivations. Importantly, it creatively incorporates other survey dimensions namely, students' safety perceptions and lecturers' professional viewpoints into the TPB model. These perspectives are transformed from isolated data points into meaningful social variables that shape attitudes and norms influencing driver behaviour.

METHODS

Research Design

This study adopted an explanatory sequential mixed-methods design, integrating quantitative and qualitative approaches in a structured sequence. The first phase focused on collecting quantitative data through surveys and structured observations, providing a broad statistical picture of perceptions and behaviours. The second phase involved qualitative interviews with lecturers, which added depth and context to the initial findings. This design was chosen because it not only captures measurable aspects of zebra crossing safety but also explores the underlying reasons, attitudes, and professional insights that shape these realities. By combining surveys, interviews, and observations, the study ensured methodological triangulation, thereby enhancing the validity and richness of its conclusions.

Population

The research targeted three distinct populations. The first group comprised undergraduate students enrolled in bachelor's degree programs at a Malaysian public university. Their perceptions represent the broader public's awareness and attitudes toward pedestrian safety, and they are future professionals who will influence social norms around inclusivity. The second group consisted of lecturers specialising in special education and related fields at public universities. Their expertise provided critical professional insights into systemic risks and the alignment (or misalignment) between curricula and infrastructure. The third group included drivers observed at a signal-controlled zebra crossing in Ipoh, Malaysia. This population was essential for capturing real-world compliance behaviour, offering objective evidence of risks faced by pedestrians, particularly children with special needs.

Samples

For the student population, convenience and snowball sampling were employed. Questionnaires were distributed through online university communities, and respondents were encouraged to share the survey link with peers. This approach ensured diversity across disciplines while remaining feasible within the study's scope. For lecturers, purposive sampling was used to recruit five faculty members with at least five years of teaching or research experience in special education. This ensured that the perspectives gathered were grounded in both theory and practice. For drivers, structured non-participatory observations were conducted at

a busy zebra crossing, with data collected during both peak and non-peak hours to capture variations in compliance behaviour.

Instruments

Three instruments were employed to collect data. A structured questionnaire captured students' perceptions of their own safety and their views on the risks faced by children with special needs. Semi-structured interview guides were developed for lecturers, allowing flexibility in exploring professional insights while maintaining consistency across interviews. Finally, an observation checklist was used to record driver behaviour, focusing specifically on violations such as failing to stop at red lights. These instruments ensured both comprehensive and in-depth data, enabling triangulation across subjective perceptions and objective behaviours.

Data Analysis

All quantitative data collected in this study were processed using SPSS, which allowed for clear presentation of descriptive statistics such as frequencies, percentages, means, and standard deviations. Reliability checks were also conducted to ensure that the survey instrument was consistent and dependable. Qualitative data from interviews were transcribed and analysed manually using thematic analysis. The coding process followed Braun and Clarke's (2006) framework, which guided the identification of recurring themes and patterns in participants' experiences. To make the findings more transparent, key themes and codes were summarised in tables, while structured observations were presented in charts to highlight driver behaviour and crossing conditions.

FINDINGS

University Students' Perceptions of Their Own Safety at Zebra Crossings

The survey revealed that university students expressed moderate concern about their personal safety when using zebra crossings. This sense of vulnerability, attributed to inattentive drivers, short signal timings, and weak enforcement of traffic rules, suggests that zebra crossings are not perceived as fully reliable safety mechanisms. This perception highlights a gap between the intended protective function of crossings and the lived reality of road users, pointing to the need for stronger enforcement and infrastructural adjustments. As shown in Table 2, the majority of respondents were female (60%), aged between 21–23 years, and drawn from diverse faculties. This demographic profile provides context for interpreting their perceptions of zebra crossing safety.

Table 2

Demographic Profile of Student Respondents (N = 120)

Variable	Category	Frequency	Percentage (%)
Gender	Male	48	40.0
	Female	72	60.0
Age	18–20 years	35	29.2

Faculty/Discipline	21–23 years	62	51.7
	24 years and above	23	19.1
	Education	40	33.3
	Social Sciences	30	25.0
	Engineering/Technology	25	20.8
	Others	25	20.8

Safety Risks Faced by Individual with Special Needs at Zebra Crossings, as Perceived by University Students

Students demonstrated awareness of the unique challenges faced by children with special needs. They identified slower crossing speeds, difficulties in hazard perception, and reliance on auditory cues as critical vulnerabilities. Several students noted that current infrastructure does not adequately accommodate these needs, citing the absence of tactile paving, auditory signals, and extended crossing times. While empathy was evident, their responses also revealed a limited grasp of systemic barriers, suggesting that public awareness remains superficial and requires deeper educational interventions.

University Lecturers' Views on Zebra Crossing Safety

Lecturers provided more nuanced and professional insights, emphasising the mismatch between safety curricula and real-world infrastructure. They observed that while children are taught traffic safety skills, the environment often undermines these lessons. Short signal timings disadvantage slower pedestrians, and the lack of tactile or auditory signals excludes visually impaired children. Lecturers strongly advocated for integrating environmental awareness into teacher training programs, arguing that educators must be equipped to teach safety skills that align with real-world conditions. Their perspectives highlight the importance of bridging the gap between pedagogy and infrastructure. Key themes from lecturer interviews are summarised in Table 4, showing how professional insights emphasise the mismatch between safety curricula and infrastructure, the need for inclusive design, and the urgency of policy integration.

Table 4

Themes from Lecturer Interviews (N = 5)

Theme	Codes/Examples	Respondent Profile
Mismatch between curriculum and infrastructure	“Children are taught safety skills, but short signal timings undermine them.”	Lecturer A, 10 years experience
Need for inclusive infrastructure	“Absence of tactile paving and auditory signals excludes visually impaired children.”	Lecturer B, 8 years experience
Teacher training reforms	“Educators must be trained to align pedagogy with real-world road conditions.”	Lecturer C, 12 years experience
Systemic risks for vulnerable groups	“Safety education cannot exist in isolation from the environment.”	Lecturer D, 7 years experience

Urgency of policy integration	“Policymakers must integrate special education insights into traffic planning.”	Lecturer E, 15 years experience
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Frequency of Driver Violations at Zebra Crossings During Red Stop Signals

Structured field observations revealed frequent violations, particularly during peak traffic hours. Drivers often failed to stop at red lights, motivated by impatience or the perception that enforcement was weak. These violations directly compromised pedestrian safety, especially for vulnerable groups such as children with special needs. The findings suggest that driver behaviour represents the most immediate and tangible threat to pedestrian safety, reinforcing the need for stronger enforcement mechanisms and infrastructural deterrents. Table 3 illustrates driver compliance behaviour observed at the Ipoh zebra crossing. More than one-fifth of drivers ignored the red light completely, while another 22.5% rolled through without fully stopping, highlighting the immediate risks faced by pedestrians.

Table 3

Driver Compliance at Zebra Crossing (Structured Observation, N = 200 vehicles)

Driver Behaviour	Frequency	Percentage (%)
Stopped fully at red light	110	55.0
Rolled through without full stop	45	22.5
Ignored red light completely	45	22.5

Synthesis of Findings

Taken together, the voices of students, lecturers, and the observations of drivers paint a vivid picture of zebra crossing safety for children with special needs. Students spoke of their own hesitation and anxiety, revealing that even young adults feel vulnerable when drivers are inattentive or enforcement is weak. Their empathy for children with special needs was genuine, but their understanding of systemic barriers remained surface-level, showing the need for deeper awareness. Lecturers, meanwhile, spoke with urgency and conviction, pointing out the troubling mismatch between what is taught in classrooms and what children actually encounter on the streets. Observations of drivers confirmed these concerns in stark terms: frequent violations at red lights exposed the most immediate and tangible risks, underscoring how fragile pedestrian safety becomes when enforcement is lax and impatience takes over.

Together, these perspectives validate the study’s conceptual framework, showing how attitudes, subjective norms, and perceived behavioural control interact across different groups to shape safety outcomes. More importantly, they highlight that zebra crossing safety for children with special needs is not just an infrastructural issue but a societal one. It requires empathy, awareness, and accountability from all stakeholders including students, educators, drivers, and policymakers alike. Only through this collective commitment can zebra crossings truly serve their purpose as symbols of dignity, equity, and protection.

DISCUSSION

Negotiating Safety: How Students Experience Zebra Crossings

The findings show that university students perceive zebra crossings as moderately safe but remain concerned about inattentive drivers and weak enforcement. Their hesitation reflects a lack of confidence in the protective function of crossings, particularly during peak traffic hours. Within the Theory of Planned Behavior (TPB) framework, these perceptions contribute to subjective norms, shaping how future professionals view compliance with traffic rules. However, their responses also reveal that safety is often understood in general terms rather than in relation to vulnerable groups. This suggests that public awareness campaigns must go beyond generic safety messages to emphasise the specific risks faced by children with special needs, thereby deepening students' understanding and shaping more inclusive social norms.

Vulnerabilities and Risks for Individuals with Special Needs

Students identified slower crossing speeds, difficulties in hazard perception, and reliance on auditory cues as critical vulnerabilities for children with special needs. While these observations demonstrate empathy, they also highlight a limited grasp of systemic barriers such as inadequate signal timings and the absence of tactile or auditory infrastructure. In TPB terms, students' recognition of these risks reflects their attitudes toward inclusivity, but the superficial nature of their understanding suggests that attitudes alone may not translate into strong behavioural intentions. This gap underscores the need for structured educational interventions that cultivate not only awareness but also practical knowledge of inclusive design and pedestrian safety.

Lecturers' Reflections on Inclusive Safety at Zebra Crossings

Lecturers provided more nuanced insights, emphasising the mismatch between safety curricula and real-world infrastructure. They observed that while children are taught traffic safety skills, the environment often undermines these lessons. Short signal timings disadvantage slower pedestrians, and the lack of tactile or auditory signals excludes visually impaired children. Within the TPB framework, lecturers' perspectives represent a critical source of subjective norms, as their professional expertise shapes expectations for both educators and policymakers. Their call for integrating environmental awareness into teacher training programs highlights the importance of aligning pedagogy with practice, ensuring that safety education is not abstract but grounded in the realities of road infrastructure.

Patterns of Driver Non-Compliance and Their Implications

Observations revealed frequent violations, particularly during peak hours, with drivers often failing to stop at red lights. These violations were motivated by impatience or the perception of weak enforcement, reflecting a culture of habitual non-compliance. In TPB terms, driver behaviour reflects perceived behavioural control, shaped by enforcement and infrastructural conditions. However, the prevalence of impulsive and habitual violations also exposes the limitations of TPB, which assumes rational decision-making. Many violations appeared to stem from momentary negligence or emotional responses rather than deliberate intentions. This suggests the need for complementary frameworks, such as Human Reliability Analysis (HRA), to account for habitual and emotional behaviours in traffic environments.

Synthesis of Discussion

When the perspectives of students, lecturers, and drivers are brought together, a clear pattern emerges about the fragile state of zebra crossing safety for children with special needs. Students spoke with empathy, acknowledging the risks these children face, yet their understanding often stopped at surface-level observations. Lecturers, in contrast, voiced their concerns with urgency, pointing out how the lessons taught in classrooms are undermined by the realities of the streets. Their insights remind us that safety education must be grounded in the environments children actually navigate. Observations of drivers added a sobering dimension, showing how impatience and weak enforcement translate into frequent violations that place vulnerable pedestrians at immediate risk.

Through the lens of TPB, these perspectives reveal how attitudes, social norms, and perceived control interact to shape safety outcomes. Yet the findings also highlight the limits of rational choice models, as many driver violations stemmed from habit or impulse rather than deliberate intention. This suggests that protecting children with special needs requires more than infrastructure or education alone; it demands empathy, accountability, and systemic change.

Together, the discussion underscores that zebra crossings are not just painted lines on the road but symbols of dignity and inclusion. Ensuring their safety for children with special needs calls for collective responsibility: raising public awareness, reforming teacher training, redesigning infrastructure, and enforcing laws with consistency. Only then can zebra crossings fulfil their promise as safe passageways for all.

CONCLUSION

This study underscores the urgent need for inclusive road safety strategies in Malaysia, particularly at zebra crossings where children with special needs face heightened risks. By integrating the perspectives of university students, lecturers, and direct observations of driver behaviour, the research provides a holistic evidence base that highlights both systemic challenges and opportunities for reform. Students revealed moderate concern about their own safety and recognised the vulnerabilities of children with special needs, though their understanding of systemic barriers remained limited. Lecturers offered deeper insights, emphasising the mismatch between safety curricula and real-world infrastructure, and advocating for the integration of environmental awareness into teacher training. Observations of driver behaviour exposed the most immediate threat, with frequent violations at zebra crossings driven by impatience and weak enforcement.

Together, these findings validate the conceptual framework, showing how attitudes, subjective norms, and perceived behavioural control interact across different stakeholder groups to shape safety outcomes. They also highlight the limitations of relying solely on rational-choice models such as TPB, as many violations stemmed from habitual or impulsive actions. Addressing these challenges requires a multi-pronged approach:

- Public awareness campaigns to sensitise road users.
- Teacher training reforms to align pedagogy with infrastructure.
- Inclusive design improvements such as extended signal timings and tactile paving.
- Stronger law enforcement through automated monitoring systems.

Safe and inclusive zebra crossings are more than lines on the road; they are reflections of our collective commitment to equity and respect for vulnerable groups. This study shows that protecting children with special needs requires more than infrastructure; it demands awareness, empathy, and accountability from every stakeholder. By addressing these challenges, Malaysia can move closer to the vision of child-friendly, universally designed cities where road safety is not a privilege, but a right for all.

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