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School of Transportation Sciences

Master of Transportation Sciences

Master's thesis

Evaluation of classroom road safety education on knowledge and socio-cognitive variables of behaviour and evaluation of the implementation process

Titus Kofi Dabla

Thesis presented in fulfillment of the requirements for the degree of Master of Transportation Sciences, specialization Transport Policy and Planning

SUPERVISOR :
Prof. dr. Davy JANSSENS

CO-SUPERVISOR :
Prof. dr. Ariane CUENEN

2023
2024

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I want to express my deep appreciation to various individuals for their support in completing this survey.

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Abstract

This study evaluated the efficacy of a school-based road safety campaign model "Stay Safe, Arrive Alive" in the Weija-Gbawe district of Ghana on road safety knowledge and behaviour (i.e., intention and attitude) of school children aged 7-11. Using a controlled pre-post-test design and structured questionnaire for data collection, the study applied the ANCOVA General Linear Model with Repeated Measures for evaluation or analysis to identify changes in road safety knowledge while McNemar's test analysed shifts in socio-cognitive variables as posited by the Theory of Planned Behaviour among the intervention group. The results showed significant improvement in road safety knowledge scores in the post-test compared to the control group, thus indicating that the campaign successfully increased awareness about safety. In addition, significant positive changes were noted within the test group regarding socio-cognitive constructs such as behaviour intentions and attitudes. The RE-AIM framework assessed the campaign's reach, effectiveness, adoption, implementation, and maintenance. The results also show that while parents have the habit of teaching the children road safety awareness, the schools, which are one primary source of socialisation, are doing very little in that regard. In general, the "Stay Safe Arrive Alive" initiative successfully enhanced both awareness and behavioural intention toward road safety issues for the participants, underscoring the educational interventions' capability to improve road safety knowledge and socio-cognitive skills in other regions of Ghana.

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List of Abbreviations

Abbreviation	Full Form
WHO	World Health Organization
RSE	Road Safety Education
RTAs	Road Traffic Accidents
GSS	Ghana Statistical Service
RE-AIM	Reach, Effectiveness, Adoption, Implementation, and Maintenance
TPB	Theory of Planned Behaviour
PSG	Paediatric Society of Ghana
SRTS	Safe Routes to School
KRSP	Kids' Road Safety Panel
GRSC	Ghana Road Safety Commission
OECD	Organisation for Economic Co-operation and Development
ETSC	European Transport Safety Council
RSC	Road Safety Campaign

1 General Introduction

1.1 Introduction

Road mobility is beneficial to countries and individuals as it enables the transportation of commodities and people (Peden & World Health Organization, 2008). In metropolitan areas of Ghana, buses, private vehicles, taxicabs, cycling, and walking are all viable transportation options for accessing services and job opportunities (Adom-Asamoah et al., 2015) . Children in Ghana mostly rely on roads as the primary means of transportation to access services, jobs, and schools due to the well-developed infrastructure compared to other modes (Adom-Asamoah et al., 2015).

Approximately 1.2 million individuals die annually in global traffic accidents, with 20 to 50 million sustaining non-fatal injuries (Peden & World Health Organization, 2008). According to Nakao et al. (2023), road traffic accidents are the primary cause of death for children globally, presenting a significant health hazard with major socioeconomic implications. Road traffic injuries are the leading cause of death for children and adolescents aged 5-19 and the second most frequent cause of death for those aged 5 to 14 (World Health Organization, 2018). Road traffic crashes are expected to be the seventh most significant cause of mortality by 2030 if no continuous action is taken (WHO, 2018).

The fatality rate in traffic accidents fluctuates significantly by region, and there has been a consistent frequency of these deaths since 2010. In 2016, the African region had the greatest prevalence rate of 26.6 per 100,000 people, whilst the European region had a lower rate of 9.3 per 100,000 people compared to the world average (WHO, 2018). According to the Global Status Report on Road Safety (WHO, 2018), vulnerable road users account for 53% of road user fatalities in Africa. Of the numbers, 4% are bicycles, 9% are people on two or three wheels, and 40% are pedestrians, posing a significant health hazard with societal implications. In low and middle-income countries such as Ghana, the situation is even more dire because inadequate infrastructure and limited road safety measures exacerbate the risks faced by young pedestrians and cyclists (Odero et al., 2003).

Previous studies have emphasised that road safety education is important in preventing road accidents among children as stated by (Bakhtari Aghdam et al., 2020; Vu Hong, 2021). Although the importance of road safety education for children has been highlighted many times, the discussion on the type and implementation of road safety education has mainly been led by academics and policymakers from the global north, even though children in the global south experience more injuries (Nasrudin & Nor, 2013). Adom-Asamoah et al. (2015) pointed out how early education about roads can prevent several Road Traffic Accidents (RTA) involving children. According to Fokides and Costas (2008), road safety includes all the necessary abilities, attitudes, knowledge, actions, and positive behaviours for safe mobility.

Ghana's distressing road safety statistics underscore the need for road safety interventions, especially for children vulnerable to road RTA. Many efforts or interventions have been made to improve road safety in Ghana (Mesic et al., 2023). However, statistics show that the implementation of the interventions in Ghana has been slow due to numerous challenges (Mesic et al., 2023). This research attempts to contribute to the general efforts made by the Government of Ghana and other stakeholders through a classroom-based road safety awareness campaign to prevent child-related deaths or injuries related to RTA in Ghana and make active mobility safe for students on their way to or from school.

1.2 Problem Statement

Ghana's road fatalities are a serious problem, with an upward trend over the past two decades (Dotse et al., 2019; National Road Safety Authority, 2016). Children are particularly exposed to the risk of traffic accidents because they mostly use roads for transportation to access services, jobs, and schools due to the well-developed infrastructures compared to other modes (Adom-Asamoah et al., 2015). Those aged below 35 years account for more than 60% of all deaths resulting from road traffic crashes in Ghana (Blankson & Lartey, 2020). As Poku-Boansi et al., (2019) Observed, between 2014 and 2016, children under 16 accounted for nearly one-tenth of urban road accident victims.

These young pedestrians have extremely dangerous commuting windows which include early mornings from seven o'clock until eight o'clock and afternoons between two o'clock and four o'clock p.m. (Adanu et al., 2023). The finding is corroborated by Poku-Boansi et al. (2019), who also discovered from their research that most cases of children RTA are caused by accidents that occur within school hours in Ghana.

However, despite these alarming statistics of child-related RTA and the risk students are exposed to during school hours in all parts of Ghana, Accra remains the focal point of the few road safety education programs that have been implemented (Odame et al., 2024). The research by (Odame et al., 2024) reveals that current road safety education initiatives like the "SAVE WAYS" campaign introduced into the National Curriculum for all schools in Ghana are not well integrated into the primary school curriculum. It also focuses on five primary pupils with no other active modes apart from walking. This leads to a wide gap in coverage and efficiency, especially among young, vulnerable populations outside Accra. From these findings, comprehensive and inclusive road safety interventions are considered essential and urgent for implementation in order areas of Ghana.

1.3 General Objectives

The main purpose of this study is to promote safe and sustainable school mobility among school children by adopting the "Stay Safe - Arrive Alive" initiative from the United Kingdom, which will be modified to suit Ghana. This campaign provides a comprehensive approach for promoting road safety which meets the needs of young pedestrians and cyclists across different age groups, going beyond only class 5 pupils. The objective of the research is to implement and evaluate primary 2-6 students on campaign efficacy and process in Weija-Gbawe, which is situated outside Accra Metropolis.

1.4 Specific Objectives

1. To evaluate how the "Stay Safe, Arrive Alive" campaign affects students' road safety knowledge
2. To examine how the "Stay Safe, Arrive Alive" campaign affects students' socio-cognitive variables of behaviour
3. To evaluate the implementation process of the "Stay Safe, Arrive Alive" road safety campaign.
4. To identify the contributions of crucial environments to promoting road safety among students in the district.
5. To ascertain the opinion of participants about this program.

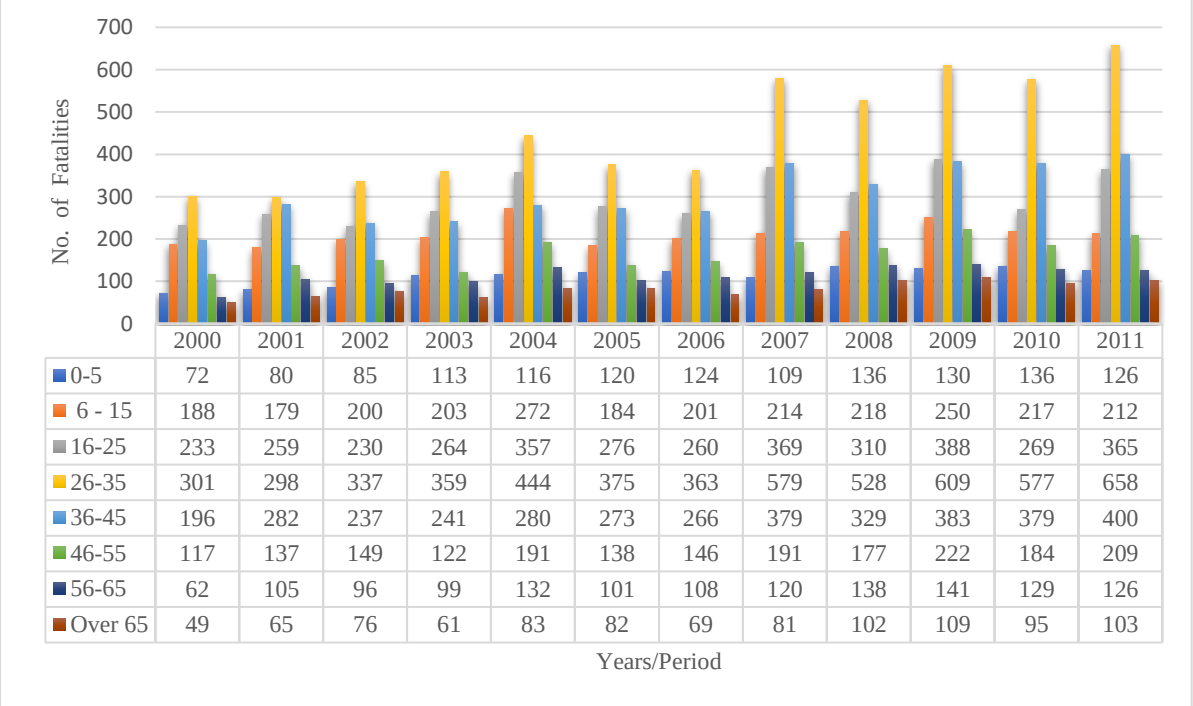
1.5 Research Questions

1. What is the impact of the "Stay safe, arrive alive" road safety campaign on road safety knowledge?
2. What is the impact of the "Stay safe, arrive alive" road safety campaign on- socio-cognitive variables of behaviour?
3. What factors could contribute to the success or failure of the campaign when implemented?
4. How do environmental agents such as schools and parents influence/promote active and safe transport among children?
5. What is the opinion of participants about this program?

2 Literature Review

2.1 Trends and Statistics of Road Traffic Accidents Involving Children in Ghana

Road traffic accidents are a significant concern in Ghana, and unfortunately, children are not exempted from this predicament (Adanu et al., 2023). The statistics in Figure 1 provide an overview of road traffic accidents involving children in Ghana, highlighting the magnitude of the issue



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
0-5	72	80	85	113	116	120	124	109	136	130	136	126
6 - 15	188	179	200	203	272	184	201	214	218	250	217	212
16-25	233	259	230	264	357	276	260	369	310	388	269	365
26-35	301	298	337	359	444	375	363	579	528	609	577	658
36-45	196	282	237	241	280	273	266	379	329	383	379	400
46-55	117	137	149	122	191	138	146	191	177	222	184	209
56-65	62	105	96	99	132	101	108	120	138	141	129	126
Over 65	49	65	76	61	83	82	69	81	102	109	95	103

FIGURE 1 Annual Distribution of Fatalities by Age Group (National Road Safety Authority, 2016)

Contextualising road traffic fatality trends and statistics in Ghana, Figure 1 gives an elaborate age-specific distribution of mortalities from 2000 to 2011 (NRSA, 2016). The number of accidents seems to affect more of those within the age range 26-35, and clearly, peaks of fatalities can be seen in the years 2007 to 2011. Special attention is also drawn to the figures by the age group 6-15. Even though the figures for children aged 6-15 are below those for children aged 16-25, 26-35, and 36-45, they still have a steady level of risk, which should be given attention. Surprisingly, only five of the regions including Greater Accra region accounted for a shocking 75.5% of all road traffic crashes in Ghana

as at 2016 showing there is an urgent requirement of targeted interventions to address safety on roads and save lives in all parts of the those five areas (NRSA, 2016).

2.2 Road User Categories and Impact on Children

Pedestrian fatalities remain high, with children constituting a significant portion of these statistics in Ghana. According to the Ghana National Road Safety Commission (2018), as cited by (Gyimah, 2023) and as revealed in Figure 3, pedestrians represented 39.5% of road traffic fatalities, followed by motorcycle users (21%) and minibuses (17.5%) of all fatalities in Ghana. Although there has been a slight improvement in pedestrian fatality rates from 46% in 2016 to 39.5% in 2018, as shown in Figures 2 and 3, the risk to children remains substantial. According to Poku-Boansi et al. (2019), between 2014 and 2016, around 9% of recorded casualties in Ghanaian towns and cities involved children below the age of 16. Their finding revealed that out of the total number of fatalities, which totalled 5,722 during that period, 13.5 % were children within the school-going age group. In Ghana, child pedestrians of children account for more than one in four of the people killed or seriously injured in traffic accident (Ackaah & Adonteng, 2011). In addition, majority of road traffic fatalities or accident victims are children and young people under the age of 35, indicating their susceptibility to mishaps (Blankson & Lartey, 2020). According to statistics from 2000 till now, this horrifying statistic shows children always featured in accidents statistics in Ghana.

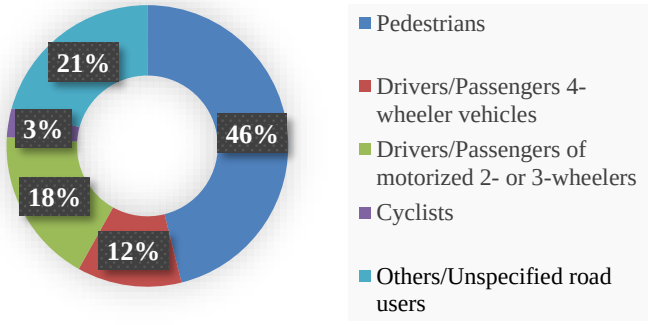


FIGURE 2 Death by Road User Category in Ghana (World Health Organization, 2016)

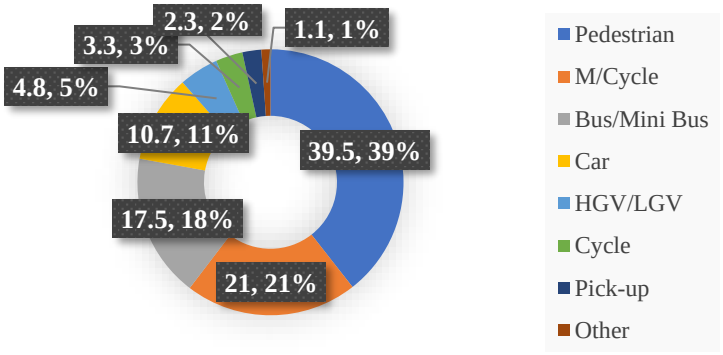


FIGURE 3 Deaths by Road User Category in Ghana.
Source: Ghana National Road Safety Commission, 2018 (as cited by (Gyimah, 2023).

2.3 Time of Day and Child-Pedestrian Collisions

Collisions between children and cars in Ghana have two major peak periods reported by (Adanu et al., 2023) and supported by Figure 4. This period coincides with the time of entry and departure from the school of children of school age. The major findings on accident characteristics during these peak hours on different days as documented by Adanu et al. (2023), were similar. This result is also in line with the findings of Poku-Boansi et al. (2019) which disclosed that injuries to Ghanaian children occur most commonly during school hours. These figures reveal the necessity for more concern for child safety in Ghana.

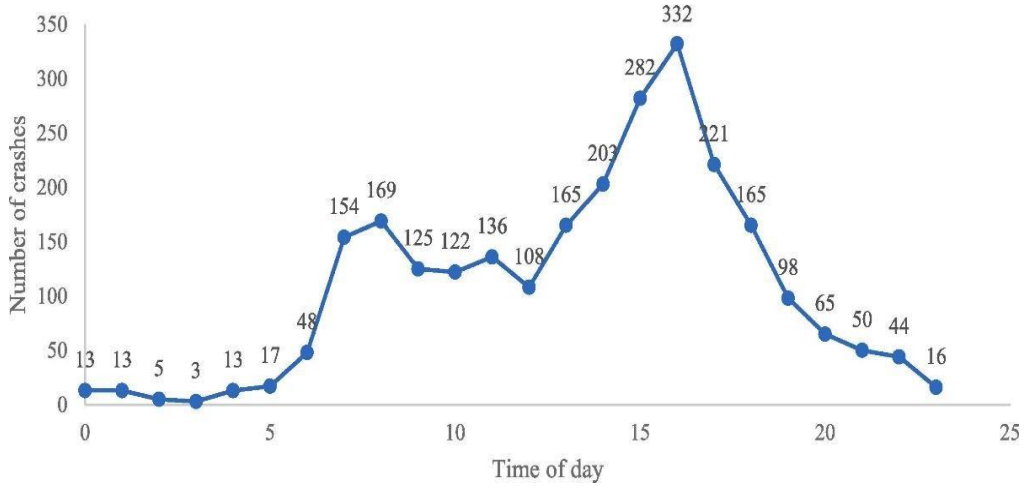


FIGURE 4 Number of Road Traffic Crashes Involving Children and Time of Day
Source: (Adanu et al., 2023)

By prioritising child safety and implementing evidence-based interventions, it is possible to reduce the number of child casualties and fatalities on the roads.

2.4 Understanding Student Active Transportation Modes and Challenges

The current state of student transportation safety is a multifaceted issue examined by various researchers in different contexts. Several studies were reviewed to understand this issue, with each contributing unique insight.

Stewart (2011), observed that distance, income, traffic, crime, fear, parental attitude to school travel and schedules are some of the key factors influencing active transportation to school. The study also found that children who live closer to school, reside in urban areas or have positive attitude towards walking or biking were more likely to walk or cycle. Also, those living in disadvantaged neighbourhoods often resorted to ATS as other means of transport were limited.

Boarnet et al. (2005) investigated the effects of changes in physical design on walking and bicycling trips to school. It focused on California's Safe Route2Schools program which financed construction projects for enhancing pedestrian and cyclists' safety. According to their study, changes in urban design coincided with higher levels of active travel among children passing SR2S projects.

One of the great contributions made by Bennet (2015) was its ability to examine variations regarding safe routes among children across the study locations involved. Their analysis proved valuable because it helped identify what causes collisions between child pedestrians and motor vehicles. By using such

a small geographic scale as one road segment at a time, it was possible through their study not only to examine how different elements of local roads influenced pedestrian safety but also if these elements interacted.

Davison et al. (2008) studied predictors and health consequences of active commuting to school. The paper highlighted the various factors that affect children's active commuting patterns, including individual and family, school and environmental characteristics. Distance to school was a significant barrier to active commuting, and parental and community support played essential roles.

Many features are evident during ongoing physical, cognitive and behavioural development in children, putting them at higher risk of road accidents (Meir et al., 2015). According to their research findings, underdeveloped cognitive skills, behaviour issues and physiological limitations among children diminished their ability to perceive risk, which in turn increased their vulnerability to RTA or injuries.

Younger children below 13 years old cannot accurately assess vehicle speeds, travel directions, and distances from crosswalks. This means they frequently pick unsafe places for crossing streets, leading to more accident-related injuries (Barton et al., 2007; Foot et al., 1999; MacGregor et al., 1999).

According to research by Leden et al. (2006) and Meir et al. (2015), young children find it hard to orient themselves within urban settings and identify possible road dangers when crossing them. They also indicated that most urban areas are not designed with child pedestrians' requirements in mind leading to higher crash rates among these individuals.

Also, according to a research by Poku-Boansi et al. (2019), 41.7% of the children were found to be at risk of getting knocked down by cars when crossing the streets or walking on them in Accra. Their study also revealed that over 27 % of these minors were seen crossing roads at the wrong locations.

According to Yankson et al. (2020), research shows that children are as vulnerable to accidents as pedestrians. This is because they start going out too early when they have not yet developed good road skills, abilities and awareness. Exploring major reasons why so many pedestrian accidents involving kids occurred between 2001 and 2005, Yankson et al. (2020) point out that younger children had lesser exposure to traffic, but older ones were still learning road skills. Among its findings, the study identified a greater percentage of male (55%) deaths compared to female (45%) deaths, while those aged between four and six or seven and nine years experienced most cases of fatalities attributable to pedestrian injuries. These findings reinforce Strukcinskiene (2010) research showed that girls behave more safely on the road than boys.

Different factors contribute to child students' accident proneness in Ghana (Gyimah, 2023). Poor state of the roads, careless drivers, general illiteracy, lack of road safety awareness, stress, indiscipline, inadequate signs, speeding, and lack of enforcement are some of the major causes of road accidents in Ghana (Gyimah, 2023).

These findings show how crucial it is for all parties involved to make efforts toward preventing such public health problems like road safety accidents from happening at all costs

2.5 Local Road Safety Strategies in Ghana

In Ghana, road safety campaigns and programs have been introduced and are still being implemented. Their usefulness, however, is still being contested. The National Road Safety is the lead agency overseeing road safety issues. Some Media Stations and Non-Governmental Organisations, such as the Paediatric Society of Ghana (PSG) and Vivo Energy Ghana Limited, also help promote Road safety among children in Ghana (Paediatric Society of Ghana, 2024).

Vivo Energy's Junior Road Care "My Road Safety, My Life," Ghana's broader road safety campaign, is an annual instructive yet enjoyable event in which participating primary schools compete in dance, theatre, poetry, and quizzes all linked to road safety (MyJoyOnline.com, 2019).

In addition, a non-governmental organisation named Global Coalition for Road Safety also organised another road safety campaign for children in Ghana, dubbed "Kids' Road Safety Panel (KRSP)." Their effort focuses on educating youngsters from schools with much high-risk traffic. A panel of motivated and determined young people was formed as part of their project to educate and correct students who violate school traffic regulations (Global Youth Coalition for Road Safety, 2021)

Other common local campaign strategies in Ghana are outreach programs at religious gatherings, drama, folk, songs, floats with music and banners, open forums, focus group discussions with Playmat demonstrations, role play on TV, Information Services and local FM or TV stations, testimonies from local accident victims and Outreach programs (Ravn, 2008).

According to Yankson et al. (2020) traffic campaigns such as Readers and Assignment Books, which emphasise road safety in Ghana, encourage visiting those handicapped in road crashes to schools as part of RSE programs.

Overall, these local initiatives and activities have contributed significantly to promoting safe and sustainable transport to schools in Ghana and have helped to improve the health, safety, and well-being of school children; however, a lot still needs to be done.

2.6 Five (5) E's of Road Safety

Humans interact with the physical environment, such as roads, vehicles, buses, and other road users, under complex settings and with their vulnerabilities, leading to road safety challenges. Education, encouragement, engineering, enforcement, and evaluation are necessary to address road injury problems in various time frames and domains. The "5 E's" countermeasure was used by the United States Safe Routes to School (SRTS) program to promote road safety among kids and parents ("The "5 E's" of Safe Routes to School," n.d.). The countermeasure used by SRTS is explained in the following information.

1. Education

   Teach students and community members how to walk and bike safely. In-school curricula, bike/ped safety assemblies, newsletter blurbs, tip sheets, and send-home brochures are all options for educating students.

2. Encouragement

Host special events, walk, buses, bikes, and trains, hold schoolwide competitions, or honour biking and walking with student art or other projects to get kids and parents interested in walking and bicycling.

3. Enforcement

Working with local law enforcement can help reduce bad habits like speeding, double parking, and ignoring traffic signals. Officers can attend walking activities to watch for speeders or form bonds with schoolchildren and neighbours.

4. Evaluation

Examine strategies to determine whether they are working. To evaluate the efficacy of an SRTS program, schools and local governments can track walking and bicycling rates, parent concerns, and traffic data. Evaluation activities might also help set goals and establish baseline data for project planning.

5. Engineering

Enhance the physical environment for walking and biking. Schools can collaborate with local government agencies to assess whether infrastructure upgrades are required to enable students to walk or bike to school safely.

2.7 Road Safety Education for Children

One of the essential pillars of the road safety "5 E's" countermeasure is Road Safety Education (RSE). RSE is defined by the European Transport Safety Council (ETSC, 2018) as acquiring knowledge of traffic circumstances and rules and improving and developing skills required to engage in traffic through experience and safety training. RSE is designed to help road users manage traffic risks and improve mobility safety (OECD, 2004). According to ROSE 25 (2005), RSE includes all strategies to favourably affect traffic behaviour patterns, as seen in Figure 5.

- Advancement of understanding and knowledge of situations and traffic rules.
- Development of skills via experience and training.
- Increasing awareness of personal safety, the safety of other road users, and risk.

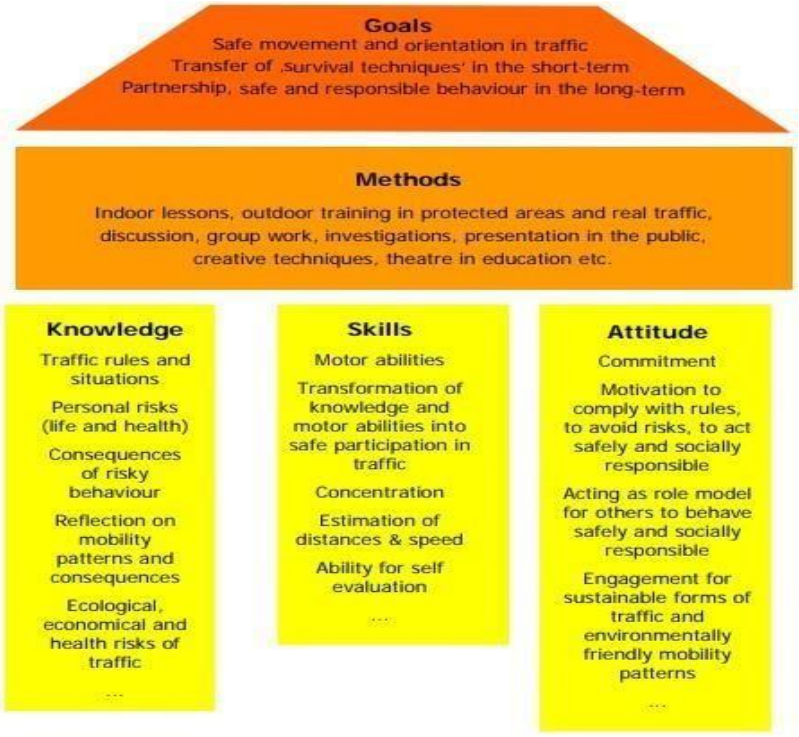


FIGURE 5 Definition of Road Safety Education (ROSE25, 2005)

According to the OECD (2004) RSE objective can be characterised as establishing an ideal utilisation of the transportation system with optimum safety for all road users. According to (Dragutinovic & Twisk, 2006), the goal of the RSE program is to reduce the number of injuries and crashes. Also, RSE is a lifetime learning process utilised as a countermeasure for all types of road safety hazards and road user groups, from young children to the elderly (OECD, 2004)

RSE is frequently directed at juvenile road users, who have cognitive and physical impairments that make them more vulnerable in traffic than adults (WHO, 2015). Children's cognitive limitations cause them to lack the skills, information, and attitude necessary to operate safely in traffic conditions, and resolving these deficiencies will lower their chance of being hurt or killed on or near the road (WHO, 2015). The United Nations Convention on the Rights of the Child highlighted the importance of road safety education for children. Furthermore, Article 3 of the United Nations' 1968 Convention on Road Traffic specifies that "contracting parties should take essential means to ensure systematic and continuous traffic education at all levels of schooling (OECD, 2004).

RSE for kids promotes safe behaviour by influencing attitudes and knowledge and equipping kids with the proper methods and abilities to navigate their environment securely. Knowledge reinforces and connects skills while boosting awareness and comprehension of obligations, hazards, and safe driving behaviour. Meanwhile, attitude is critical because if only skills and knowledge are improved, there is a risk of overestimating an individual technical ability to conduct properly in traffic, which leads to increased crash risks and risky behaviour. According to the OECD (2004), education influences attitudes about road safety, such as crossing the road, driving while intoxicated, speeding, etc. Education can also be utilised to increase safety awareness.

Road safety education requires the deployment and development of suitable skills and the development and comprehension of positive attitudes toward individual safety and the safety of others. In research by Thomson et al. (1996) as cited by OECD (2004), road safety education initiatives must indicate the safe behaviours that are being targeted by:

- Defining the psychological skills and analysing the task-underpinning behaviour.
- Establish the skill development level that children of various ages may accomplish.
- Investigating the impact of training and education on skill performance

Road safety education should not be a one-time event; instead, it should be a series of ongoing, concept-based interventions. Three critical phases for RSE deployment are recommended by (ROSE 25, 2005):

- Clearly stated goals for clearly defined target groups,
- Well-defined contents and techniques, and
- Implementation strategies

2.8 Target Groups and Learning Targets

To develop appropriate RSE measures, they should be arranged based on the target group and age. All age groups could benefit from gaining more knowledge, improving their skills, and changing their attitude, yet each may face different challenges. Furthermore, each target group identifies risk factors and prevents injury differently. The RSE exercise for children should be suited to their maturity and growth, as it will help them comprehend traffic rules and improve their attitude toward road safety. On the other hand, children's abilities develop at different rates, and individual differences might be significant. The OECD (2004) came to the following main conclusions concerning children's growing capacities based on previous empirical investigations:

- Children ages 5-7: Have a broad grasp of risk but still need to learn a lot about road safety. Lack of the ability to give relevant cues to adequate priority and to know what is irrelevant and relevant to the road crossing task.
- Children aged 7-8: Demonstrate the ability to conduct thorough visual scans of the road surroundings. and clear improvements in strategic thinking.
- Children aged 8-10: Able to switch between tasks due to developmental shifts in their ability to reason casually and understand the pedestrian task. Nevertheless, their ability to concentrate is still not improved. Education may aid in developing abilities that necessitate concentration on a crossing task.
- Children aged 11-12: (Thomson et al., 1996) as cited in OECD (2004) as pedestrians, children in the UK approach adult levels of performance, according to the report

Brake, a road safety charity from the United Kingdom, New Zealand and Australia, has created guidelines on what road safety education to teach different age groups from ages 2 to 18 (Brake, n.d.). The organisation recommends RSE education to cover awareness (traffic is dangerous and can hurt), behaviour (how to stay safe), and making a safer choice. Children aged 2-7 years can be taught awareness and behaviour, such as dangerous things to do while walking/cycling on the road (texting and not wearing a helmet); the danger of speeding and driving while texting, street features (paths and pavements are for people and roads are for traffic); hold hands with grown-up when near roads; stop at cross read unless told not to; danger on play on roads; look and listen for traffic to cross safely; read and understood the mean of traffic lights; and to wear bright clothes to be seen in traffic. Children under

8 are ill-equipped to make their own choices; however, it is still essential for them to recognise safer choices.

The learning targets of different age groups are further defined by (Brake, n.d.)

- Age 2-5 (early years): development of children's creative and motor skills, language skills, understanding of the world, and emotional, social, and personal development.
- Age 5-7 (key stage 1): To help ensure their road safety is well engrained when they are independent road users, teach them knowledge of traffic rules and encourage them to follow them; develop an understanding of the dangers of traffic and how to avoid them.
- Age 7-11 (key stage 2): Develop children's engagement and knowledge of road hazards, risk-taking (things that expose them to danger), and the consequences of it (injury and death).
- Age 11-14 (key stage 3): Children become more independent road users and more exposed to road risks. RSE is increasingly important.
- Age 14-18 (key stage 4): Some are already thinking about learning to drive, and some are already able to thus the target is to raise awareness about sustainability and road safety use for passengers, drivers, cyclists, and pedestrians, and also help them consider their travel options.

2.9 Educational Contents

In European elementary schools, the content is defined into two broad categories: traffic rules and behaviour (ETSC, 2018). OECD (2004) stated that educational content mainly concentrates on children as pedestrians since children are often involved in "dart out" incidents, risk-taking behaviour because of themselves (e.g. "playing chicken"), unawareness (e.g. not wearing a seatbelt), or peer pressure (e.g. not wearing a helmet). Risks taken in traffic environments must continually be managed and assessed by everyone who uses the road to minimise the crashes on children. The "dartout" is attributed to an incident where children did not look in both directions when crossing. Furthermore, children are much more likely to behave because of peer pressure, which may lead them to take risks as road users. Taking risks may enable them to gain acceptance into a particular peer group, to be able to feel in charge of their lives, and to resist authority. Some children may be unaware of the risks; others may deliberately choose to take risks owing to peer pressure. Risk-taking on young people may be a natural part of growing up, but it needs to be managed and continually assessed by all road users to minimise the incidence of crashes. It is essential to consider variations in risk while creating RSE educational content. The organisation also recommends teaching ideas for different age groups:

- Children aged 5-7: Name different street features (pedestrian, zebra crossing, curb); how small their body size is compared to traffic; discuss what to do when their toy is thrown on the road, a safe place to play, how helmet keeps humans safe, and why holding hands with adults in traffic keeps them safe.
- Children aged 7-11: learn to look and listen to traffic to cross safely; discuss traffic lights' colours and the school area's speed limit. Brake also developed PowerPoint slides containing discussion for this age that can be used through safety videos or online games that will be further discussed:

  - How to cross the road with safe traffic lights' colours and the school area's speed limit: Van der Molen (as cited by Clayton et al., 1995) studies children's crossing behaviour, which is running,

stopping, curb delay, and the gap is chosen. - How drivers break the rules and endanger people: driving too fast, distracted, speeding, etc.

- Roads are shared with other road users, who must look after themselves. - Spot dangerous behaviour: cycling without a helmet, crossing the road while texting, talking on mobile while driving, not using a seatbelt, crossing next to a parked car, and playing a ball game on the road.
- Spot safe behaviour: using a helmet, holding hands with adults while crossing, crossing at zebra cross.
- Spot road hazards: walking or cycling in the dark/foggy/raining, fast traffic, standing next to large vehicles, crossing between parked vehicles, and roads with no pavement.
- Spot road elements that help to stay safe: zebra cross, roads with a low-speed limit, and cycle lanes. - Explain why fast traffic is dangerous.

- Children aged 11-14: Discuss the importance of staying safe and taking care of roads by discussing different kinds of road injuries, statistics of road deaths and injuries, the relationship between speed and braking distance, and peer pressure.
- Children aged 14-18: Discuss road safety features, safer routes, and how to avoid hazards; analyse different modes of transport; and study road casualty data.

Educational material must also consider cultural, socioeconomic, and demographic disparities among children, particularly those related to low literacy and language obstacles (OECD, 2004). According to Assailly, (2017), education must be adjusted to the cultural predictors of traffic crash involvement, such as feelings of invulnerability and fatalism, in developing countries.

According to the OECD (2004), the RSE process emphasises the development of decision-making and problem-solving methods and skills through inquiry-based and more learner-centred approaches to teaching and learning. Most road safety instruction for children is delivered in schools because its primary function is education, and schools have the required resources (e.g., teachers, classrooms, computers, multi-media facilities, etc.) to do so.

The importance of simplicity and clarity in developing questionnaires for children is highlighted by Borgers et al. (2004). Borgers et al. (2004) posit that the younger respondents, because of their developing cognitive skills, tend to provide more accurate answers when asked direct questions without using sophisticated words or language patterns. This is contributed by the fact that complicated grammar or unfamiliar terminologies can easily confuse them and make them respond incorrectly (Borgers et al., 2004). Another writer, Holaday and Turner-Henson (1989), points out the importance of clear and plain language use when creating surveys for children. They observe that children frequently take what they are told; hence, if the survey's language is not carefully selected, it might lead to misunderstandings. Both studies stresses making sure that questions are adjusted according to the cognitive levels of children to obtain reliable and valid data

2.10 Methods of Delivery of Educational Content

There are numerous approaches to educating students. Raftery and Wundersitz (2011) and OECD (2004) have studied the effectiveness of different methods of road safety education for children, such as:

- Guest Speakers: The transmission of information by guest speakers such as police officers, firefighters, road safety professionals, and persons involved in a road traffic accident is a regularly used RSE strategy. According to the OECD (2004) research shows that while visits from road safety enthusiasts and professionals may appeal to a broad audience, they are mainly unsuccessful since RSE should be progressive and organised. The employment of experts should improve the information's credibility, but this is contingent on the individual's perceptions of and attitudes toward the question expert.
- Drama and Role Play crash scenes with children acting as emergency personnel and road users involved in the tragedy and consequences of a crash can provide a sense of realism that cannot be achieved through other means (e.g., video or still images). OECD (2004) stated that this method has been found effective with detailed development, discussion, and follow-up activities. Role-playing as school crossing patrols will encourage children to take responsibility for their safety. Role-playing and drama may be particularly effective ways to focus on the consequences of actions, beliefs, motivation, and social norms. Nevertheless, there are some concerns regarding children as school crossing patrols because of the risks they may face.
- In-group interactive training, as cited by Raftery and Wundersitz (2011), the effectiveness of interactive exhibits is typically measured by their ability to hold and attract an individual's attention, with the implication that interacting and attending to a display requires cognitive investment and thus must promote some learning. The pre-and post-visit road safety knowledge of RoadZone (an interactive road safety exhibition for 914-year-olds in Australia) users found that 80% of pupils had gained awareness of at least one new road safety concern.
- Computer-based training: Many schools require students to use computers and the Internet, which provides access to a range of road safety instruction websites. Lonero et al. (as cited by OECD (2004)) stated that simulation games can modify behaviour and attitudes and develop skills. Dragutinovic and Twisk (2006) studied Scottish computer software to teach children how to cross the road safely, show that Knowledge was improved due to the training session, and this development, in turn, changed behaviour. Furthermore, rather than on-site roadside training, classroom simulations can expose youngsters to a variety of driving settings.

Since RSE is most efficient to be delivered in school, Raftery and Wundersitz (2011) describe school-based implementation strategies as the following categories:

- Indirect or comprehensive approaches: Problem-solving, risk awareness, and resilience are strategies that tackle the cause of problem behaviours in general.

- One-time interventions: Short-term programs may include school visits from organisations' road safety experts (e.g., fire services or police). These usually use upsetting pictures or exhibitions to depict the effects of collisions dramatically and accurately. Interactive exhibits that imitate or emulate driving-related abilities may be used as another educational approach or tool (e.g., reaction time).

- Driver training: Designed to increase the abilities of young drivers to control a motor vehicle.

- Curriculum-based or cross-curriculum: RSE elements are included in other disciplines or specific road safety subjects (e.g., Health, Physics, Physical Education, English, etc.).
- Multi-modal: Programs that combine teaching with other tactics, such as targeted enforcement, supporting healthier, environmentally sustainable commuting options, or improving pedestrian infrastructure through engineering.

2.11 Supportive Role of Stakeholders in Student's Road Safety

OECD (2004) underscores the need for different stakeholders to collaborate to develop a safety culture for children. Road safety education is effective when it involves several players, each with unique roles to ensure students' safety. It highlighted that although the students gain the most from road safety programs, they can only be as efficient as they involve multiple stakeholders alongside parents, educators, practitioners and policymakers.

Regarding traffic safety, parents have the unique opportunity to give information that is related to the child's age and local traffic environments (Feng et al., 2022). According to Taubman-Ben-Ari and Katz-Ben-Ami (2013) Parents play roles in modelling, monitoring, and communicating with children about their safety awareness, and they are important role models whose actions affect how their children think and behave. In this way, parents who follow up closely on their children while discussing freely about safety matters reduce greatly the risks of dangerous behaviours among young people in society through practically displaying safe practices.

While promoting road safety is the responsibility of parents, other stakeholders are involved. Teachers act as exemplary figures that reinforce positive behaviours and include road safety issues in the school's curriculum (OECD, 2004). Likewise, educational contexts require teachers who guide the students effectively towards observing all rules governing their road safety (OECD, 2004). Hence, practitioners, including those from law enforcement or transport departments, are essential in promoting road safety for children

This implies that (ROSE 25, 2005) policymakers play a crucial role in providing infrastructure and resources which support effective teaching on road safety. Some of their tasks encompass ensuring programs receive substantial budget allocations as well as consistent support for training, investigations and assessment leading to long-term student protection outcomes.

A holistic approach to ensuring students' road safety can be achieved by acknowledging and utilising each category of stakeholders' specific strengths and obligations, from parents and educators to policymakers, among others.

2.12 Evaluations of RSE

It is vital to assess various road safety education deliverers and sources and review and determine what works when addressing best practices in road safety education (OECD, 2004). According to Raftery and Wundersitz (2011), comprehensive evaluations are required to determine an RSE program's efficacy and provide recommendations for improvement. However, conducting RSE program evaluations is a complex undertaking. For program follow-up evaluation and implementation,

Dragutinovic and Twisk (2006) noted that evaluators must comprehend the program and the types of outcomes that can be predicted within the time range.

According to Raftery & Wundersitz (2011) there are two types of evaluations used to determine program effectiveness:

- Process evaluations: evaluate the program's implementation, including the appropriateness of its content, the amount to which the program reaches the intended audience, and the efficiency with which it is delivered.
- Outcome evaluations: assess the program's efficacy in terms of the desired outcome in a specific demographic. Changes in behavioural intentions or observable conduct, self-reported attitudes or beliefs, and knowledge are all examined in these assessments.

The most obvious way to assess the RSE program's efficacy is to check if it reduces the number of accidents (Assailly, 2017). However, crashes are rarely used as outcome measures because they are infrequent events. As a result, data from large populations over a long period is required to prove a statistically significant influence of RSE on crashes. Furthermore, several factors, such as the economy and other countermeasures, can influence crash statistics, and it is difficult to determine which causes are responsible for a change in crash numbers. Only a few school-based road safety education programs have been examined using collisions as an outcome measure, according to Raftery and Wundersitz (2011).

According to Assailly (2017) substitute measurements of RSE impacts that can forecast crashes but are more accessible to collect are needed, such as:

- Safety performance indicators: These indicators effectively predict crashes in

  road safety research. This could be in the form of a logical relationship (increased collision risk is assumed) or empirically tested relationships (increased crash risk is known), such as rates of dangerous street crossings, speeding, and intoxicated driving, among other things. Self-reports via questionnaires or observation in real-world traffic scenarios can be used to measure risky behaviour, and both methods have predictive validity.

- Social psychology research efforts have identified psychological precursors of risky behaviours as causative mechanisms. Beliefs, behavioural intentions, attitudes, and other similar concepts are examples. Social psychology studies based on theoretical models, such as the theory of planned behaviour, have demonstrated how they might anticipate risky or safe activities.

According to Raftery & Wundersitz (2011), RSE evaluations should be based on before-and-after assessments of variables or behaviours that can be objectively observed and are closely related to the program objectives or goals.

- Allow enough time for the "before" measurement to be completed before the start of the program. However, the period leading up to the start of a program is frequently insufficient to prepare and conduct a baseline measurement.
- Include a control and a treatment group. Ideally, people should be allocated to the group randomly to avoid self-selection bias (for example, more safety-oriented individuals may opt to engage in a program), especially if participation is voluntary.

Nevertheless, only a few RSE evaluation programs use the above criteria (Raftery & Wundersitz, 2011). This is because:

- When complete populations are targeted, the inclusion of a control group is not feasible
- Randomized trials are expensive and challenging to conduct.
- Lack of resources or expertise necessary to conduct a scientific evaluation.

2.13 Additional Factors Influencing the Effectiveness of Road Safety Education Programs

The effectiveness of road safety education programs has been widely studied and documented in a number of literature reviews.

One of the most profound literature reviews on this topic was done by Dragutinovic and Twisk (2006) at SWOV Institute for Road Safety Research. This analysis involved assessing evaluation research, effectiveness of road traffic safety programs, as well as similarities to other areas in education.

The following are the major findings:

• The majority of evaluations have concentrated more on intermediate outcomes for instance knowledge, attitudes or self-reported behaviours rather than real accident or injury figures.

• Many evaluated schemes have targeted children's protection with an emphasis on walking safely.

• Geographical location such as high-income countries in Western hemisphere accounted for the majority of studies thus reducing generalizability across different places.

In addition, this review indicated that there were several commonalities that exist in road safety teaching and health promotion training. These similarities include systematic evaluation studies required in both fields and reliance on indirect determinants instead of direct health/safety outcomes.

When it comes to effective program components, the literature review showed some elements which enhance success in road such as:

- Starting education as early as ages 4-5 and continuing through primary and secondary school
- Incorporating adult-led learning and peer collaboration to leverage social influences
- Incorporating small, practical training sessions to reinforce concepts
- Complementing classroom instruction with demonstrations and computer-supported training

Enjoyment of educational content or sessions has also been investigated in different educational contexts. Discussing it in road safety education is essential because of its benefits to students. Hernik and Jaworska (2018) found that enjoyable learning materials make students become active learners, which helps them have better memory retention and holistic learning. This need not be overemphasised in road safety education since information recall can shape students' real-life precautionary actions.

Similar research by Kelly et al. (2024) demonstrated that joy during learning was directly linked to increased motivation and academic performance. According to their findings, once students enjoy studying, they tend to be more committed to the subject matter and feel like part of the entire educational framework. This desire is essential for successful knowledge transfer, which would entail comprehending safety issues and putting them into practice.

By integrating enjoyable activities within educational sessions, inactive involvement can thus be transformed into active participation. Engaging activities help students understand the material better and motivate them to use it practically. The available literature suggests that making road safety teaching fun improves students' memory recall skills on essential safety rules and helps develop their commitment towards adopting safe habits. Thus, incorporating happiness in road traffic education is advantageous only if long-term, meaningful behaviour changes have occurred.

In their study, Fredricks et al. (2004) emphasised the importance of behavioural engagement in achieving positive educational outcomes. They indicate that students must engage actively in the process of learning, which includes putting an effort into understanding and being persistent for both concepts to be internalised well. Additionally, the authors argue that interactive elements and collaboration facilitate engagement. Although their study focuses on a broader education spectrum, these principles can also be applied to road safety education. Educators could enhance the retention of road safety knowledge by fostering behavioural engagement through interactive activities, collaborative learning, and active participation, among others, thereby encouraging lifelong responsible attitudes and behaviours toward safety.

In their study, Qureshi et al. (2023) researched the influence of active students' involvement in collaborative learning and learning performance within higher education. The study highlights that social interactions, particularly peer collaboration and student-teacher interaction, are essential for creating a learning environment where every student is actively involved. This active engagement, in turn, leads to deeper learning and improved academic outcomes. The findings from this research indicate that when students are actively engaged in cooperative activities, their engagement is helpful for understanding and remarkably increases overall learning performance. These results emphasise the need to include cooperative learning and foster social interaction in higher education institutions to promote deep-seated learning and enhance students' outcomes.

According to (Bigelow, 2006) as cited by Combrinck and Govender (2012) research has consistently demonstrated that learners become more engaged when studying materials related to their lives. In addition, encouraging and supporting them to integrate the subject matter with broader life contexts and activities in the real world makes their engagement and understanding deeper (Bigelow, 2006).

Hernik and Jaworska (2018) pointed out how pleasure has a great impact on learning outcomes. Their study demonstrates that positive emotions, specifically enjoyment, significantly boost students' ability to hold and recall information. According to them, Students who enjoy their learning are more involved in it and understand the subjects better leading to improved retention. Their research highlights the importance of creating learning atmospheres that are informative as well as entertaining to maximise immediate educational results while also enhancing long-term knowledge acquisition.

2.14 The RE-AIM Planning and Evaluation Framework

The RE-AIM planning and evaluation framework is commonly used to assess and plan interventions to enhance public health and promote healthy behaviour change. According to Glasgow et al. (2019), the approach consists of five primary domains: reach, effectiveness, adoption, implementation, and maintenance.

The definitions for each domain, as referenced by Shelton et al. (2020) are provided below:

- Reach: Participation in an endeavour, program or intervention, as well as the percentage of the population interested in participating and the rationale behind their interest or lack thereof.

- Effectiveness: The Effects of an intervention on a critical outcome. This encompasses possible negative impacts, life satisfaction, and economic outcomes. Comprehending the causes of variation (heterogeneity) among segments is equally crucial.
- Adoption: The total number, percentage, and different settings and people willing to initiate a program or provide their stamp of approval to strategies, along with the reasons for their yes or no. Take note that both the staff and the settings can have multiple levels: for example, delivery workers can be nested under supervisors, and health systems, communities, and schools can all have multiple levels of staff.
- Implementation: This domain pertains to the degree to which staff members adhere to the program provided by the developers. This encompasses the consistency of delivering the intervention as planned, any modifications to the intervention or implementation tactics, and the time and money involved in the program.
- Maintenance: The degree to which a program or policy integrates into the standard organisational procedures and policies. Recent recommendations include customising the maintenance schedule to address individual challenges and programs and assessing the modifications made for long-term support. Maintenance at the individual level pertains to the enduring impact of a program on results following the latest intervention interaction. The maintenance evaluation timeframe should be customised according to the program and health conditions.

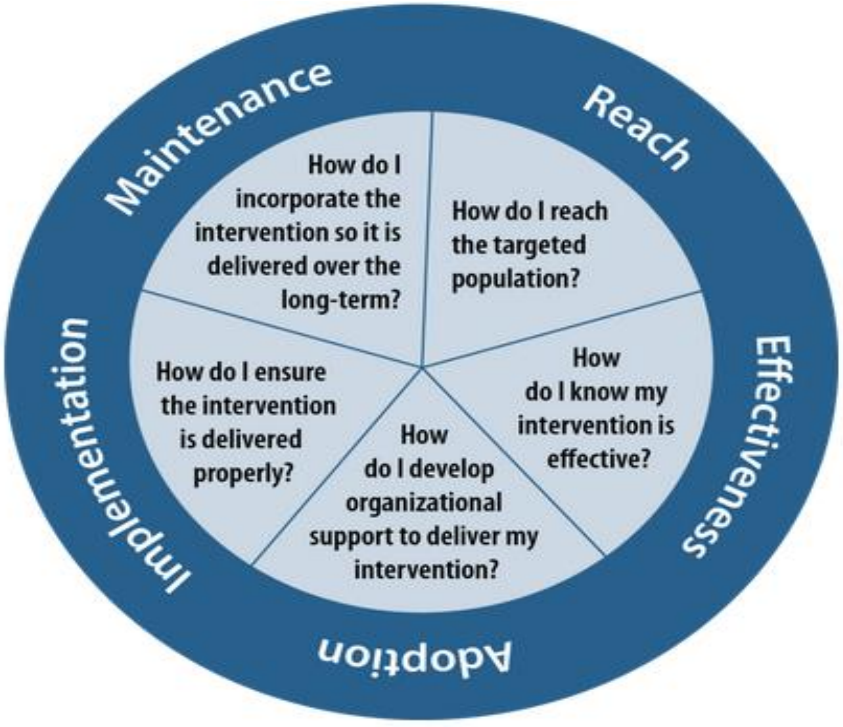


FIGURE 6 The RE-AIM framework (Shelton et al., 2020)

Since its introduction in 1999, the RE-AIM framework has been used to plan and evaluate interventions in various contexts and with different groups. According to a 2013 systematic review by Gaglio et al. (2013), the framework has been utilised extensively. However, only a few studies have reported on all five dimensions or all assessment criteria within a RE-AIM dimension (Gaglio et al., 2013)

In a more recent publication, Glasgow et al. (2019) It was claimed that RE-AIM can be used iteratively to provide guidance and adjust methods and approaches while they are being implemented. Shelton et al. (2020) describes an expansion of RE-AIM that improves the assessment of the long-term viability of policies, programs, and practices grounded in evidence. The framework has evolved from its original purpose as a quantitative post-hoc evaluation tool to a planning and evaluation tool that welcomes and encourages using qualitative and mixed methods approaches. According to the developers, RE-AIM can be utilised iteratively to inform treatment changes and tactics during implementation. Nevertheless, developers have pointed out the difficulties of the RE-AIM framework and have proposed more realistic approaches, including partial application (Glasgow et al., 2019)

The focus of the RE-AIM planning and Evaluation frame will make the process evaluation of the "Stay safe, arrive alive" intervention campaign for Weija-Gbawe worthwhile.

2.15 Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) is still considered the best predictor of human behaviour, according to Ketphat et al. (2013) because it provides prospective predictors for identifying crucial aspects of linking determination. TPB is a more traditional technique for explaining the relationship between behaviour and attitudes (Poulter & McKenna, 2010). TPB maintains that behaviour is determined by behavioural intention, which is anticipated by attitude to the behaviour, subjective norms, and perceived behavioural control, according to Ajzen & Fishbein (1980) in **Figure 7**.

To begin, instrumental views about the consequences of completing the behaviour are predicted, and outcome evaluations of the desirability of those outcomes weigh these beliefs. On the other hand, subjective norms are predicted by normative ideas about the acceptance of significant individuals (e.g., family members) on the conduct and weighted by the individual's drive to comply, leading the individual to act in a way that would meet the approval of others. Finally, PBC is the product of two factors: the degree to which an individual believes his or her behaviour is controlled. The first aspect is control beliefs, which refer to an individual's ability to perform or refrain from behaviour in various situations; the second is control frequency, which refers to how frequently one is in those situations. However, because circumstances outside of volitional control can obstruct conduct, perceived behavioural control can predict behaviour directly (Paris & Broucke, 2008)

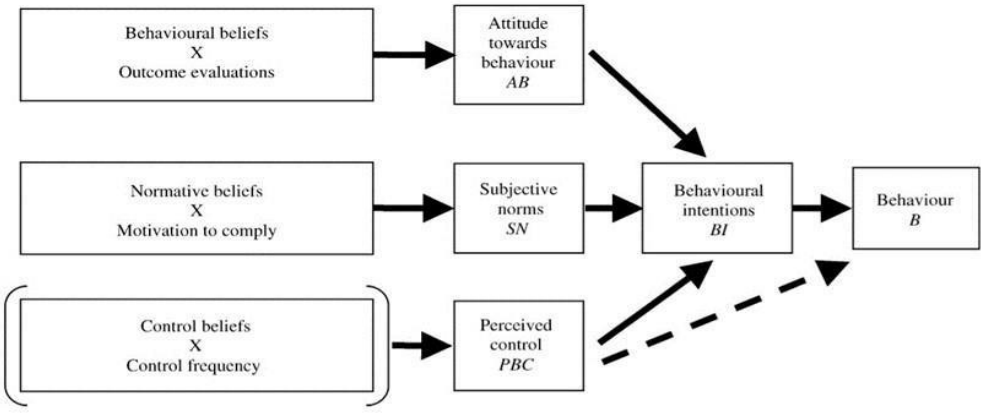


FIGURE 7 Theory of Planned Behaviour (Ajzen & Fishbein, 1980)

TPB is one of the most scientifically supported behavioural theories, having been validated in various research disciplines (Brijs et al., 2014). It has also been widely used for various health-related behaviours, including road safety (Stead, 2004). According to Stead (2004) the TPB model offers much potential for informing the progress of behaviour modification treatments. Poulter and McKenna (2010) suggested that assessments of health education interventions should evaluate attitudinal changes alongside behaviour or intention changes to determine whether any intervention failure happens because it simply has no effect or results in unintended outcomes. In addition, the study stated that a failure to effect a change in behaviour or intention does not essentially mean that there was no change in psychological antecedents to behaviour or intention.

Matović et al. (2024) investigated the psycho-social factors that influence pedestrians' attitudes to disobey traffic rules by using the theory of planned behaviour extensively. It was found that personal norms based on an individual's moral obligation and expectations of feeling sorry had the highest potential for predicting behavioural intentions compared to cognitive attitude and subjective norms. This indicates that it is through moral and social forces that intentions towards involvement in or prevention of dangerous behaviours are formed. Consequently, a study conducted by these scientists examines how vital is perceived control over one's behaviour, such as those who perceive themselves as more competent at following safe practices will be less likely to break the rules. These findings imply that interventions focused on personal norms and perceived behavioural control may prove particularly fruitful in influencing road safety behaviours, improvements corresponding to students' attitudes and confidence after road safety interventions

2.16 Insights of road safety Interventions for school children Across Global Contexts.

The diverse range of existing studies in Table 1 summarises empirical works on road safety education. These studies suggest that different approaches and techniques have various degrees of impact, which is helpful for this research.

TABLE 1 Summary of Past Works on the Effectiveness of Road Safety Education for Students

Author	Method/ Instruments for Evaluation	Objective	Target Population	Findings/ Results
Yankson et al. (2020).	Unobtrusive observational study and checklist	To observe the road use behaviour of public primary school pupils in Ablekuma Education Circuit, Accra.	Primary one to six pupils in Ablekuma South in Accra	$p < 0.001$; 95% CI in all cases There were significant differences in safe road-use behaviours, with girls performing better in specific tasks like stopping at the kerb and looking before crossing
Sayer et al. (1997)	Interviewer-administered questionnaire	To evaluate the effectiveness of the 'Safe Ways Education resource 'on school children's behaviour and knowledge	Children of 10 and 11 years in Accra	The group of children exposed to the resource showed a significant increase in knowledge of safe behaviour, unsafe behaviour, and crossing behaviour compared with the control group. Significantly more children exposed to the 'Safe Ways' materials ($p < 0.05$) were seen helping younger children to 'keep safe' by 'saying things to help them keep safe' in the 'after' survey when using the road
Treviño-Siller et al. (2017)	Pre-/post-test design, surveys, observation checklists, community mapping, ethnography, and focus groups	To evaluate a public school-based educational intervention (EI) designed to increase knowledge, improve attitudes, and change practices related to road safety.	Children aged 10-15 years, predominantly male (51.1%) in rural and suburban public schools in central Mexico's Yautepec municipality.	Pedestrians continuously walked on the street rather than on the sidewalk and crossed streets unsafely. There were significant improvements in road safety knowledge, practices, and attitudes post-intervention. An increased perception of danger associated with unsafe practices. Almost half of the participants (45%) indicated road risk sites in their communities.
Perego et al. (2018)	Static Hazard Perception Task (SHPT) administered pre and post-lessons	To improve road use risk perception among schoolchildren	211 students from Suma Secondary School, Arusha, Tanzania	The training significantly improved students' hazard perception, as evidenced by the statistical results from the repeated measures ANOVA: $F(1210) = 27.519$, $p < .001$, partial $\eta 2 = .141$, indicating that students detected significantly more hazards post-training. No interaction effect of training with any sociodemographic variable or global driving experience level was found, showing that the training's effectiveness was independent of these factors.

Zainafree et al. (2022)	Social media, including interactive sessions, TikTok videos, and WhatsApp materials	To analyse the effectiveness of a road safety education program tailored to the interests and needs of adolescents, aimed at increasing knowledge, beliefs, attitudes, intentions, and safe driving behaviour	362 high school students in Semarang, Indonesia	The results of the GLM-RMA test demonstrated the effect of the Zainafree Program on knowledge ($p = 0.000$; ETA Square = 35.1), beliefs ($p = 0.000$; ETA Square = 32.0), attitudes ($p = 0.000$; ETA Square = 50.9), intentions ($p = 0.000$, ETA Square = 20.7), and behaviour ($p = 0.000$; ETA Square = 28.2). After adjusting for involvement between confounding variables ($p = 0.000$; ETA Square = 16.2), it demonstrated that the intervention could explain 16.2 changes that occurred in the scores of five aspects together. The RSE program increased students' knowledge, beliefs, attitudes, intentions, and behaviour compared to those who did not receive the program.
Nachman and Rodriguez (2023)	Self-administered surveys, Ride Report app, Pearson correlation coefficients	Evaluate the impact of a classroom-based bicycle education course on bicycling-related metrics in Alameda County and SF County	Approximately 250 adults attended the courses, with 182 participants recruited for the study and 113 completing both surveys	Confidence in traffic increased by 11% ($p < 0.05$) - Safety in car-free areas increased by 12% ($p < 0.01$) - Knowledge of road rules increased by 46% ($p < 0.01$)
Aranda-Balboa et al. (2022)	Randomised controlled trial, questionnaires, observational checklists	To Evaluate the feasibility and effectiveness of a school-based cycling intervention	122 students, nearly equal gender distribution from public secondary schools in Spain	There were improvements in knowledge at follow-up, and the cycling skill scores were medium-low. The rates of cycling to school and active commuting to/from school did not change, and only the "built environment (walk)" barrier increased in the cycling group at follow-up

3 Research Methodology

3.1 Research Design

This research used a mixed approach to accomplish its objectives. Regarding quantitative data, it used a true experimental design and descriptive and inferential statistics to examine the characteristics of the selected sample and the impact the implemented road safety intervention would have on the knowledge, skills, and behaviour of the sample (students). It also employed a qualitative approach to explore and understand any underlying reasons for any trend in the qualitative data.

3.2 Study Area Overview

Measuring approximately 47 km², the Weija-Gbawe District is in the southwestern part of Greater Accra, Ghana, with a population density of 4,522.2 people per km². With a total population of 213,674, 34% fall within 0-14,64% between 15-64 years, and 3% are 65 and over (Ghana Statistical Service, 2021). The district has over 30 primary schools and two tertiary institutions, and the sole mode of transport for all, including students, is by road (Weija-Gbawe Municipal, 2021). The district is 100% urbanised and surrounded by Ga South, Ga West, Ga Central, Ablekuma North, Ablekuma West Districts and the Gulf of Guinea (Weija-Gbawe Municipal, 2021).

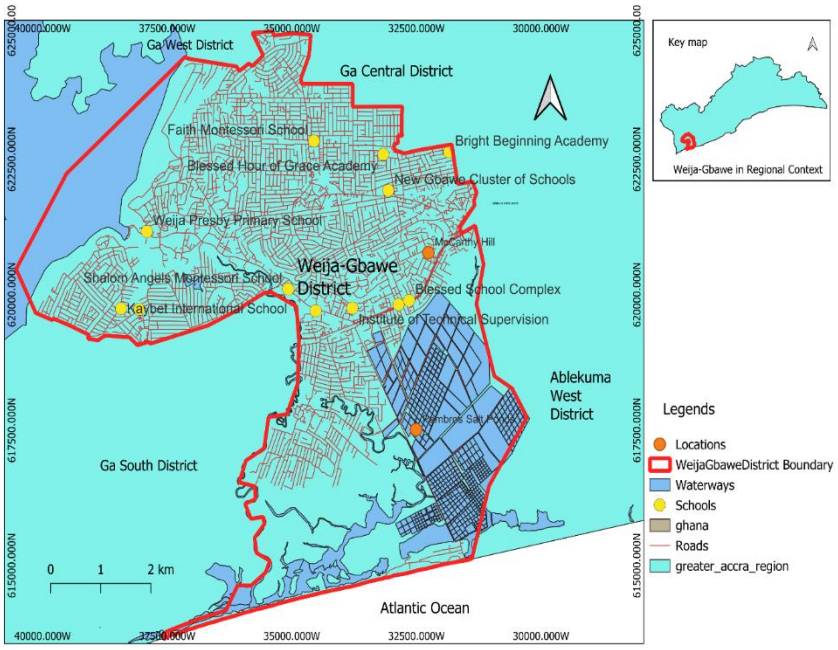


FIGURE 8 Map of Weija-Gbawe District, Ghana (Author's construct, 2024)

3.3 Target Population

The participants were students aged 7-11 from primary 2 to 6 in Great Princess International School and Brace Hill Academy in Weija Gbawe District, Ghana. Both schools selected for the project are private schools.

3.4 Duration of Data Collection

Two trained enumerators and one observer visited the selected schools in the Greater Accra region from February 9th to March 30th, 2024, to administer the questionnaires.

3.5 Sampling Strategy

The participants were chosen from schools that were easily accessible and willing to take part in the project (intervention introduction and data collection) within the limited timeframe. Four schools were planned to participate in the study, but after contacting all schools, only two met the inclusion criteria; hence, they were chosen for the study. One of the selected schools was used as the control group, and the other for the test group. The inclusion criteria for participating students were that they should be in one of the selected schools, be between the ages 7 and 11, be willing to participate and submit a signed consent form by their parents/guardian permitting them to participate in the study.

3.6 Sample Size

One hundred and forty-three students were randomly selected and assigned to either the control or test group, with 75 assigned to the test group and 68 to the control group.

3.7 Data Collection Tools

The questionnaires were written in English, primarily multiple-choice, with a few open-ended questions. It was derived from a literature review and contents of the Brakes Road Safety Campaign. All questionnaires for students and parents had a code generated from the first two letters of the student's first name, mother’s name, birthday and birth month to identify specific students and parents to be able to match the pre- and post-questionnaires and link each questionnaire to each parent. Further details on the questionnaire are below:

1. Student Questionnaires: A structured questionnaire was used to collect data to evaluate the primary target students' knowledge, attitude, and behaviour related to road safety. The students’ questionnaires were in two categories: before and after questionnaires. The questionnaire mostly used a closed-ended multi-question format, a few open-ended questions, and a Likert-scale item to achieve a more diverse student answer. For example, some of the questions the learners had to answer were "Rate your confidence in crossing the road safely" and "Describe any new road safety practices you may have adopted. The range for the Likert scale used varied based on the type of question. These scales for the Likert varied based on specific question types in order to adopt question responses to the level of the students.
2. Parent/Guardian Questionnaires: These were designed to collect data from parents or guardians about their roles in ensuring that their children walked or cycled to school safely and any changes in skills and behaviour observed after intervention. The questions ranged from quantitative to qualitative, from 'How often do you discuss road safety with your child?' to 'Please elaborate if there have been any changes noticed in your child's behaviour regarding road safety issues, and if so, kindly describe the situation.
3. School Authority Questionnaires: This included closed and open questions for the school authority of each selected school for the project. The questions included "Does the school's

curriculum include road safety education?" and "What problems does the school face in providing road safety education?"

4. Local Authority Questionnaires: These involved close-ended and open-ended questions directed at Local government officials regarding road safety and education for school children in their municipality. The questions ranged from whether "There are, in their jurisdiction, road safety regulations for school zones?" to open ones like "How does the local authority support road safety education in schools?"

The design of every tool used in this data collection was of great concern to ensure clarity, relevance, and age-appropriateness, considering the study's aims and ethical considerations. During the use of the tools, users' confidentiality and voluntary involvement were observed, with the data kept anonymous and under security to guarantee the respondents' privacy.

3.8 Procedures

Phase 1: Intensive Three Days Teacher Training

This phase involves intensive three-day teacher training for three teachers recruited to deliver the campaign lessons and three observers through Google Meet. This virtual format was pivotal, ensuring that the assisting teachers and observers received uniform and comprehensive training essential for effective intervention delivery and evaluation regardless of location.

Day 1: focused on the theoretical underpinnings of road safety, particularly emphasising active transportation modes such as walking and cycling. Utilising Google Meet's interactive capabilities, the session facilitated in-depth discussions and presentations, laying a foundational understanding of the intervention's objectives.

Day 2: transitioned to interactive learning techniques and hazard identification. The virtual platform enabled hands-on activities through features like screen sharing and breakout rooms, enhancing the teachers' ability to communicate complex safety concepts engagingly.

Day 3: On this day, the practical application of the intervention and the adaptation of teaching materials to the study's specific needs were emphasised. Role-playing exercises and discussions were conducted within the virtual environment of Google Meet, ensuring the teachers were well-prepared to facilitate dynamic and impactful learning sessions.

This three-day virtual training session was instrumental in equipping the teachers with a good understanding of the curriculum and effective pedagogical strategies. As they transitioned from trainees to facilitators, their enhanced skills were crucial in fostering an engaging and supportive learning environment, setting a solid foundation for successful intervention delivery.

Phase 2. Two weeks after training the teachers, each student in the control and test groups was assigned questionnaires to capture pre-test data on their demographic characteristics, mode of transport used to school, challenges associated with using active modes, knowledge, skills, attitude, etc. toward road safety before delivering the interventions. The control groups filled out their pre-test questionnaire three days before the test group due to the different time slots allocated by the school authorities.

Phase 3: Intervention Implementation

Two days after the pre-test data collection from the test group, three assisting teachers trained before the study on the content of the intervention and delivery strategy carried. The teachings were carried out in a classroom. Due to the limited size of the classrooms and the aim to make the teaching session more interactive and practical for students, two separate sessions were carried out within an hour and a half duration each. The same teacher who led the first session was the same who led the second session to avoid variations in the content delivery to all the test group participants. One day was used to introduce the intervention to the students. The original content (slides) from Brakes contains a few slides on seatbelts and keeping quiet in cars; however, these were skipped during the teaching session, and all other teachings related to only active modes of transport (walking and cycling) were taught. A road safety playmat was used as the road environment for demonstrations since using the main was prohibited by the school authorities due to safety reasons. Details of how the content was delivered are below.

1. Initial Engagement and Introduction (20 minutes)

The introduction was made to catch the children's attention and make them understand why road safety is essential. The introduction included a small presentation and interactive discussions on road safety. The facilitators used eye-catching visuals and fun questions to pique participants' interest and get them involved.

2. Hazard Identification and Understanding Risks (30 minutes): After the introduction, the children went through "Hazard Spot" exercises to identify what could go wrong in several road situations projected on slides and discussed with them. This practice was crucial in improving their ability to spot dangerous activities within the road environment.

FIGURE 9 Students Identifying Hazards (Field Survey, 2024)

3. Safe Practices, Rules, and Protective Gear (40 minutes)

In this session, activities were based on guiding the kids on safe road practices, the significance of following traffic rules, and the value of protective gear, including helmets.

FIGURE 10 Road Safety Practices, Rules, and Protective Gear Demonstration (Field Survey, 2024).

Using interactive talks and demonstrations, the teachers showed students the correct way to use pedestrian crossings, the value of the Green Cross Code, and how wearing safety gear could mean the difference between life and death, etc.

4. Practical Application and Reinforcement (30 minutes)

The last session of the workshop was more hands-on for students and allowed them to apply what they had learned. This was interspersed with role-play exercises that sought to practice safe crossing behaviour and activities that had the children colour road safety posters to drive home the critical lessons in a fun, memorable manner. The program finished by summing up what had been learned that day to ensure the children knew how to be safe on the road.

FIGURE 11 Practical Application of Lessons and Reinforcement (Field Survey, 2024)

Phase 4: The control and intervention groups participated in post-intervention test questionnaires three weeks after the pre-intervention responses. The post-intervention data were collected to generate assessment data on the intervention's short-term knowledge, skills, and behavioural gains. Long-term gains were impossible to measure due to the study's time constraints.

Phase 5: This is the stage where the questionnaires were distributed to stakeholders responsible for ensuring students' safety on their journey to/from school. The stakeholders to whom the questionnaires

were administered included parents and guardians, school authorities, and the representative of the District Assembly. The data collection for this phase took two weeks to complete.

3.9 Ethical Considerations

This study was conducted taking into consideration ethical considerations of research. Firstly, consent forms were distributed more than a week before the project's commencement to 169 students from the two selected schools. Overall, 150 consent forms were returned and approved; thus, the researcher established the participants' number for the investigation. The process allowed for the fact that informed consents were obtained, which indicates the active position and willingness of parents/guardians for their children's involvement. The research also ensured that the identity and privacy of the respondents were protected as outlined in the consent form. Also, care was taken to adjust the intervention content and data collection instrument to be age-specific and contextually appropriate for the participants. Participation was optional, and individuals could withdraw at any given time. It was not an explicit choice and did not suggest any undue coercion.

3.10 Data Analysis

This section outlines the methods applied in analysing collected data, which was mainly of quantitative measures and fewer qualitative responses. All statistical analyses were done using SPSS version 29 and Excel 365.

3.10.1 Impact of Intervention on Road Safety Knowledge

To evaluate the impact of the intervention on the road safety knowledge of respondents, the categorical responses obtained from respondents were coded 1 and 0, denoting correct and wrong answers, respectively. The unanswered items were classified as wrong (0). Using descriptive statistics, the means, standard deviations, and frequencies were computed for both control and intervention groups at each time point. An ANCOVA General Linear Model with Repeated Measures was then performed to determine the effects of the intervention while accounting for confounding variables that may have been present. This was done to reveal significant differences between road safety knowledge scores in terms of main effects over time (pre- vs. post-intervention) and group (control vs. intervention) and their interaction. Gender was treated as an independent variable, and age as a covariate. The significance level for all tests was set at $p < 0.05$.

3.10.2 Objective 2: Impact on Socio-Cognitive Variables

Data on this objective were treated as binary with each chosen response coded as 1 and each unchosen one coded as 0. An association between the pre-and post-data for the intervention groups was computed using McNemar’s tests. Because the data is binary, non-parametric tests were appropriate. Statistical significance was set at a p-value of 0.05.

3.10.3 Influence of Stakeholder

For this objective, binary responses were coded for yes or no questions, while categorical codes were assigned to questions measuring agreement levels and frequencies. Frequencies and percentages were calculated for each response category after.

3.10.4 Process Evaluation of the "Stay Safe, Arrive Alive" Campaign

For this objective, statistical data were created using SPSS version 29 and analysed through descriptive statistics after data coding. Questions requiring a simple “yes” or “no” response were scored as binary (e.g., ‘1’ for ‘yes’ and ‘0’ for ‘no’), while those measuring the agreement level of frequency were categorically coded. Descriptive statistics involving frequencies and percentages were computed for each response category using SPSS version 29.

3.10.5 Feedback from Students

This section had two open-ended questions analysed thematically using Excel 365, version 2406. One such question was, “Give reasons why you like the road safety training.” The rest of the questions in this objective were closed-ended and analysed using SPSS version 29. Binary response questions requiring either a yes or no were coded as (1) for ‘yes’ and (0) for ‘no’ while categorical codes were assigned to agreement/ frequency rating questions. Later, descriptive statistics such as frequencies and percentages were determined for all response categories in each case.

4 Results

4.1 Characteristics of the Sample Population

TABLE 2 Demographic Characteristics of the Sample Population

Characteristics	Type	Test Group (n=75)	Control Group (n=68)
Gender	Male	48.0% (36)	47.1% (32)
	Female	52.0% (39)	52.9% (36)
Age	7 years	12.0% (9)	11.8% (8)
	8 years	26.7% (20)	11.8% (8)
	9 years	21.3% (16)	22.1% (15)
	10 years	16.0% (12)	32.4% (22)
	11 years	24.0% (18)	22.1% (15)
Class	Class 2	18.7% (14)	22.1% (15)
	Class 3	21.3% (16)	10.3% (7)
	Class 4	21.3% (16)	26.5% (18)
	Class 5	17.3% (13)	23.5% (16)
	Class 6	21.3% (16)	17.6% (12)
Mode of Transport to School	Walk	82.7% (62)	76.5% (52)
	Bike	13.3% (10)	4.4% (3)
	Car	4.0% (3)	19.1% (13)
Distance to School	< 500m (Very Close)	22.7% (17)	13.2% (9)
	500m-1km (Close)	10.7% (8)	11.8% (8)
	1.1km-1.5km (Moderate)	4.0% (3)	4.4% (3)
	> 1.5km (Far)	62.7% (47)	70.6% (48)
Perceived Safety Concerns	Yes	53.3% (40)	20.6% (14)
	No	46.7% (35)	79.4% (54)

As seen from Table 2, both groups have evenly balanced gender in the sample, with males accounting for 48.0% in the test group and 47.1% in the control group. Also, females comprised 52% and 52.9% of the test and control groups, respectively, which shows minimal differences in the gender distribution. While differences in age distribution revealed that the test group has more 8-year-olds (26.7%) than the

control group (11.8%), the control group also has more 10-year-olds (32.4%) than the test group (16%). For class structure, the test group has a higher percentage of Class 3 (21.3%) than the control group (10.3%), while the control group has relatively more students in Class 4 (26.5%) than a test. The age and class distinctions could affect how students view and respond to road safety education.

For students' mode of getting to school, most of the students in both groups mostly walked, with a percentage of 82.7% for the test group and 76.5% for the control group. There is an observed difference in using cars for commuting to school, with 19.1% of the control group using cars compared to zero per cent for the test group. The different modes of transport used to or from school meant that the road safety training for this project promotes road safety for all modes users, especially for cycling and walking, which is the survey's focus.

As far as distance from school is concerned, most students live over 1.5 km away from school, particularly in the control group (70.6 %) compared to the test group (62.7%). The resemblances in distance distribution suggest that both categories of pupils face similar exposure risk points. Finally, perceived safety was significantly higher in the test group, with 53.3% expressing concerns compared to 46.7% in the situation control group.

TABLE 3 Mode of Transport vs Perception of Road Safety

Mode of Transport	**Safety Perception**					
	Control Group (No)	Control Group (Yes)	**Control Group (Total)**	Test Group (No)	Test Group Yes	**Test Group (Total)**
Walk	42	10	52	34	28	62
Car	10	3	13	3	3	6
Bike	2	1	3	6	4	10
Total	54	14	68	43	35	78

Table 3 shows that of those who walked to school in the control group, an overwhelming majority (42 of the 52 students) did not feel safe, whereas only 10 felt safe. Students who get to school by car also felt unsafe, with overwhelmingly 10 of 13 indicating safety concerns. Also, of the three students who used bikes in the control group, two felt safe, and the remaining one reported feeling unsafe.

Also, looking at risk perceptions of students for the test group based on their mode of transport, Table 3 further reveals that, perceptions of safety and environments are almost similar among students who walk to school, where 34 reported feeling safe, while slightly less, at 28, did not feel safe. More than half of students who commute to school by cycling feel safe, while 4 reported not feeling safe. Risk perceptions among those who use the car are split evenly, with 3 reporting that they feel safe while the other 3 reporting that they feel unsafe.

4.2 Outcome Evaluation of the "Stay Safe, Arrive Alive" Road Safety Campaign Implemented.

4.2.1 Descriptive Statistics

Table 4 displays the mean scores and standard deviations for the Control and Test groups, categorised by gender and time points 1 and 2. This table provides an overview of the groups' performance before and after the intervention.

TABLE 4 Descriptive Statistics for the Road Safety Training Scores

Group			Mean	Std. Deviation	N
time_1	Test	Male	37.63	14.52	36
		Female	42.31	14.07	39
		Total	40.06	14.39	75
	Control	Male	37.78	12.08	32
		Female	38.26	12.64	36
		Total	38.03	12.29	68
	Total	Male	37.70	13.33	68
		Female	40.36	13.47	75
		Total	39.10	13.42	143
time_2	Test	Male	72.47	17.07	36
		Female	78.90	15.93	39
		Total	75.82	16.70	75
	Control	Male	40.58	11.06	32
		Female	37.52	12.64	36
		Total	38.96	11.93	68
	Total	Male	57.46	21.59	68
		Female	59.04	25.28	75
		Total	58.29	23.53	143

Table 4 shows that the mean scores for the control and test groups at time point 1 were similar, indicating no significant differences in road safety knowledge between the two groups before the intervention. However, the standard deviations at Time Point 1 reveal variation within each grouping.

At Time point 2, the mean scores for both groups differ considerably. There is a much higher score increase for the test group than the control group. More specifically, the mean score for male students in the test group went up from 37.63 at Time 1 to 72.47 by Time 2, and for female members, it increased from 42.31 to 78.90. On the other hand, the Control group showed a moderate increase in scores in each case, with increases from 37.78 to 40.58 for males and 38.26 to 37.52 for females.

4.2.2 Multivariate Tests

The multivariate tests in Table 5 below investigate the primary effects of the factors and the covariate age and their interaction on the scores.

TABLE 5 Multivariate Tests

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Time	Wilks' Lambda	.997	.359[b]	1.000	138.000	.550	0.003
Time * Gender	Wilks' Lambda	1.000	.006[b]	1.000	138.000	.939	0.000
Time * Group	Wilks' Lambda	.446	171.132[b]	1.000	138.000	<.001**	0.554
Time * Age	Wilks' Lambda	.952	7.022[b]	1.000	138.000	.009*	0.048
Time * Gender * Group	Wilks' Lambda	.993	1.013[b]	1.000	138.000	.316	0.007

*<.05, **<.001

As can be seen from Table 5, the interaction between group and time was highly significant with Wilks' Lambda = .446, F (1,138) =171.132, p< .001. The high partial eta square value (55.4%) suggests that the interaction accounted for more than half of the total score variation.

Moreover, there was a significant Time*Age interaction with Wilks' Lambda = 0.952, F (1,138) =7.022, and p = 0.009, showing that the effect of age on students' scores is different at the two time points.

In addition, Wilks' Lambda=.993, F (1-138) =1.013, p<0.316 implies that none of these three factors: Time * Gender * Group interacted with each other. Therefore, the interaction of time, gender and group was not statistically significant in relation to scores. The small partial eta squared (0.007) indicated that whether the test or control group recorded different scores over time was not significantly influenced by the participant's sex.

There was no significant main effect of time, as shown in Table 6 with Wilks' Lambda = 0.997, F (1, 138) = 0.359, and p = 0.550. This means that being a mere passage of time had no significant effects on scores. Just a fraction of the variance in scores was explained by a small partial eta-squared value of 0.003.

Finally, there was no significant interaction between gender and time, as evidenced by Wilks' Lambda = 1.000, F (1, 138) = 0.006, and p = 0.939. This indicates that boys and girls tended to score similar marks over the time points; its partial eta squared is zero, hence explaining virtually none of the variance in scores.

4.2.3 Pairwise Comparisons for Time * Group

After identifying a statistically significant interaction between Time and Group, pairwise comparisons were performed, as shown in Table 6, to explain this interaction further. By comparing means scores of control and intervention groups at pre-test and post-test measures, these comparisons give a clearer picture of the differences.

TABLE 6 Pairwise Comparisons for Time * Group

Group	Before	After	Mean Difference (Before-After)	Std. Error	Sig. b	Lower Bound	Upper Bound
Control	1	2	-1.022	1.882	.588	-4.743	2.699
Control	2	1	1.022	1.882	.588	-2.699	4.743
Test	1	2	-35.502*	1.801	<.001**	-39.063	-31.941
Test	2	1	35.502*	1.801	<.001**	31.941	39.063

*<.05, **<.001

From Table 6 above, the increase in scores from timepoint 1 to timepoint 2 (1.02 %) for students in the control group is not statistically significant. However, the increase in scores from timepoint 1 to timepoint 2 (35.50%) for students in the Test group is statistically significant.

4.2.4 Interaction of Age and Time * Scores

Also, following the identification of a statistically significant interaction between Time and Age, further analysis was made, as shown in Figure 12, to examine more closely the precise disparities in score according to age over the two time points in the study.

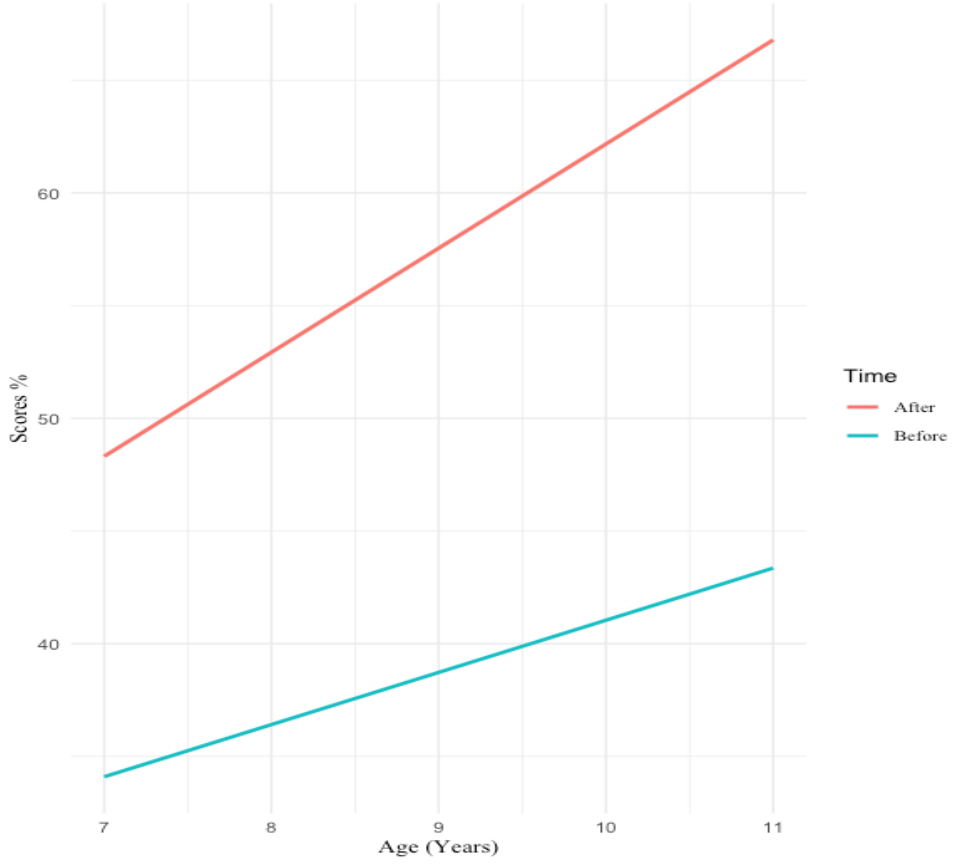


FIGURE 12 Interaction of Age * Time on Scores

It can be observed from Figure 12 that before the intervention, scores start at around 40% for age 7 and increase slowly to nearly 50% by age 11. On the other hand, after the intervention, average scores begin from about 50% for age 7 and extend up to over 60% for age 11.

4.2.5 Tests of Between-Subjects Effects.

Table 7 presents the results of the analysis of the impacts of gender, group, age, and their interactions on the scores of road safety training. At the macro level, the Tests of Between-Subjects Effects look at how time-dependent factors affect everything simultaneously.

TABLE 7 Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Intercept	1018.656	1	1018.656	4.987	.027	0.035
Gender	979.686	1	979.686	4.797	.030*	0.034
Group	27117.829	1	27117.829	132.768	<.001**	0.490
Age	7771.870	1	7771.870	38.051	<.001**	0.216
Gender * Group	863.864	1	863.864	4.229	.042*	0.030
Error	28186.461	138	204.250			

*<.05, **<.001

The result from Table 7 revealed a very significant main effect of group membership on scores with an F-value of 132.768 and $p < .001$, meaning that group membership accounted for 49.0% of the variance in scores (partial eta squared).

Also, age had a significant main effect on scores with an F-value of 38.051 and $p < .001$, which explained 21.6% of the variance in scores (partial eta squared).

In addition, the results also indicated that gender significantly influenced test scores, as signified by the F-value equal to 4.797 and $p = .030$, accounting for only 3.4% of the variances.

Moreover, there was a significant interaction effect between gender and group ($F = 4.229$, $p = .042$), explaining only about 3% of the variance in scores this suggests that the effects of group may vary by gender.

4.2.6 Parameter Estimates

In Table 8, specific parameter estimates show the separate effects of gender, group, and age and their interactions on road safety training scores at two different time points. This detailed information is crucial for understanding the extent and direction of each factor's influence and understanding how these variables affect the results.

TABLE 8 Parameter Estimates

Dependent Variable	Parameter	B	Std. Error	t	Sig.	95% Confidence Interval		Partial Eta Squared
						Lower Bound	Upper Bound	
time_1	Intercept	19.581	7.452	2.628	.010	4.847	34.316	34.316
	Age	2.547	.802	3.176	.002	.961	4.132	4.132
	Male	-5.797	3.025	-1.916	.057	-11.778	.184	.184
	Control Group	-4.246	3.005	-1.413	.160	-10.188	1.696	1.696
	Male * Control Group	4.289	4.359	.984	.327	-4.330	12.908	12.908
time_2	Intercept	33.005	7.284	4.531	<.001	18.602	47.408	47.408
	Age	5.144	.784	6.562	<.001	3.594	6.694	6.694
	Male	-8.683	2.957	-2.937	.004*	-14.529	-2.836	-2.836
	Control Group	-41.780	2.937	-14.223	<.001**	-47.588	-35.972	-35.972
	Male * Control Group	9.650	4.261	2.265	.025	1.224	18.075	18.075

*<.05, **<.001

At Time 1 (preintervention), with an estimate of the significant variance intercept (B=19.581, p=.010), the baseline score of the subjects is shown. The effect of age on the scores was significant (B=2.547, p=.002), indicating that initially, older students had higher scores. This conclusion can be drawn from the positive B value for age, which means this score increases as age increases. In contrast, the impact of gender (B=-5.797, p=.057) is not significant, suggesting no noteworthy difference among males or females in pretest scores. Similarly, the group effect (B=-4.246, p=.160) is insignificant, suggesting no significant difference in pretest scores between the Test and Control groups. Moreover, the interaction between gender and group (B=4.289, p=.327) does not reach statistical significance, suggesting no difference in pretest scores between males and females in either the Test or Control groups.

At Time 2 (postintervention), the point estimate changed significantly (B=33.005, p <.001), showing an overall improvement in performance after the intervention. The effect of age was still significant (B=5.144, p <.001), meaning that older students continue to affect scores, with improvement this time. The difference between male and female performance postintervention became statistically significant (B=-8.683, p=.004), suggesting that female students still score higher than male peers. The group effect was highly significant (B=-41.780, p <.001), indicating a substantial difference in results between the Test and Control groups, which strongly supports our conjecture as to the efficacy of the intervention. In addition, the interaction effect between gender and group became significant (B=9.650, p=.025), suggesting that the intervention had different impacts on males and females within these and any randomised control groups.4.2.8 Profile Plots for Estimated Marginal Means

The profile plots depict how the interaction of time, group, and gender affects the estimated marginal means of scores. They display how scores change over time in each group and whether these changes differ between genders.

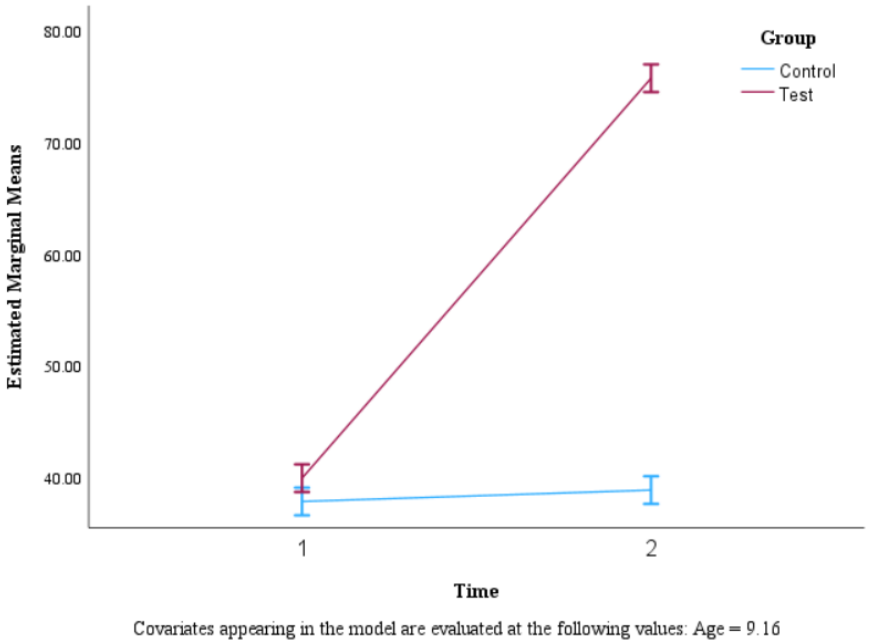


FIGURE 13 Estimated Marginal Means of Scores

Figure 13 shows the overall profile plot for all control and test group students. As can be seen, there was no statistically significant difference between the control group's test scores and those of students in the test group at point one. However, at the second time point, there is a significant difference. The scores of the Test group students increased rapidly between Time 1 and Time 2 compared with those from the Control group, which increased slightly. This overall trend affirms that the intervention was working, leading to a marked improvement in Test group scores at later points.

4.2.6 Testing of Repeated Measures ANCOVA Model Assumptions

1. Sphericity

Sphericity refers to the condition where the variances of the differences in scores between all possible pairs of groups are equal. This test can be applied only when at least three measurement time points exist. Unfortunately, this study design has only two time points, making this test inapplicable.

2. Levene's Test of Equality of Error Variances

TABLE 9 Levene's Test of Equality of Error Variances

Time	F	df1	df2	Sig.
time_1	0.424	3	139	0.736
time_2	1.607	3	139	0.191

Levene’s Test tests the null hypothesis that the error variance of the dependent variable is equal across groups. This assumption can be considered satisfied from the table since the p values at both time points are greater than the significance level of 5%. Thus, it can be concluded that the error variance of the dependent variable is equal across groups

3. Q-Q plot to check the normality assumption of the model residuals

Assessing the normality of residuals is paramount to verify assumptions that ANCOVA analysis relies on. The distribution of residuals is tested graphically by quantile-quantile (Q-Q) plots. Figures 15 and 16 showed Q-Q plots of residuals at two-time points to validate this assumption.

From the QQ plots in Figure 14, the residuals can be assumed to follow a normal distribution for the first time since the points closely follow the diagonal line. Hence, the normal assumption for the ANCOVA can be considered satisfied.

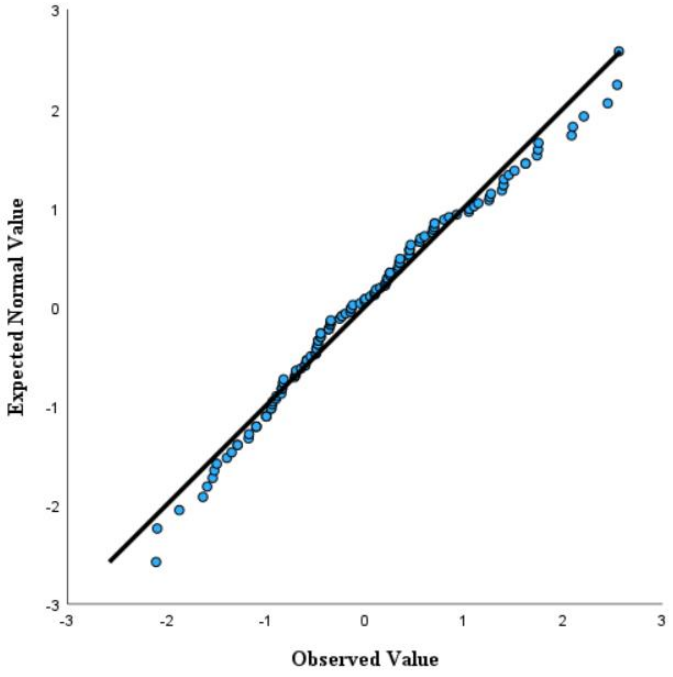


FIGURE 14 Standardised Residual for time_1

Similarly, from the Q-Q plot below in Figure 15, the residuals can be assumed to follow a normal distribution for the second time point since the points closely follow the diagonal line. Therefore, the normality assumption for the ANCOVA is considered satisfied.

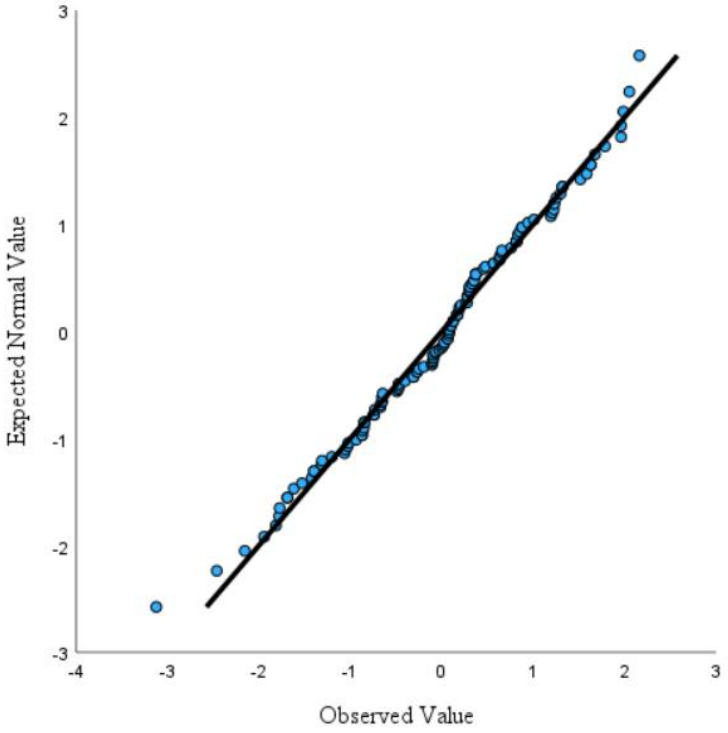


FIGURE 15 Standardised Residual for time_2

4.3 Theory of Planned Behaviour Construct

Students' attitudes, subjective norms, perceived behavioural control, and behavioural intentions about road safety are examined in Tables 10–13, which show the impact of the "Stay Safe, Arrive Alive" campaign. To evaluate the impact of the intervention on students' attitudes and behaviour, The TPB construct was used with pre- and post-intervention responses where applicable.

TABLE 10 Attitude

Question	Response Option	Before (n, %)	After (n, %)	Sig. (p-value) (McNemar)
Believe that the RSC has improved road safety knowledge	Agree	N/A	67 (94.40%)	N/A
	Disagree	N/A	4 (5.60%)	N/A
Believe that obeying road safety rules reduces the risk of accident	Agree	40 (69%)	66 (93%)	<0.001
	Disagree	18 (31%)	5 (7%)	0.007
Believe that the road is always safe and involves no dangers	Agree	40 (61.5%)	19 (29.70%)	<0.001
	Disagree	25 (38.5%)	45 (70.3%)	0.001
Importance of observing road safety rules	Very Important	39 (79.6%)	59 (88.1%)	<0.001
	Not Very Important	10 (20.4%)	8 (11.9%)	0.774

N/A=Data not Available

Table 10 shows that the campaign has impacted students' attitudes toward road safety. 69% of students before the intervention believed adhering to road safety regulations would reduce the likelihood of accidents; however, the number increased to 93 % after the intervention ($p < 0.001$), meaning an addition of 24% of students believe that following will reduce their risk of exposure to accident. On the contrary, 31% of students before the intervention did not believe adhering to road safety regulations would reduce the likelihood of RTI; however, the number decreased to 7 % after the intervention.

The number of students who believed before the intervention that crossing the road was always safe and did not involve danger decreased from 61.5% to 29.7% (p<0.001) after the intervention. A change also occurred in students' beliefs on the importance of complying with road safety regulations, which showed an increase of 8.5% from 79.6% in previous responses.

TABLE 11 Subjective Norms

Construct	Response Option	Before F (n, %)	After (n, %)	Sig. (p-value) (McNemar)
Pressure from friends and families to be careful on roads	Always	39 (75.0%)	52 (86.7%)	<0.001
	Sometime	4 (7.7%)	2 (3.3%)	0.500
	Rarely	9 (17.3%)	6 (10.0%)	0.508
Support from friends to follow road safety rules	Very Much	39 (73.6%)	52 (85.2%)	<0.001
	Neutral	4 (7.5%)	2 (3.3%)	0.500
	Not Supportive	10 (18.9%)	7 (11.5%)	0.508
Support from family to follow road safety rules	Yes	58 (96.7%)	58 (96.7%)	-
	No	2 (3.3%)	2 (3.3%)	-

Table 11 data shows a significant difference in social influences on road safety behaviours following the campaign. The proportion of students who said their parents and friends always prompt them to be careful around roads significantly raised from 75.0% to 86.7% ($p < 0.001$). On the other hand, the percentage of participants who sometimes felt pressurised or rarely did not show any substantial changes, with values dropping from 7.7% to 3.3% ($p = 0.500$) and from 17.3% to 10.0% ($p = 0.508$), respectively. Between the two time periods, there was also a significant increase in friends' support for safe road safety behaviour, from 73.6% to 85%. Students who prefer to stay neutral in response to family support decreased from 7.5% to 3.3% of the respondents. In comparison, those who reported not receiving any support from parents to behave safely around the road decreased from 19.9 to 11.5% of the respondents. Furthermore, family support for following road safety rules remained unchanged at 96.7% before and after the campaign.

TABLE 12 Perceived Behavioural Control

Question	Response Option	Before (n, %)	After (n, %)	Sig. (p-value) (McNemar)
Ease of following road safety rules after RSC	Very	N/A	40 (54.8%)	N/A
	Somewhat	N/A	30 (41.1%)	N/A
	Difficult	N/A	3 (4.1%)	N/A
Ease to follow all road safety rules after training	Very	N/A	46 (79.3%)	N/A
	Somewhat	N/A	7 (12.1%)	N/A
	Difficult	N/A	5 (8.6%)	N/A
Confident in staying safe on roads after RSC.	Very confident	N/A	25 (36.8%)	N/A
	Confident	N/A	35 (51.5%)	N/A
	Somewhat confident	N/A	2 (2.9%)	N/A
	Not very confident	N/A	5 (7.4%)	N/A

N/A=data not available

As shown in Table 12, more than half the surveyed students, 54.8%, believe in their ability to follow the road safety rules quickly after participating in the road safety training. Less than half that number,

40%, believe it will be slightly tricky to follow the road safety rules after the intervention. In comparison, 4.1% believe it would be difficult to follow the road safety rules even after the road safety training.

Moreover, 79.3% of students believe they were likely to consistently follow all road safety rules after the road safety training. Another set of students, thus 12.1%, who are not confident in their abilities, believe they will only be able to follow road safety consistently slightly. Additionally, 8.6% of students believe they will find it challenging to consistently abide by road safety rules after the road safety campaign.

Regarding confidence in commuting safely to school by the road, 36.8% of students felt very confident, and 51.5% felt moderately confident. On the other hand, 7.4% of students reported low confidence, and 2.9% felt only slightly confident.

TABLE 13 Behavioural Intentions

Question	Response Option	Before (n, %)	After (n, %)	Sig. (p-value) (McNemar)
Intention to follow road safety rules after the RSC	Yes	N/A	68 (91.9%)	N/A
	No	N/A	6 (8.1%)	N/A
Intention to promote road safety practices among your peers and family after RSC	Yes	N/A	62 (88.6%)	N/A
	Not sure	N/A	8 (11.4%)	N/A

N/A=data not available

Table 13 indicates that the participants' behavioural intentions were notably positive after the campaign. Many participants, precisely 91.9%, expressed their intention to adhere to road safety regulations. Additionally, 88.6% of participants wanted to encourage similar behaviours among their peers and family members.

4.4 Process Evaluation of Stay Safe, Arrive Alive" Road Safety Campaign using RE-AIM Framework

The RE-AIM framework was used to evaluate the processes of "Stay Safe, Arrive Alive" Road Safety Campaign. The assessment offered useful input on the campaign's success in multiple important areas, such as Reach, Effectiveness, Adoption, Implementation, and Maintenance. As indicated by finding eleven in Table 14 below, the evaluation underscores its achievements while pointing out its weaknesses, thereby leaving a better picture of how it worked and suggestions for improvement.

TABLE 14 Process Evaluation of the Road Safety Campaign

Domain	Metric	Outcome
Reach	Intended Reach	Four schools
	Actual Reach	Two schools (50% of target)
	Eligible Students	286 students
	Participating Students	143 students (50% of eligible)
	Gender Distribution	48% male, 52% female
	Barriers to Participation	Logistical challenges, resource limitations, 136 students did not get consent from parents, and limited time made it impossible for the extra two schools targeted to adjust their curriculum for the RSC.
Implementation	Teacher Training	3 teachers successfully trained
	Training Method	Three-day intensive training via Google Meet
	Consistency and Delivery	All three observers reported lessons well implemented as recommended.
	Challenges	Complex language in questionnaires, lack of practicality at the roadside,
	Fidelity Measures	High fidelity in lesson delivery
	Cost and Resources	€923.50 (Refer to Appendix 8)
	Resource Utilization	Efficient use of available resources. E.g., a road safety mat, classroom, projector, PowerPoint with visuals etc.
	Scheduling Issues	Introduction of Intervention and data collection sessions overlapped with school exams and other events, causing delays in the start of the project
Effectiveness	Knowledge Improvement	Highly significant ($p < .001$) from time*group (GLM with Repeated Measures ANCOVA
	Behavioural Changes	79% of students reported positive changes after RSC
	Parental Observations	90.3% of parents noted improvements at least some behaviour changes after the RSC
	Questionnaire Feedback	Generally clear, some suggestions for improvement
Adoption	School Participation	Two schools (50% of target) adopted the campaign
	Teacher Training	3 teachers adopted and implemented lessons
	Parental Involvement	75 parents from the test group agreed and took part in campaign
	Facilitators	Administrative support from participating schools
	Barriers	Logistical issues, limited time, and the challenge of rescheduling classes to make way for the RSC.
Maintenance	Sustainability Likelihood	68 of the students have an Intention to follow road safety rules after the RSC

The RE-AIM framework's implementation evaluation identifies "High fidelity in lesson delivery" as a critical indicator of the success of the "Stay Safe, Arrive Alive" Road Safety Campaign. Fidelity, in this case, refers to how much the campaign was given exactly as planned or designed including following the instruction plan; using teaching aids and materials; and general participation from pupils. Table 6 gives more insight into that by giving individual ratings on fidelity provided by three different observers. These ratings clearly show if the campaign is on course with its prescribed means of meeting educational objectives.

TABLE 15 Fidelity of the "Stay Safe, Arrive Alive" Road Safety Campaign

Criteria	Observer 1 Rating (1-5)	Observer 2 Rating (1-5)	Observer 3 Rating (1-5)	Average Rating
Following the Lesson Plan	4	5	4	4.3
Use of Recommended Teaching Material	5	5	5	5.0
Student Involvement	5	4	4	4.3
Clearness in Instructions	4	5	3	4.0
Time Management	4	4	4	4.0

The high ratings across all criteria in Table 6 indicate the strong fidelity of the road safety campaign. Based on this table, it is evident that the lessons were delivered according to the curriculum. Following the teaching guide closely earns a rating of 4.3, which shows that the teachers adhered to what was planned on how to deliver their content. Critically important here is scoring an all-time high of 5.0 for using recommended teaching materials which proves that different observers unanimously maintained constancy and efficiency in material use implying higher fidelity. The overall scores suggest a fair amount of clarity in instructions as well as intended delivery with average scores of clearness at 4.0 Time management aspect indicates a score of also 4.0 thus adhering strictly to their pre-arranged timetable thus improving overall fidelity through maintaining schedules and plans for implementation purposes regarding this public health issue by abiding by time limits imposed while planning about it.

4.5 The Role of Parents and Schools in Promoting Road Safety Among Students

This section focuses on the critical roles that parents and schools play in promoting understanding and students' behaviour regarding traffic safety. Their essential contributions, as well as opinions from parents of test group students and what their teachers passed on to them, are highlighted in ensuring the safety of children on the road.

4.5.1 Demographic Characteristics of Parents

TABLE 16 Demographic Characteristics of Parents/Guardians

Demographic Characteristics	Type	Frequency n=75	Percentage (%)
Age	18-25 years	5	6.7%
	26-33 years	16	21.3%
	34-41 years	28	37.3%
	42-50 years	16	21.3%
	50+ years	10	13.3%
Gender	Male	31	41.3%
	Female	44	58.7%
Level of Education	Finished intermediate	21	28.0%
	Finished secondary	21	28.0%
	University degree or higher	24	32.0%
	No education	9	12.0%

Table 16 shows that the largest age bracket among the parents/guardians is represented by those aged 34-41, making up almost 37% of the sample population, which reflects a predominantly middle-aged demographic. The distribution of gender is more inclined towards females, constituting about 58.8% of participants, indicating that there is a higher participation by female parents/guardians in this survey. Regarding educational attainment, majority have at least completed secondary school, with 32 % having studied up to university level or above. This indicates a relatively high level of education among the parents/guardians, as seen from their academic achievement standards. This demographic profile can affect what they think and how much they are engaged in conversations regarding the educational issues polled on, like how effective educational measures influence their children's lives.

4.5.2 Parents' Understanding of Road Safety Issues

Figure 16 shows that 37.3 per cent of 72 parents who responded to this question regard their understanding of road safety issues as very high, while 18.7 per cent rated it above average. This suggests that many parents have a solid understanding of road safety, which makes it possible for them to pass road safety practices on to their children.

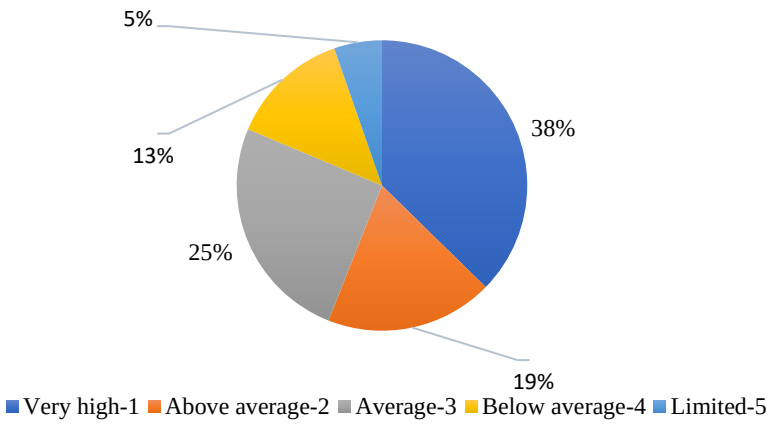


FIGURE 16 Level of Parents' Understanding of Road Safety Issues

4.5.3 Importance of Road Safety Compared to Other School Issues

Parents were asked to rate the importance of road safety issues compared to other difficulties experienced by their communities on a scale from 1 to 5. The results are shown in Figure 17.

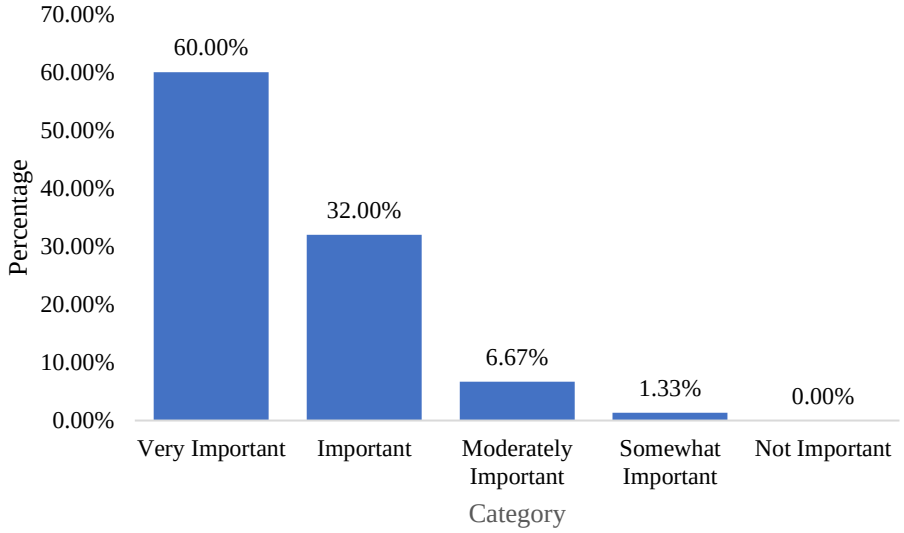


FIGURE 17 Parents' prioritisation of road safety

60% of all surveyed parents or guardians rated road safety as very important, 32% rated it as necessary, 6.67 moderately important and 1.33 as important.

4.5.4 Parental Perceptions of Child Safety While Walking or Cycling to School

In the survey, parents were asked about their perception of the safety of their children's commute to and from school using the roads in their community. Their responses reveal how different parents view the risks their children face when walking or cycling to school. The responses to these variables have been consolidated in Figure 18 below.

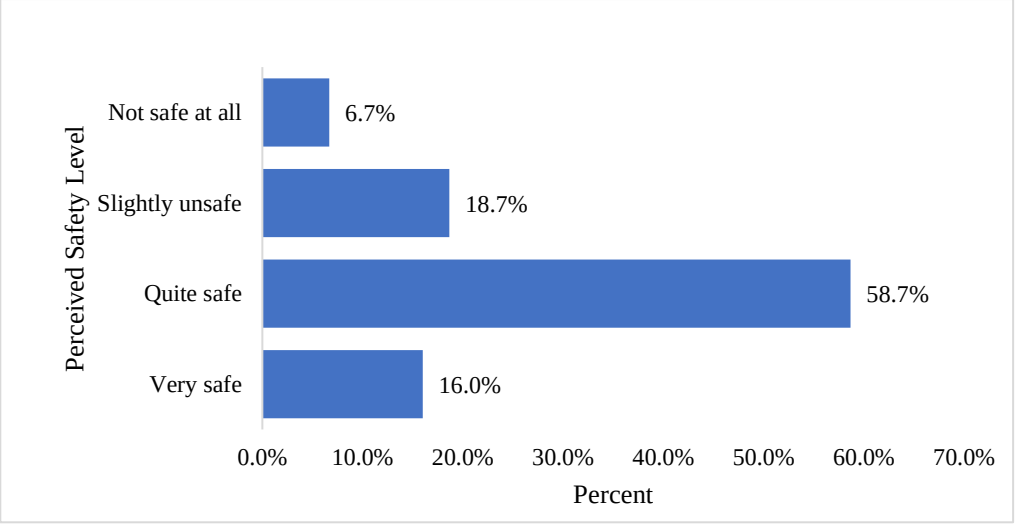


FIGURE 18 Parental Perceptions of Child Safety While Walking or Cycling to School

Figure 18 reveals that more than half of the respondents thus, 58.7% of parents of the targeted parents, perceive their children's travel to or from school as quite safe, while only 16.0% consider it very safe. Additionally, 18.7% of parents find it slightly unsafe, and 6.7% believe it is unsafe.

4.5.5 Parental-Students on Road Safety Discussions

Figure 19 seeks to determine whether parents, the primary agents of behaviour change in the community, deliberate road safety matters with their children.

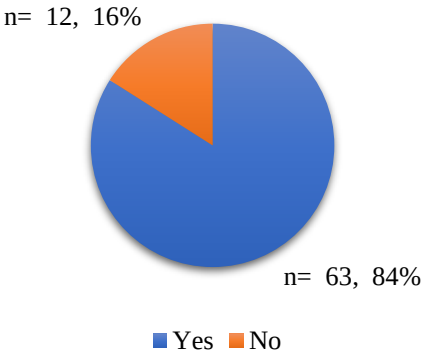


FIGURE 19 Proportion of Parents Who Talk About Road Safety with Their Children

Figure 19 reveals that 84% of parents in the survey discuss road safety with their children. This high percentage of parents actively participating in home-based safety discussions is a significant factor in promoting excellent road safety. These joint discussions between parents and children are not just conversations but a means to establish road safety precautions in children's minds. They play a crucial role in ensuring children remember and practice these good habits, thereby shaping their behaviour positively.

4.5.6 Topics Discussed with Children About Road Safety

The data presented in Figure 20 demonstrates that 63% of parents whose children benefited from the road safety intervention teach their children some basic skills in road safety on topics such as playing

on busy streets (37.9%) and looking both right and left before crossing roads (33.3%) dominates their discussions. Other topics parents discuss with children are crossing at the zebra crossing (37.9%) and not running on the streets (37.9%). This discussion or teaching emphasises general hazard avoidance and basic crossing techniques in parent-child safety dialogues.

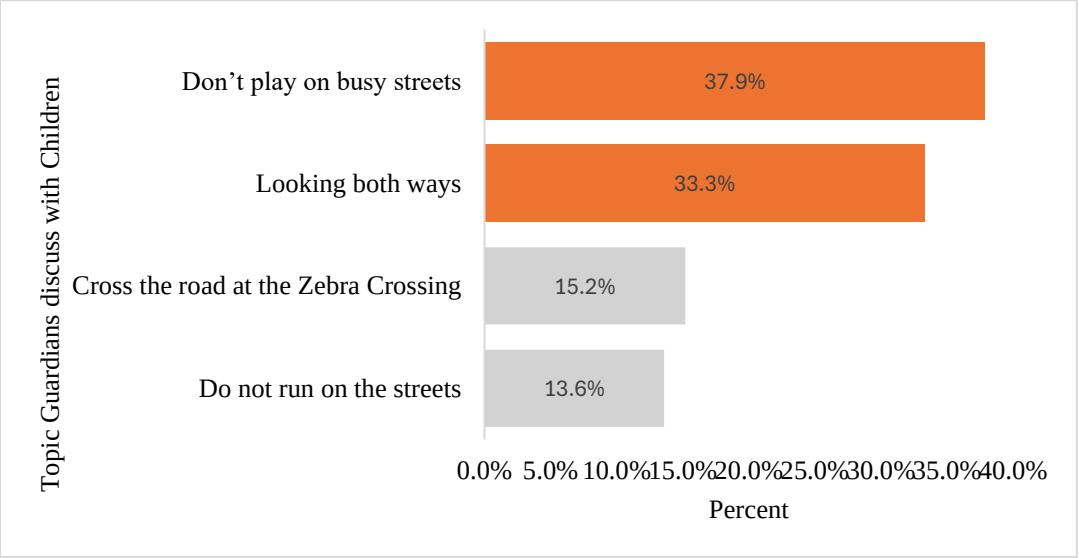


FIGURE 20 Topics Discussed with Children About Road Safety

4.5.7 Reported Behaviour Changes in Children After Road Safety Training

During the survey, parents in the test group were asked to report any observable variations in their children 's commuting to and from school behaviour following intervention. The research results revealed some observable changes, summarised and presented in Table 17 below.

TABLE 17 Summary of Behaviour Changes in Children After Road Safety Training

Behaviour Change Objective	Description	Frequency	Valid Percent
Major Improvement	Always observes traffic signal rules and has a high awareness of traffic safety.	16	22.20%
	Example: Always waits for the green light, uses crossings, and reminds friends.		
Significant Improvement	Generally, it follows traffic safety rules and shows clear traffic consciousness.	33	45.80%
	Example: Normally, stops and looks both ways before crossing, but sometimes, one needs to remind oneself.		
Moderate Improvement	Temporarily follows traffic signal passage laws and increases traffic consciousness across the board, but ought to make it a consistent behaviour	10	13.90%
	Example: Use crosswalks correctly, occasionally check for cars, but more often, should be followed by the author		
Slight Improvement	Seldom follows traffic signal laws and needs more traffic consciousness.	6	8.30%
	Example: Occasionally remembers to hold an adult's hand when crossing a street but often forgets other rules to obey.		
No Improvement	No change in traffic behaviour after retraining.	7	9.70%
	Example: Still ignores traffic signals after training		
Total		72	100.00%

Table 17 reveals that parents observed improvement in their children's road safety behaviours after the training session. Almost half of the respondents, 45.8%, showed significant improvement, and a quarter of 22.2% reported showing major improvement, i.e. students always observe traffic signal rules and are highly aware of traffic safety. Furthermore, 13.9% of the students showed moderate improvement and 8.3% showed slight improvement in road safety behaviour as reported by their parents according to the parents. Unfortunately, 9.7% of the student's parents reported no change in their children's road safety behaviour after the RSC.

4.5.8 Parental Confidence in Children's Safety Post-Training

Figure 21 shows parents expressing extreme confidence in their children's ability to walk and cycle safely to school after completing the Road Safety training. Almost half of the respondents, 43.8%, said they were very confident in their children's ability to travel to or from school safely, and more than half, 55%, expressed slight confidence in travelling to school safely. 35.6% described themselves as quite confident. After the training, one parent confirmed not having confidence in the child's ability to use it safely.

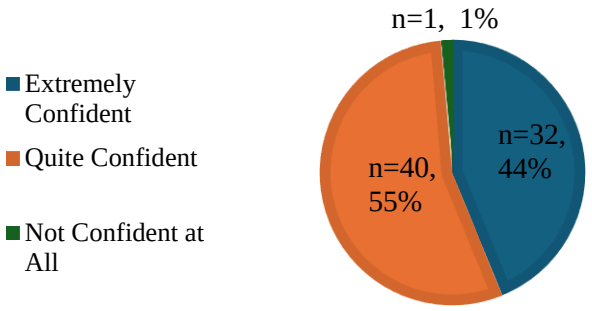


FIGURE 21 Parental Confidence in Children's Safety Post-Training

4.6 Contribution of School

Two schools host the road safety training intervention, and it is important to understand the conditions in the school environment that constrain it or give it the strength to ensure students have the necessary support to sustain the impact of the road safety training on their skills and behaviour in the long term.

4.6.1 Curriculum Inclusion and Frequency of Road Safety Lessons

For training programs that seek to guide safety habit development in road safety education, its inclusion in the school curriculum is essential. Details in Table 18 explore how road safety education is included in the host schools' curricula and how regularly they are implemented.

TABLE 18 Curriculum Inclusion and Frequency of Road Safety Lessons

Does the curriculum capture road safety education?	Daily	Weekly	Monthly	Rarely	Not Taught	Total
Yes	-	-	-	1	1	2
No	-	-	-	-	-	-
Total	-	-	-	1	1	2

Table 18 indicates that although road safety education is part of the curriculum supplied by the Ghana Education Service, it is rarely taught in one of the schools. In the other school, it is not taught at all.

4.6.2 Methods of Incorporating Road Safety Education into Teaching

Understanding how schools incorporate road safety education into teaching can yield information on how successfully road safety messages are getting through and being absorbed.

TABLE 19 Methods of Incorporating Road Safety Education into Teaching

Method	Frequency	Valid Percent
Integrated into other subjects	2	100.00%
Total	**2**	**100.00%**

Table 19 presents evidence that road safety is not an independent theme introduced by the Ghana Education Service to such schools; it is integrated into other subjects.

4.6.3 Challenges the Two Schools Face in Implementing Road Safety Education

Several challenges hinder the effective implementation of road safety education by the schools of participants schools. The data in Table 20 highlights issues such as limited budgets, lack of resources, and time constraints, with limited time being the most frequently reported challenge.

TABLE 20 Challenges of Road Safety Education in Participants' Schools

Challenges	Daily	Weekly	Monthly	Rarely	Not Taught	Total
Budgetary constraints	0	0	0	1	1	2
Resource constraints	0	0	0	1	1	2
Time constraints	0	0	0	2	0	2
Human resource constraints	0	0	0	1	0	1
Total	0	0	0	5	2	7

The data in Table 20 shows that the main obstacles to successful road safety teaching in the researched schools are small budgets, the absence of resources, and time limitations, with short time being the most common issue.

4.7 Student Feedback on Road Safety Training

This section reports students' feedback on the road safety intervention and the survey. Understanding how students view their training sessions is essential for evaluating the program's effectiveness. The feedback includes a wide range of topics: whether they enjoyed doing this or that environmental health subject, area suggestions for improvement, influence on behaviour, and future needs in training.

4.7.1 Enjoyment of the Road Safety Sessions

To gauge their feelings, we asked the students to tell us how much they liked the road safety sessions. Figure 21 below provides an overview of their opinions.

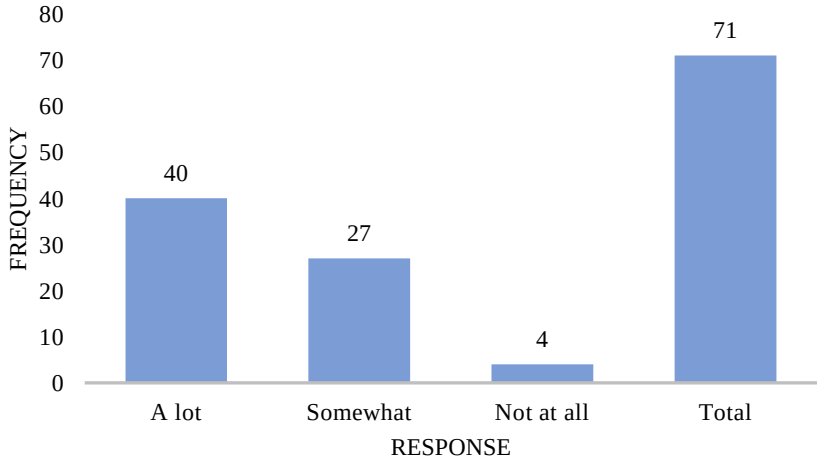


FIGURE 22 Level of enjoyment of road safety sessions among students.

According to Figure 22 above, 40 students (56.3%) thought the road safety workshops were great, and another 38.0% thought they were good to a certain degree. An overwhelming majority of respondents (94.3%) found the experience enjoyable. Four students, or 5.6% of the participants, were not pleased

with the road safety sessions. The findings reveal that most students (67 out of 71) enjoyed the road safety classes slightly. This high level of satisfaction indicates that the sessions were exciting and well-accepted.

4.7.2 Reasons for Road Safety Enjoyment

The 71 students who said they enjoyed the road safety training were asked the reasons they enjoyed the RSC. The responses are summarised in Figure 23 below.

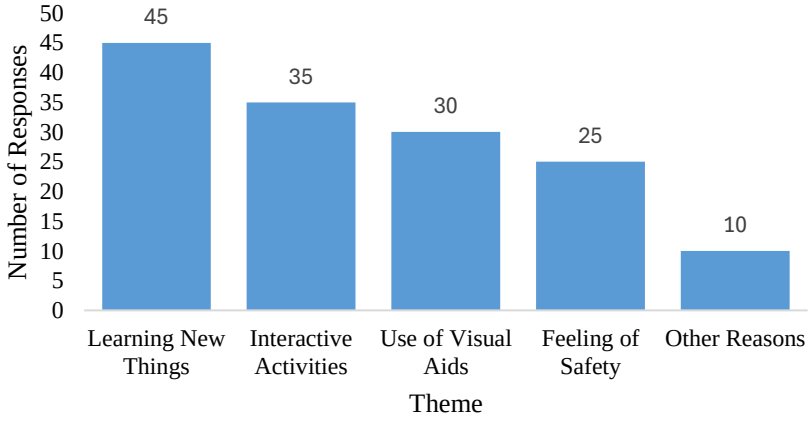


FIGURE 23 Reasons for Liking RSC

Figure 23 shows that students gave several reasons for liking the road safety training. In total, 142 responses were given by 71 students. The leading reason is learning new things, which accounted for 31.7% of the reaction. The second most mentioned reason was interactive activities (24.6%), followed by using Visual aids (21.1%) and feeling safe after the RSC (17.6) respectively. A small portion of respondents' answers were related to other reasons (7%).

4.7.3 Participation in Activities and Discussions

Students were also asked about their participation in activities and discussions within the sessions. The result is presented in Figure 24.

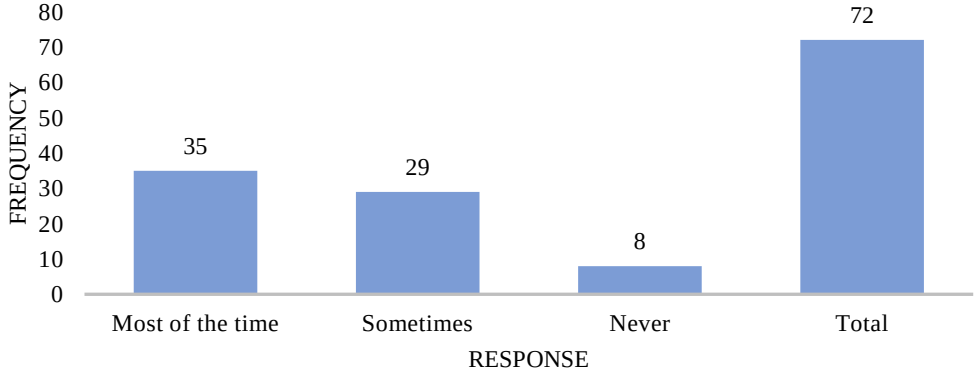


FIGURE 24 Students' Level of Participation in Road Safety Training Activities and Discuss

Figure 23 shows that almost half of all students (48.6%), 35 out of 72, stated that they had participated most of the time in these activities and discussions. Additionally, 29 out of 72 students (40.3%)

mentioned participating some of the time. By contrast, 8 out of 72 students reported never participating in the activities and discussions. Although these students were small, their lack of participation in training sessions is a concern.

4.7.4 Suggestions for Improvement

To understand areas where the program could be improved, students were asked what they disliked about the training. The responses are summarised in Table 23.

TABLE 21 Dislikes of the Road Safety Training

Response	Frequency	Valid Percent (%)
Some words are too hard	37	51.4
The questions are too long	20	27.8
Some questions are about things I know nothing about	16	22.2
I did not find the questions difficult	23	31.9
Did not practice at the roadside	2	2.8
Total	**72**	**100.0**

Table 21 identified several significant issues reported by students. The most frequent problem was vocabulary difficulty, with 51.4% of the students reporting that some words in the questionnaire were too hard. Surprisingly, 31.9% of the participants did not feel the questions were difficult, contrasting with those who felt they were challenging to understand. Another main issue was the length of the questions, with 27.8% of participants mentioning that the questions were too long. Almost 22.2% of respondents reported that there were questions based on things they were not knowledgeable about in the pre-intervention questions, reflecting that the road safety intervention helped teach new information and hone the learning of the participants. A meagre number, thus 2.8%, referred to a lack of practice on the side of the road as challenging and requested for the request for more practical content.

4.7.5 Behavioural Impact

Students were asked if they had observed any changes in their behaviour related to road safety since participating in the campaign, just as their parents were also asked. The responses are summarised in Figure 25.

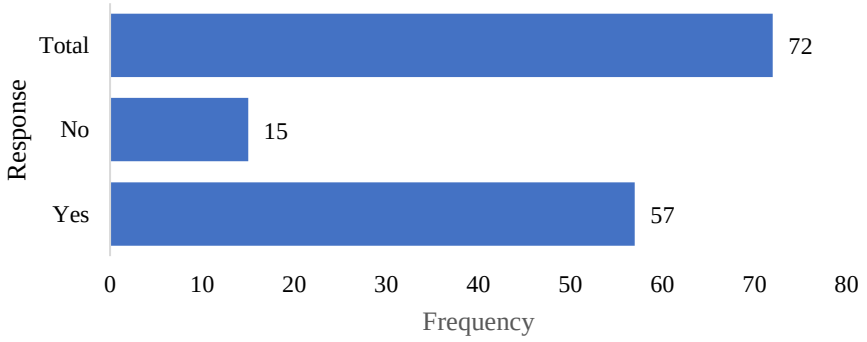


FIGURE 25 Number of students who observed changes in their road safety behaviour post-training.

According to Figure 25, 79% of the students, representing 57 of the respondents, were sure the road safety campaign positively influenced their road safety behaviour. Only a few, 21%, representing 15 students, did not notice any change in their road safety behaviour after the campaign.

4.7.6 Future Training Preferences

To understand students' interest in continuing their road safety education, they were asked if they would like to have the training again in the future and how often they would prefer these sessions. This section summarises their responses, highlighting their willingness to participate in future training and their preferred frequency for such sessions.

TABLE 22 Willingness to Have Training Again

Response	Frequency	Valid Percent (%)
Yes	62	88.6
No	1	1.4
Neutral	7	10.0
Total	**70**	**100.0**

Table 22 shows that 88.6% of students intend to participate in road safety education again, which demonstrates their belief in the capability and importance of such training. However, 1.4% of students declared they would no longer participate in the new road safety competitions, whereas 10% are unsure about participating in future campaigns.

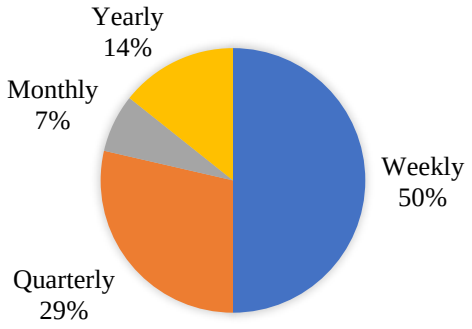


FIGURE 26 Future Training Preferences

Figure 26 reveals that 88.6% of the respondents are eager to take road safety training later. The data shows that 50% of the students favour weekly training, 29% choose quarterly sessions, 14% prefer an annual frequency, and 7% request a monthly frequency. The fact that students have different wanted training session frequencies indicates that they very seriously think about their overall health and safety.

5 Discussions of the results

This study seeks to promote safe and sustainable mobility among school children by adopting the "Stay Safe-Arrive Alive" initiative from the United Kingdom to suit the Ghanaian environment. This campaign provides a thorough strategy for promoting road safety, catering to the requirements of young pedestrians and cyclists across various age groups and with much coverage beyond primary 5 pupils. The study intends to implement and assess the efficacy and process of the campaign on primary 2 to 6 students in Weija-Gbawe, a district outside Accra Metropolis. The specific objectives are to evaluate the intervention's impact on students' knowledge and socio-cognitive skills, evaluate the campaign process, identify the role of schools and parents in promoting road safety among children, and finally get student feedback on the program.

5.1 Impact of Intervention on Students' Knowledge

5.1.1 Interaction of Time and Group

Firstly, the time and group interaction in the multivariate test, corroborated by the pairwise comparisons between the test and control group, reveal a significant difference in scores between the test and the control group after the road safety intervention. Besides, a pairwise comparison showed a significant mean increase in scores of 35.502% ($p < .001$) from the first to the second time point for the Test group and an insignificant mean increase in scores of 1.022% ($p < .001$) from the first to the second time point for the control group. Additionally, a partial eta squared value of 0.554 for time and group interaction from the multivariate test shows that the intervention accounted for approximately 55.4% of the variance between the two groups over time, which is a large effect size. Similar findings have been obtained in the greater Accra (Yankson et al. 2020) and Winneba (Sayer et al. 1997) of Ghana, where school children's road safety knowledge improved after exposure to a localised school-based road safety intervention. There has also been evidence of using RSCs as a countermeasure for enhancing the road safety situation of children in other developing countries (Aranda-Balboa et al., 2022; Nachman & Rodriguez, 2023). The results obtained in this study affirm that properly coordinated school-based road safety initiatives can enhance young students' awareness of road safety rules in Ghana and other regions.

5.1.2 Age-Related Efficacy

This study found a significant interaction between time and age (Wilks' Lambda = 0.952, $F(1, 138) = 7.022$, $p = .009$), suggesting that the efficacy of the "Stay Safe, Arrive Alive" road safety campaign differs with varying age levels. Increases in scores were observed among older students, as evidenced in Figure 12 and Table 8. Older students benefited more from the “Stay Safe, Arrive Alive” road safety campaign. They performed better on questionnaire items, thereby highlighting consideration for age-related disparities in designing school-based road safety initiatives for basic schools.

This finding confirms the findings by Rosenbloom et al. (2016) who found that age can influence the adoption of road safety interventions. The finding is further corroborated by OECD (2004), that cognitive development facilitates a deep understanding of educational content. Designing age-based road safety education interventions can have a significant impact compared to the generalised approaches used. Differences in cognitive and developmental changes affect learning, among other things, which explains why the road safety campaign was less effective for younger pupils than their older counterparts. Age-dependent cognitive development determines how children perceive and apply principles outlined in traffic education programs.

The implications are crucial for developing student-specific interventions, such as those aimed at enhancing achievement through remediation or acceleration initiatives aimed at all pupils without discriminating factors like age, among others, within the context of schools.

5.2 Impact of Intervention on Socio-Cognitive Variables of Behaviour of Students

The "Stay Safe-Arrive Alive" program successfully increased key social-cognitive constructs in students, including attitudes, subjective norms, and perceived behavioural control. The perception of students who believed that observing road safety regulations can reduce RTA increased from 69% to 93% ($p < 0.001$). On the other hand, there was a decrease in the proportion of students considering roads as being always safe from 61.5% to 29.7% ($p < 0.001$). The finding suggests a shift towards a more positive attitude toward road safety after participants were exposed to the intervention. Previous studies have confirmed that favourable attitudes towards an act are more likely to result in intentions to engage in that activity (Ajzen & Fishbein, 1980).These attitudes can also be shaped by peer pressure from the society. The percentage of students who experience varied levels of influence from friends and family to adopt safe road behaviours increased from 75% to 86.7% ($p < 0.001$), enhancing subjective norms. According to the findings on the extended TPB model of Matović et al. (2024), increased subjective norms are predictors of enhanced pedestrian behaviour intention.

Also, 67 participants expressed at least some level of confidence; very confident, confident and somewhat confident after the RSC. This indicates a high probability that 67 students out of the 75 participants, representing 89% of the participants, will follow road safety after the campaign. According to (Ajzen & Fishbein, 1980)), people are more likely to implement their intentions when they have self-efficacy beliefs about being able to perform desired behaviour (s). This finding concurs with Matović et al. (2024) conclusions that perceived behavioural control as a self-efficacy component can predict whether a pedestrian will hold safe or risky intentions. It is also important to note that these findings correspond to findings from other researchers. For instance, Zainafree et al. (2022) established that a school-based road safety program significantly improved students' intentions and behaviours regarding traffic safety.

The results have implications for practitioners who use the Theory of Planned Behaviour in designing their intervention because they show how all three aspects were improved, thus possibly lessening the chances of road-related risks. Nonetheless, no control group was involved, thus making it impossible to attribute changes solely to the intervention. However, future research should be designed with a control group to evaluate its specific impacts better and establish causal relationships more firmly.

5.3 Process Evaluation of Stay Safe, Arrive Alive" Road Safety Campaign using RE-AIM Framework

Although the Stay Safe, Arrive Alive" Road Safety Campaign significantly enhanced students' knowledge and behaviours towards road safety, it had difficulty reaching its target audience as intended. However, it managed to train three teachers who facilitated the sessions in two of the four planned schools. Only 50% of eligible pupils and schools were reached due to limited resources (i.e., logistics for training) and time. These considerations should be made in future studies to address administration and resource barriers associated with school-based road safety experiments, as this will improve their reach. The overall implementation was successful because there was a significant increase in students' road safety knowledge over the two time periods for the test group ($p < .001$), with TPB variables also seeing increases. In addition, 57 of the participants reported positive behavioural changes. These results

are consistent with other studies (Sayer et al., 1997; Treviño-Siller et al., 2017) amplifying school-based road safety interventions as effective ways of improving road safety awareness and behaviour among school children.

The implementation processes demand key improvement to enhance its effectiveness. Although well received by students, some found the vocabulary aspect of the questionnaire difficult, while others commented on non-applicability at the roadsides. Also, the scheduling conflicted with the school examination timetable, causing a delay in this project. Easy-to-use road safety content can be integrated into road safety campaign material in Ghana to minimise obstacles associated with accessibility and adoption. Challenges regarding conflict with academic timetables were curtailed due to solid administrative support, but obstacles relating to resources (i.e., logistics and timing) could not be avoided during the campaign's execution. For better adoption and sustainability of school-based road safety programs within the study area and other similar regions within Ghana, broadening stakeholder involvement is required. For instance, 68% of students showed intentions towards following the road safety rules after the intervention, which could imply the sustainability of such behavioural change impacts in communities like Weija-Gbawe if follow-up campaigns are encouraged.

These study's findings have profound implications for advancing future road safety education campaigns in Ghana and other developing countries. However, underlying barriers should be overcome. Future campaigns should prioritise logistical planning, institutional involvement, and the development of appropriate assessment materials to improve the evaluation of the impact of similar interventions.

5.4 Role of Parents and Teachers

5.4.1 Parental Influence

The present study revealed that 37.3% of parents understand road safety issues, while 18.7% rated it above average. Many participants' parents knew basic road safety measures based on their children's immediate needs, as they observed them, with most parents actively discussing these issues with their children. This is important because it proves parents have the potential to support the sustainability of road safety education impact. In addition, while students participated in the road safety campaign, parents provided a conducive environment for sustaining the campaign's impact. Also, they monitored students' behaviour during the campaign, which suggests their possible influence on the road behaviour of their children. Feng et al. (2022) found that parents and children have potential leading roles in safety education within the family, which aligns with this research's findings. Taubman-Ben-Ari and Katz-Ben-Ami (2013) revealed that emphasising effective parental modelling, monitoring, and communication can significantly influence children's safety behaviours. Generally, the high level of confidence among parents after post-training, followed by their monitoring of children's behaviour after the RSC and also teaching them road safety rules, indicates that parents of participants in the test group play a significant role in their children's road safety awareness and behaviour.

These findings imply that road safety programs should actively involve parents to reinforce children's learning and support road safety initiatives since they have already shown the potential to do so from the findings in this study. Integrating parental engagement strategies can enhance the overall impact of road safety education, leading to sustained behavioural changes in children.

5.4.2 Role of Schools

Moreover, the findings on the roles of stakeholders show that although both schools in Weija-Gbawe engage parents and work together with researchers to implement initiatives such as the "Stay Safe, Arrive Alive" campaign, these schools lack adequate teaching and delivery of road safety lessons within their premises. Both schools intervened and admitted that road safety education is primarily integrated into other subjects instead of being taught separately. Hence, there is no dedicated or consistent teaching of road safety in these schools, indicating their contribution to educating or sustaining the impact of external campaigns for road safety is minimal despite being a key agent of socialisation for children.

The findings also show that when RSC is integrated into other subjects, it may be overshadowed by other topics, leading to shallow coverage. In addition, infrequent delivery of road safety instructions also reduces the impact on students' awareness and behaviour change. This situation aligns with previous studies highlighting Ghana's road safety education challenges. For example, a study in Winneba, Ghana, by Odame et al. (2024), showed that a formal educational system does not ensure children learn about safe street crossing or traffic rules. In addition, the findings confirm similar findings by (Odame et al., 2024) the current road safety education initiatives like the "SAVE WAYS" campaign introduced into the National Curriculum for all schools in Ghana are not well integrated into the primary school curriculum to benefit students.

These findings imply that the Ghana Educational Service and other stakeholders in charge of including Road safety education into the curriculum of these two Weija-Gbawe schools need to reassess their road safety education approaches in two ways. If they decide to maintain the current approach, there would be a need for more time, resource allocation, and teacher training so that students can adequately comprehend and remember such messages. Otherwise, designing and implementing a stand-alone road safety curriculum with specific time, training materials, and trained facilitators would be more meaningful. However, regardless of the decision, adequate resource allocation towards road safety education and continuous evaluation and engagement with external campaigns are indispensable in creating a sustainable culture of road safety within communities with an apparent reduction in young people's vehicle accidents due to traffic.

5.5 Student Feedback on Road Safety Training

5.5.1 Engagement and Enjoyment

The study identified a high degree of enjoyment (94.3%) about road safety training, indicating that the content and delivery methods appealed to students, which could capture their interest and maintain their attention. The study found that 94.3% of students enjoyed the road safety sessions, with most rating them as great or good. Furthermore, there is a strong willingness to participate in future training by 88.6%. The high level of enjoyment reported likely contributed to their understanding of the issues discussed in the road safety campaign and their ability to remember items discussed or demonstrated in the training session. Hernik and Jaworska (2018) confirm this, showing that when students have enjoyable learning, they are more likely to retain and remember information later. Thus, this is relevant since road safety education depends heavily on students remembering and applying safety information long after the formal sessions. The connection between enjoyment and retention highlighted by Hernik and Jaworska (2018) re-emphasizes the significance of ensuring that these sessions are enjoyable so as not only to make the messages understandable but also easily recalled in real-life situations. In addition,

Kelly et al. (2024) showed how fun learning can increase students' motivation and boost their overall academic achievements.

The implication is that educators should focus on creating training sessions that are both informative and enjoyable to maximise the effectiveness of such programs. This way, the students will retain vital safety information and motivate them for future training. Ultimately, adding pleasure to an educational program concerning road safety would ensure continuous participation by individuals and enhanced knowledge sustainability while safeguarding against dangerous behaviours.

In addition, the survey identified high participation rates in activities and discussions during the training session, indicating a high level of engagement and the relevance of the training materials to participants. This active involvement is crucial for deep learning and participants' internalisation of road safety concepts and likely contributed to the effectiveness of the campaigns for the students. Dragutinovic and Twisk (2006) reported that the impact of interaction in adult-led learning training on performance must not be underestimated due to the influence of social interaction on learning. Fredricks et al. (2004) also concluded that participation in activities enhances learning outcomes and engagement. Qureshi et al. (2023) also highlighted that active collaborative learning and student involvement influence their learning performance. The finding also aligns with Bigelow (2006), as cited by Combrinck and Govender (2012), who observed that students are more involved in issues or contents that are relevant to them. Hence, the high participation in discussions validates the appropriateness of Stay Safe-Arrive Alive to students in the two schools in Weija Gbawe.

The implication is that Road safety programs that emphasise interactive, participatory, and relevant elements for the target population will likely have higher participation in discussions and positive outcomes on their performance.

5.5.2 Challenges with Campaign Assessment Materials and Training

There were some observed challenges during the implementation of the Stay Safe-Arrive Alive campaign in the study area. A total of 23 students, representing 31.9% of the 72 who responded to the specified questions, were not concerned with the assessment material. Others had different concerns ranging from understanding or complex vocabulary and extended lengths of questions. 2.8% of the students faced challenges with practising in a real road experiment outside the classroom. The observed variations align with the OECD (2004) recommendation that varied educational resources are required for different students, especially those struggling with language and literacy. Borgers et al. (2004) suggested that younger children need simple questions and answers directly related to difficult words. Similarly, and Turner-Henson (1989) reveal the importance of using uncomplicated language when examining children, as they tend to be accurate for them.

Moreover, 2.8% of students preferred practical work over classroom instruction. This inclination towards learning through experience thus necessitates the inclusion of diverse assessment styles, like practical experiments, into the curriculum, which might help teachers find more learners who do not fall into one learning style category or have a particular taste for certain evaluation forms. These findings reveal a need to consider the characteristics of participants in designing examination materials that enhance access and inclusivity for all children within the specific target group. Moreover, future assessment models should be simplified and engaging, like application-simulating demonstrations to enable participants from all walks of life to learn about road safety while measuring their understanding of its aspects.

5.6 Policy recommendations

1. In future studies, researchers should also use observational data alongside self-reported responses to assess the intervention's impact.

2. Future studies are recommended in other parts of Weija Gbawe and other regions in Ghana to generalise findings across various contexts.

1. Researchers and funding bodies should secure additional funding and partnerships to expand the study and include more participants, allowing for generalisation in Weija Gbawe and other regions.

2. Follow-up assessments should be implemented at multiple intervals of at least three time points to evaluate long-term knowledge retention and assess skills and behaviour from road safety training.

3. In the future, researchers should also study whether there are differences in road safety issues depending upon whether the area is rural or urban and to places where no such training has been given.

4. In further research, researchers should use robust randomisation and matching procedures to control for baseline differences and potential confounding variables.

5. Educational authorities and the government must support schools in the district, including the private ones, in teaching road safety instead of just making it part of their curriculum.

6. In the future, other possible confounding variables, such as preliminary knowledge and a person's psychological condition during the survey, enjoyment, and participation, need to be included in the General Linear Model to identify the variance in the model explained by them, if any.

7. Future studies need to integrate control groups in their design to allow comparison of results and validate the specific impact of the intervention on TPB.

5.7 Limitations and Future Research

1. Because of safety concerns and institutional restrictions, the road safety intervention occurred in the classroom with conditions different from the actual road environment.

2. Self-reported questionnaires were used to collect data from students, parents, and school staff. These could give biased responses on behaviour and skills as participants might overstate their knowledge or behaviour changes.

3. The study was restricted to only two schools in Weija-Gbawe District of Accra, Ghana; its conclusions may not be generalised to other areas.

4. A few pupils could not get parental consent, thus affecting the research sample's representativeness. As a result, this study can only partially represent the two schools that participated in the campaign.

5. Because the survey time was short and the cost of conducting such a survey high, the researcher was unable to employ a larger sample size as planned

6. The Survey lasted a little over one and a half months, limiting the ability to assess the long-term impact of the interventions on knowledge, skills, and behaviour.

7. The study took place in an urban area and can only be said to be useful within an urban area.

8. Confounding variables like previous experiences of road traffic safety knowledge and transitory social status were not examined, and so their impacts on results were not measured

9. The sample consists of 143 participants from two private schools only. Public school pupils were not included, meaning the findings in research cannot be generalised to include public schools.

10. The study has a major limitation due to the non-inclusion of the control group for the TPB, which restricts causal claims about the effectiveness of the intervention. Other factors might have influenced such changes, making establishing definite causality difficult.

6 Conclusion

This study has highlighted the importance of teaching children about road safety in the Weija-Gbawe community in Ghana. The research shows that well-designed road safety education increases students' knowledge and awareness and shapes their behaviours towards safety for young traffic participants. These results support the above-stated conclusions, which have shown a clear improvement in students' understanding of road safety knowledge and changes in their social cognitive abilities as reported by themselves and behaviour change reported by parents after participating in the Stay Safe, Arrive Alive Campaign.

This study is, therefore, important from various perspectives. It enriches existing knowledge about road safety education for children in Ghana and other regions, especially developing ones. It emphasises the significance of RSE as one of the most crucial elements to be considered within public health alongside other road safety strategies currently being used by policymakers in Ghana. By implementing the intervention program in this study, there is a potential to mitigate socio-economic costs related to road injuries among students who walk or to school in Ghana and even increase active mobility to school. The possibility of preventing child deaths or injuries from road accidents through targeted educational initiatives is highlighted, thereby avoiding these significant socio-economic burdens and the fear of using active modes of transport.

Additionally, the research stresses the vital roles of major stakeholders such as parents, teachers, and schools in promoting a road culture that will culminate in safe roads and the sustainability of impacts from road safety campaigns. These stakeholders need to work together to implement holistic approaches that solve different problems associated with road safety education. Children can learn safely on roads if equipped with the skills, knowledge, attitudes and behaviours necessary for becoming integrated members of society who can benefit and contribute to their communities.

Collaborative efforts involving family, school, and researchers are essential for developing a child-friendly, safe environment free from harm to children caused by motor vehicle crashes in school areas,

with social and economic costs attached to it. When road safety education is given precedence while striving towards collective responsibility for child protection, safer streets will be achieved where everyone lives.

In conclusion, The Stay Safe, Arrive Alive program in Weija Gbawe, Ghana, was a good way to reach the participants who do not get a road safety education in their schools. Teachers in other parts of Ghana can repeat the program for a sustainable increase in road safety awareness among school children. Policy implications

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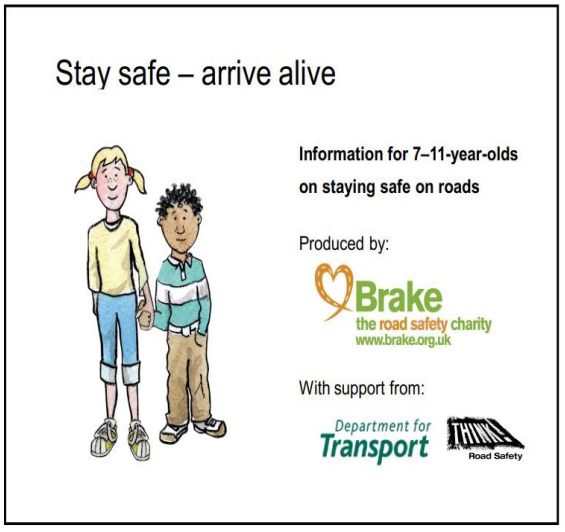
Appendix 1: Stay Safe, Arrive Alive Campaign Lesson Material



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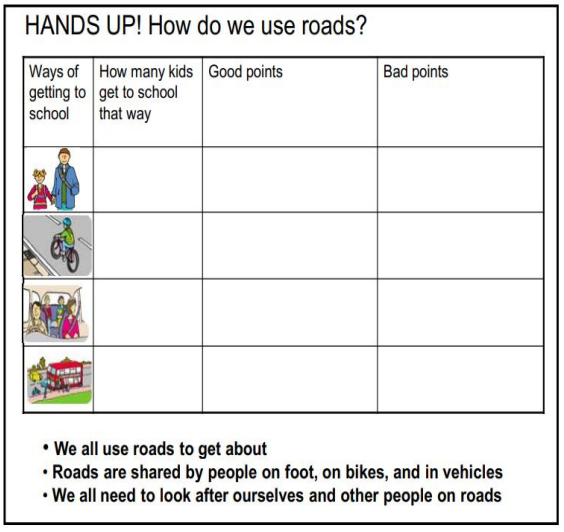

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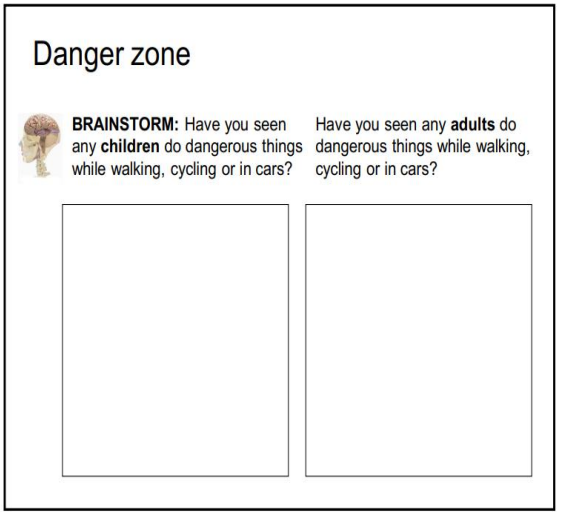

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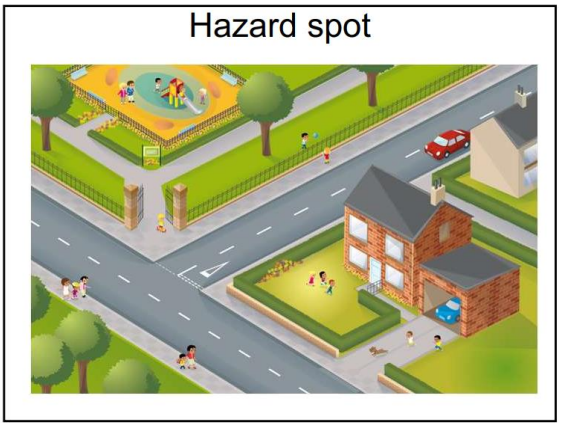
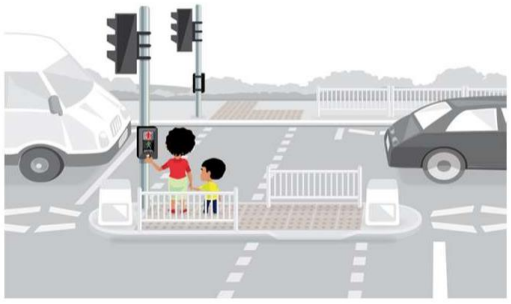


6

Hazard spot



7

Hazard spot

8

Hazard spot

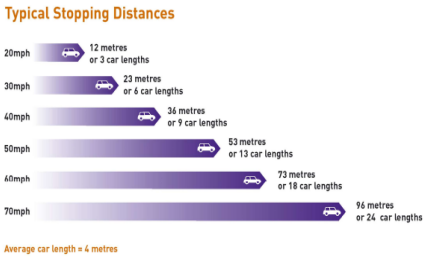
What are the hazards around your school and home?

9

QUIZ TIME: why is fast traffic dangerous?

FACT: It takes time for vehicles to come to a complete stop.

Q: As vehicles get faster, do their stopping distances:
a) Increase? b) Decrease? c) Stay the same?
A: Increase



10

What happens if you don't stay safe on roads?

THE FACTS:
- You could get seriously injured – or even killed
- 160 8-11 year-olds are hurt or killed on roads every week in Britain
- Kids age 11-14 are more likely to get hurt or killed while walking or cycling than younger kids

BRAINSTORM:
Why do you think older kids are more likely to get hurt or killed than younger kids?

11

BELT UP AND SHUT UP!

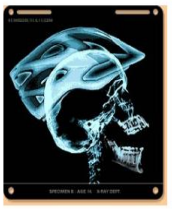
- ✓ Belt up before the car sets off – tell the driver to hold on
- ✓ Belt up for every journey – short and long
- ✓ Check everyone else belts up too – front and back, kids and adults!
- ✓ Never undo your seat belt on the journey
- ✓ The law says you have to use a booster seat if you're under 135cm tall – otherwise your seat belt can't do it's job

12

FACT: if you're not belted up and you're in a crash, you would be thrown forward with the force of a small elephant

13

GET THE GEAR!



- ✓ Wear a helmet whenever you cycle
- ✓ If you have a bike, keep it in good shape

For more info on cycle safety, go to www.cyclesense.net

- ✓ Be bright, be seen – wear high-vis gear morning and night!

CLICK HERE to see a Hedgehogs advert about being bright

14

FACT: at night a driver can usually see you from about **30 metres** away. If you wear high-vis gear they can see you from **160 metres** away (more than five times further!)

BRAINSTORM:
Look at the pictures of Amy and Ben. What high-vis gear could they wear?

15

PLAY IT SAFE!

- ✓ Play in the park or a garden - never in the street
- ✓ Don't muck about near roads – keep your cool and stand up for safety!
- ✓ Keep well away from traffic on rollerblades or skateboards

16

CROSS SMART!

- ✓ Choose safe routes
- ✓ Use crossings if you can
- ✓ If there's no crossing, find somewhere safe – away from parked cars and bends in the road
- ✓ Stay focussed – never cross while using a mobile or stereo
- ✓ Don't trust traffic
- ✓ Use the Green Cross Code

THE GREEN CROSS CODE

THINK FIRST

STOP

USE YOUR EYES AND EARS

WAIT UNTIL IT'S SAFE TO CROSS

LOOK AND LISTEN

ARRIVE ALIVE

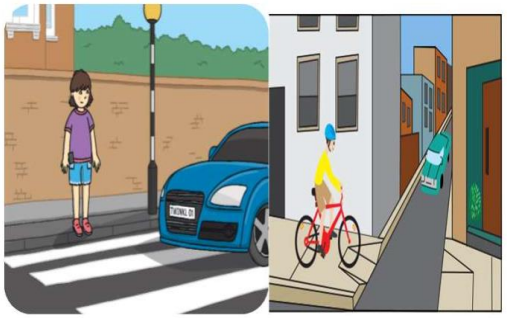
17

The crossing guard

- On some roads there are people to help you cross. The crossing guard will hold up a special sign to ask cars to stop so that people can cross the road safely.

18

Crossings

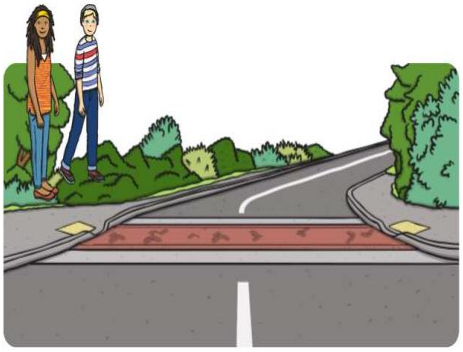


19

Stop at the side of the road.

20

Wait until any vehicles have passed.



21

Cross the road – but keep looking and listening.

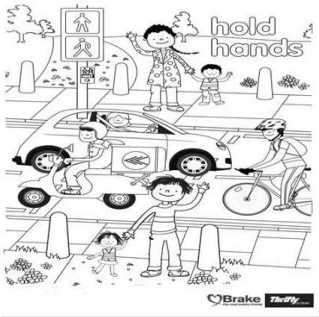
22

Walking with Adults

- When walking with an adult, hold their hand – especially when you need to cross a road.

23

Colouring of poster



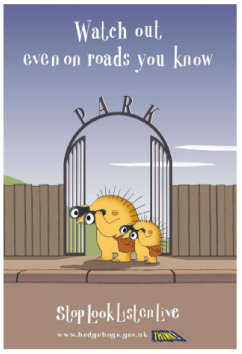
24

Cycling safety

25

FACT: you need to watch out – even on roads you know

Click here to see an advert about watching out for dangers



26

What's road safety all about?

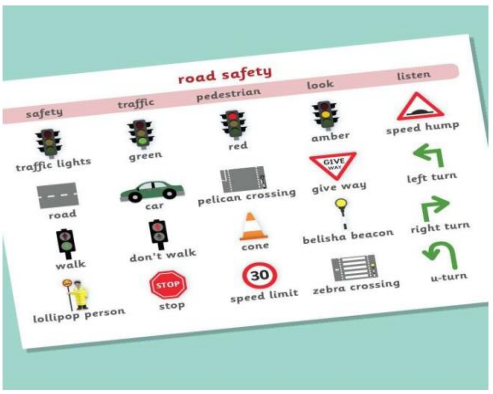
It's about:

- ✓ walking safely, cycling safely, and being safe in cars
- ✓ keeping yourself safe - and your friends and family too
- ✓ making smart choices
- ✓ making sure you don't get hurt – or even killed

STAY SAFE – ARRIVE ALIVE

27

Signs and elements in Road environment



28

Appendix 2: Consent Form for Students

Consent Form for Students/Parents

Researcher: Titus Kofi Dabla

Welcome to this survey as a part of my master's Thesis about Road Safety

The survey aims to promote Safe and Sustainable Transport among children to/from school.

It only takes about 15-20 minutes to complete the survey. There are no right and wrong answers, and please answer each question honestly.

Before you and your child take part in this survey, please read the information below thoroughly:

- I have read the above information about this study.
- I understand the purpose of this study and what is expected of me and my child during this study.
- I understand that me and my child's participation in this study is voluntary and that we can choose to discontinue it if necessary.
- I do not have to give a reason for this, and I know that no disadvantage can arise for us.
- I understand that the results of this research may be used for scientific purposes and may be published. Neither my name nor my child's name will be published, and the confidentiality of my data is guaranteed at every stage of the research.
- I know that the results of this research will be kept for two years, starting from 26/02/2023, and will be deleted after this period.
- For questions, I know I can contact you after my participation: titus.dabla@student.uhasselt.be
- For any complaints or other concerns regarding the processing of personal data, I can contact the UHasselt data protection officer at dpo@uhasselt.be

☐ I agree and would like me and my child to take part in the survey.

☐ I disagree and would not like or permit my child to take part in the survey.

I understand that the data collected from my participation will be used for a purpose (e.g., thesis, journal publication, etc.), and I consent to its use.

Signed Date:
...../...../.....

…….

Name of student Parent…….

Name of Student……

Appendix 3: Preintervention Questionnaire for Both Test and Control Group`

1. Code	2 Grade * *Mark only one oval.* ◯ Class 2 ◯ Class 3 ◯ Class 4 ◯ Class 5 ◯ Class 6
3. Age *Mark only one oval.* ◯ 7yrs ◯ 8yrs ◯ 9yrs ◯ 10yrs ◯ 11yrs	4. Gender *Mark only one oval.* ◯ Male ◯ Female
5 How do you usually go to school? *Mark only one oval.* ◯ Walk ◯ Bike ◯ Car ◯ Bus ◯ Other: _____	6. What are the main reasons you travel this way to school? (Tick ALL that apply) *Check all that apply.* ☐ Good my health. ☐ Distance between home and school is short ☐ Distance between home and school is far ☐ Only means to get there ☐ Cheapest means from house to school ☐ Safest mode from house to school ☐ Other: _____
7. What are the rules for crossing the road safely? (Tick ALL that apply) *Check all that apply.* ☐ Look left and right before crossing. ☐ Wait for the traffic light signal. ☐ Cross only at designated crosswalks. ☐ Hold hands with an adult when crossing.	8 What would you do if a ball rolled onto the road while you were playing? (Tick ALL that apply) *Mark only one oval.* ◯ Run to get it immediately. ◯ Ask an adult for help. ◯ Wait for the ball to come back. ◯ Leave the ball and inform an adult.

9. What are some things on the road that can help you cross safely? (Select all that apply)

Check all that apply.

- [ ] Traffic lights
- [ ] Zebra crossing
- [ ] Pelican
- [ ] Footbridge
- [ ] Lollipop

10. Crossing the road can be very safe, and no dangers are involved.

Mark only one oval.

- ◯ True
- ◯ False

Explain how to use a zebra cr ssing safely.

Mark only one oval.

- ◯ Zebras crossing is for animals, not for crossing roads.
- ◯ Wait for cars to stop, and then cross at the zebra crossing.
- ◯ Run quickly across the zebra crossing without looking.

12. Why is it important to stop at the edge of the sidewalk before crossing the road?

Mark only one oval.

- ◯ I can just cross the road whenever I want.
- ◯ Stopping helps me check for cars before crossing safely.
- ◯ Stopping is for grown-ups, not for kids like me.

13. Why is it important to look both ways before crossing the road, even with a green signal?

Mark only one oval.

- ◯ Green means it's always safe to cross.
- ◯ Looking both ways ensures no unexpected dangers
- ◯ I only need to look left before crossing; that's enough.

14. Why is it not safe to run near the road?

Mark only one oval.

- ◯ Running can be dangerous because cars may not see me.
- ◯ Cars need time to stop, making running hard for them.
- ◯ All the above.

15 Which of the following is a safe bicycling behaviour?

Mark only one oval.

- ◯ Riding in the same direction
- ◯ Weaving through traffic to get to the front.
- ◯ Riding while texting

16. What safety item should you always wear when cycling?

Check all that apply.

- [ ] helmet
- [ ] Shin pads
- [ ] Safety glasses

17. How should you show other road users that you are turning left?

Mark only one oval.

- Put out your right-hand
- Put out your left hand.
- Move over to the left.
- Putting no hands

18. Which of the following should you not wear when riding a bicycle?

Mark only one oval.

- Gloves
- Helmet
- Earphones

919 Do you see others do danger us things near the road?

Mark only one oval.

- Yes
- No

20. What factors, if any, have prevented you from using a bicycle to/from school if you don't use a bicycle?

Mark only one oval.

- Safety concerns
- Lack of bicycle access
- Distance to school.
- Other:

21. Have you ever experienced a near-miss or accident on your road to school, either walking or cycling?

Mark only one oval.

- Yes
- No

22. Have you ever experienced a situation where you or someone else had to be careful on the road?

Mark only one oval.

- Yes
- No

23 If yes, what happened? (Open-ended response)

24. Do you feel safe using the road on foot or bicycle to School??

Mark only one oval.

- Yes
- No

25. Give reasons for your answer in 34.

Mark only one oval.

- Heavy traffic Volume
- lack of pedestrian or bicycle infrastructure
- Speeding vehicles.
- History of accidents on the roads I use to school.

26. What specific session of the road does your answer refer to?

Mark only one oval.

- ◯ The entire road from house to school
- ◯ Specific intersections
- ◯ Crosswalks
- ◯ bike lanes.
- ◯ Other: _____

27 Have you ever participated in any road safety activities or drills at or outside school?

Mark only one oval.

- ◯ Yes
- ◯ No

28. Who organised this event?

Mark only one oval.

- ◯ School Administration
- ◯ Parent-Teacher Association (PTA)
- ◯ Student Council
- ◯ Local Community Organization
- ◯ Other: _____

29. What road safety advice have your parents or guardians given you? (Open-ended response?

Mark only one oval.

- ◯ Looking Both Ways
- ◯ Using Crosswalks
- ◯ Being Aware of Surroundings
- ◯ Nothing

30. Have you ever discussed road safety with any other family members at home aside parents?

Mark only one oval.

- ◯ Yes
- ◯ No

31. If yes, who were they?

Mark only one oval.

- ◯ Brother
- ◯ Sisters
- ◯ Other: _____

32. What role do teachers play in teaching road safety in your school?

Mark only one oval.

- ◯ Actively lead road safety lessons
- ◯ Help organize road safety activities
- ◯ Ensure students understand road safety rules.
- ◯ Limited involvement
- ◯ Not involved

33. What challenges do you face in following road safety rules?

Mark only one oval.

- ◯ I do not know all the rules.
- ◯ Sometimes forget to be safe
- ◯ Busy streets are hard to cross.
- ◯ Friends not following rules
- ◯ Other: _____

34. Have you ever attended any road safety awareness programs in school or outside of school?

Mark only one oval.

- ◯ Yes
- ◯ No

35. If yes, what was the most interesting thing learned from these programs?

Mark only one oval.

- ◯ How to cross the road safely
- ◯ Identifying road signs
- ◯ Rules for using pedestrian crossings
- ◯ Dangers of distracted walking or driving
- ◯ Importance of following traffic signals
- ◯ Other: _____

36. How often do you witness adults following road safety rules?

Mark only one oval.

- ◯ Always
- ◯ Most of the time
- ◯ Sometimes
- ◯ Rarely
- ◯ Never

37.

Spot the good behavior (2), and any hazards (3) *

Check all that apply.

	Good Behavior	Hazard	None
Children playing in the p...	☐	☐	☐
Adults walking on the si...	☐	☐	☐
Children chasing a dog t...	☐	☐	☐
Children playing in the h...	☐	☐	☐
Child skating near the ro...	☐	☐	☐
Adult holding the hand o...	☐	☐	☐
Children playing with a b...	☐	☐	☐

38. Spot the good be aviour (2), and any hazards (1)

Check all that apply.

	Good Behaviour	Hazard	None
Holding hands with an a...	☐	☐	☐
Pressing the button at t...	☐	☐	☐
Vehicle on the left appro...	☐	☐	☐

39. Spot the good behavior (2), and any hazards (1)

Check all that apply.

	Good behavior	Hazard	None
Moving vehicle on the cr...	☐	☐	☐
Stopping at the median ...	☐	☐	☐
Child holding adults hand	☐	☐	☐

Appendix 4: Post-Intervention Questionnaire (Test Group)

1. 0. Code _____	2. Have you taken part in the road safety training programme *Mark only one oval.* ◯ Yes ◯ No
3. How important do you think it is to follow road safety rules *Mark only one oval.* ◯ Very important ◯ Not very important	4. Did you learn about different aspects of road safety in the sessions? *Mark only one oval.* ◯ Yes ◯ Neutral ◯ No
5. Were the activities and lessons explained i a way that you could understand? *Mark only one oval.* ◯ Did not understand at all ◯ Understood very little ◯ Understood some parts ◯ Mostly understood ◯ Fully understood	6. What do you dislike about road safety training? 7. What do you like about the road safety training? 8. What do you think should be improved about the road safety training?
9. Did you enjoy the road safety sessions? *Mark only one oval.* ◯ A lot ◯ Somewhat ◯ Neutral ◯ Not really, ◯ Not at all	10. Give reason for your answer _____

11. Did you participate in the activities and discussions during the road safety sessions? *Mark only one oval.* ◯ Always ◯ Most of the time ◯ Sometimes ◯ Rarely ◯ Never	12. Was learning about road safety enjoyable for you? *Mark only one oval.* ◯ Yes ◯ No
13. Considering your overall experience, how likely will you recommend this road safety workshop to your peers? *Mark only one oval.* ◯ Not at all ◯ Slightly ◯ Moderately ◯ Very ◯ Extremely	14. Have you observed any changes in your behaviour related to road safety since participating in the campaign? *Mark only one oval.* ◯ Yes ◯ No
15. If yes, please describe the changes _____ _____	16. How much do your friends support you in following road safety rules? *Mark only one oval.* ◯ Very supportive ◯ Neutral ◯ Not supportive
17. Do you feel your family encourages you to practice road safety? *Mark only one oval.* ◯ Yes ◯ No	18. How easy or difficult are you to remember and follow road safety rules after training? *Mark only one oval.* ◯ Very easy ◯ Somewhat easy ◯ Difficult

19. Do you plan to follow road safety rules after the campaign? *Mark only one oval.* ◯ Yes ◯ No	20. Do you intend to promote road safety practices among your peers and family? *Mark only one oval.* ◯ Yes ◯ Not Sure yet
21. If you wanted to, how easy would it be for you to follow all road safety rules consistently after training? *Mark only one oval.* ◯ Very easy ◯ Somewhat easy ◯ Difficult	22. How confident are you in staying safe on the road, even in challenging conditions after training (e.g., bad weather, heavy traffic)? *Mark only one oval.* ◯ Very confident ◯ Confident ◯ Somewhat confident ◯ Not very confident ◯ Not confident at all
22. How confident are you in staying safe on the road, even in challenging conditions after training (e.g., bad weather, heavy traffic)? *Mark only one oval.* ◯ Very confident ◯ Confident ◯ Somewhat confident ◯ Not very confident ◯ Not confident at all	23. How often do you feel pressure from your friends or family to engage in safe road behaviours? *Mark only one oval.* ◯ Always ◯ Sometimes ◯ Rarely
24. Following road safety rules reduces my risk of being in an accident? *Mark only one oval.* ◯ Agree ◯ Disagree	25. What are the rules for crossing the road safely? (Tick ALL that apply) *Check all that apply.* ☐ Look left and right before crossing. ☐ Wait for the traffic light signal. ☐ Cross only at designated crosswalks. ☐ Hold hands with an adult when crossing.

26. What would you do if a ball rolled onto the road while you were playing? Tick ALL that apply

Check all that apply.

- [ ] Run to get it immediately.
- [ ] Ask an adult for help.
- [ ] Wait for the ball to come back.
- [ ] Leave the ball and inform an adult.

27. What are some things on the road that can help you cross safely? (Select all that apply)

Check all that apply.

- [ ] Traffic lights
- [ ] Zebra crossing
- [ ] Crosswalks
- [ ] Footbridge

28. Crossing the road is always very safe, and no dangers are involved.

Mark only one oval.

- ◯ True
- ◯ False

29. Explain how to use a zebra crossing safely.

Mark only one oval.

- ◯ Zebra crossing is for animals Wait for cars to
- ◯ stop, ensure drivers see me Run quickly across
- ◯ crossing without looking.
- ◯ Other:

30. Why is it important to stop at the sidewalk's edge before crossing the road?

Mark only one oval.

- ◯ Stopping is not necessary
- ◯ Helps check for cars before crossing safely.
- ◯ Stopping is for grown-ups, not for kids like me.

31. Why is it crucial to look both ways before crossing the road, even if there is a green signal?

Mark only one oval.

- ◯ Looking both ways is unnecessary.
- ◯ To ensure no unexpected dangers cross.
- ◯ I only need to look left before crossing.

32. Have you used a bicycle after the training?

Mark only one oval.

- ◯ Yes
- ◯ No

33. What factors have prevented you from using a bicycle to/from school?
(Tick all that apply

Check all that apply.

- [ ] Safety concerns
- [ ] Lack of bicycle access
- [ ] Distance to school
- [ ] Nothing

34. Which of the following is a safe bicycling behaviour?

Mark only one oval.

- Riding in the same direction
- Weaving through traffic to get to the front.
- Riding while texting

35. What safety item should you always wear when cycling?

Mark only one oval. helmet

- Shin pads
- Safety glasses
- Helmet

36. How should you show other road users that you are turning left?

Mark only one oval.

- Put out your right-hand
- Put out your left hand.
- Move over to the left.
- Putting no hands

37. Why is it not safe to run near the road?

Mark only one oval.

- Running can be dangerous because cars may not see me.
- Cars need time to stop, making running hard for them.
- All the above.

38. Do you see other people doing dangerous things near the road?

Mark only one oval.

- Yes
- No

39. Can you now effectively communicate road safety information to your peers or family members?

Mark only one oval.

- Not at All
- Somewhat
- Neutral
- Yes

41. What do you dislike about the question (Tick all that apply)

Check all that apply.

- [ ] Some words are too complicated.
- [ ] The questions are too long.
- [ ] Some questions are about things I know nothing about
- [ ] I do not find questions difficult

42. Do you believe the training has improved your road safety knowledge?

Mark only one oval.

- Yes
- No

43. Would you like to have this training again in the future? *Mark only one oval.* Yes No Maybe	44. If yes, how often would you like to have this training again? *Mark only one oval.* weekly monthly quarterly yearly
45. Refer to Q. 37 in Appendix C	46. Refer to Q. 38 in Appendix C
47. 45. Refer to Q. 39 in Appendix C	

Appendix 5: Post-Intervention Questionnaire (Control Group)

1. Code _____	2. How important is it to follow road safety rules? *Mark only one oval.* ◯ Very important ◯ Not very important
3. What are the rules for crossing the road safely? Tick ALL that apply *Check all that apply.* ☐ Look left and right before crossing. ☐ Wait for the traffic light signal. ☐ Cross only at designated crosswalks. ☐ Hold hands with an adult when crossing	4. What would you do if a ball rolled onto the road while you were playing? Tick ALL that apply *Check all that apply.* ☐ Run to get it immediately. ☐ Ask an adult for help. ☐ Wait for the ball to come back. ☐ Leave the ball and inform an adult
5. What are some things on the road that can help you cross safely? (Select all that apply) *Check all that apply.* ☐ Traffic lights ☐ Zebra crossing ☐ Crosswalks ☐ Footbridge	6. Crossing the road is always very safe, and no dangers are involved. *Mark only one oval.* ◯ True ◯ False
7. Explain how to use a zebra crossing safely *Mark only one oval.* ◯ Zebras crossing is for animals ◯ Wait for cars to stop ◯ Run quickly across without looking.	8. Why is it important to stop at the sidewalk's edge before crossing the road? *Mark only one oval.* ◯ Stopping is not necessary. ◯ Helps check for cars before crossing safely. ◯ Stopping is for grown-ups, not for kids like me.

9. Why is it crucial to look both ways before crossing the road, even if there is a green signal?

Mark only one oval.

- ◯ Looking both ways is unnecessary
- ◯ Ensures no unexpected dangers cross.
- ◯ I only need to look left before crossing.

10. What factors have prevented you from using a bicycle to/from school? (indicate all that apply)

Check all that apply.

- ☐ Safety concerns
- ☐ Lack of bicycle access
- ☐ Distance to school
- ☐ Nothing
- ☐ Other:

11. Which of the following is a safe bicycling behaviour?

Mark only one oval.

- ◯ Riding in the same direction
- ◯ Weaving through traffic to get to the front.
- ◯ Riding while texting

12. What safety item should you always wear when cycling?

Mark only one oval.

- ◯ helmet
- ◯ Shin pads
- ◯ Safety glasses

13. How should you show other road users that you are turning left?

Mark only one oval.

- ◯ Put out your right-hand
- ◯ Put out your left hand.
- ◯ Move over to the left.
- ◯ Putting no hands

14. Which of the following should you not wear when riding a bicycle?

Mark only one oval.

- ◯ Gloves
- ◯ Helmet
- ◯ Earphones

15. Why is it not safe to run near the road?

Mark only one oval.

- ◯ It can be dangerous because cars may not see me.
- ◯ Cars need time to stop All the
- ◯ above.

16. Do you see other people doing dangerous things near the road?

Mark only one oval.

- ◯ Yes
- ◯ No

17. How much do your friends support you in following road safety rules? *Mark only one oval.* ◯ Very supportive ◯ Neutral ◯ Not supportive	18. Do your family encourage you to practice road safety? *Mark only one oval.* ◯ Yes ◯ No
19. How often do you feel pressure from your friends or family to engage in safe road behaviours? *Mark only one oval.* ◯ Always ◯ Sometimes ◯ Rarely	20. Following road safety rules reduces my risk of being in an accident. *Mark only one oval.* ◯ Agree ◯ Disagree
21. What do you dislike about question (Tick all that apply) *Check all that apply.* ☐ Some words are too hard. ☐ The questions are too long. ☐ Some questions are about things i know nothing about ☐ I do not find questions difficult	Q.22. Refer to Q. 37 in Appendix C
Q. 23. Refer to 38 in Appendix C	Q. 23. Refer to 39 in Appendix C

Appendix 6: Parents Questionnaire

1. Code	2. Gender *Mark only one oval.* Male Female
3. Level of Education *Mark only one oval.* Finished intermediate education. Finished secondary education. University degree or higher No education Other:	4. On most days, how does your child leave to/ from school? *Mark only one oval.* Walk Bike School Bus Car Other:
5. How far does your child move to/from school? *Mark only one oval.* less or equal to 500m 0.5-1km 1.1-1.5km More than 1.5km	6. How would you rate your understanding of road safety issues? (please circle one only) *Mark only one oval.* Very high-1 Above average-2 Average-3 Below average 4 Limited-5
7. Please indicate on the scale below how important you believe road safety is compared to other issues at the school. (please circle one only) *Mark only one oval.* Very important -1 Important-2 Moderately important-3 Somewhat important-4 Not important-5	8. How safe do you feel for your child to walk or cycle on the roads they use to school? (Tick one box only) *Mark only one oval.* Very safe Quite safe Slightly unsafe Not safe at all I don't know.

9. Do you talk about road safety with your child?

Mark only one oval.

- ◯ Yes
- ◯ No

10. Could you state what you discuss with your child?

Mark only one oval.

- ◯ Don't play on busy streets.
- ◯ Do not run on the streets.
- ◯ Cross the road at the Zebra Crossing
- ◯ Looking both ways:
- ◯ Walk or Cycle safely
- ◯ Other:

11. Which of the following issues affected your decision to allow or not to allow your child to walk or bike to school?

Mark only one oval.

- ◯ Distance is short.
- ◯ Distance is far.
- ◯ Lack of pedestrian-friendly infrastructure
- ◯ Safe road conditions Potential
- ◯ contact with strangers
- ◯ Other:

12. Do you feel more confident about your child's ability to walk and cycle safely after the training?

Mark only one oval.

- ◯ Extremely Con dent
- ◯ Quite Con dent
- ◯ Moderately Con dent
- ◯ Not Very Con dent
- ◯ Not Con dent at All

13. After participating in the road safety training, how has your child's behaviour evolved around roads and traffic for walking and cycling?

Mark only one oval per row.

	Remarkable Improvement	Positive Changes	Moderate Improvement	Limited Improvement	No improvement
Row 1	◯	◯	◯	◯	◯

Appendix 7: School Authorities Questionnaire

1. Position in School *Mark only one oval.* ◯ Header master ◯ Headmistress ◯ Teacher ◯ Director ◯ Other:	2. Gender *Mark only one oval.* ◯ Male ◯ Female
3. In your opinion, how safe is the nearest road to school? *Mark only one oval.* ◯ Very safe ◯ A little safe ◯ Neither safe nor unsafe ◯ A little unsafe ◯ Very unsafe	4. Does the curriculum capture road safety education? *Mark only one oval.* ◯ Yes ◯ No
5. If yes, what is the usual length of each lesson? *Mark only one oval.* ◯ Less than 15 minutes 1 ◯ 5-30 minutes ◯ 31-45 minutes ◯ 45-60 minutes ◯ Other:	6. How do you incorporate road safety education into your teaching? *Check all that apply.* ☐ Dedicated lessons ☐ Integrated into other subjects ☐ Special events or activities ☐ Other:

7. Which prevents you from teaching road safety and healthy mobility? (please tick all that apply) *Check all that apply.* ☐ We have no budget ☐ Limited Time ☐ We have no resources ☐ It's not part of the curriculum ☐ We do not have anyone qualified to teach i ☐ It is not relevant	8. Has your school been affected by road death or serious injury? *Mark only one oval.* ◯ Yes ◯ No
9. If yes, how many students? *Mark only one oval.* ◯ 1-5 ◯ 6-10 ◯ 11-15 ◯ 15 and above ◯ Other:	

Appendix 8: Cost and Observation Checklist

TABLE A8.1 Details of Cost of Conducting the "Stay Safe, Arrive Alive" Road Safety Campaign

Cost item	Amount (€)
Printing of questionnaires, checklists, and road safety playmats	250.00
Allowances for 3 instructors for teaching, data collection and data entry	320.00
Allowances for 3 observers	80.00
Transportation of trainers, observers, materials, projector	70.00
Cost of hiring a projector for presentations	50.00
Phone calls, internet, and other communication expenses	25.00
Meals provided for instructors and observers	128.50
Total	**923.50**

TABLE A8.1

Observation Checklist for the "Stay Safe, Arrive Alive" Road Safety Campaign Delivery

Observer Name: _____
Date of Observation: _____
School: _____
Teacher Observed: _____

Rating Scale Explanation

Rating	Description
1 (Poor)	The criterion was not achieved or was poorly achieved.
2 (Fair)	The standard was partially met.
3 (Good)	Adequate meeting of the criterion. The delivery generally conformed to the plan except for some slight deviations or areas for improvement.
4 (Very Good)	The lesson has been delivered effectively with only few minor issues or deviations.
5 (Excellent)	The criterion was fully achieved and consistently applied throughout.

Checklist/Rubric

Criteria	Description	Rating (1-5)
Following the Lesson Plan	The teacher(s) follow(s) content of road safety training lessons as planned	
Use of Recommended Teaching Material	Use of teaching materials like play mat and visual aids adequately	
Student Involvement	Teaching methods such as interactive discussions and demonstrations were used	
Clearness in Instructions	Lessons plans presented clearly so that they can be understood	
Time management	Lesson delivered within allocated time	

Observer Signature: _____
Date: _____