

# Increasing traffic safety at schools in Zambia – a before and after study

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## Kort sammanfattning

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Fotgängare är den grupp som löper störst risk att bli inblandade i en trafikolycka, särskilt barn och ungdomar (Världshälsoorganisationen, 2023). I den afrikanska regionen står fotgängare för 33 procent av dödsoffren i trafiken, även om detta varierar beroende på sociala och ekonomiska faktorer.

Enligt polisens rapporter dödas 350 barn i Zambia årligen när de är på väg till skolan. Fordonens hastighet är en viktig faktor som är nära förknippad med dödsolyckor. Studier har visat att fotgängare som blir påkörda av ett fordon som överstiger 30 km/tim löper större risk att dödas, än om hastigheten är lägre. Barn är också mer sårbara på grund av sin ringa storlek.

Syftet med denna studie var därför att förbättra säkerheten utanför två zambiska skolor med hjälp av olika insatser; en yta för fotgängare som är separerad från fordon med hjälp av reflekterande pollare, hastighetsskyltar och skyltar som informerar förare om att de kör in i en skolzon. På en av skolorna anlades även ett övergångsställe och en fartpuckel. Studien använde både objektiva mått (t.ex. fordons hastighet) och subjektiva mått (enkäter till barn, föräldrar och lärare) för att utvärdera effekten.

Resultaten visade att fordonens hastighet reduceras vid de skolor som genomgick ombyggnationer. Men bara vid en av skolorna sänktes hastigheten till under 30 km/tim. Den större hastighetssänkningen på denna skola berodde troligen på införandet av både ett övergångsställe och en fartpuckel. När man analyserade skillnaden före och efter ombyggnationen visade resultaten att eleverna blivit mindre rädda för trafiken och mindre oroliga för att bli påkörda av ett fordon när de korsade vägen. Detta noterades särskilt av elever som gick i den skola där alla planerade åtgärder hade genomförts. Däremot hade eleverna på kontrollskolan blivit mer rädda och oroliga.

Enkäterna riktade till de som var kopplade till de två utvalda skolorna fick även svara på några specifika frågor om rekonstruktionen. Resultaten visade att eleverna kände sig tryggare när de korsade vägen efter förändringarna. Både föräldrar och lärare noterade förbättringar i säkerheten, även om vissa farhågor kvarstod. Studien belyser effektiviteten av dessa säkerhetsåtgärder och avslutas med några rekommendationer hur en standardiserad process för infrastrukturförändringar på skolor kan genomföras.

### Nyckelord

Skolzon, fotgängare, elever, resor till skolan, rekonstruktion, fordons hastighet, föräldrar, lärare.

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## Abstract

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Pedestrians are the group most at risk to be involved in a road crash, especially children and young people (World Health Organization, 2023). In the African Region pedestrian fatalities account for 33% of road deaths, although this varies according to social and economic factors.

According to police data 350 children are killed in Zambia annually, while traveling to school. The speed of vehicles is an important factor closely related to fatal accidents. Studies have found that pedestrians hit by a vehicle exceeding 30 km/h are more likely to face fatal consequences than if the speed is lower. Children are also more vulnerable due to their small size. The aim of this study was therefore to improve safety outside two Zambian schools using various interventions, pedestrian areas separated from vehicles by reflective bollards, speed limit signs and signs informing drivers that they were entering a school zone. At one of the schools, a zebra crossing and a speed hump were also introduced. The study used both objective measures (i.e., vehicle speed) and subjective measures (i.e., surveys of children, parents, and teachers) to assess the impact.

The results showed a reduction in vehicle speed at the schools that underwent reconstructions. However, in only one of the case schools was the speed reduced to under 30 km/h. The greater speed reduction at this school was probably due to the introduction of both a zebra crossing and a speed hump.

When analysing the difference before and after the reconstruction, the results showed that pupils had become less afraid of the traffic and less worried of being hit by a vehicle when crossing the road. This was especially noted by pupils who attended the school where all the planned measures had been implemented. In contrast, pupils at the control school had become more afraid and worried.

The surveys which participants connected to the case schools completed included some specific questions about the reconstruction. The results showed that pupils felt safer crossing the road after the changes, while parents and teachers also noted improvements in safety, though some concerns remained. The study highlights the effectiveness of these safety measures and ends with some recommendations how a standardized process for infrastructure changes at schools can be conducted.

### **Keywords**

School zone, pedestrians, pupils, travel to school, interventions, vehicle speed, parents, teachers.

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## Summary

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In Africa pedestrians are the group most at risk to be involved in a road crash. Children are especially vulnerable when walking to school, often without an adult. In Zambia alone and based on statistics from the Zambian Police, approximately 350 children are killed annually while travelling to school<sup>1</sup>. Consequently, special attention must be given to the protection of school children.

The focus of this study was therefore to increase safety outside two different schools in Zambia. To assess the impact of the changes taking place both objective and subjective measures were used. To control for any confounding factors a 'control school' was included in the study.

The interventions were multifaceted, including the installation of bollards to separate pedestrians from vehicles and signs indicating that drivers were entering a school safety zone with a speed limit of 30 km/h. Outside one of the schools a zebra crossing and a speed hump were installed.

The evaluation was designed as a before- and after study. The objective measures included the measurement of speed on the road outside the school.

To assess the subjective perception of safety around the schools, three different questionnaires were used to collect data before and after reconstruction. The participants were school children (aged 8 to 12), parents and teachers. In the after study the participants connected to any of the case schools were also asked about the changes to the infrastructure. This approach ensured a comprehensive analysis that involved not only data based on observations but also personal experiences and insights.

The results from the objective measures showed that the speed of vehicles was reduced at the two schools which were subject to change. The greatest reduction was observed at the school where a zebra crossing and a speed hump had been implemented. At that school the average speed was reduced by 15 km/h. In contrast, the speed at the control school increased by 9 km/h.

The results from the surveys showed that 230 participants responded to the first survey: 150 children, 50 teachers and 30 parents. The number of respondents in the second survey were 212: 149 children, 27 teachers and 36 parents. The survey did not include anything that could identify the participants, which meant that it was not possible to determine if they took part in both studies.

The results showed that most of the pupils walked to school, either on their own or in the company of another child, the same age or younger than themselves. Hardly any of the pupils travelled to school with a parent or another adult. Regarding their perception of road safety around the school, the majority who responded to the before study were afraid of the traffic when crossing the road, mainly due to the speed of vehicles. They were also worried that a motor vehicle would hit them when crossing the road. When analysing the difference before and after the results showed that pupils at the case schools had become less afraid of the traffic and less worried of being hit by a vehicle when crossing the road. In contrast pupils at the control school had become more afraid and more worried.

The results also showed that the effect was greatest at the school where zebra crossings and speed humps were introduced. Pupils at this school felt significantly safer to cross the road in the after study than pupils at the other two schools. They also argued that it had become easier to cross the road. Pupils at the other two schools expressed more problems crossing in the after study compared to the before study.

The responses from the parents showed that most of the parents were worried about the driving speed of vehicles around the school and the intensity of traffic. They were also worried about their child being hit by a vehicle when crossing the road and the child's own crossing behaviour. In general, the results showed very small or no changes when comparing the results from the before- and after study,

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<sup>1</sup> <https://www.undp.org/zambia/press-releases/improving-road-safety-reducing-speeding-around-schools-lusaka>

something which applied to all schools but with some exceptions. For instance, parents with one or more child at the control school were less worried about the speed of vehicles and the intensity of traffic in the before study than parents at the case schools.

The responses from the teachers showed that almost all of them would argue that safety was a problem around the schools. What concerned them most was the speed of vehicles and the intensity of the traffic. Therefore, they were very worried that a pupil would be hit by a motor vehicle when crossing the road and they were also very worried of the pupil's own behaviour when crossing the road. Despite the above, the results from the before study demonstrated some significant differences between teachers at the different schools. Since very few teachers participated in the study the results must be interpreted with caution. The tendency was that teachers at the school which subsequently would be subject to most of the changes were less worried than teachers at the other two schools. The results from the after study presented no significant differences between the schools.

The survey which participants connected to any of the case schools completed, included some specific questions about the reconstruction. The results showed that the pupils would argue that the effect was very positive. For instance, they felt safer to walk along the road after the reconstruction. Especially pupils at the school which had introduced speed humps and a zebra crossing. They also believed that drivers were driving slower than before. This could be supported by observations since the reduction of speed at this particular school was on average 15 km/h.

The parents were also very pleased with the reconstruction and that the bollards had made it safer for their child and that cars drove slower past the school than before. The general opinion was that it had helped to improve safety for the children, although parents with children attending the school with most changes were more positive than parents with children attending the other school.

The overall impression of the teachers was that they were pleased with these changes. However, a few teachers at the school with no zebra crossing did not believe that the drivers drove slower past the school than before the reconstruction. Both parents and teachers rated the impact as good or very good, even if the rating from parents were greater than from the teachers.

In conclusion, it can be stated that the initiatives undertaken by Afro-Safe in collaboration with Zambia Road Safety Trust contributed to the safety at the two schools that were subject to change. These measures have not only increased their perceived safety but have also demonstrated the potential for such interventions to be adapted and applied to other similar contexts, aiming to safeguard young lives on a broader scale. The study is anticipated to provide valuable insights into the effectiveness of further traffic safety improvements in school zones and inform future policy decisions and educational initiatives aimed at improving the safety of school children.

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## Preface

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The report present results from a sub-study within the AfroSAFE project (<https://doi.org/10.3030/101069500>), which is funded by the Horizon Europe programme. The general aim of AfroSAFE is to significantly promote the Safe System approach within the context of road safety work in African countries. This will be achieved by exposing local practitioners and decision-makers to state-of-the-art knowledge and practices in road safety management, based on Safe System principles, focusing on safe vehicles, safe infrastructure, safe road users, and post-crash responses. The long-term goal is to create a system free from death and serious injury.

The fundamental principles of the Safe System are universal, although there are many ways to implement them. To address the argument, "this works in Europe, but Africa is different," AfroSAFE aims to translate the tools and practices adopted in Europe to the African context. This includes sharing necessary knowledge, tools, and methods for road safety improvement, which will be adjusted to African conditions and in close cooperation with local actors. While project activities cover all aspects of road safety in Africa, particular attention is given to vulnerable road users and building local expertise.

The aim of the study was to increase safety outside two different schools in Zambia. A secondary aim was to understand the impact of safety measures – both subjective and objective.

The authors would like to express our gratitude to several stakeholders who made this project possible. The Lusaka City Council<sup>2</sup>, Road Development Agency<sup>3</sup> plus The Road Transport and Safety Agency<sup>4</sup> (RTSA) who played a significant role in the planning and implementation of safety measures. The local corporate company foundation InBev<sup>5</sup> provided financial support. Additionally, the project collaborated with the local traffic police to conduct safety assessments. In addition to those listed, we would also like to express our gratitude to pupils, teachers and parents who participated in the study.

Linköping, January 2025

*Sonja Forward*  
*Projekt leader*



### **Granskare/Examiner**

Johanna Larsson (VTI).

De slutsatser och rekommendationer som uttrycks är författarens/författarnas egna och speglar inte nödvändigtvis myndigheten VTI:s uppfattning./The conclusions and recommendations in the report are those of the author(s) and do not necessarily reflect the views of VTI as a government agency.

### **Publikationen godkänd för publicering/ Publication approved for publication**

Jessica Berg, VTI

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<sup>2</sup> [www.lcc.gov.zm](http://www.lcc.gov.zm)

<sup>3</sup> [www.rda.org.zm](http://www.rda.org.zm)

<sup>4</sup> [www.rtsa.org.zm](http://www.rtsa.org.zm)

<sup>5</sup> See <https://abinbevfoundation.org/our-work/>.

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## 1. Introduction

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According to the World Health Organizations estimates, 1.19 million deaths occur in traffic each year (WHO, 2023). The African region ranks third in the world for the highest number of fatalities, despite being home to only 15% of the global population. If we consider traffic fatality rate per population, then road traffic deaths are the highest in the African Region (World Health Organization, 2024).

In contrast to the global decrease in traffic deaths, the number has increased in Africa. According to the latest WHO report, traffic deaths increased by 17% between 2010 and 2021 (WHO, 2024). In Africa, approximately 78% of people walk as a mode of transport, making them the group most at risk of being involved in a road crash. Pedestrians account for 33% of road deaths in the African region. According to a recent road safety status report, this percentage is slightly higher in Zambia (49%) (Road Transport and Safety Agency, 2022). Consequently, the UNEP has urged that special attention be given to the protection of pedestrians.

Children are especially vulnerable as pedestrians, often walking to school without an adult, which exposes them to significant risks. In Zambia alone, 350 children are killed annually while traveling to school. The Zambia Road Safety Trust conducted observations of school zones and presented a concerning situation: there is a high prevalence of speeding vehicles, inadequate pedestrian infrastructure, and unsafe pedestrian behaviours, all of which contribute to a hazardous environment for children (Road Transport and Safety Agency, 2022).

This tragic backdrop emphasizes the immediate need for targeted interventions to enhance the safety of school zones for children. Recognizing the urgency of this issue, AfroSAFE, in cooperation with the Zambia Road Safety Trust, has launched initiatives aimed at transforming these high-risk areas into safe havens for students.

### 1.1. Aim

The general aim of the study was to increase safety outside two different schools in Zambia. A secondary aim was to understand the impact of safety measures – both subjective and objective.

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## 2. Method

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### 2.1. Background

Three primary schools (with pupils aged 8 to 12 years) situated in Lusaka, the capital of Zambia, were included in the study: Daina Kaimba Primary School, Kizito Primary School and Woodlands B Primary School<sup>6</sup>. The latter was used as a control school where no measures were taken to increase traffic safety.

The infrastructure changes at Daina Kaimba and Kizito Primary School were made possible through a close collaboration with multiple stakeholders. The Lusaka City Council, Road Development Agency plus The Road Transport and Safety Agency (RTSA) played a significant role in the planning and implementation of safety measures. The local corporate company foundation InBev provided financial support. Additionally, the project collaborated with the local traffic police to conduct safety assessments.

The decisions about what kind of changes should be implemented at the schools involved a thorough assessment of various factors aimed at ensuring the well-being and security of the pupils. These factors included the speed of traffic around the schools, the condition and availability of pedestrian infrastructure (such as sidewalks and crossings). Furthermore, meetings with parents, teachers, and residents were arranged to collect their input. This was done in collaboration with the school administration.

### 2.2. Infrastructural measures

The intention was to implement the same measures at both schools. Although a speed hump and a zebra crossing were only implemented at Kizito due to some other road constructions carried out by Lusaka City Council outside Daina Kaimba primary school. The measures implemented at the two case schools are presented in Table 1.

*Table 1. Implemented safety measures at the two case schools.*

School	Signs	Bollards	Walkways	Zebra crossing near the school entrance	Speed humps
Kizito	Yes	Yes	Yes	Yes	Yes
Daina Kaimba	Yes	Yes	Yes	No	No

Along the road, close to Daina Kaimba school, pedestrians were separated from vehicles by reflective bollards. The pavement was made of gravel and bricks. A similar arrangement was implemented at the second school, Kizito. However, the pavement was narrower and not made of gravel and bricks, only sand, see Figure 1 and Figure 2.

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<sup>6</sup> Kizito Primary School is located in the northwest of Lusaka, Matero off Mungwi Road (lat. -15.411723, long. 28.1743857), Daina Kaimba is also located the northwest, in Chunga off Barlastone Road near Barlastone barracks (lat. -15.4154677, long. 28.2773267) and Woodlands B Primary school is located in Woodlands off Buluwe Road near Woodland's stadium in the east part of Lusaka (lat. -15.4154677; long. 28.28325).



*Figure 1. The Daina Kaimba Primary School before and after reconstruction. The school premises are to the left-hand side. On the opposite side of the school, a tree has been removed.  
Photo: Somela Sinkala.*



*Figure 2. The Kizito Primary School before and after reconstruction. New reflected bollards are separating pedestrians from vehicles. The school premises are to the left-hand side  
Photo: Somela Sinkala.*

The new road signs informed that the driver was entering a school zone and that the speed limit was 30 km/h, see Figure 3.



*Figure 3. New road signs near the Daina Kaimba Primary School (left) and Kizito Primary School (right). As described above, a zebra crossing and a speed hump were also implemented at Kizito Primary School, see Figures 4-5.*

*Photo: Somela Sinkala.*



*Figure 4. A new zebra crossing at the entrance of Kizito Primary School.*

*Photo: Somela Sinkala.*



Figure 5. A new speed hump outside Kizito Primary School and a sign to warn vehicle drivers.  
Photo: Somela Sinkala.

Figure 6 shows the road outside the control school, Woodlands B Primary School. Being a control school no changes were made outside this school.



Figure 6. The road outside the control school, Woodlands B Primary School.  
Photo: Somela Sinkala.

## 2.3. Observations

The observations outside the schools consisted of speed counts carried out before and after the reconstruction of the new infrastructure measures.

### 2.3.1. Procedure

Speed counts for the before observations were conducted on the 22<sup>nd</sup> of November 2023. The observation time at Kizito started at 8 am and lasted to 09:30 am and at Daina Kaimba the period was

from 12 pm to 1 pm. Both observations were carried out on a sunny day. At Woodlands observations were done on January 19<sup>th</sup>, 2024, on a rainy day from 12 pm to 1 pm.

The after observations occurred on February 29<sup>th</sup>, 2024, on both schools except for the control school which was done on the 1<sup>st</sup> of March 2024. The speed counts at Kizito started from 8 am to 9 am and at Daina Kaimba the period was from 12 pm to 1 pm on a rainy day. At Woodlands speed counts were done on a sunny day from 12 pm to 1 pm.

Figure 7 shows the speed radar gun used during the speed observations. They are of the brand Pocket Radar<sup>TM7</sup> with the following measurement ranges:

- 7 to 375 kilometres per hour (km/h) (+/- 1 km/h)
- 11 to 600 miles per hour (mph) (+/- 2 mph)
- 3 to 160 meters per second (mps) (+/- 1 mps)
- Operating Frequency: X-band (24.125 GHz)



*Figure 7. Equipments for speed measuring.  
Photo: Somela Sinkala.*

## 2.4. Survey

In addition to observations, surveys were administered before and after reconstruction to parents, teachers and pupils at the different schools.

### 2.4.1. Participants

About 150 pupils, 30 parents and 40 teachers responded to the survey. Table 2 shows the total number of pupils and teachers at the school and how many pupils, parents and teachers that participated in the before- and after study.

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<sup>7</sup> <https://www.pocketradar.com/>

Table 2. Number of pupils and teachers at the schools and number of answers, before and after.

School	Pupils	Teachers	Answers from pupils		Answers from parents		Answers from teachers	
			Before	After	Before	After	Before	After
<b>Kizito</b>	3,455	48	51	46	3	12	9	4
<b>Daina Kaimba</b>	1,369	65	50	49	16	13	18	6
<b>Woodlands</b>	1,940	58	49	54	11	11	23	17
<b>Total</b>	6,764	171	150	149	30	36	50	27

The number of pupils participating in the before- and after study was more or less the same. Notice that few parents to children in Kizito school took part in the before study, and fewer teachers took part in the after study. Sex distribution and average age for the pupils are presented in Table 3.

Table 3. Average age and sex distribution, before and after, for pupils participating in the survey.

School	Average age		Girls (%)	
	Before	After	Before	After
<b>Kizito</b>	11.4	8.9	56	46
<b>Daina Kaimba</b>	10.9	11.4	50	55
<b>Woodlands</b>	10.3	10.4	50	56
<b>Total</b>	10.9	10.3	52	52

Table 3 shows that the average age was lower among the pupils that took part in the after study compared to the pre-study; this can mainly be explained by the 2.5 years lower average age among the Kizito pupils in the after study. The distribution of boys and girls was more or less the same although it was slightly more girls in Kizito. This changed in the after study since there was fewer girls who responded to the survey at Kizito compared with the other two schools.

Parents who completed the survey had slightly older children who attended the schools than the children who responded to the survey. For 11 pupils, age was not reported. Three parents reported ages ranging from 13 to 15 years. The distribution of boys and girls varied a great deal between the schools and between the before- and after study. For instance, at Daina Kaimba parents were more likely to have a girl at the school than a boy, which can be compared with a relative low number of girls at Kizito, see Table 4.

Table 4. Average age and sex distribution, before and after, for children whose parents participated in the study.

School	Average age		Girls (%)	
	Before	After	Before	After
Kizito	12.0	9.3	33	45
Daina Kaimba	12.3	10.7	81	42
Woodlands	11.2	12.2	9	64
Total	12.0	10.6	50	50

#### 2.4.2. Procedure

Three versions of the questionnaire, for pupils, teachers, and parents, were used to collect the perception of the area around the school before and after reconstruction. The questionnaire was constructed with the help of partners in the AfroSAFE project. The one for the pupils was a web version while paper versions were distributed to the parents and teachers. The questionnaires in the before study were distributed in November 2023 and the after-questionnaires in February/March 2024.

To collect data from pupils, teachers were asked to complete the web questionnaire together with them. When administrating the after-questionnaire, the teachers were asked to make sure that the pupils described the present situation. When comparing the names of the children in the two questionnaires, it was found that all names were unique, therefore changes on an individual level cannot be investigated.

To collect data from parents the local project manager distributed the questionnaire aimed for parents to 20 pupils to bring to their parents. An equal number of questionnaires was provided to teachers via the headmaster/headmistress.

The completed paper versions were scanned and then mailed to VTI by the local project manager. VTI manually registered the answers from teachers and parents in a file which comprised all data.

The questions aimed at pupils covered how they travelled to school and whether they had any company during the trip. Pupils were then asked about how it was to cross the road and where they crossed. The questions dealt with how safe it was, how easy and how afraid they were when crossing the road. One question was if they were worried about being hit by a motor vehicle, whilst crossing. All the questions were measured on a 5-point 'Likert scale' from 'very' to 'not at all'. The last question was whether they had been involved in accidents which resulted in them being hurt. This could apply to any accident and not only right outside the school.

The questions in the after study were the same as the before study except for some specific questions to the two case schools dealing with the reconstruction. This section began with "We would like to know what you think about the changes around your school. For instance, the new zebra crossing in front of your school, speed humps and barriers between the pedestrian and the vehicles". This was then followed by questions about safety whether it had become safer to walk along the road by their school, if they believed that cars had slowed down and if it had become easier and safer to cross the road. The final questions were about the involvement of accidents after the school reopened after Christmas.

Teachers and parents received a shorter questionnaire which tried to capture how they perceived the traffic safety situation outside the school. In the after study, questions about the implemented measures

were included in the versions for the two case schools. Where appropriate teachers and parents were asked the same questions as the pupils.

We have no information as to whether individual teachers and parents participated in both studies, but it cannot be excluded that some did. The answers are anyway regarded as independent samples from the before- and after studies, which means that any changes on an individual level cannot be determined.

## 2.5. Statistical analysis

The results are mainly presented in figures where the distribution of the answers on the alternatives of the questions is depicted. In addition to these descriptive sections, tests have been performed to identify any statistical differences between schools, groups of respondents, and before- and after studies. Depending on the number of groups, independent t-tests have been used when comparing average values for two groups, and analysis of variance (ANOVA) when three groups are considered. For the speed differences before and after, the hypothesis testing was used to draw conclusions.

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### 3. Results

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#### 3.1. Objective measures

##### 3.1.1. Vehicle speed

Figure 8 shows the results of the observed cars' speeds before-after the interventions for the treatment schools. Figure 9 shows the observed cars' speeds for the control school.

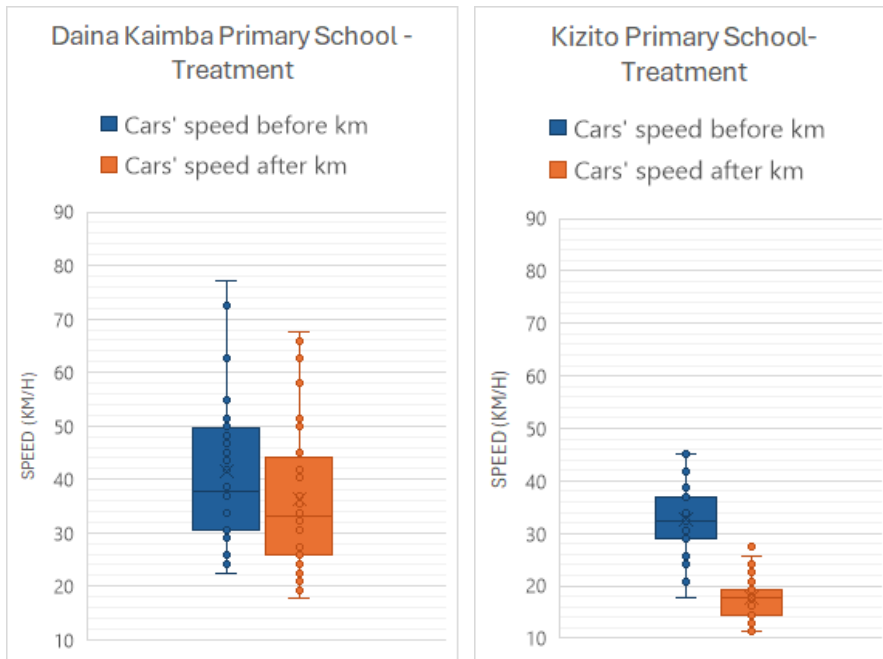


Figure 8. Mean speed of the cars at the case schools, before and after the reconstruction.

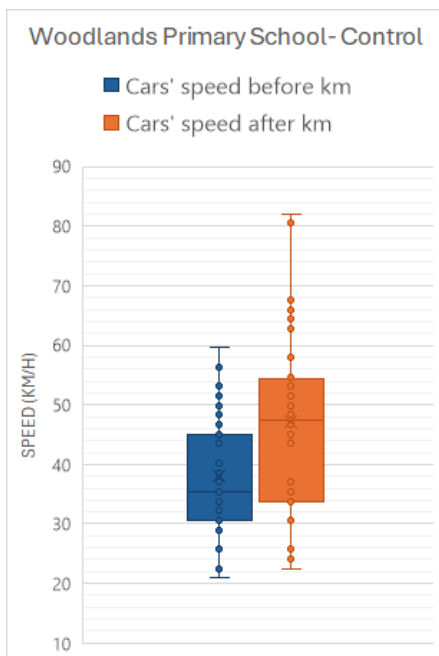


Figure 9. Mean speed of the cars at Woodlands (Control school).

Table 5 presents the same results as in Figure 8 and Figure 9, but in addition to this also the results of some independent t-tests used to determine if the changes were significant or not.

Table 5. Mean speed, standard deviation and speed difference (km/h) of free moving vehicles at the two case schools and the control school, before and after, and results of independent t-tests.

School	Mean speed before	Std before	No. of obs. before	Mean speed after	Std after	No. of obs. after	Speed diff.	t-test	p-value
Kizito	32.7	6,6	40	17.7	4.1	27	-14.9	11.20	<0.000
Daina Kaimba	41.5	13.2	40	36.2	13.1	40	-5.3	1.79	0.077
Woodlands	38.0	9.4	39	47.2	14.5	40	+9.2	-3.32	<0.001

At Kizito the speed was reduced by 15 km/h (significant) and at Diana by 5.3 km/h (not significant). This can be compared with the control site where the speed significantly increased with 9.2 km/h.

### 3.2. Subjective measures

In this study a questionnaire was completed by the pupils at the different schools, parents and teachers. The presentation of results starts with the responses from the pupils.

#### 3.2.1. Responses from the pupils

##### Travelling to the schools

The first question the pupils had to respond to was how they arrived at the school in the morning. Concerning the two case schools, almost every pupil walked to school, see Figure 10 and 11. Only a few pupils went by bus or got a ride by car to Kizito and Daina Kaimba. The responses from the before- and after studies were basically the same. Keep in mind that it is not the same individuals in the before- and after study for either of the schools.

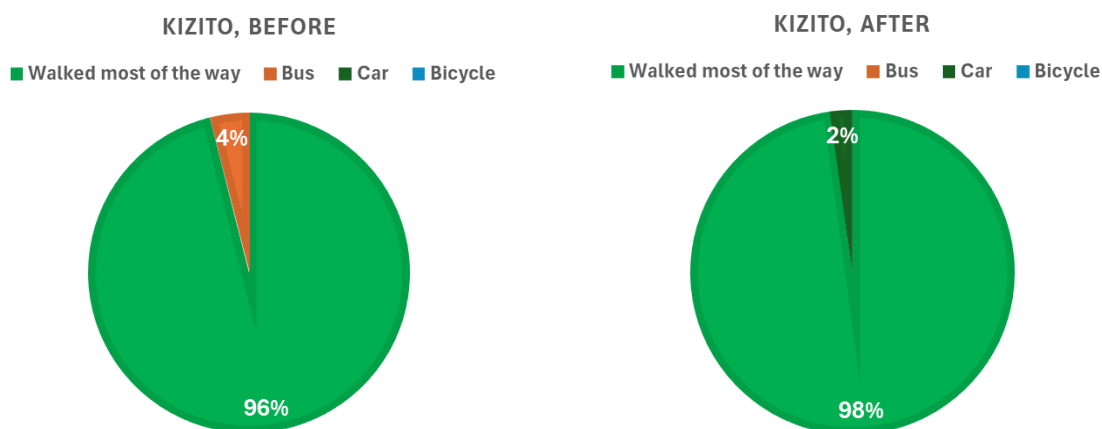


Figure 10. Mode of transport to the school. Kizito before and after, n=51 respectively 46.

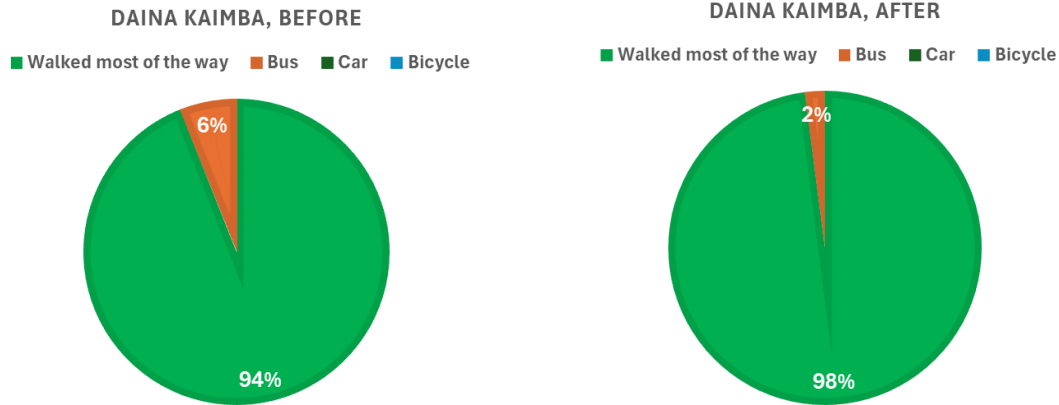


Figure 11. Mode of transport to the school. Daina Kaimba before and after, n=50 respectively 49.

Pupils attending Woodlands used more modes of transport than pupils at Daina Kaimba and Kizito, see Figure 12. About one out of four pupils went by bus to the control school. Some of the pupils also arrived by car, 12 percent in the before study and 4 percent in the after study. Of all the three schools, only one pupil biked to school and that was reported in the before study by pupils at Woodlands.

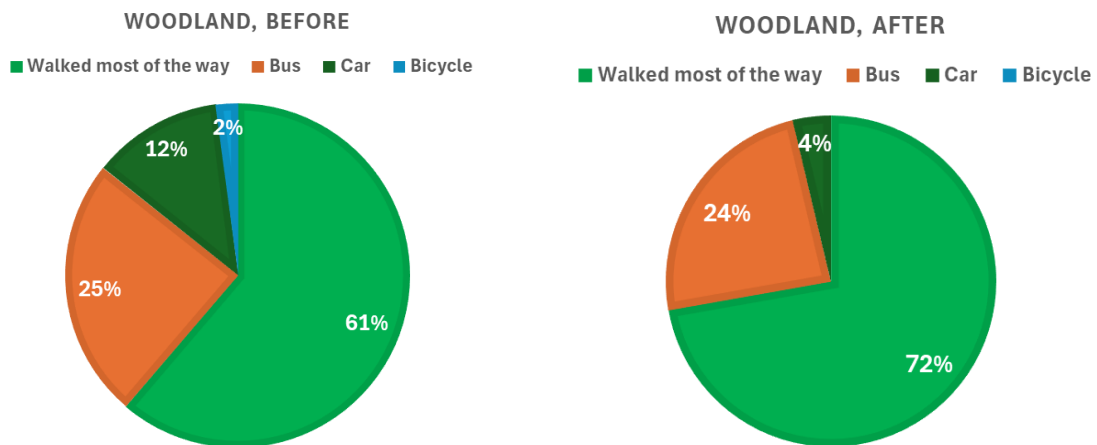


Figure 12. Mode of transport to the school. Woodlands before and after, n=49 respectively 54.

### Travel company

Usually, regardless of school, 60-65 percent of the pupils were most likely to travel on their own to school and 20-25 percent were in company with another child which was of the same age or younger. This pattern was similar in both the before- and after study, see details in Figure 13 and 14.

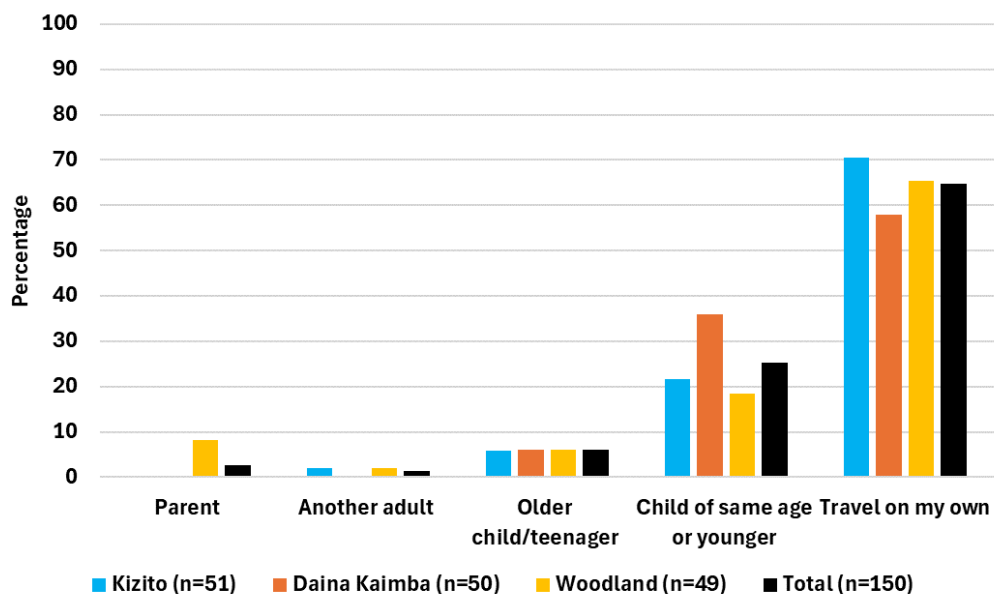


Figure 13. If the pupil had company when travelling to school, before study.

When comparing the different schools, some small changes were noted in how they travelled to school. Pupils at Kizito were more likely to travel on their own. Although most of the pupils at Daina Kaimba also travelled on their own a larger percentage of them travelled with another child of the same age or younger than themselves than the other schools. At Daina Kaimba and Kizito none of the pupils travelled with a parent.

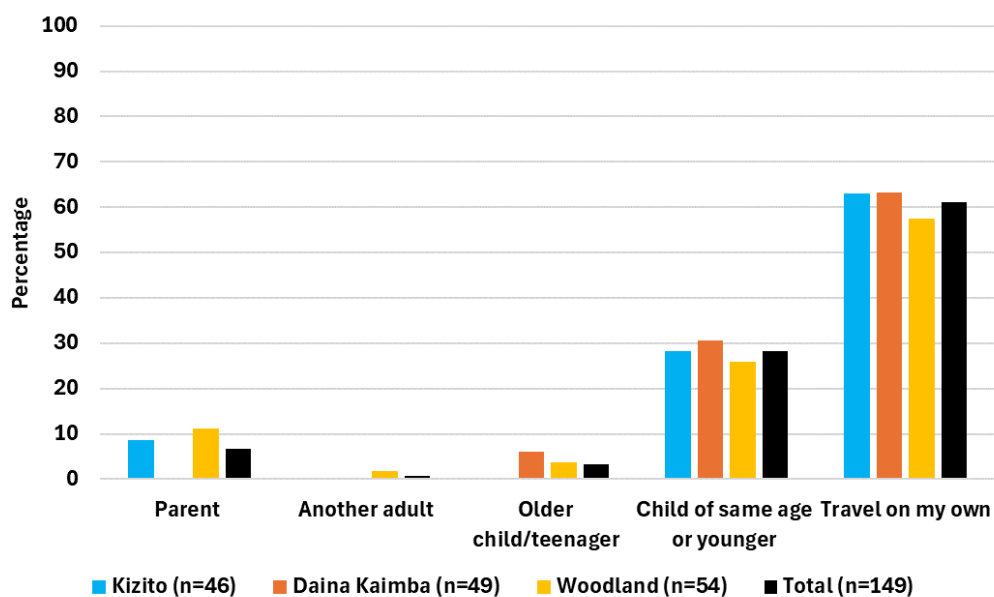


Figure 14. If the pupil had company when travelling to school, after study.

The results from the after study show less differences between the schools than those presented in Figure 13. As before most of the pupils travelled on their own, but this time a small percentage of the pupils at Kizito travelled with a parent.

#### Perception of traffic safety near the school before and after

The pupils' perception about traffic near the school is presented in Figure 15. This question was not presented for pupils going by bus and crossing the road in the before study. As a result, answers from 12 pupils from Woodlands, 3 from Daina Kaimba och 2 from Kizito are not included in the results.

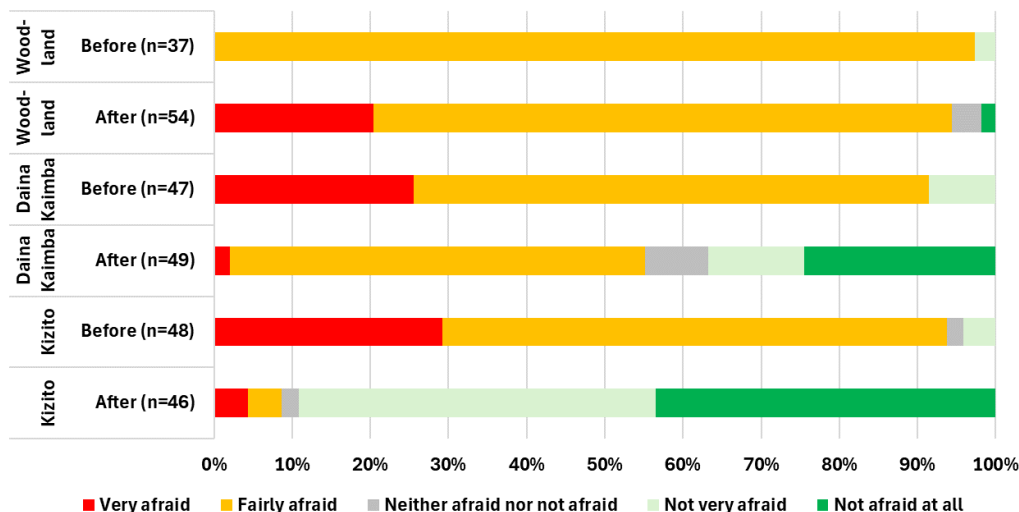


Figure 15. Distribution of answers for the question “When you are near the school how afraid are you of the traffic?”.

The difference before and after shows that for Kizito and Daina Kaimba it was significant ( $p < 0,001$ ) which meant that they had become less afraid of the traffic in the after study, that is after the reconstruction. This was especially apparent for the pupils at Kizito where all planned safety measures had been implemented. The same pattern was not noted for Woodlands (i.e. the control school). An ANOVA test was performed to compare the different schools with each other. The results show no difference between the schools in the before study. However, in the after study, there were significant differences between all the schools. Pupils at Woodlands were more afraid than pupils at the other two schools.

### Crossing the road

The results showed that most of the pupils had to cross the road: Kizito (90% before; 89% after), Daina Kaimba (72% before; 41% after) and Woodlands (100% before; 74% after). As described earlier, a zebra crossing was only implemented at Kizito, subsequently this was then used by almost every pupil, 36 of 41 or 88%.

Pupils who crossed the road were asked how safe it was, how easy and how afraid they would be to cross the road. Figure 16 shows how safe they felt in the before- and after study.

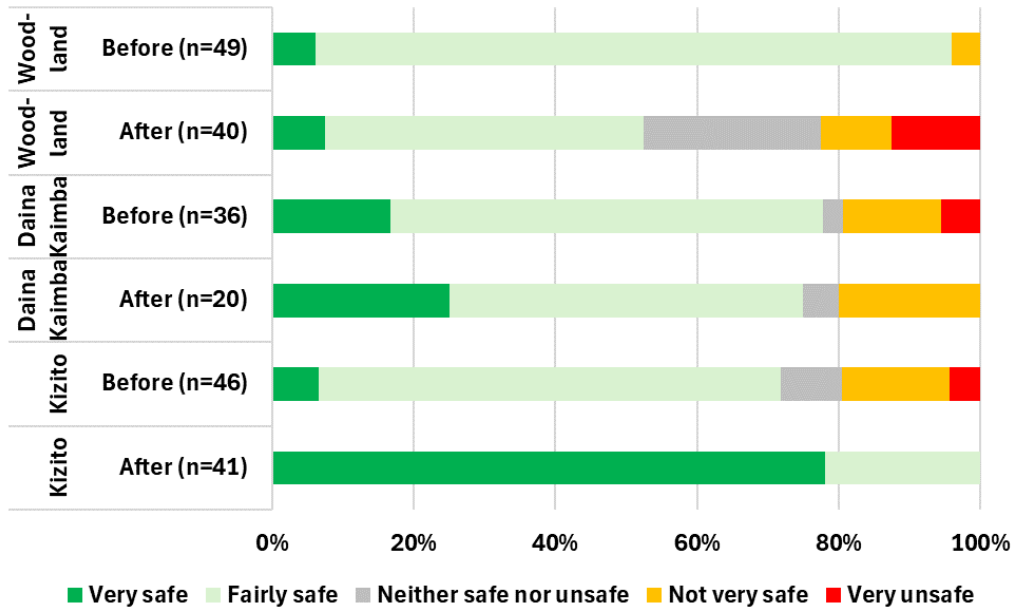


Figure 16. How safe the pupils felt when crossing the road, before and after

The results show that only pupils at Kizito felt significantly safer in the after study compared with the before study. In contrast pupils at Woodlands felt more unsafe in the after study. At Daina Kaimba no significant changes were observed. In the before study the pupils at Woodlands felt that it was safer to cross the road than pupils from Kizito. In the after study, the Kizito pupils felt safer than pupils from both Woodlands and Daina Kaimba. Figure 17 shows how easy or hard it was for them to cross the road.

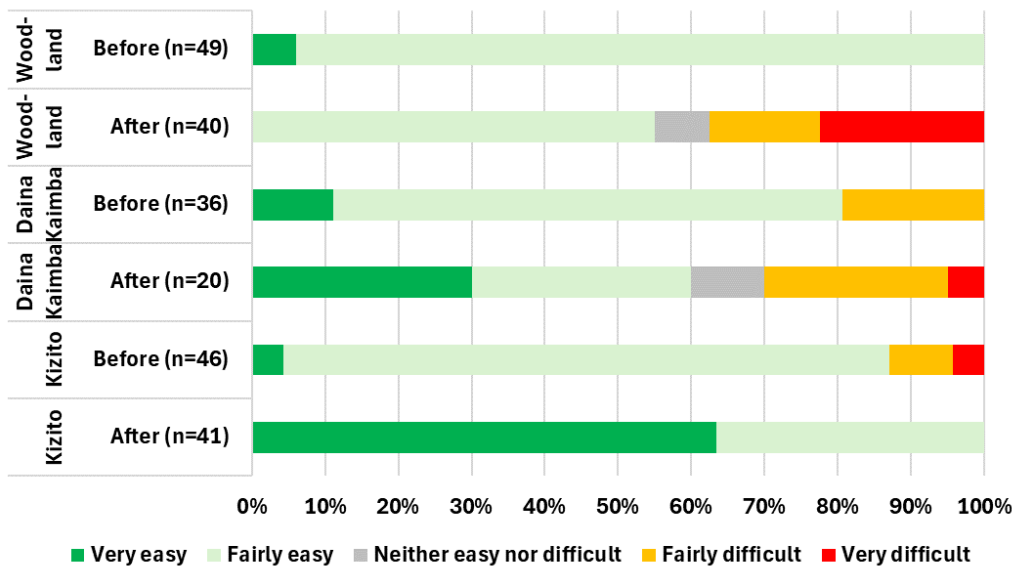


Figure 17. How easy it was for the pupils to cross the road, before and after.

The results presented in Figure 17 show a positive change for pupils at Kizito who would argue that it was significantly easier to cross the road in the after study ( $p < 0,001$ ). Pupils at both Daina Kaimba and Woodlands expressed more problem to cross in the after study compared to the before study. In the before study the tendency was that pupils at Kizito and Woodlands believed that it was easier to cross the road than pupils from Daina Kaimba. In the after study some significant differences were noticed; the Kizito pupils meant that it was easier than pupils from both Woodlands and Daina Kaimba to cross the road ( $p < 0,001$ ). Figure 18 show how afraid they were of the traffic when crossing the road.

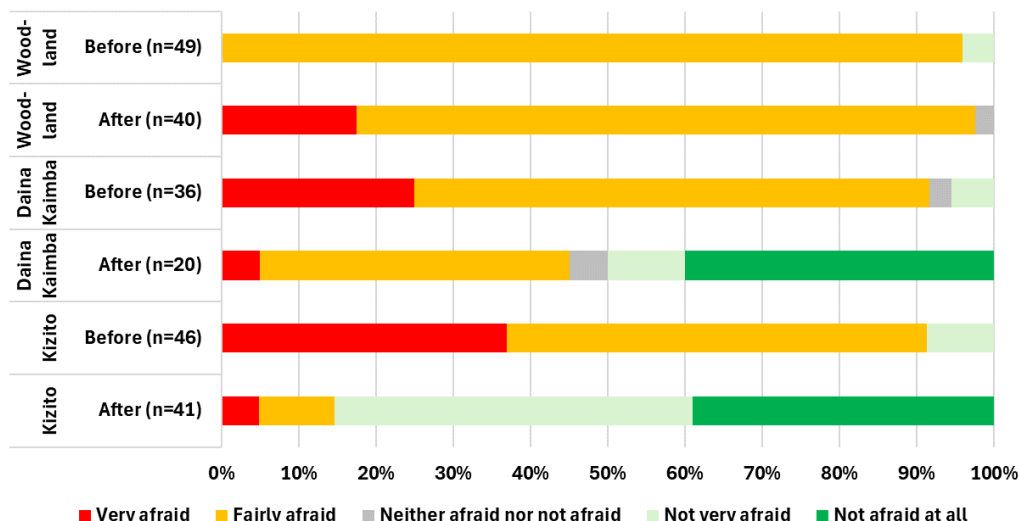


Figure 18. How afraid the pupils were of the traffic when crossing the road, before and after.

The results presented in Figure 18 showed that the difference before and after was significant in all the schools (Kizito and Daina Kaimba:  $p < 0,001$ ; Woodlands:  $p = 0,001$ ). However, it was only pupil who attended the cases schools who had become less afraid of the traffic when crossing the road. In contrast the pupils at the control school indicated that they were more afraid. When comparing the different schools with each other the results presented no differences in the before study. However, after the reconstruction significant differences were noticed ( $p < 0,001$ ); pupils from the case schools were less afraid compared to pupils from the control school.

Pupils that answered: “Very afraid”, “Fairly afraid” or “Neither afraid nor not afraid”, were asked to describe what made them afraid. The free-text responses were then categorized into four groups: afraid of being hit by vehicles, the speed of vehicles, intensity of traffic and infrastructural deficits, see Table 6.

Table 6. What the pupils were afraid of when crossing the road, percentage and number of pupils before and after for each school.

School		Hit	Speed	Intensity	Infra-structure	Total, %	Total, n
Kizito	Before	17	78	5	0	100	41
Kizito	After	0	50	50	0	100	6
Daina Kaimba	Before	6	88	0	6	100	33
Daina Kaimba	After	0	80	20	0	100	10
Woodlands	Before	0	100	0	0	100	47
Woodlands	After	0	100	0	0	100	39

The predominant reason for being afraid in the before study was the speed of the vehicles. In the after study a greater number of pupils also indicated that the intensity of the traffic made them afraid when crossing the road. This was especially noted amongst the pupils at Kizito. Six percent, equal to two pupils, from Daina Kaimba stated that the infrastructure made them afraid, one of them specifically mentioned lack of road signs. Figure 19 shows how worried pupils were about being hit by a motor vehicle when crossing the road.

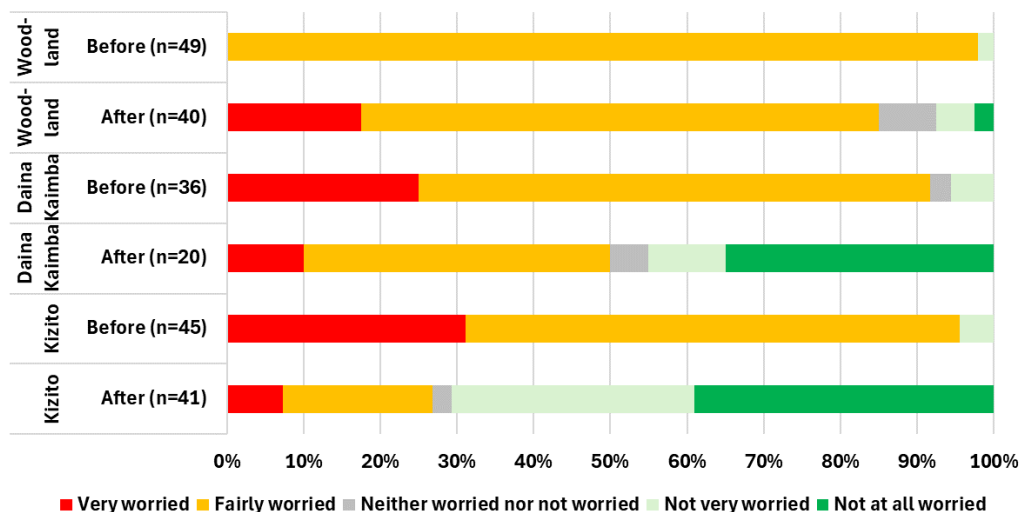


Figure 19. How worried the pupils were that a motor vehicle would hit them when crossing the road, before and after.

The results show that pupils at Kizito and Daina Kaimba were significantly less worried that a motor vehicle would hit them in the after study ( $p < 0,001$  and  $p = 0,001$ , respectively). The same effect was not demonstrated at Woodlands, instead the tendency was that the pupils at this school were more worried in the after study.

The test used to compare the results from the different schools with each other presented no differences between the schools. However, in the after study, Woodlands differed from the other two schools; pupils from this school were more worried about being hit when crossing the road.

### 3.2.2. Responses from the parents

#### Perception of the traffic situation near the school before and after

Only a few parents participated in the study, in total 66 parents, 30 in the before study and 36 in the after study, see Table 7. This was especially noted in Kizito where only 15 parents responded to the surveys. To remind, probably all parents in the before- and after study were unique. This, together with the few answers, implies that the results from the parents must be interpreted with care.

Table 7. If the parents thought road safety was a problem around the school.

	Kizito		Daina Kaimba		Woodlands		Total	
	Before	After	Before	After	Before	After	Before	After
<b>Yes</b>	1	6	7	7	8	4	16	17
<b>No</b>	2	6	9	6	3	7	14	19
<b>Total</b>	3	12	16	13	11	11	30	36
<b>% Yes</b>	33%	50%	44%	54%	73%	36%	53%	47%
<b>% No</b>	67%	50%	56%	46%	27%	64%	47%	53%

The results presented in Table 7 shows that the tendency in the case schools was that a higher percentage of the parents argued that road safety around the school was a problem in the after study. The trend in Woodlands was the opposite, with a lower percentage stating that this was a problem.

Limiting to the case schools, 42% (n=8) the parents in the before study thought that road safety was a problem around the two schools, in the after study it was 52% (n=13). This difference is however not statistically significant, as well as the total difference for all schools (53 % vs. 47%). How worried the parents were about the speed of the vehicles near the school is shown in Figure 20.

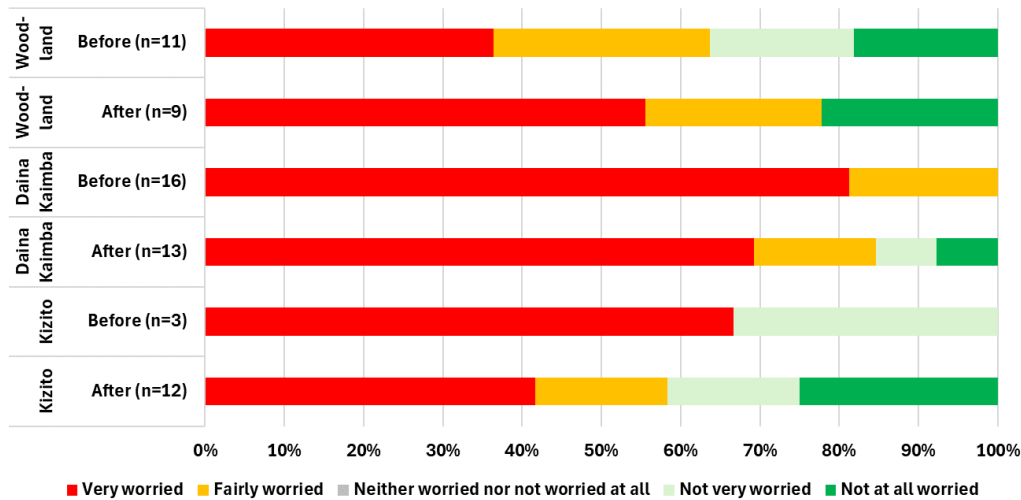


Figure 20. How worried the parents were about the driving speed of vehicles around the school, before- and after study.

The results show that a large percentage of parents, both before and after, were very worried about the speed of vehicles around the school. In none of the schools were the responses before and after significantly different from each other. However, when comparing data from the different schools a significant difference was found between Woodlands och Daina Kaimba in the before study (p=0,014). Parents from the former school were less worried about the speed of vehicles. Finally, the parent’s views about traffic intensity are presented Figure 21.

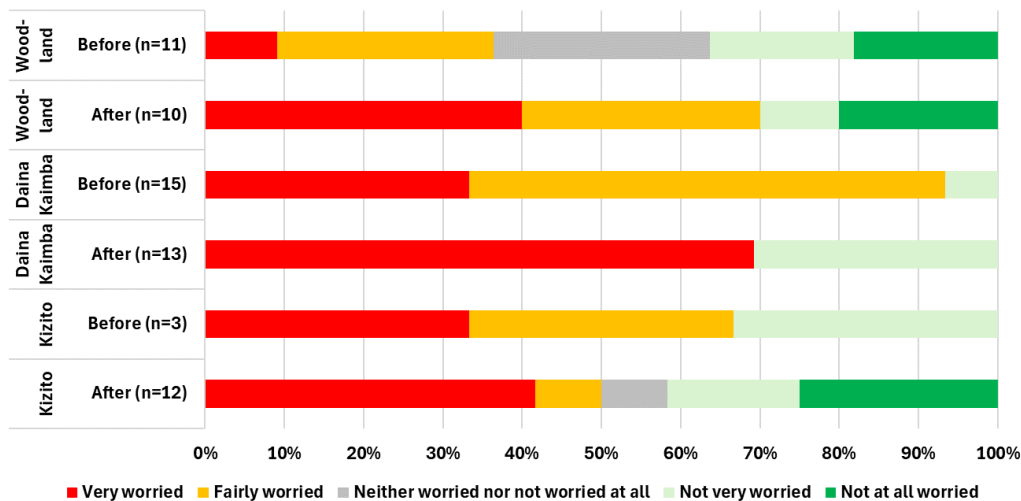


Figure 21. How worried the parents were about traffic intensity around the school, before- and after study.

The results presented in Figure 21 show that parents were very or fairly worried about the intensity of traffic around the school both before and after. Although the figure shows that the parents were more worried after implementation, especially at the case schools, due to the low number of participants the results were not significant. When comparing the different schools with each other the results from the before study presented a significant difference between Woodlands och Daina Kaimba (p=0,015, as

before the parents at Woodlands were less worried about traffic intensity around the school. No differences were found between the schools in the after study.

**Crossing the road**

Parents in the before study replied that the child had to cross the road to get to the school. In the after study some of the parents indicated that the child did not have to cross (17%). The proportion of children who did not cross according to the parents was; 25% for Kizito, 15% for Daina Kaimba and 9% for Woodlands. When the child did not cross the road, the instruction in the questionnaire was to go to the next section, but these parents didn't follow that instruction. Despite this all the answers were included in the follow-up questions. By that, we can capture all parents' general view on the traffic safety around the school. It was a tendency, according to the parents, that fewer children crossed the road on their own in the after study at the case schools, see Table 8.

Table 8. If the child in general crossed the road without an adult according to the parents.

	Kizito		Daina Kaimba		Woodlands		Total	
	Before	After	Before	After	Before	After	Before	After
Yes	3	9	14	11	8	10	25	30
No	0	3	2	2	3	1	5	6
Total	3	12	16	13	11	11	30	36
% Yes	100%	75%	88%	85%	73%	91%	83%	83%
% No	0%	25%	12%	15%	27%	9%	17%	17%

As seen in Table 8, no change between before and after occurred when data from all the schools were combined (83% and 17%). Due to small number of respondents, it was not possible to test if the differences were significant for separate schools. Parents' perception of how safe it was for the child to cross the road is presented in Figure 22.

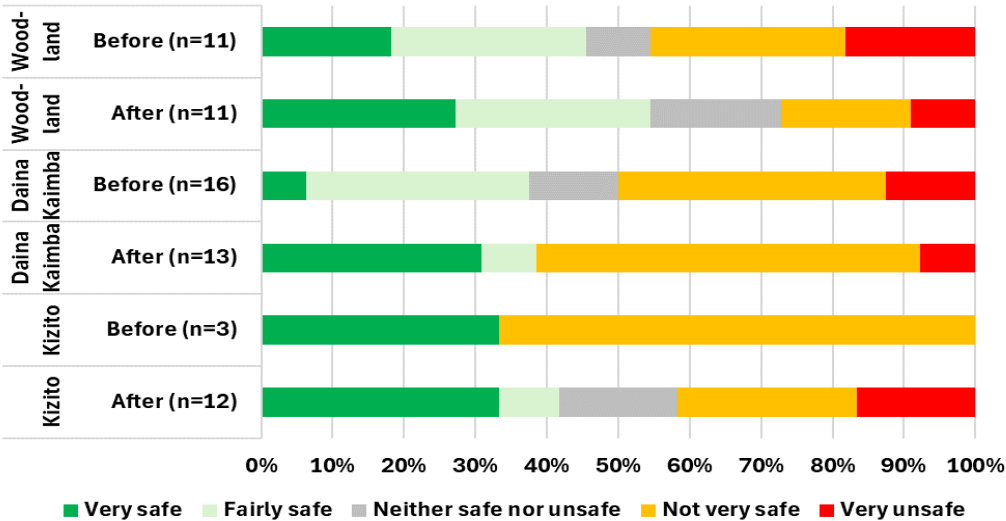


Figure 22. How safe the parents perceived it was for their child to cross the road, before- and after study.

Parents perception of how safe it was for their child to cross the road did not differ in any significant way between the schools. Between 30 to 50 percent would argue that it was safe. When comparing the results before and after from each school no significant results were presented. In a similar question, their perception of how easy it was to cross the road was examined, see Figure 23.

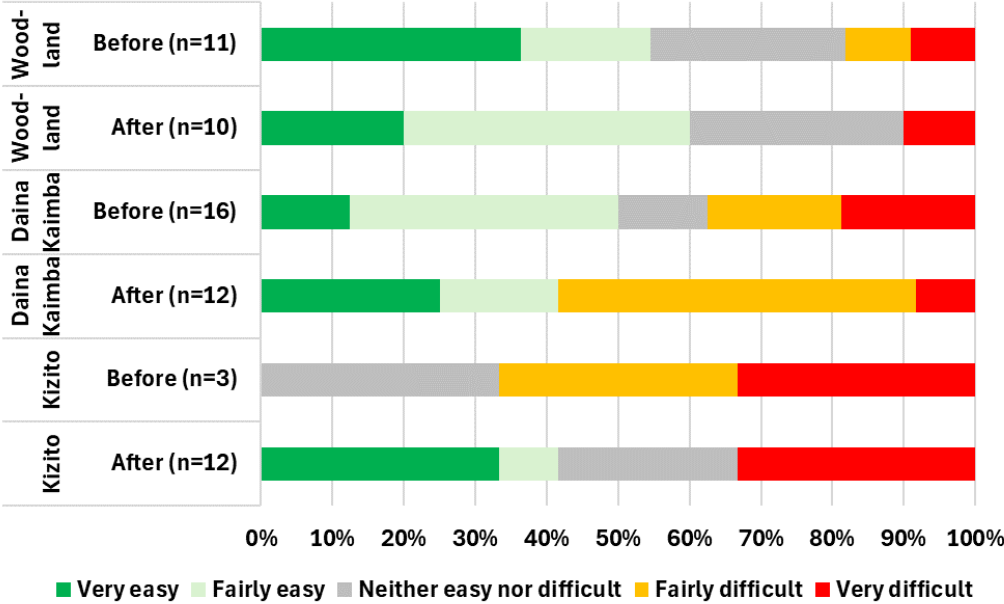


Figure 23. How easy the parents perceived it was for their child to cross the road, before- and after study.

The results presented no significant differences in their perception of how easy it was for their child to cross the road. This applied to results from within-school comparisons and between-schools before and after respectively. Corresponding results about the parents’ fear of the child being hit by a vehicle is shown in Figure 24.

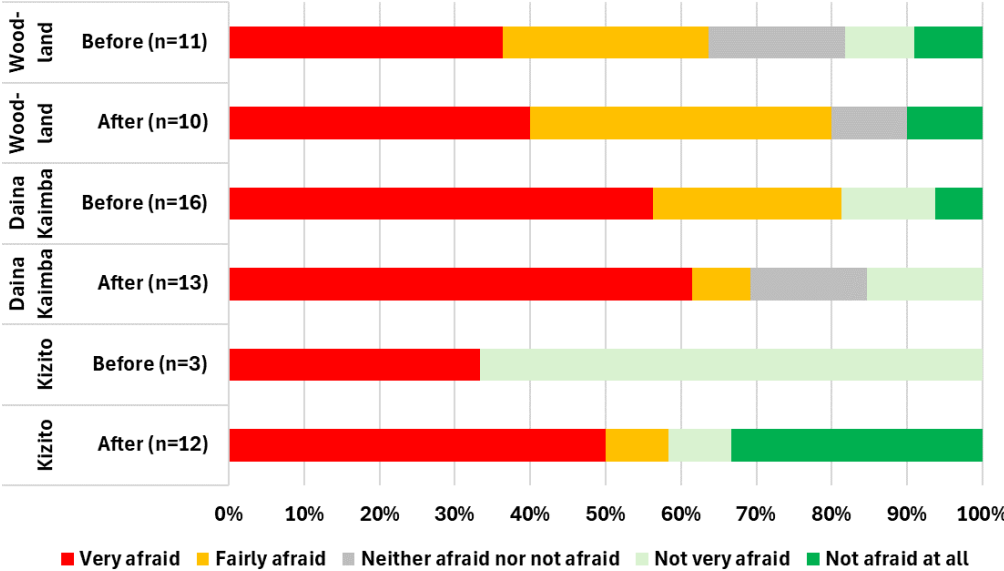


Figure 24. How afraid the parents were that the child would be hit by a vehicle when crossing the road, before- and after study.

The results show that many of the parents were very afraid that the child would be hit by a vehicle when crossing the road. When comparing the results from the different school no significant

differences was found. The same was noted when comparing the same school before and after. How worried the parents were about their children's behaviour when crossing the road, can be seen in Figure 25.

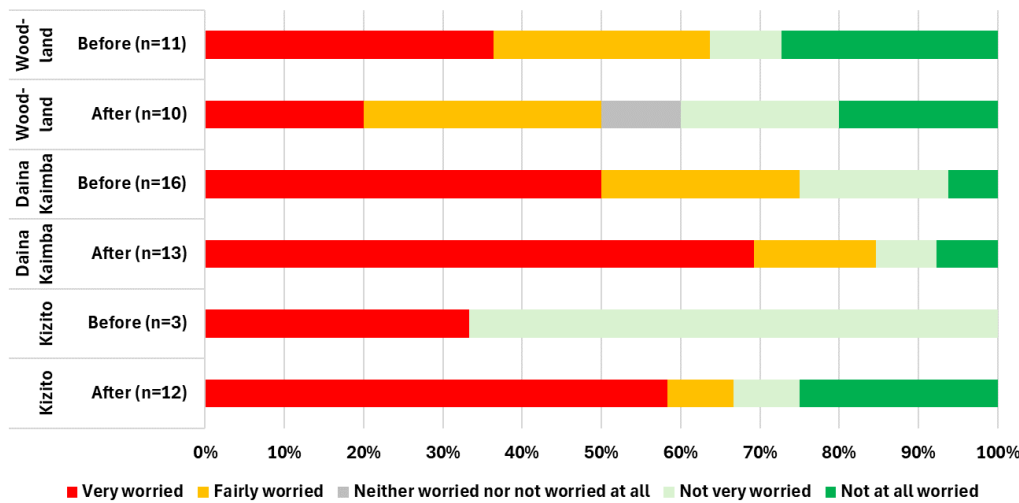


Figure 25. How worried the parents were about their child's behaviour when crossing the road, before- and after study.

Figure 25 shows that parents were very or fairly worried about the child's behaviour when crossing the road. No clear pattern was shown since some of the parents who responded to the after study were more worried than those who responded to the before study and for some it was the opposite. However, these differences were not significant, neither when it came to within-school comparisons or between-schools, before respectively after.

How the parents perceived drivers' attention to children crossing the road is shown in Figure 26.

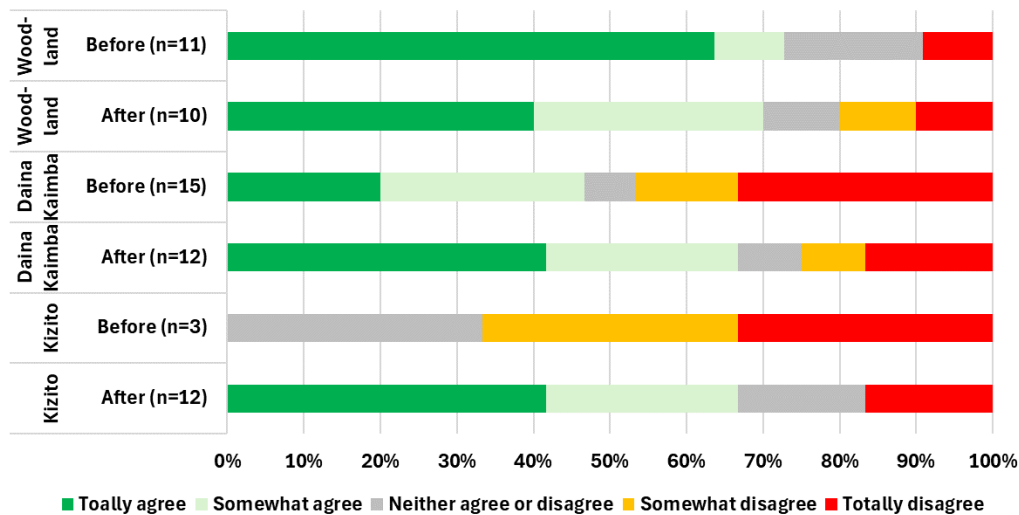


Figure 26. To which extent parents agreed/disagreed that drivers of motorized vehicles paid enough attention to children when crossing the road, before- and after study.

A significant difference in their responses before and after was only presented for Kizito ( $p=0,039$ ). This meant that they agreed more strongly with the statement that motorized vehicles paid enough attention to the children crossing the road. When comparing the schools with each other, analysis showed that it was a tendency in the before study that parents at Woodlands were more likely to argue that they paid enough attention to the children compared to the two other schools. No differences between the three schools were noticed in the after study.

### 3.2.3. Responses from the teachers

#### Perception of the traffic situation near the school before and after

The result presented in Table 9 shows that fewer teachers at the case schools believed that road safety around the school was a problem in the after study (on average 50%) compared with the before study (93%). Due to the small numbers of participants, it was not possible to investigate any significant difference between before and after at each individual school, only differences between schools.

Table 9. If the teachers thought road safety was a problem around the school.

	Kizito		Daina Kaimba		Woodlands		Total	
	Before	After	Before	After	Before	After	Before	After
<b>Yes</b>	8	1	17	4	22	14	47	19
<b>No</b>	1	3	1	2	1	2	3	7
<b>Total</b>	9	4	18	6	23	16	50	26
<b>% Yes</b>	89%	25%	94%	67%	96%	88%	94%	73%
<b>% No</b>	11%	75%	6%	33%	4%	12%	6%	27%

#### Crossing the road

The proportion of teachers claiming that the pupils crossed the road without the company of an adult did not change in the after study compared to the before study; on average 90% meant this described the situation. Figure 27 show how safe the teachers believed that it was for the pupils to cross the road.

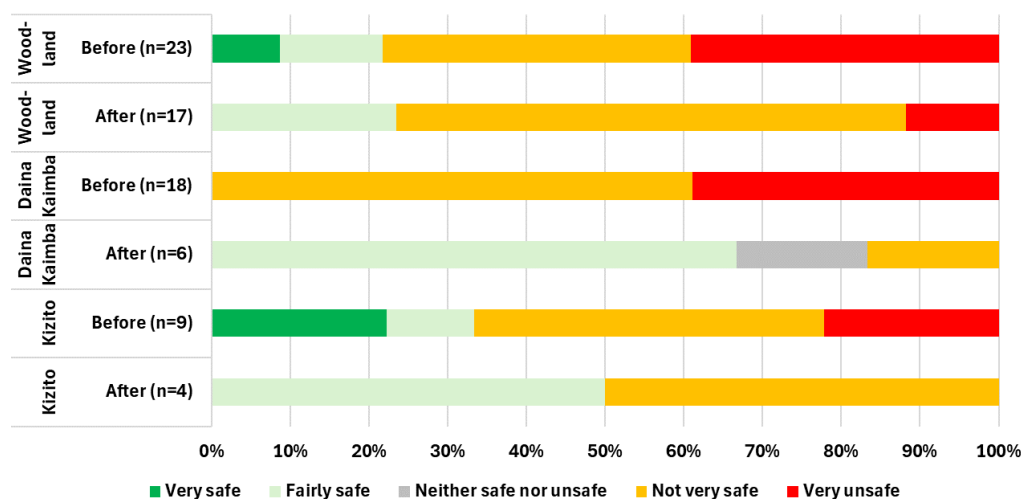


Figure 27. How safe the teachers perceived it was for the pupils to cross the road from the bus stop, before- and after study.

The results showed that the teachers' perception was very similar since no significant differences were found when the responses from the different schools were compared. Teachers' perception of how easy it would be for their pupils to cross the road is presented in Figure 28.

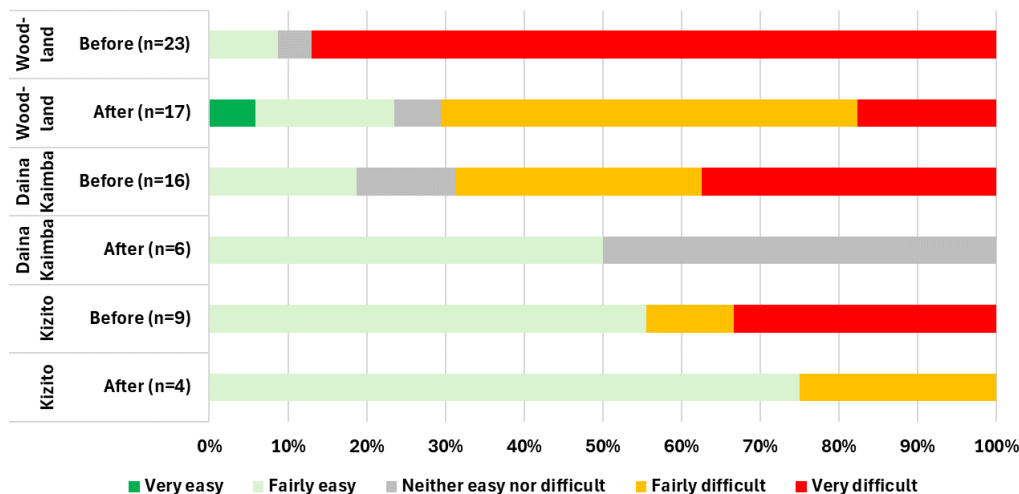


Figure 28. How easy the teachers perceived it was for the pupils to cross the road from the bus stop, before- and after study.

One significant difference between the schools in the before study was noticed when the teacher’s responses to how easy it was to cross was compared. Teachers at Woodlands perceived it as more difficult and teachers at Kizito as less difficult ( $p=0,006$ ). In the after study the teacher’s perception was more similar since no differences between the schools were found. How afraid the teachers were that a pupil would be hit by a vehicle when crossing the road is presented in Figure 29.

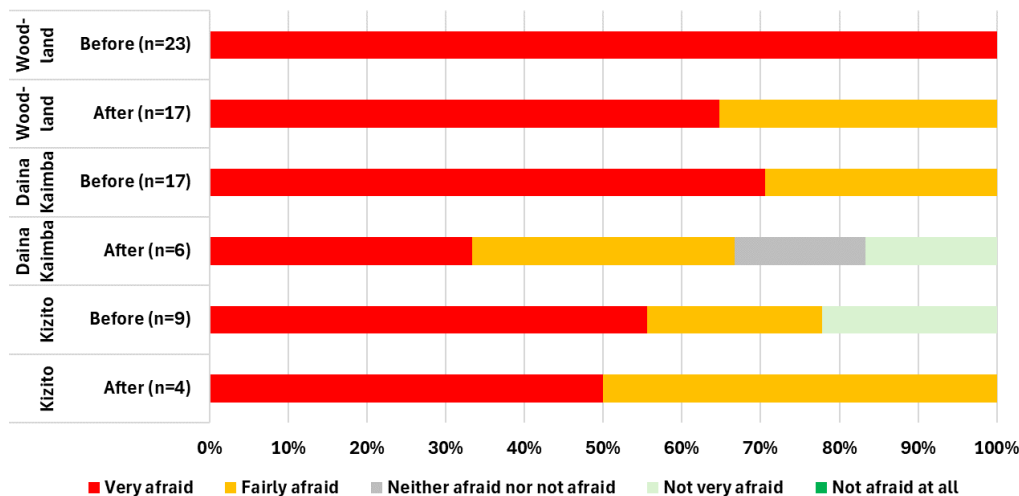


Figure 29. How afraid the teachers were that a motor vehicle would hit one of their pupils when crossing the road, before- and after study.

A significant difference was noticed between Kizito and Woodlands when the three schools were compared in the before study ( $p=0,001$ ). Teachers at Woodlands were more afraid that a motor vehicle would hit one of the pupils than teachers at Kizito. In the after study no differences between the schools were found. Figure 30 shows how worried the teachers were about the pupil’s own behaviour

when crossing the road.

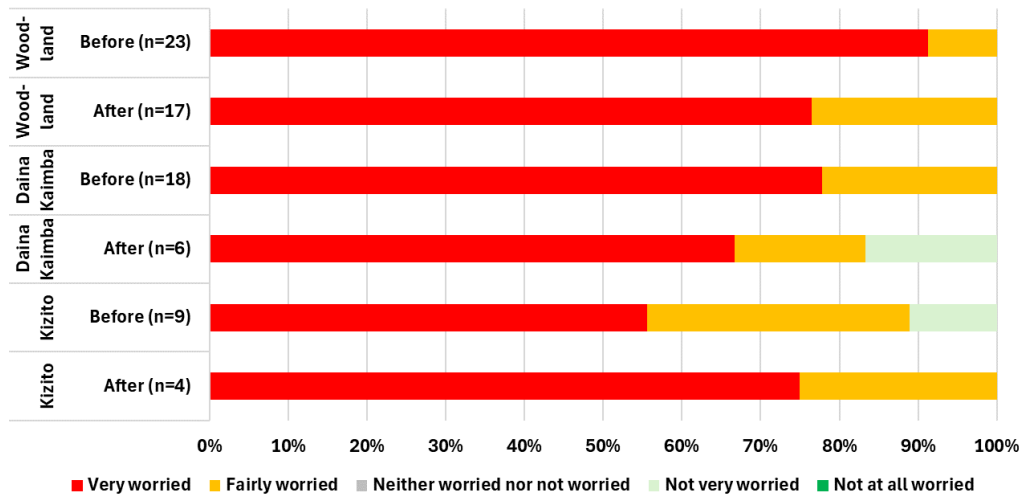


Figure 30. How worried the teachers were about their pupil’s behaviour when crossing the road-

The results presented in Figure 30 show that teachers were very worried about their pupil’s behaviour when crossing the road. However, when the schools were compared in the before study; a significant difference was noticed between Kizito and Woodlands ( $p=0,019$ ). Teachers at Woodlands were more worried about the pupil’s behaviour than teachers at Kizito. In the after study, no differences between the schools were present. How worried teachers were about the intensity of traffic is shown in Figure 31.

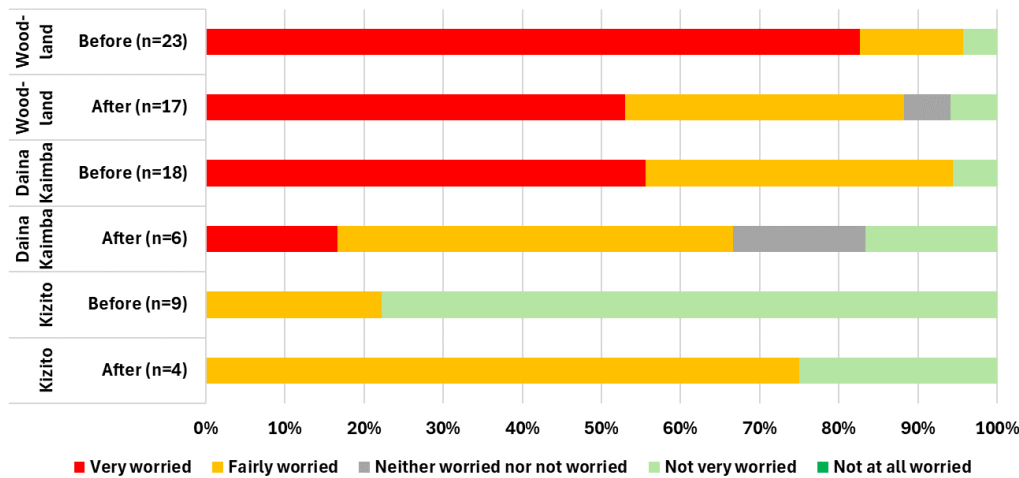


Figure 31. How worried the teachers were about traffic intensity around the school.

When comparing the results from the before study Kizito differed from both Daina Kaimba and Woodlands with them being less worried than the other two ( $p=0,001$ ). No differences were present between the schools in the after study. Figure 32 shows how worried teachers were about the speed of vehicles around the school.

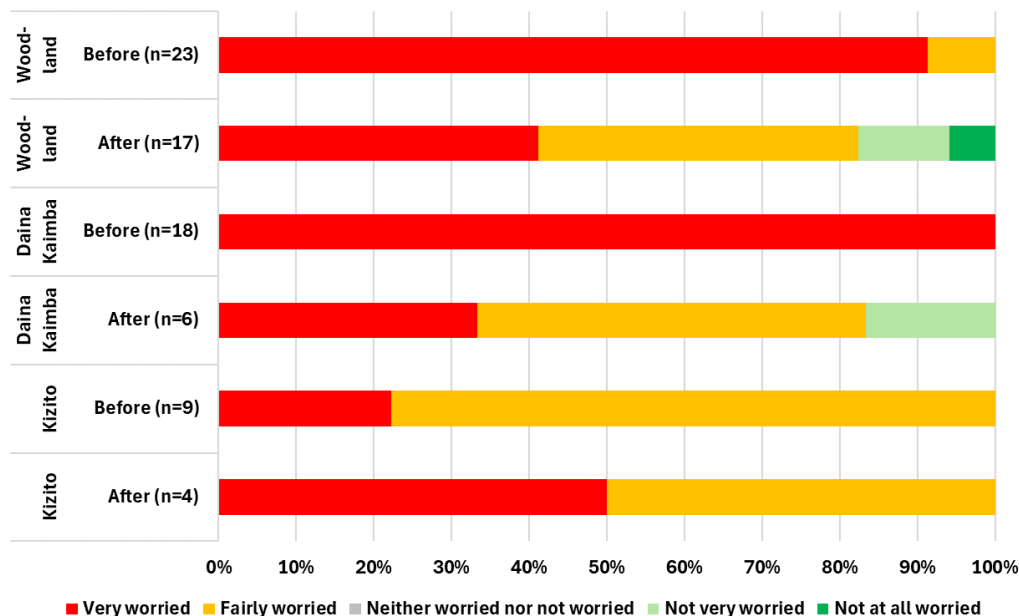


Figure 32. How worried the teachers were about the driving speed of the vehicles.

Teachers at both Daina Kaimba and Woodlands were significantly less worried about the speed of vehicles when the results from the before- and after study are compared ( $p=0,038$  and  $p=0,038$  respectively). When assessing the difference between schools the results showed that teachers at Kizito were less worried in the before study than teachers at the other two schools ( $p=0,001$ ). No differences were presented between the schools in the after study. Finally, the teachers' perception of drivers' attention to pupils crossing the road was addressed, see Figure 33.

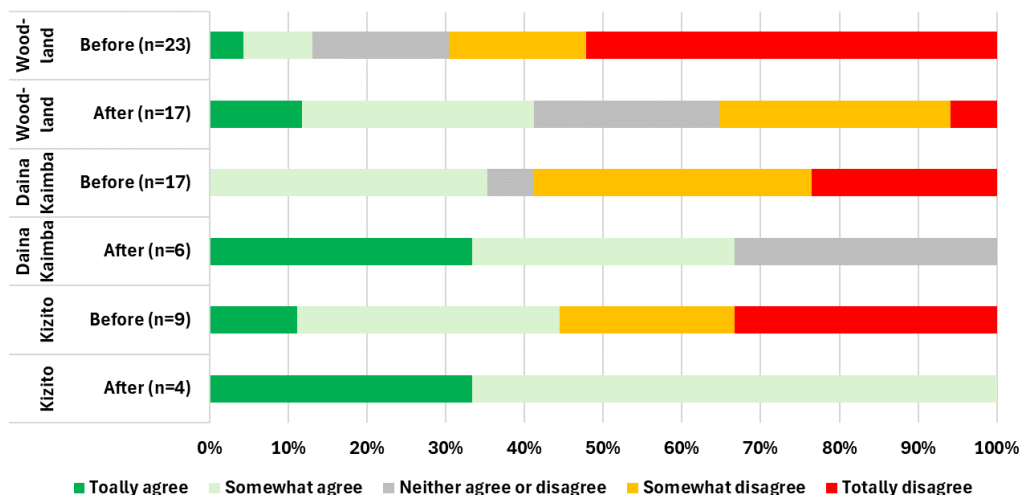


Figure 33. To what extent teachers agreed with that driver's paid enough attention to pupils crossing the road.

Teachers at Daina Kaimba and Kizito more often agreed that the drivers paid attention to the pupils in this situation in the after study, but the difference was only significant for Daina Kaimba ( $p=0,014$ ). When comparing the different schools with each other no significant differences were found, this applied to both the before and the after study.

### 3.2.4. Pupils', parents', and teachers' perception of the area outside the school

To get an understanding if the perception of the area around the schools differed between the three study groups, between-groups analyses were conducted. Figure 34 shows how safe they perceived it to be crossing the road.

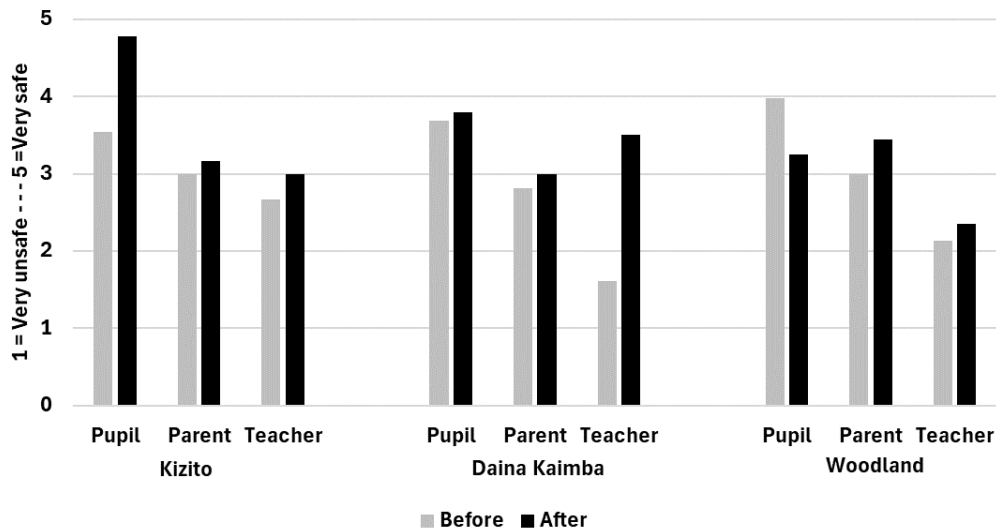


Figure 34. How safe it was for the child to cross the road, opinions of the three target groups, before and after. Mean values on the 5 grade-scale.

Starting with Kizito, the results show that the perception of safety around the school was fairly similar among the groups, although teachers perceived it as slightly less safe. When looking at the difference between before and after, the results showed that the pupils had become much more positive than the other two groups ( $p=0,001$ ).

At Daina Kaimba, the response from the before study showed that the three groups were significantly different from each other ( $p=0,014$  or less). Teachers were the most negative, followed by parents, and then pupils. In the after study, their opinions about safety became fairly similar.

At Woodlands, all three groups were significantly different from each other according to the results from the before study ( $p=0,037$  or less). Teachers were the most negative, followed by parents and pupils. In the after study, pupils and parents at Woodlands had a similar opinion, whereas teachers remained the most negative group ( $p=0,042$  or less). Worries about being hit by a vehicle when crossing the road are presented in a similar way, as shown in Figure 35.

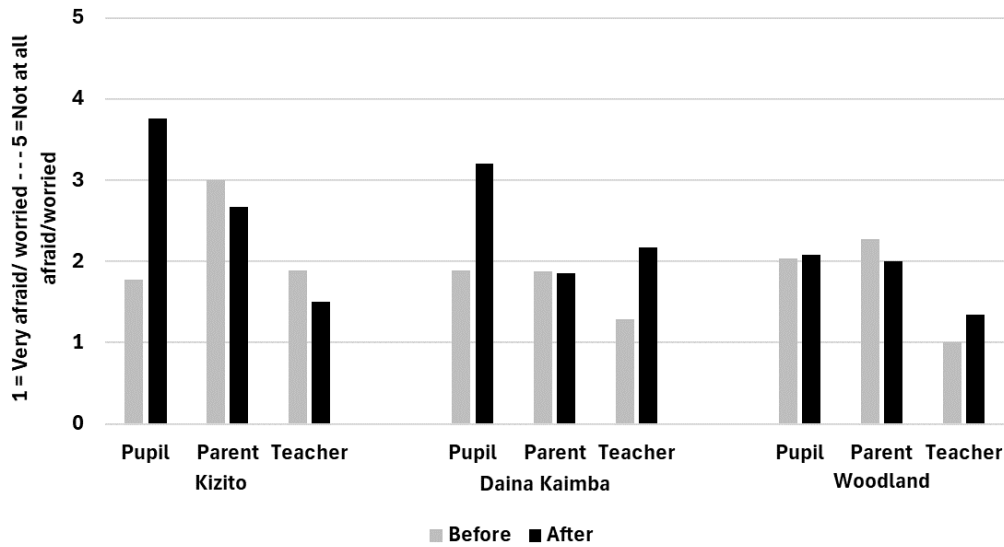


Figure 35. Fear of being hit by a vehicle when crossing the road, opinions of the three target groups. Mean values on the 5 grade-scale.

The results presented no significant differences between the three groups at Kizito in the before study, even though it appeared that pupils and teachers were more afraid that a child would be hit by a vehicle than the parents. In the after study the pupils were less worried about being hit by a vehicle than the teachers ( $p=0,013$ ).

For Daina Kaimba, the results presented a difference between pupils and teachers in the before study ( $p=0,05$ ) and between pupils and parents in the after study ( $p=0,026$ ). Pupils were less afraid than teachers in the before study and in the after study, pupils were less afraid than parents.

The pattern for Woodlands was fairly similar in the before- and after studies. Pupils and parents had the same view on both occasions, and in the before study they differed significantly from the teachers' view ( $p=0,001$ ). In the after study pupils and teachers differed significantly from each other, with pupils being less afraid than teachers ( $p=0,011$ ).

Finally, the opinion about how easy it was to cross the road is shown in Figure 36.

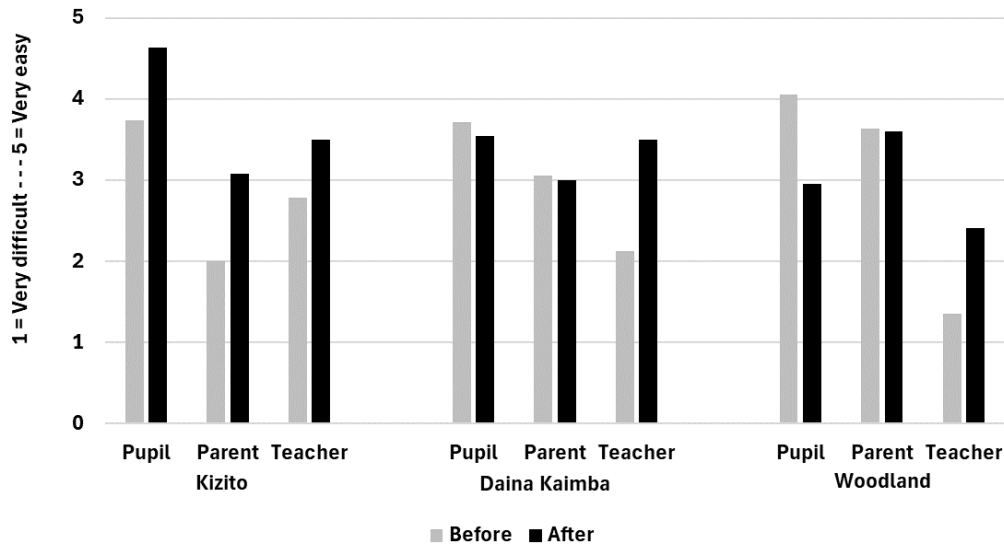


Figure 36. How easy it was for the child to cross the road, opinions of the three target groups. Mean values on the 5 grade-scale.

The results from the before study show that pupils at Kizito believed that it was easier to cross the road than both teachers and parents ( $p=0,024$  and  $p=0,011$  respectively), which meant that it was rather easy. In the after study pupils at Kizito were still more positive, but this time the difference was only between themselves and parents ( $p<0,001$ ).

At Daina Kaimba similar results as that from Kizito were presented which meant that pupils perceived the crossing to be easier than teachers ( $p<0,001$ ). Although this time a significant difference was also noted between teachers and parents ( $p=0,047$ ). The group who found it most difficult in the before study were the teachers. In contrast to Kizito no difference between the groups were noted in the after study.

Results from Woodlands show that teachers in the before study believed that it was more difficult to cross the road than the other two groups ( $p<0,001$ ). No difference between the groups were found in the after study.

### 3.2.5. Effects of the reconstruction

The survey which participants connected to the case schools completed included some specific questions about the reconstruction. The following section presents the pupils opinions first followed by parents and teachers.

#### Pupils' opinion

Figure 37 show how safe the pupils feel when walking along the road after the reconstruction.

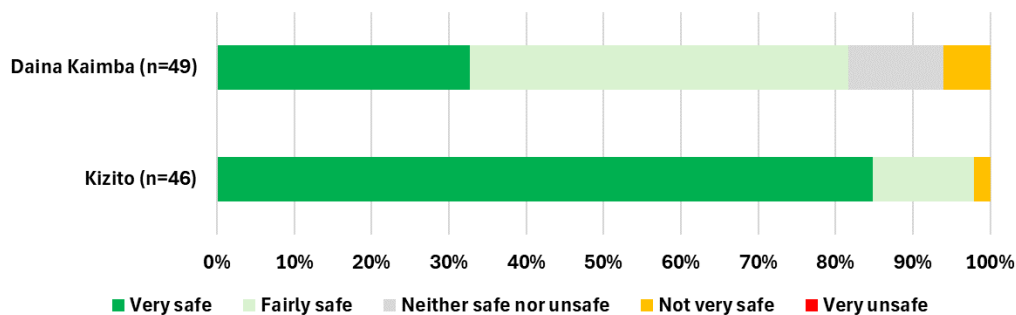


Figure 37. How safe the pupils felt when walking along the road after the implemented measures

The results showed that most of the pupils felt very or fairly safe when walking along the road after the reconstruction. However, the results also showed that pupils at Kizito felt safer than pupils at Daina Kaimba. Their perception of vehicle speed is presented in Figure 38.

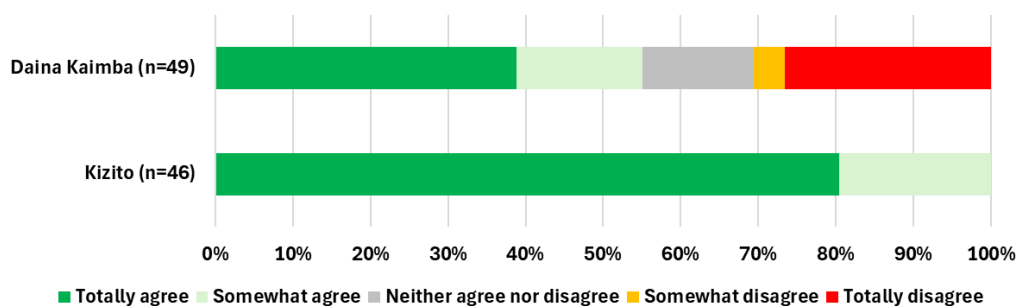


Figure 38. To which extent the pupils agreed/disagreed that vehicle drivers now drove slower past the school compared with last year.

All the pupils from Kizito agreed to some extent with the statement that drivers after the reconstruction were driving slower in the vicinity of the school. The corresponding proportion for pupils at Daina Kaimba was 55%. Finally, questions dealt with effects of zebra crossing. Since this measure only was implemented at Kizito, only pupils' opinions from this school are shown in Figure 39.

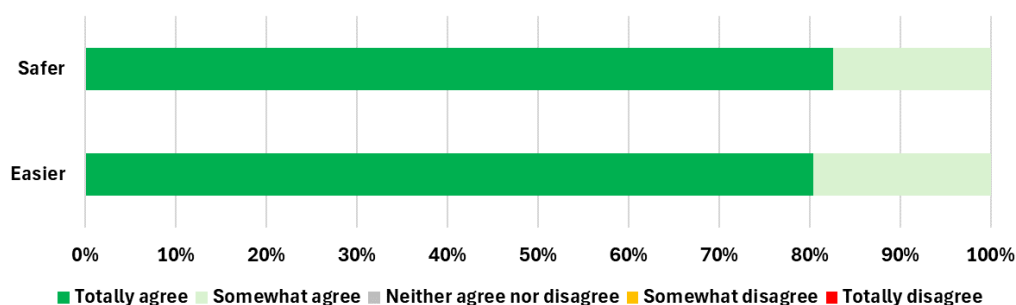


Figure 39. To which extent the pupils at Kizito agreed/disagreed that it now was safer and easier to cross the road because of the new zebra crossing in front of the school (n=46).

A vast majority of pupils at Kizito agreed that the changes had made it both safer and easier for them to cross the road. Results also showed that the new zebra crossing was used by almost every pupil when crossing the road (36 of 41, 88%). Those who did not use the new zebra crossing crossed either further from the school or at another crossing further away.

## Parents' opinion

Parents with children attending the two case schools were also asked to express their opinions about the implemented measures, see Figure 40, where the effects of bollards and whether drivers drove slower past the school are shown.

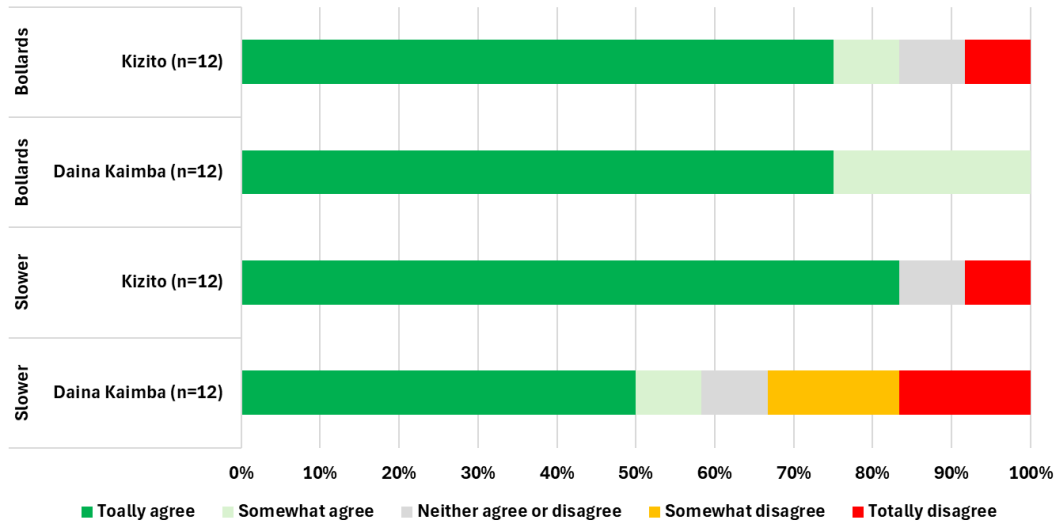


Figure 40. To which extent parents agreed/disagreed that the new bollards have made it safer for the child to walk along the road and if drivers drove slower past the school.

The results show that parents were very pleased with the reconstruction. They felt that the bollards made it safer for their children and that cars drove slower past the school than before. Statistical testing presented no significant differences between the parents at the two different schools. Figure 41 show that most of the parents strongly agreed that the road sign made drivers more careful and that the new zebra crossing made it easier and safer for pupils to cross the road.

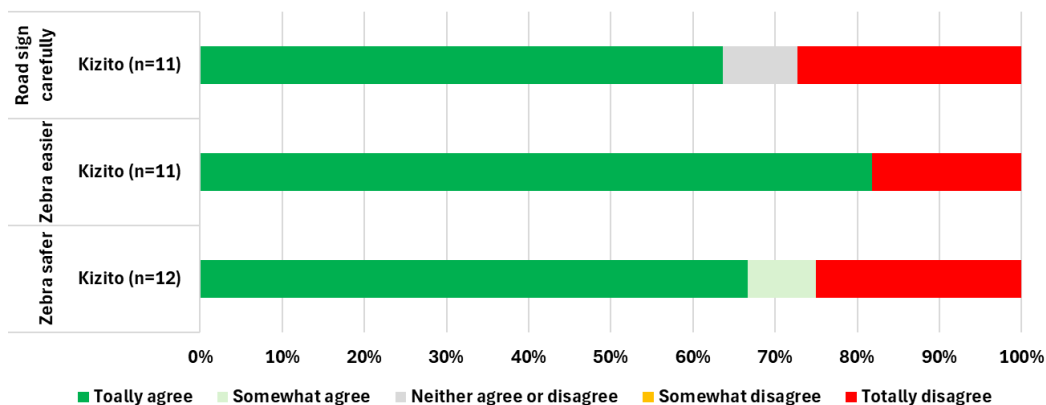


Figure 41. To which extent the parents agreed/disagreed that it now was safer and easier to cross the road because of the new zebra crossing in front of the school and whether the road sign resulted in more careful drivers.

The parents were also asked to express their overall opinion about the measures, see Figure 42.

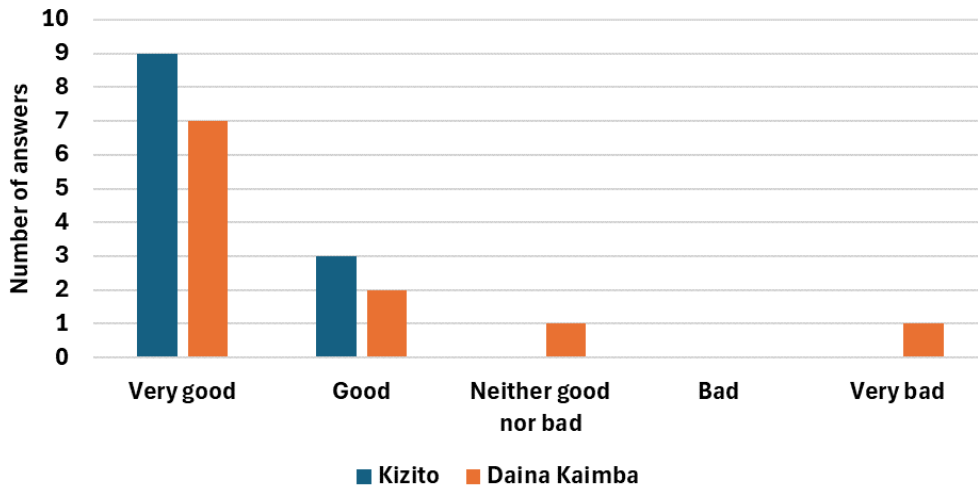


Figure 42. Overall rating by the parents of the impact of the reconstruction when it comes to improving safety for the children.

Most of the parents would argue that the changes around the school had helped to improve safety for the children, especially parents with children attending Kizito.

### Teachers' opinion

Data about the teachers' view on the effects of the reconstruction is even more limited than data from parents, only 8-9 teachers answered these questions in total. Figure 43 show their opinions about bollards and the speed of vehicles passing the school.

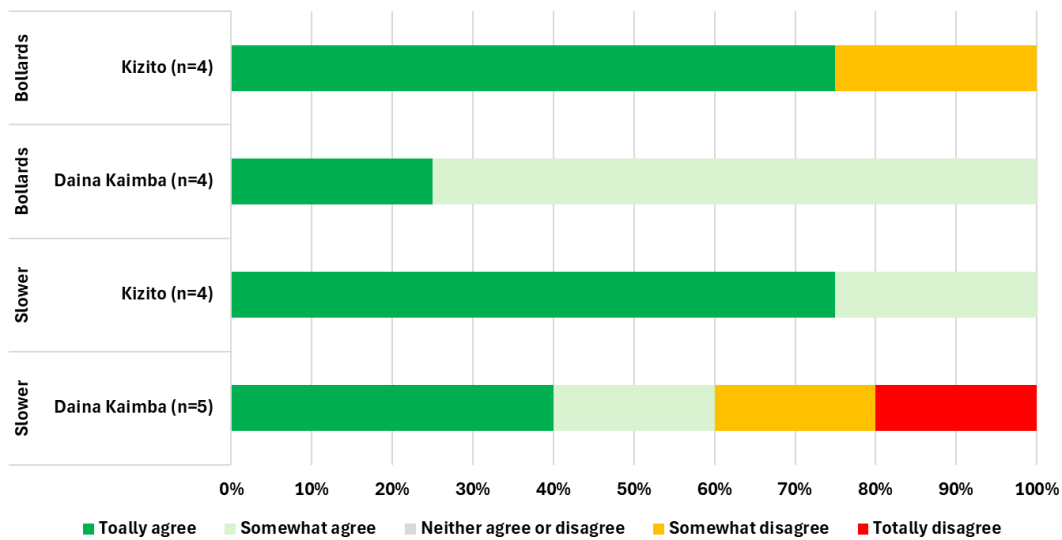


Figure 43. To which extent teachers agreed/disagreed that the new bollards have made it safer for the child to walk along the road and if drivers drove slower past the school.

The results presented in Figure 43 show that the overall impression is that teachers were pleased with the changes. However, a few teachers at Daina Kaimba did not believe that the drivers drove slower past the school after the reconstruction. Figure 44 shows what teachers at Kizito thought about the new zebra crossing.

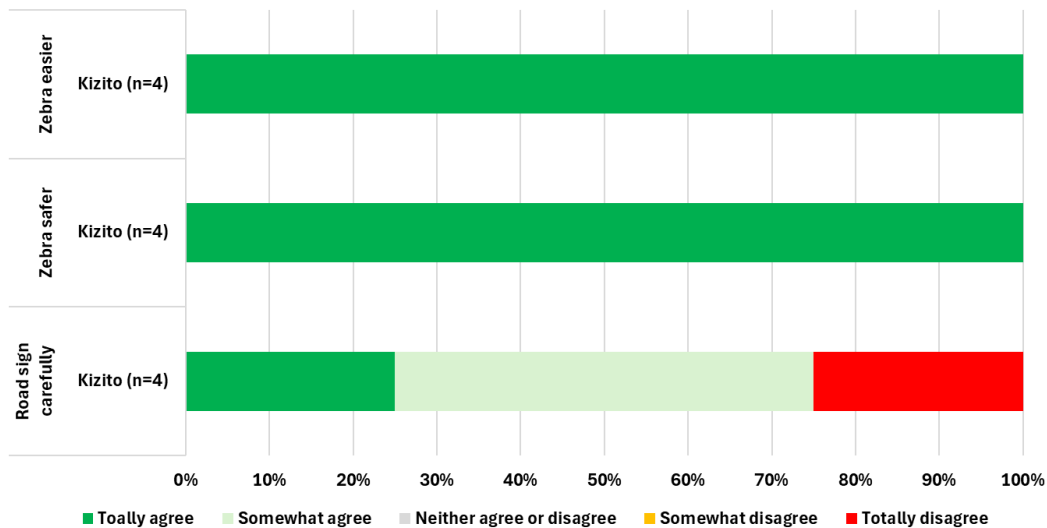


Figure 44. To which extent the teachers agreed/disagreed that it now was safer and easier to cross the road because of the new zebra crossing in front of the school and whether the road sign resulted in more careful drivers.

Figure 44 shows that the teachers were very pleased with the reconstruction, although they were more pleased with the zebra crossing than the road signs. The zebra crossing made it easier and safer for the children to cross. While cars were generally driving more carefully past the schools, some teachers disagreed with this observation. Finally, teachers rating of the implemented measures are presented in Figure 45.

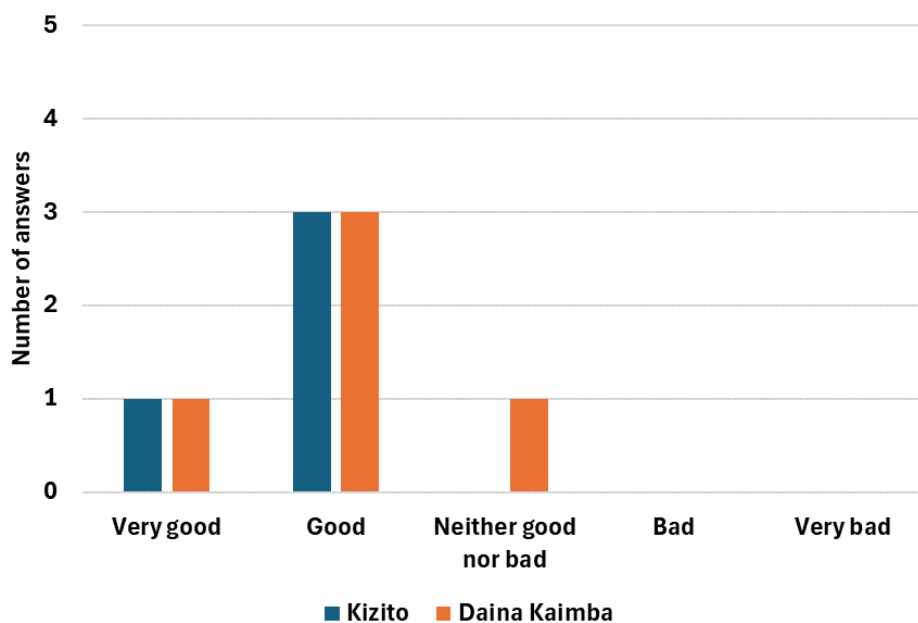


Figure 45. Overall rating by the teachers of the impact of the reconstruction when it comes to improving safety for the children.

The results show that most of the teachers rated the impact of the reconstruction as good and one of them as very good. In contrast, one of the teachers at Daina Kaimba was less pleased and could not decide if the result was good or bad.

### 3.2.6. Accident involvement

Both pupils and parents responded to a question about involvement in a traffic accident which resulted in the child being hurt by a passenger car, lorry or a motorcycle. All accidents that ever have occurred and not only those which occurred in the vicinity of the school was considered. In the after study the aim was to assess traffic accidents after the school opened in the new year, which included only two months. The pupils' answers are presented in Table 10.

*Table 10. Reported accident involvement based on pupils' responses, before and after by school.*

Accident	School	Before, no of pupils	After, no of pupils	Before, % of pupils	After, % of pupils
No	Kizito	47	43	94	93
	Daina Kaimba	48	48	96	98
	Woodlands	46	54	94	100
Yes	Kizito	3	3	6	7
	Daina Kaimba	2	1	4	2
	Woodlands	3	0	6	0

In total, 8 pupils had been involved in 9 accidents according to the answers from the before study. Most of them occurred near the pupil's home (3 from Kizito, 2 from Daina Kaimba och 2 from Woodlands). One pupil from Woodlands reported two accidents, both occurred outside the school. Fewer pupils described accidents in the after study: 3 from Kizito (also near their home) and 1 from Daina Kaimba which occurred when the pupil crossed the road outside the school. The corresponding results from the parents' questionnaire are found in Table 11. In total only three pupils had been involved in an accident according to the parents.

*Table 11. Reported accident involvement based on parents' responses, before and after by school.*

Accident	School	Before, no of pupils	After, no of pupils	Before, % of pupils	After, % of pupils
No	Kizito	2	11	67	100
	Daina Kaimba	15	11	94	92
	Woodlands	11	10	100	100
Yes	Kizito	1	0	33	0
	Daina Kaimba	1	1	6	8
	Woodlands	0	0	0	0

The Kizito pupil that, according to its parents in the before study, had been involved in accidents, had experienced such 10 (!) times outside the school. Maybe the respondent in this case was referring to incidents, i.e. near-accidents, or just misunderstood the question. One pupil from Daina Kaimba were according to the before study involved in accident when travelling to school.

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## 4. Discussion

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The study was designed as a before-and after study to better understand the effect different implementations outside a primary school have on children's safety. Both objective and subjective measures were employed to evaluate the impact at two case schools and one control school.

The results from the objective measures showed that the speed before the reconstruction was on average 38 km/h (Diana Kaimba, 42 km/h, Woodlands, 38 km/h and Kizito 33 km/h). When considering human tolerance to injury, a pedestrian hit by a vehicle exceeding 30 km/h often faces fatal consequences (World Health Organization, 2004). Children are particularly vulnerable due to their small size (Rothman et al., 2022). Therefore, it was crucial to reduce the speed limit outside the schools.

The results from the after study showed that the speed outside one of the case schools and the control school was still more than 30 km/h. The only school with a speed less than 30 km/h was Kizito. In this school the average speed was 17 km/h, which meant that it had been reduced by 15 km/h. The speed at Diana Kaimba was only reduced with about 5 km/h and the speed at the control school was increased by 9 km/h. The greater speed reduction at Kizito is most likely due to the introduction of both a zebra crossing and a speed hump. The increased speed at the control school is more difficult to explain. Perhaps it was due to weather conditions. When the first measures were recorded it was raining and in the after study it was sunny. However, for the case schools it was the opposite, i.e. sun in the before study and rain in the after study. It can therefore not be entirely ruled out that weather conditions could have an effect of the measured speed.

The subjective measures consisted of a survey used to assess the perception of safety before and after the reconstruction but also modal choice. The results showed that most of the pupils walked to school, either on their own or in the company of another child, the same age or younger than themselves. Hardly any of the pupils travelled to school with a parent or another adult. This would indeed expose them to greater risk since we cannot expect children to be mature enough to understand the complexity of traffic (Rothman et al., 2022).

In the survey the pupils were asked questions about the area around the school, focusing on their perception of road safety. In the before study, a large number of pupils indicated concerns about lack of safety around the school. For instance, most of the children were very afraid of crossing the road and being hit by a motor vehicle. Pupils who stated that they were afraid of crossing the road were asked to describe what made them afraid. The results showed that the predominant reason for being afraid in the before study was the speed of the vehicles. This is indeed a legitimate fear since most road user fatalities are because of pedestrians being hit by a motor vehicle, a risk that increases with speed (World Health Organization, 2004). Even if the children might not have been aware of this, other studies have found that vehicle speed is something pedestrians perceive as dangerous (Andersson et al., 2023).

When analysing the difference before and after, the results showed that pupils who attended any of the case schools had become less afraid of the traffic and less worried of being hit by a vehicle when crossing the road. This was especially noted by pupils at Kizito, where all the planned measures had been implemented and where the largest reduction in speed had been observed. In contrast, pupils at the control school had become more afraid and worried. Perhaps the survey itself had made them more aware of traffic safety in a way they were not before? Another explanation could be that the pupils taking part in both surveys were not identical.

Pupils who attended Kizito primary school would also argue that it had become easier to cross the road. Pupils at the other two schools argued that it had become more difficult. The ease of crossing for pupils at Kizito is understandable since they were provided with a zebra crossing and speed humps. However, understanding why pupils at the other schools had become more negative is less straight

forward, especially at Daina Kaimba. It is quite possible that the road construction taking place during the study period at Daina Kaimba could explain this. It would have exposed them to noise and dust, as well as various road construction machines.

The results from the survey completed by parents showed that they were very concerned about road safety around the school. Parents were especially worried about driving speed of vehicles around the school and the intensity of traffic. When it came to their child having to cross the road, they were very worried that they would be hit by a motor vehicle and could not fully trust that their child would cross safely. However, there were some differences between parents at the different schools, albeit small. For instance, parents at the control school were less worried about the speed of vehicles and the intensity of traffic in the before study than parents with children at Daina Kaimba primary school. The intensity of traffic at the different schools was not measured, but for speed, we can see that the average speed was 4 km/h faster at Daina Kaimba than at Woodlands.

In general, the results showed very small or no changes, when comparing the results from the before- and after study, something which applied to all schools but with some exceptions. For instance, parents who had at least one child attending any of the case schools had become more concerned about road safety around the school than before. In contrast parents at Woodlands, the control school, would argue that it was less of a problem in the after study. A possible reason that the parents' perception of safety had changed at the case schools might be that they had become more aware of the conditions around the school due to the reconstruction. This might sound like an anomaly but if we consider that only a few parents travelled together with their child to school it might be a reasonable explanation.

The responses from the teachers showed that almost all of them would argue that safety was a problem around the schools. What concerned them most was the speed of vehicles and the intensity of the traffic. They expressed great worry about their pupils' behaviour when crossing the road and that they would be hit by a motor vehicle. Some differences were also presented when comparing the view of teachers at the different schools. Very few teachers participated in the study means that the results must be interpreted with caution. The results from the before study showed that teachers who worked at Kizito primary school were less worried than teachers at the other two schools. The results from the after study presented no significant differences between the schools.

When comparing the perception of pupils, teachers and parents, the results showed that pupils at the case schools were more positive. The results from the before study showed that their view about how safe it was to cross the road was fairly similar at Kizito but different at the other two schools. At Daina Kaimba and Woodlands, the teachers were more concerned about this than parents and pupils. In the after study, pupils at Kizito had become more positive about safety than the other two groups. At Woodlands teachers were the group most negative and at Daina Kaimba, the three groups' views were very similar. It is understandable that pupils at the school with the most changes have become more positive, as they experience the traffic environment around the school more than others. However, it is more difficult to explain why teachers at Woodlands were more negative and why no changes were observed between the groups at Daina Kaimba.

The response to the question about how easy it was to cross the road presented some significant differences. Pupils at Kizito and Daina Kaimba argued that it was easier than both teachers and parents. The results from the after study presented a difference between pupils, teachers and parents at Kizito. Pupils perceived that it was much easier than the other two. For the other two schools, no difference between the groups was presented. That the pupils were more positive about crossing the road might not be so difficult to understand since children have a lower perception of road hazards compared to adults (Meyer, Sagberg & Torquato, 2014). It could also be because they were more familiar with crossing the road than both teachers and parents.

## 4.1. The perception of the reconstructions

In general, the reconstruction made the pupils feel safer to walk along the road, especially at Kizito. Pupils at this school also believed that drivers were driving slower than before. This perception could be supported by observations, as the reduction of speed at this particular school was on average 15 km/h. Pupils at Kizito received a specific question about the zebra crossing and all of them responded that it had made it safer and easier for them to cross the road.

Most parents also agreed that things had improved after the reconstruction. They were especially pleased with the new bollards, which, according to them, had made it safer for their child to cross the road. The introduction of both a zebra crossing and speed humps was also well received. However, there was not total consensus, as one in four parents expressed the opposite view, believing that it did not make it safer.

When it comes to teachers, the vast majority were also positive about the changes made outside the school. Although, a few teachers at Daina Kaimba did not believe that the drivers drove slower past the school than before the reconstruction. At Kizito, a consensus was reached, as all the teachers argued that the zebra crossing made it easier for the pupils to cross. Both parents and teachers rated the impact as good or very good, even if the rating from parents was higher than from the teachers. That their perception of the reconstruction differed might be because the perception of safety is very subjective and influenced by various factors including individual attitudes, experiences and contextual elements. Some individuals might also accept more risk than others.

## 4.2. Limitations

It would have been desirable if the same individuals had responded to both surveys. We can therefore not rule out that differences before and after reflected this rather than an actual change in perception. The few responses from mainly teachers but also parents meant that comparisons within and between schools become uncertain.

When measuring the speed at the case schools before the reconstruction it was sunny whereas after the reconstruction it was raining. The opposite applied to the control school, rain first and then sun. Perhaps this could partly explain the variation in speed.

Finally, it was very short period in the follow-up study (2 months) from which accidents would be reported, while in the before study all accidents up to the completion of the questionnaire would be considered.

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## 5. Recommendations

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### STANDARDIZED PROCESS FOR INFRASTRUCTURE CHANGES AT SCHOOLS

#### **Initial Assessment and Stakeholder Engagement**

*Objective:*

Identify the need for infrastructure changes around the school and engage relevant stakeholders.

*Actions:*

- Conduct a preliminary assessment of the school's infrastructure and surrounding area.
- Identify key stakeholders (e.g., local government, road safety authorities, corporate sponsors, school administration).
- Organize initial meetings with stakeholders to discuss potential safety concerns and improvement areas.
- Collaboration with Key Authorities

*Objective:*

Work closely with relevant authorities to plan and implement safety measures.

*Actions:*

- Collaborate with local government bodies (e.g., City Council, Road Agency/Authority, etc.) to develop a detailed plan for infrastructure changes.
- Engage with local traffic police to jointly identify high-risk areas.
- Ensure that all parties are aligned on objectives, timelines and responsibilities.
- If possible, select and Control Sites (i.e., an unchanged sites).
- Financial Planning and Resource Allocation

*Objective:*

Secure funding and resources necessary for implementing the changes.

*Actions:*

- Identify potential financial sponsors, such as corporate foundations or government grants.
- Develop a budget and allocate resources for the project.
- Ensure transparency and accountability in the use of funds.
- Involve both the community and the school.

*Objective:*

Collect information from the community and the school.

*Actions:*

- Arrange meetings with parents, teachers, children and local residents to gather input on safety concerns and potential solutions.
- Collaborate with the school administration to ensure that their needs and insights are considered.
- Use community feedback and safety assessments to inform the final decision on infrastructure changes.

## **Implementation and Monitoring**

### *Objective:*

Implement the planned infrastructure changes and record any problems during implementation.

### *Actions:*

- Supervise the implementation of the changes in collaboration with stakeholders.
- Monitor the impact of the changes on school safety and adjust as needed.
- Regularly report progress and outcomes to all stakeholders.

## **Evaluation and Replication**

### *Objective:*

Evaluate the success of the project and create a template for future replication.

### *Actions:*

- Conduct a before- and after study to assess the effect on social and psychological factors. If possible, ensure that the same children, parents and teachers take part in both studies.
- Conduct observations before and after the implementation. If possible: Accident data analysis, Traffic counting, Speed measuring and Conflicts between pupils and vehicles using video recording (for instance, yielding or not and pupils' crossing behaviour).
- Write the evaluation report and present the findings
- Develop a standardized template based on the successful elements of the project for use in other schools or communities.

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