Final Report

Research Grant 2021

ATRANS

ASIAN TRANSPORTATION RESEARCH SOCIETY

Road Safety Education on Potential of Safe Routes to School Program in Thailand

Sittha Jaensirisak
Paramet Luathep

Road Safety Education on Potential of Safe Routes to School Program in Thailand

Final Report

March 2022

ATRANS
ASIAN TRANSPORTATION RESEARCH SOCIETY

902/1 9th Floor, Glas Haus Building, Soi Sukhumvit 25 (Daeng Prasert),
Sukhumvit Road, Klongtoey-Nua, Wattana, Bangkok 10110, Thailand
Tel. (66) 02-661-6248 FAX (66) 02-661-6249
http://www.atransociety.com

List of Members

- **Project Leader**
  - Assistant Professor Dr Sittha Jaensirisak
    Ubon Ratchathani University

- **Project Members**
  - Assistant Professor Dr Paramet Luathep
    Prince of Songkla University

- **Advisors**
  - Mr.Chamroon Tangpaisalkit
    ATRANS Chairperson
  - Dr Tuenjai Fukuda
    Secretary General, Asian Transportation Research Society (ATRANS)

Table of Contents

	Page
Chapter 1 Introduction	**1**
1.1 Introduction	1
1.2 Objectives	3
Chapter 2 Review of Designing Safe Routes to School	**4**
Chapter 3 Methodology and Case Study	**7**
3.1 The first phase of survey	8
3.2 The second phase of survey	8
3.3 Case Studies	11
Chapter 4 Results	**12**
4.1 Descriptive results from the first survey	14
4.1.1 Relationship between age and experience of motorcycle using	14
4.1.2 Travel modes and distances to school	15
4.1.3 Perceptions of problems along the route to school	16
4.1.4 Perceptions of existing conditions of the route to school	17
4.1.5 Needs for the route to school	17
4.1.6 Summary of the first survey	18
4.2 Descriptive results from the first survey	19
4.2.1 Perception of road space allocation	20
4.2.2 Perception of pedestrian crossing	21
4.2.3 Perception of speed on the routes to school	22
4.2.4 Perception of travel modes to school	23
4.3 Statistical analysis results	24
Chapter 5 Conclusions	**27**
References	**30**
Appendix A – Logistic Regression Analysis	**31**

CHAPTER 1 Introduction

1.1 Introduction

Safe routes to school (SRTS) program has been interested and implemented in many developed countries, e.g. the United States, United Kingdom, and Austria. Active transport modes (such as walking and cycling) to school associate with daily physical activities for youngsters. Literature reviews have been conducted on relationships with physical activity and health outcomes [1-9].

SRTS is an approach that promotes walking and bicycling to school through engineering (infrastructure improvement), enforcement, education, and encouragement on walking and bicycling to school (U.S. Department of Transportation and http://guide.saferoutesinfo.org).

Developing a SRTS program involves looking at the journeys that children make to and from school and how the safety on these routes can be improved. This process involves the whole school community in assessing risks and working collaboratively to promote safe active travel (Public Health England 2016 Road injury prevention - Resources to support schools to promote safe active travel).

In the United States, McDonald et al. [10] used data collected between 2007 and 2011 at 14 schools with and without SRTS programs and found that education combined with other SRTS interventions (such as sidewalks, crosswalks, and covered bike parking) was associated with increases in walking and biking of 5–20 percentage points. Chillón [11] reviewed SRTS interventions used in the United States, Australia, and the United Kingdom, and identified 14 interventions that focused on active transportation to school for primary school children.

Moreover, it is found that active travel is also associated with environmental characteristics and suggested that school planners should consider these factors when siting schools in order to promote increased physical activity among students [12].

However, in developing countries, creating and innovating to achieve suitable adaptations of these programs with local actors and conditions should receive careful attention [13].

In Thailand, in the past, most of student went to school by themselves either walking or cycling. Nowadays, parents need to accompany their children to schools by motorcycles and private cars. For high school student, most of them ride their own motorcycles to schools. Even many of them live not far from schools (within walking and cycling distance). This is because not only motorcycle is more convenient, but also walking and cycling is not safe (in both traffic safety and security aspects), particularly for primary school students.

Statistics on accidents involving students on their way to school in Thailand and Travel Modes to school are presented in Table 1.1, 1.2 and 1.3, respectively. Most of students travel to school by motorcycle, either self-riding or with parents. Currently, the fatality rate is still rather high, although it seems to decrease, comparing to the peak in 2016.

Table 1.1 Statistics on accidents involving students on their way to school in Thailand

Year	**No. of sample**	**No. of accidents**	**No. of injury**	**No. of disability**	**No. of fatality**	**Rate of fatality (per 100,000)**
2020	261,673	52	51	1	1	0.38
2019	270,752	245	259	-	5	1.85
2018	310,144	185	267	1	5	1.61
2017	307,604	155	248	-	8	2.6
2016	501,287	517	877	1	15	2.99
2015	451,659	234	407	2	11	2.44
2014	419,336	39	194	-	8	1.91
2013	315,395	27	75	1	2	0.63

Source: Road Accident Victims Protection Company Limited - Road Safety Campus www.rvprsc.com/trafficRSC.php

Table 1.2 Travel Modes to school

Travel Modes	No. of sample	Percent
Riding/Driving	22,849	25%
With parents	25,867	29%
School bus	25,436	28%
Public transport	9,580	11%
Walking	3,625	4%
Total	89,793	100%

Table 1.3 Riding/Driving modes to school

Riding/Driving modes	No. of sample	Percent
Bike	2,552	12%
Motorcycle	18,134	85%
Car	255	1%
Pickup	285	1%
Others	37	0%
Total	21,263	100%

Thus, the main aim of this research is to design, organise, monitor and assess safe routes to school program. The output should guide and encourage schools, communities and local governments to plan for safe routes to school program.

1.2 Objectives

It should be noted that the proposed objectives (in the proposal) of this research were: (1) to educate stakeholders (teachers, students, parents and communities) to evaluate and design Safe Routes to School Program by themselves, and (2) to design, organise, monitor and assess safe routes to school programs in Thailand.

However, because the Covid-19 pandemic has been still critical during 2021, these objectives together with the methodology need to change due to group meeting was not allowed by the government's restriction to limit the outbreak.

Thus, new objectives are:

- to understand students' travel behaviours to school,
- to understand students' perceptions of the routes to school, and
- to understand students' perceptions of the safe system, speed and alternative travel modes to school

It is expected that output of the study would provide suggestions on designing interventions of road safety education for designing safe routes to school program.

In summary, this study attempts to understand interaction of students' perceptions and safe system. This would be called a social environment affecting social norm which leads to road user behaviours, e.g. traffic rule compliance and mode choice. The framework of this study can be presented as Figure 1.1.

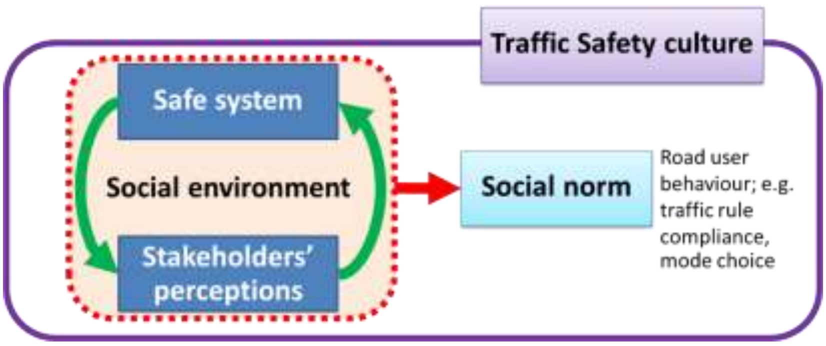

Figure 1.1 Framework for Conceptualising Traffic Safety Culture

CHAPTER 2 Review of Designing Safe Routes to School

Safe routes to school (SRTS) program has been interested and implemented in many developed countries. Successes of the previous programs have been reported, for example:

- Alexander LM, Inchley J, Todd J, Currie D, Cooper AR, Currie C. The broader impact of walking to school among adolescents. BMJonline 2005;331(7524):1061-2.
- Chillón P, Evenson KR, Vaughn A, Ward DS. A systematic review of interventions for promoting active transportation to school. International Journal of Behavioral Nutrition and Physical Activity 2011;8:10.
- Davison KK, Werder JL, Lawson CT. Children's active commuting to school: Current knowledge and future directions. Preventing Chronic Disease 2008;5(3).
- DiMaggio C, Li G. Effectiveness of a Safe Routes to School Program in Preventing School-Aged Pedestrian Injury. Pediatrics 2013;131(2):290-296.
- Hume C, Timperio A, Salmon J, Carver A, Giles-Corti B, Crawford D. Walking and cycling to school: predictors of increases among children and adolescents. American Journal of Preventative Medicine 2009;36:195–200.
- Johnston C, Moreno J. Active commuting to school. American Journal of Lifestyle Medicine 2012;6(4):303-305.
- Kerr J, Rosenberg D, Sallis JF, Saelens BE, Frank LD, Conway TL. Active commuting to school: associations with environment and parental concerns. Medicine and Science in Sports and Exercise 2006;38:787-794.
- Larsen K, Gilliland J, Hess P, Tucker P, Irwin J, He M. The influence of the physical environment and sociodemographic characteristics on children's mode of travel to and from school. American Journal of Public Health 2009;99:520–526.
- Lubans DR, Boreham CA, Kelly P, Foster CE. The relationship between active travel to school and health-related fitness in children and adolescents: A systematic review. International Journal of Behavioral Nutrition and Physical Activity 2011;8:5.
- Mendoza JA, Watson K, Baranowski T, Nicklas TA, Uscanga DK, Hanfling MJ. The walking school bus and children's physical activity: A pilot cluster randomized controlled trial. Pediatrics 2011;128(3):e537–e544.
- Muennig PA, Epstein M, Li G, DiMaggio C. The Cost-Effectiveness of New York City's Safe Routes to School Program. American Journal of Public Health 2014;104(7):1294-9.
- National Center for Safe Routes to School (NCSRTS). How Children Get to School: School Travel Patterns from 1969 to 2009. Chapel Hill, NC: NCSRTS; 2011.

- National Center for Safe Routes to School (NCSRTS). Shifting modes: A comparative analysis of Safe Routes to School Program elements and travel mode outcomes. Chapel Hill, NC: NCSRTS; 2012.
- Orenstein MR, Gutierrez N, Rice TM, Cooper JF, Ragland DR. Safe routes to school safety and mobility analysis. Berkeley: UC Berkeley, Traffic Safety Center, California Department of Transportation (Caltrans); 2007.
- Ragland DR, Pande S, Bigham J, Cooper J. Ten years later - examining the long-term impact of the California Safe Routes to School Program. Berkley, CA: UC Berkley, Safe Transportation Research & Education Center; 2013.

One of the best guidelines for designing safe routes to school is a report titled “Designing Street for Kids” by National Association of City Transportation Officials, NACTO (2020) [14]. This focuses on the specific needs of children as pedestrians, cyclists, and transit users in urban streets. It provides clear guidelines and examples for cities to implement streets that are safe and healthy, comfortable and convenient, inspirational and educational streets that not only for kids but for everyone.

Some important issues that learn from this report and can be taken to design safe routes to school are:

- Knowing children’s needs from streets,
- Identifying challenges, and
- Setting street design strategies.

Along to routes to school, children not only need safety and security, but also many other aspects, for example [14]:

- Reliable mobility choices
- Space
- Places to pause and stay
- Social interaction
- Visibility
- Play and learning
- Security
- A safe environment

There are many challenges should be identified in order to design safe routes to school, for example [14]:

- Fast-moving traffic

- Lack of infrastructure
- Noise pollution
- Lack of exposure to nature
- Poor visibility
- Vehicle design
- Poor water management
- Lack of maintenance
- Personal safety issues
- Urban heat island
- Lack of mobility options

Designing routes to school that meet all the children's needs and be able to tackle the challenges is a difficult task. Street redesign fitting with local contexts should at least consider improving infrastructure quality, slowing vehicles, and protecting pedestrians and cyclists. Multiple design strategies are suggested [14], for example:

- Upgrading streets to meet basic standards of safety and accessibility at a minimum of adequate facilities for walking, cycling, and taking transit
- Designing for appropriate speeds
- Reallocating space for people, sustainable and efficient mobility: walking, cycling and public transport

These design strategies are very useful for designing safe routes to school. They are considered for developing the study methods in Chapter 3.

CHAPTER 3 Methodology and Case Study

Initially the project proposal was divided two tasks: (1) designing and organising safe routes to school program, and (2) monitoring and assessment. These intended to involve safe routes to school program with five groups of interventions, including: engagement, enforcement strategies, engineering strategies, education activities, and encouragement activities, as presented in Figure 3.1.

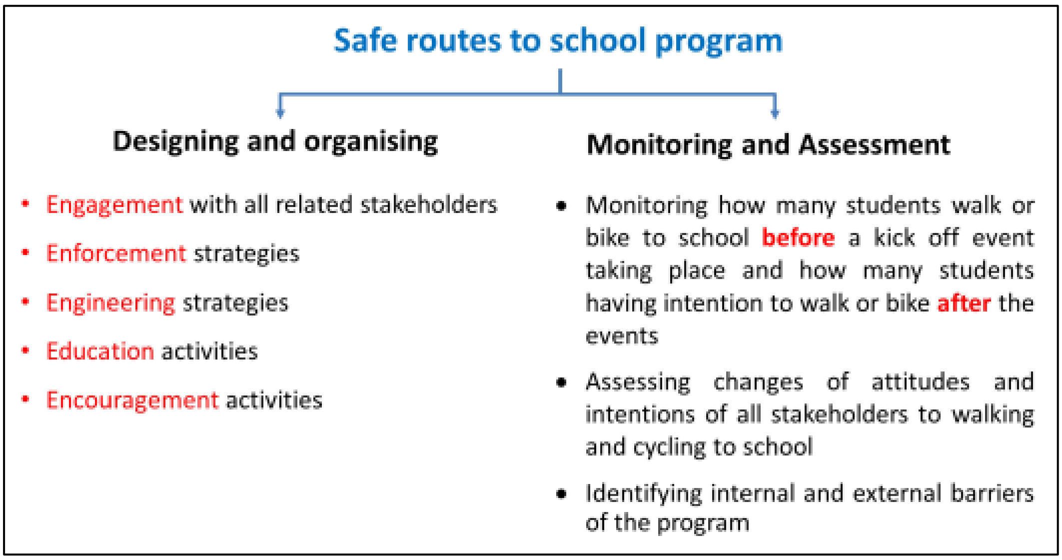

Figure 3.1 Summary of methodology

However, because the Covid-19 pandemic has been still critical during 2021, this methodology needs to change from participatory education process to questionnaire surveys, according to the change of objectives of this project (see Chapter 1). There were two phases of survey. The first one was to understand overall pictures relating to travel behaviours to schools, existing conditions of the route to school and students' needs for the route to school. The second survey was to understand more on how students perceive about the safe system.

The surveys were designed basing on the review in Chapter 2 on children's needs from streets, challenges in designing streets for kids, and street design strategies that consider improving infrastructure quality, slowing vehicles, and protecting pedestrians and cyclists.

3.1 The first phase of survey

The first questionnaire survey was conducted in November 2021 at two case studies, including (1) Thaluang Cementhaianusorn Technical College in Saraburi province, and (2) Suphanburi Technical College in Suphanburi province. There were 361 and 304 respondents, respectively.

This survey was to understand overall pictures relating to travel behaviours to schools and conditions of routes to school. The questionnaire was divided into five main parts, including:

- personal characteristics (gender, age, personal income, household income, driving experience, driving licence, and accident experience)
- travel behaviours to schools (mode choice, alternative mode choice, travel time, travel distance, and travel cost)
- perceptions on problems along the route to school (respondents were asked to rate how serious of problems, including: traffic congestion, air pollution, noise pollution, traffic accident, and security)
- perceptions on existing conditions of the route to school (a prepared list of conditions provided to respondents to rate (5-scale) how much they agree/disagree with each issue, including: secure to travel, shortest, convenient and comfort, coherent, attractive, fully with cars and trucks, speeding cars and trucks, and parking on shoulder lane)
- needs for the route to school (a prepared list of needs provided to respondents to rate (5-scale) how much they need for each issue, including: speed limit at 50 km/hr, speed limit at 80 km/hr, safe and convenient walking route, safe and convenient pedestrian crossing, safe and convenient bike lane, safe and convenient motorcycle lane, standard bus service, route with shady trees, and public space on the way)

3.2 The second phase of survey

The second questionnaire survey was conducted in January 2022 at three case studies, including (1) Thaluang Cementhaianusorn Technical College in Saraburi province, (2) Suphanburi Technical College in Suphanburi province, and (3) Ubon Ratchathani University in Ubon Ratchathani province. There were 568, 361 and 107 respondents, respectively.

Based on the results of the first survey, the second survey was to understand more on how students perceive about the safe system. This included (1) perception of road of road space allocation and pedestrian crossing, (2) perception of speed, and (3) perception of alternative travel modes (walking, cycling and public transport).

Different types of road space allocation and pedestrian crossing were design by the research team and proposed to respondents to choose options that they perceived on four aspects: safety, comfort, attractiveness, and coherence.

The designs of road space allocation for two- and four-lane roads in front of Suphanburi Technical College and Thaluang Cementhaianusorn Technical College present in Figures 3.2 and 3.3, respectively. Option 1 is the current situation, which space allocation and road marking are not clear. Options 2, 3 and 4 are designed to increasingly reallocate more space for walking, cycling and motorcycle.

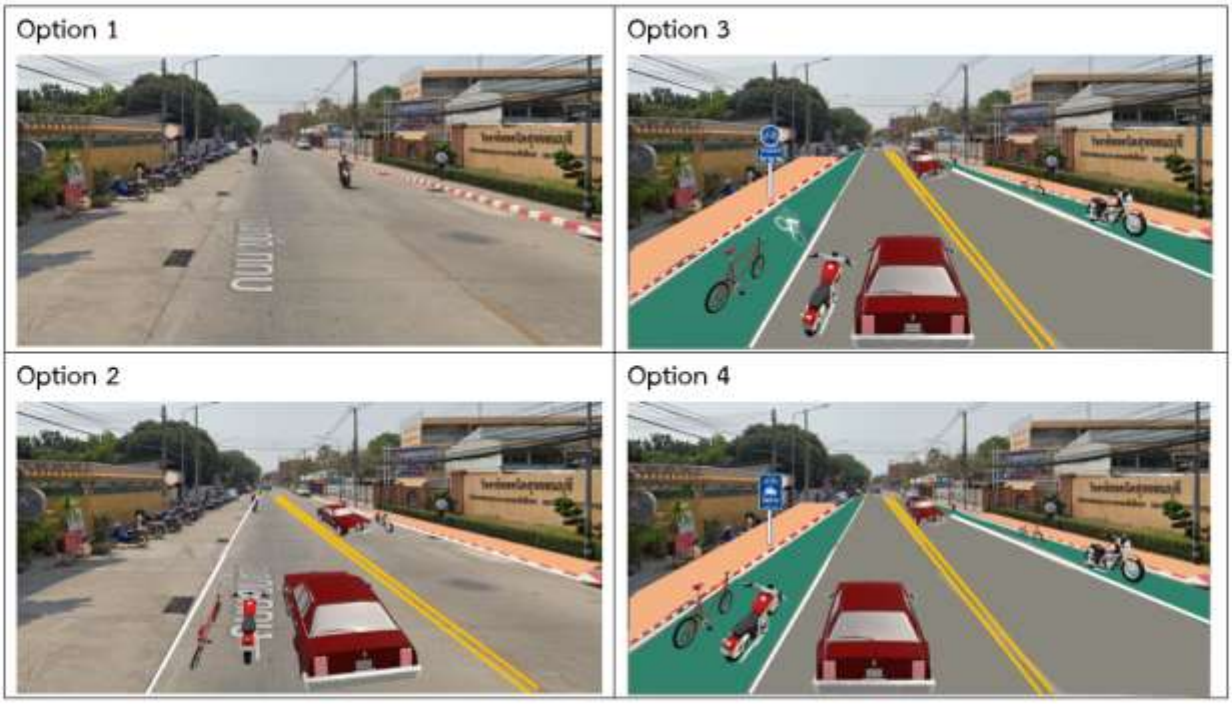

Figure 3.2 Road space allocation for two-lane road

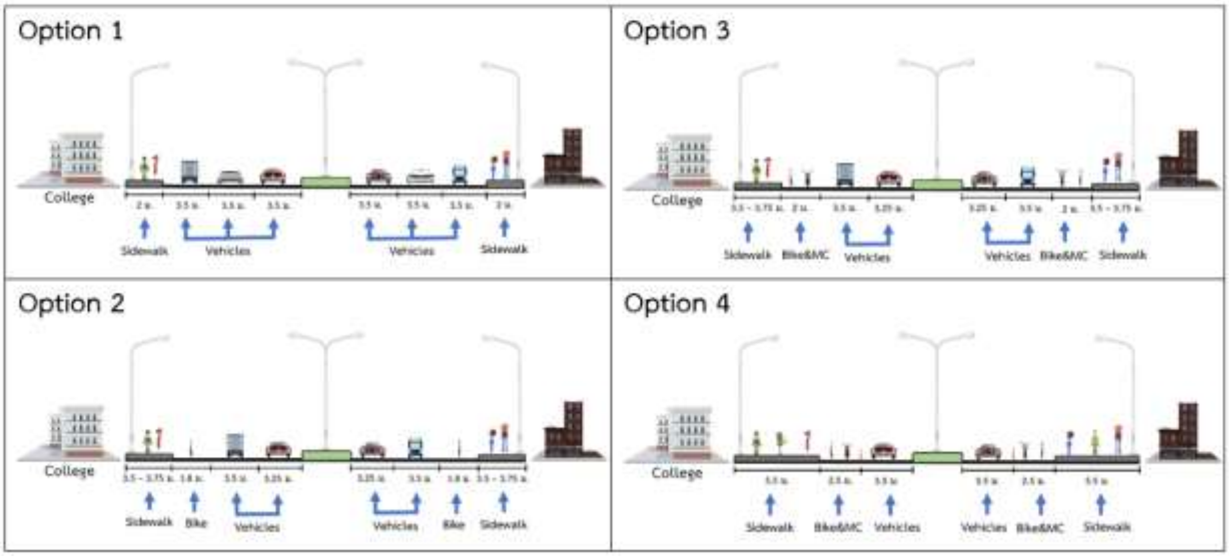

Figure 3.3 Road space allocation for four-lane road

The designs of pedestrian crossing for two- and four-lane roads in front of Suphanburi Technical College and Thaluang Cementhaianusorn Technical College present in Figures 3.4 and 3.5 respectively. Option 1 is the current situation, which pedestrian crossing is not clear. Options 2, 3 and 4 are designed more and more road markings to identify the crossing, which lead to be a safer crossing.

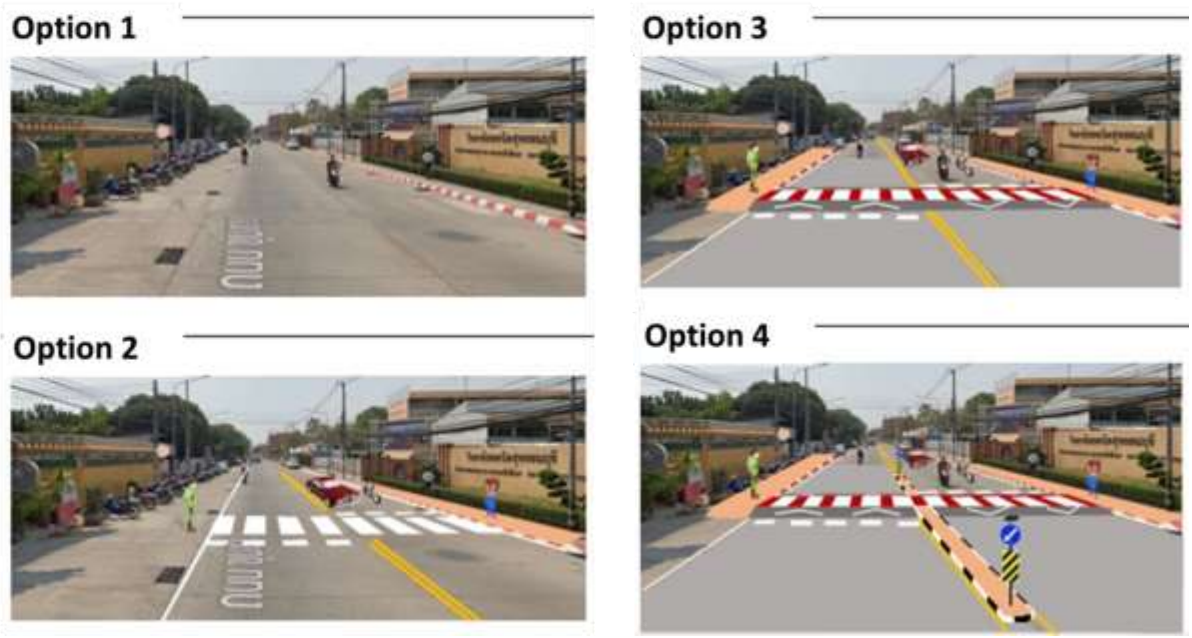

Figure 3.4 Pedestrian crossing for two-lane road

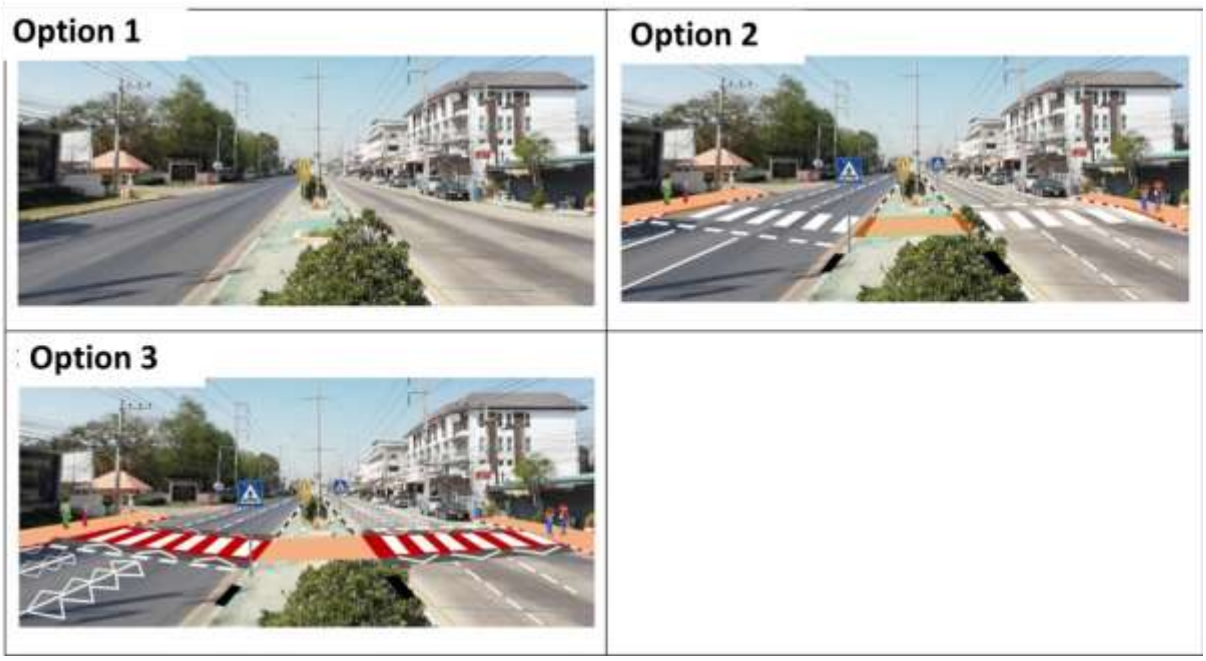

Figure 3.5 Pedestrian crossing for four-lane road

3.3 Case studies

These were three case studies (Figure 3.6) in three provinces in Thailand, including:

- Saraburi province - Thaluang Cementhaianusorn Technical College
- Suphanburi province - Suphanburi Technical College
- Ubon Ratchathani province - Ubon Ratchathani University (UBU) (only the 2nd survey)

Case studies locations

Figure 3.6 Locations of the three case studies

CHAPTER 4 Results

This chapter presents results from the two phases of survey (see Chapter 3). The first one was to understand overall pictures relating to travel behaviours to schools, existing conditions of the route to school and students' needs for the route to school. The second survey was to understand more on how students perceive about the safe system, speed and alternative travel modes to school.

The first questionnaire survey was conducted in November 2021 at two case studies, including (1) Thaluang Cementhaianusorn Technical College in Saraburi province, and (2) Suphanburi Technical College in Suphanburi province. There were 361 and 304 respondents, respectively. Sample characteristics of the first survey are presented Table 4.1.

Table 4.1 Sample characteristics of the first survey

Characteristics	**Saraburi**	**Suphanburi**
Number of samples	361	304
Age (years)	15-22	15-22
Gender		
male	44%	82%
female	56%	18%
Personal income		
Less than 5,000 Baht	93%	88%
5,000 – 9,999 Baht	6%	10%
10,000 Baht or more	1%	2%
Monthly Household income		
Less than 5,000 Baht	16%	13%
5,000 – 9,999 Baht	20%	26%
10,000 – 14,999 Baht	30%	28%
15,000 – 19,999 Baht	13%	9%
20,000 Baht or more	21%	24%
No driving licence	71%	58%

The second questionnaire survey was conducted in January 2022 at three case studies, including (1) Thaluang Cementhaianusorn Technical College in Saraburi province, (2) Suphanburi Technical College in Suphanburi province, and (3) Ubon Ratchathani University (UBU) in Ubon Ratchathani province. Respondents from UBU were two groups. One was the 2nd year student who ever attended basic engineering courses, and the other was 3rd student who ever attended basic engineering and highway engineering courses. Sample characteristics of the second survey are presented Table 4.2.

Table 4.2 Sample characteristics of the second survey

Characteristics	**Saraburi**	**Suphanburi**	**UBU University**	
			2nd year	**3rd year**
Number of samples	568	361	46	61
Age (year)	15-22	15-22	19-22	20-24
Gender				
male	57%	83%	46%	66%
female	43%	17%	54%	34%
Personal income				
Less than 5,000 Baht	91%	89%	65%	54%
5,000 – 9,999 Baht	8%	10%	26%	43%
10,000 Baht or more	1%	1%	9%	3%
Monthly Household income				
Less than 5,000 Baht	16%	15%	11%	3%
5,000 – 9,999 Baht	24%	26%	20%	16%
10,000 – 14,999 Baht	24%	27%	20%	25%
15,000 – 19,999 Baht	12%	12%	22%	13%
20,000 Baht or more	23%	20%	28%	43%
No driving licence	71%	48%	32%	13%

4.1 Descriptive results from the first survey

The first survey was to understand overall pictures relating to travel behaviours to schools, existing conditions of the route to school and students' needs for the route to school. The main issues studied in the first survey includes:

- Relationship between age and experience of motorcycle using
- Travel modes and distances to school
- Perceptions of problems along the route to school
- Perceptions of existing conditions of the route to school
- Needs for the routes to school

4.1.1 Relationship between age and experience of motorcycle using

In Thailand, by laws, the minimum driving age for motorcycle (MC) is 15 years old. But it was obviously found that many motorcyclists are younger than 15 years old. The survey found that high proportion of students has experience of using MC more than 3 years, even they are just 15-16 years old, as presented in Table 4.3.

Table 4.3 Relationship between age and experience of motorcycle using

Experience of MC using	**Age** (year)					
	15	**16**	**17**	**18**	**19**	**20+**
Less than 1 year	20%	14%	10%	5%	13%	8%
1 year	**7%**	12%	4%	6%	4%	2%
2 years	**22%**	**12%**	13%	9%	8%	4%
3 years	**11%**	**23%**	**13%**	16%	8%	11%
4 years	**22%**	**14%**	**14%**	**16%**	9%	12%
5 years or more	**18%**	**25%**	**46%**	**49%**	**59%**	64%

4.1.2 Travel modes and distances to school

Table 4.4 shows that majority of students use motorcycle to school in both provinces. A few uses alternative travel modes (walking, cycling and public transport). Even those who live less than three kilometres from school, majority of them still use MC, as presented in Table 4.5).

Table 4.4 Travel modes to school for the first survey (%)

Travel modes	**Saraburi**	**Suphanburi**
Motorcycle (MC)	84%	70%
MC – self riding	59%	59%
MC – with parent	10%	3%
MC – with friend	15%	8%
Car	5%	7%
Bus	4%	14%
Shuttle bus	1%	4%
Walk	1%	1%
Bike	6%	4%

Table 4.5 Relationship between distance and travel mode

Travel mode	**Distance**		
	≤ 1 km	**1.1 - 3.0 km**	**> 3.0 km**
Car	7%	7%	6%
Bus		3%	10%
Shuttle bus		1%	3%
Bike	7%	4%	5%
Walk	13%	2%	
MC – self riding	**52%**	**53%**	61%
MC – with parent	**3%**	**12%**	6%
MC – with friend	**19%**	**18%**	10%

4.1.3 Perceptions of problems along the route to school

The survey asked students to rank most serious of the five problems, that they perceived along the way to school, including: traffic congestion, air pollution, noise pollution, traffic accident and security. The result presents in Figure 4.1 showing that students perceived traffic accident as a problem much less than traffic congestion, and less than security and air pollution problems. This reflects that students seem not to be aware of traffic accident, comparing to tangible problems that they are facing in their daily life.

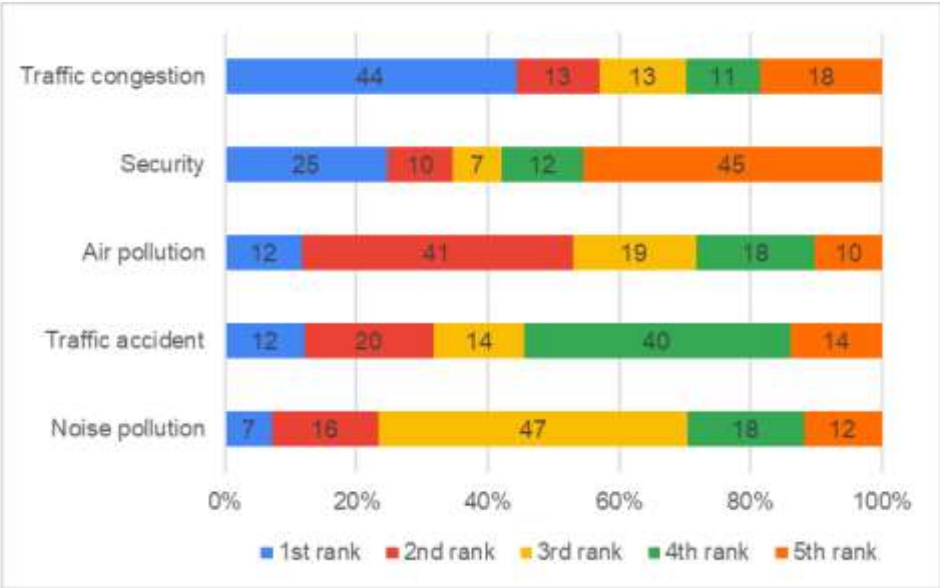

Figure 4.1 Perceptions of problems along the route to school

4.1.4 Perceptions of existing conditions of the route to school

When asking students about existing conditions of their routes to school, it found (Figure 4.2) that they perceived their routes to school having a lot of speeding cars and trucks, and they were not safe and secure to travel to school.

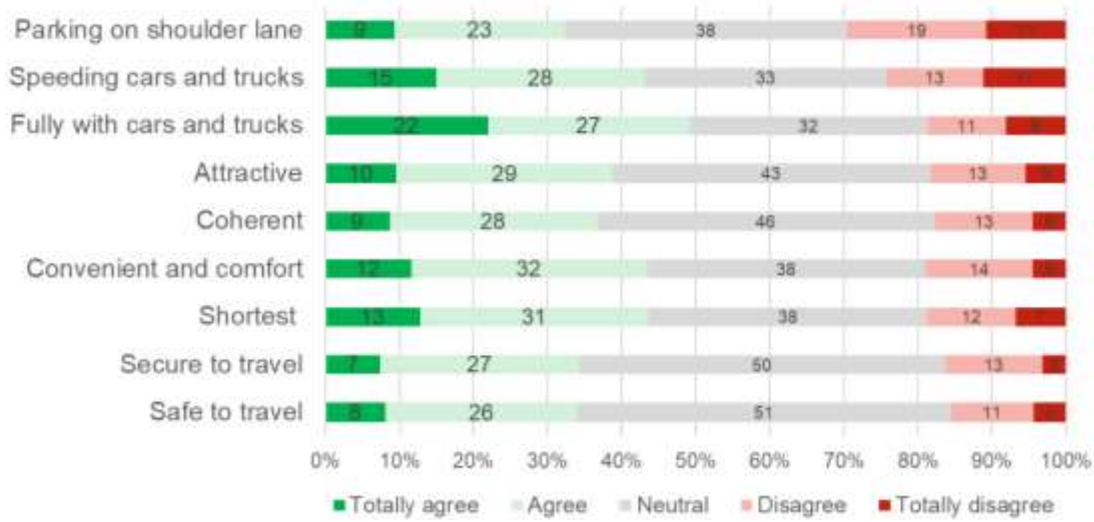

Figure 4.2 Perceptions on existing conditions of the route to school

4.1.5 Needs for the route to school

When asking students what they needed for the route to school, it found (Figure 4.3) that safe infrastructure and alternative modes were needed, but speed limit was less acceptable by students even at 80 km/hr. This may be because students do not understand or have less awareness about safe speed.

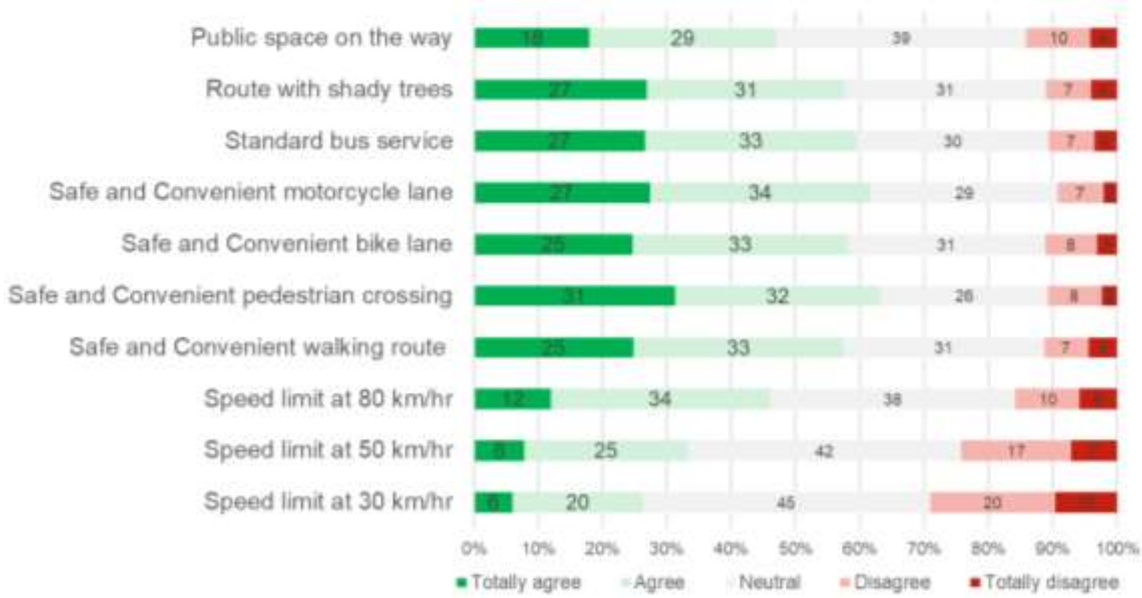

Figure 4.3 Needs for the route to school

4.1.6 Summary of the first survey

The first survey was to understand overall pictures relating to travel behaviours to schools, existing conditions of the route to school, and students' needs for the route to school. It found that most of students travelled to school by motorcycle, even they lived not far from school. They were less aware of traffic accident (compared to traffic congestion) along the routes to school, even they perceived that along the routes were fully with speeding cars and trucks. Thus, they stated that they needed safe and convenient infrastructure for walking, cycling, motorcycle, and bus. However, it surprised that they did not support limiting speed for all vehicles on the route to school. This may be because they would not like to be limit speed when using motorcycle and may not understand or have less awareness about safe speed.

The results from the first survey, therefore, led to some key issues, that were taken into the second survey, for designing safe route to school; including:

- road infrastructure - pedestrian crossing and road space allocation for active transport modes (walking and cycling) and motorcycle,
- speed, and
- alternative modes – bus, walking and cycling

4.2 Descriptive results from the second survey

Samples of the second survey were from the three case studies, including (1) Thaluang Cementhaianusorn Technical College in Saraburi province, (2) Suphanburi Technical College in Suphanburi province, and (3) Ubon Ratchathani University (UBU) in Ubon Ratchathani province.

Similar to the first survey, majority of students used motorcycle to school (presented in Table 4.6). A few used alternative travel modes (walking, cycling and public transport).

Table 4.6 Travel modes to school for the second survey (%)

Travel modes	**Saraburi**	**Suphanburi**	**UBU 2nd yr**	**UBU 3rd yr**
Motorcycle (MC)	83%	69%	74%	84%
MC – self riding	63%	61%	72%	84%
MC – with parent	7%	2%		
MC – with friend	13%	6%	2%	
Car	4%	6%	4%	2%
Bus	3%	7%	7%	2%
Shuttle bus	2%	5%		
Walk	1%	1%		
Bike	7%	11%	15%	13%

The second survey was to understand how students perceive about the safe system, speed and alternative travel modes to school. The main issues studied in the second survey includes:

- Perception of allocation of road space
- Perception of pedestrian crossing
- Perception of speed on the route to school
- Perception of travel modes to school

4.2.1 Perception of road space allocation

The different designs of road space allocation for two- and four-lane roads in front of Suphanburi Technical College and Thaluang Cementhaianusorn Technical College presented in Chapter 3. Option 1 was the current situation, which road space allocation and marking were not clear. Options 2, 3 and 4 were designed to increasingly reallocate more space for walking, cycling and motorcycle. These were proposed to ask respondents to choose options that they perceived on four aspects: safety, comfort, attractiveness, and coherence, and finally ask which option was the most wanted.

The results were not significantly different when respondents choosing the options for different aspects and the option they wanted. Tables 4.7 and 4.8 presents percentages of selection of each option based on safety aspect and wanted option for different sample groups.

Table 4.7 Perception of road space allocation for two-lane road in Suphanburi (% selection of each option)

Option	Safety aspect			Want		
	Suphanburi	UBU 2nd yr	UBU 3rd yr	Suphanburi	UBU 2nd yr	UBU 3rd yr
1 (Current)	19	2	0	19	0	0
2	4	0	2	6	4	2
3	27	48	57	28	46	57
4	50	50	41	46	50	41

Table 4.8 Perception of road space allocation for four-lane road in Saraburi (% selection of each option)

Option	Safety aspect			Want		
	Saraburi	UBU 2nd yr	UBU 3rd yr	Saraburi	UBU 2nd yr	UBU 3rd yr
1 (Current)	18	11	5	18	11	0
2	22	15	23	19	20	23
3	30	61	48	36	61	56
4	30	13	25	28	9	21

The results demonstrated that:

- although most of students wanted options that reallocation of road space for vulnerable road users, “pro-active” options (3+4), still rather high proportion of students in Suphanburi and Saraburi (technical colleges) selected “pro-car” options (1+2),
- very high proportion of students in UBU (civil engineering students) selected “pro-active” options (3+4).

These reflected that there was significant difference of the perceptions of road space allocation between those who have and do not have engineering background knowledge. This is statistically tested in the next section (Section 4.3).

4.2.2 Perception of pedestrian crossing

The designs of pedestrian crossing for two- and four-lane roads in front of Suphanburi Technical College and Thaluang Cementhaianusorn Technical College presented in Chapter 3. Option 1 was the current situation, which road marking was not clear. Options 2, 3 and 4 were designed more and more road markings to identify the crossing, which lead to be a safer crossing (only three options for the four-lane road in Saraburi). These were proposed to ask respondents to choose options that they perceived on four aspects: safety, comfort, attractiveness, and coherence, and finally ask which option was the most wanted.

The results were not significantly different when respondents choosing the options for different aspects and the option they wanted. Tables 4.9 and 4.10 presents percentages of selection of each option based on safety aspect and wanted option for different sample groups.

Table 4.9 Perception of pedestrian crossing for two-lane road in Suphanburi (% selection of each option)

Option	Safety aspect			Want		
	Suphanburi	**UBU 2nd yr**	**UBU 3rd yr**	**Suphanburi**	**UBU 2nd yr**	**UBU 3rd yr**
1 (Current)	5	0	0	6	0	0
2	15	4	5	19	7	5
3	27	15	13	32	13	20
4	53	80	82	43	80	75

Table 4.10 Perception of pedestrian crossing for four-lane road in Saraburi (% selection of each option)

Option	Safety aspect			Want		
	Saraburi	**UBU 2nd yr**	**UBU 3rd yr**	**Saraburi**	**UBU 2nd yr**	**UBU 3rd yr**
1 (Current)	4	2	0	4	7	0
2	30	11	8	39	13	13
3	66	87	92	57	80	87

Similar to the perception of road space allocation, the results demonstrated that although most of students wanted options "pro-active" options (3+4), still rather high proportion of students in Suphanburi and Saraburi (technical colleges) selected "pro-car" options (1+2). There was also very high proportion of students in UBU (civil engineering students) selected "pro-active" options (3+4). There was difference of the perceptions of crossing between those who have and do not have engineering background knowledge. This is statistically tested in the next section (Section 4.3).

4.2.3 Perception of speed on the routes to school

Most of students from all case studies perceived that vehicle speed along their routes to school was more than 50 kilometres per hour (kph), shown in Table 4.11. They also agreed that "Speed is a main cause of road crashes", shown in Figure 4.4. It was obviously seen differences between technical college students (in Saraburi and Suphanburi) who did not have engineering knowledge background and university students (in Ubon Ratchathani) who had engineering knowledge background. This is statistically tested in the next section (Section 4.3).

Table 4.11 Perception of speed on the route to school (% of sample)

Speed	Saraburi	Suphanburi	UBU 2nd yr	UBU 3rd yr
Less than 30 kph	12	9	2	5
30 - 50 kph	24	23	35	33
50 - 80 kph	48	49	48	56
More than 80 kph	16	20	15	7

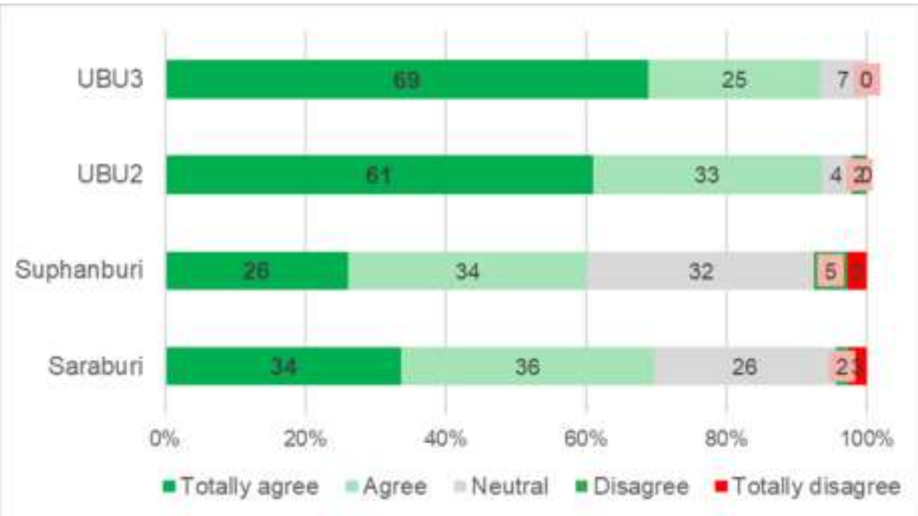

Figure 4.4 Perception of speed as a main cause of road crashes

Although most of students agreed that speed is a main cause of road crashes, acceptability of speed limits (all vehicles on the routes to school) was not as high as expected, particularly rather low for technical college students, as shown in Table 4.12.

Table 4.12 Acceptability of speed limits (% of sample)

Speed limit	Saraburi	Suphanburi	UBU 2nd yr	UBU 3rd yr
30 kph	30	21	28	31
50 kph	45	32	59	61
80 kph	47	39	67	66

4.2.4 Perception of travel modes to school

Majority of students used motorcycle to school. When asking reasons of mode choice, it found that most of them highly concerned on convenience, rather than safety and security, which were the lowest concerns (shown in Table 4.13).

Then asking possibility to change from the current travel modes to alternative modes: walking, cycling and public transport, if there were good facilities and services provided, and also if they lived not far from school for the cases of walking and cycling, about 15-20% would “definitely use” the alternative modes (shown in Table 4.14).

Table 4.13 Reasons of current mode choice (% of sample)

Reasons	Saraburi	Suphanburi	UBU 2nd yr	UBU 3rd yr
No alternative	29	21	35	38
Affordable	23	33	48	46
Security	19	18	22	13
Traffic safety	21	19	24	21
Convenience	70	70	85	93
Fast	43	41	76	72

Table 4.14 Modal shift to alternative modes (% of sample who answer “definitely use”)

Travel Modes	Saraburi	Suphanburi	UBU 2nd yr	UBU 3rd yr	Average
Walking*	18	15	9	16	14
Cycling*	20	15	17	23	19
Bus	14	11	15	18	15

* if living not far from school

4.3 Statistical analysis results

Statistical analysis is based on binary logistic regression. It is to find out what factors affecting the perceptions of students on choosing road space allocation options and pedestrian cross options (different design options presented in Chapter 3), and the acceptability of speed limit.

Factors considered include personal characteristics (gender, age, household income, and driving licence) and experiences (motorcycle using experience and basic engineering background), as presented in Table 4.15.

Table 4.15 Studied factors affecting perceptions of safe system and speed

Studied factor	Variable name	Data type
Gender	• Female - Dummy variable of female	Category data (based group – Male)
Age	Age	Scale data (unit - Year)
Household income	• Income2 = Dummy variable of 10,000 – 19,999 Baht/month • Income3 = Dummy variable of 20,000 Baht/month or more	Category data (based group – Less than 10,000 Baht/month)
Driving licence	• Licence2 = Dummy variable of having licence 1-2 years • Licence3 = Dummy variable of having licence 2 years or more	Category data (based group – no licence or having licence less than one year)
Motorcycle using experience	• Exp2 = Dummy variable of using motorcycle 1-2 years • Exp3 = Dummy variable of using motorcycle 3-4 years • Exp4 = Dummy variable of using motorcycle 5 years or more	Category data (based group – never using motorcycling or using motorcycle less than 1 year)
Basic engineering background	• Eng2 = Dummy variable of UBU 2nd year students with basic engineering background • Eng3 = Dummy variable of UBU 3rd year students with basic and highway engineering background	Category data (based group – Dummy variable of technical college students without basic engineering background

These studied factors were treated as independent variables. Dependent variables were perceptions on safe system and speed (descriptive results presented in Section 4.2) including:

- Perception of road space allocation for two-lane road
- Perception of road space allocation for four-lane road
- Perception of pedestrian crossing for two-lane road
- Perception of pedestrian crossing for four-lane road
- Perception of 30kph speed limit
- Perception of 50kph speed limit

The perceptions of road space allocation and pedestrian crossing were discrete data divided into two groups, including “pro active” and “pro car”. The first one was the safer options (3 or 4) for walking, cycling and motorcycle, and the later one was the less safe or current options (1 or 2). Perception of 30 and 50 kph speed limit was in terms of acceptability, divided into acceptance and unacceptance of 30 and 50 kph speed limit.

Binary logistic regression analysis for choosing “pro active” option is presented, as follows:

$$ln\left[\frac{P\,r(\,pro\ active)}{P\,r(\,pro\ car)}\right] = Constant + \ \beta 1(variable1) + \beta 2(variable2) + \cdots$$

Where:

Pr(pro active)	= Probability of choosing “pro active” option
Pr(pro car)	= Probability of choosing “pro car” option
β1	= Coefficient of variable 1
β2	= Coefficient of variable 2

Binary logistic regression analysis for acceptance of speed limit is presented, as follows:

$$ln\left[\frac{P\,r(\,acceptance)}{P\,r(\,unacceptance)}\right] = Constant + \ \beta 1(variable1) + \beta 2(variable2) + \cdots$$

Where:

Pr(acceptance)	= Probability of acceptance of speed limit
Pr(unacceptance)	= Probability of unacceptance speed limit
β1	= Coefficient of variable 1
β2	= Coefficient of variable 2

Analysis results show that only some variables significantly affect the perceptions, parameters in the models are presented in detail in Appendix A1-A6. Summary of the results is presented in Table 4.16.

Table 4.16 Summary of binary logistic regression analysis

Dependent variables	Significant factors at 95% confidence	Sign
Perception of road space allocation for two lane road	UBU2 UBU3 Constant	+ + +
Perception of road space allocation for four lane road	UBU3 Constant	+ +
Perception of pedestrian crossing for two lane road	UBU2 UBU3 Female Constant	+ + + +
Perception of pedestrian crossing for four lane road	UBU2 UBU3 Constant	+ + +
Perception of 30kph speed limit	Female Constant	+ –
Perception of 50kph speed limit	UBU2 UBU3 Constant	+ + –

These results can be summarised and interpreted as follows:

- The main factors that significantly positive (+ sign) influence all perceptions are UBU2 and UBU3. This reflects that those who have basic and highway engineering background have more awareness of safe system and speed than those who do not have engineering background.
- The other positive significant factor is Female, which affecting the perception of pedestrian crossing for two lane road and perception of 30kph speed limit. This reflects that females are more concern than males on safety for two lane road (without pedestrian island) and speeding vehicles.
- Constant is positive significant affecting the perceptions of road space allocation and pedestrian crossing. This reflects that there are other factors that positively influence the perceptions. But constant is negative significant affecting the perceptions of speed limit. This reflects that students generally do not accept speed limit.
- Other factors do not significantly affect the perceptions of safe system and acceptance of speed limit at 95% confidence.
- Having driving licence is not significant, so the perceptions of safe system and acceptance of speed limit between those who have and do not have driving licence are not different. This reflects that the road safety education and driving licence test may not be effective.

CHAPTER 5 Conclusions

Designing routes to school that meet all students' needs and be able to tackle the challenges is a difficult task. Street redesign fitting with local contexts should at least consider improving infrastructure quality, slowing vehicles, and protecting pedestrians and cyclists.

This research focuses on how to design safe routes to school to fit with Thailand's conditions. Therefore, the objectives are: (1) to understand students' travel behaviours to school, (2) to understand students' perceptions of the routes to school, and (3) to understand students' perceptions of the safe system, speed and alternative travel modes to school.

Multiple design strategies based on the literature review in this study are:

- Upgrading streets to meet basic standards of safety and accessibility at a minimum of adequate facilities for walking, cycling, and taking transit
- Designing for appropriate speeds
- Reallocating space for people, sustainable and efficient mobility: walking, cycling and public transport

These were considered for developing the study methods. There were two phases of survey. The first one was to understand overall pictures relating to travel behaviours to schools, existing conditions of the route to school and students' needs for the route to school. The second survey was to understand more on how students perceive about the safe system.

These were three case studies in three provinces in Thailand, including: (1) Thaluang Cementhaianusorn Technical College in Saraburi province, (2) Suphanburi Technical College in Suphanburi province, and (3) Ubon Ratchathani University (UBU) in Ubon Ratchathani province. Students participated in the surveys were 15-24 years old.

Overall pictures relating to travel behaviours to schools and conditions of the route to school were:

- majority of students used motorcycle to school, even those who lived less than three kilometres from school,
- high proportion of students started using motorcycle when they were 10 or 11 years old,
- students were less aware of traffic accident, comparing to other tangible problems e.g. traffic congestion, security and air pollution problems,

- for the route to school, students would like to have safe infrastructure and alternative modes, but speed limit was less acceptable by students,

These results led to some key issues for designing safe routes to school; including:

- road infrastructure - pedestrian crossing and road space allocation for active transport modes (walking and cycling) and motorcycle,
- speed, and
- alternative travel modes – bus, walking and cycling.

Different types of road space allocation and pedestrian crossing were design by the research team (see Chapter 3) and proposed to ask respondents to choose options that they wanted, also ask about perceptions on speed limit and alternative travel modes.

The key findings were that:

- most of students wanted options that reallocation of road space and pedestrian crossing design for protecting vulnerable road users (pedestrians, cyclists and motorcyclists),
- still rather high proportion of students in Suphanburi and Saraburi (technical colleges) selected less-safe options,
- very high proportion of students in UBU (civil engineering students) selected safe options,
- although most of students agreed that speed is a main cause of road crashes, acceptability of speed limits (all vehicles on the routes to school) was not as high as expected, particularly rather low for technical college students,
- for reasons of travel mode choice to school, most of them highly concerned on convenience, rather than safety and security,
- if there were good facilities and services provided, about 15-20% would shift to use alternative travel modes (walking, cycling and public transport),
- those who have basic knowledge on highway engineering have more awareness of safe system and speed than those who do not have (some students cannot identify safe and unsafe road infrastructure and speed),
- females are more concern than males on safe system and speed,
- the perceptions of safe system and acceptance of speed limit between those who have and do not have driving licence were not different. This reflects that the road safety education and driving licence test may not be effective.

In conclusions, for the engineering aspect, designing safe routes to school needs to consider improving infrastructure quality (particularly pedestrian crossing and road space reallocation for vulnerable road users), and slowing vehicles. Moreover, providing good alternative travel modes can encourage some modal shift. On the other hand, road safety education needs to increase awareness of students on safe system and speed. Providing students on basic knowledge on highway engineering may influence awareness of safe system and speed.

Future research may study on:

- integrating road safety education with engineering design, which may motivate awareness of students on safe system and speed,
- contributing of safe infrastructure (e.g. road space reallocation) to health [15] and the environment (e.g. climate change),
- effect of young people's attitudes towards health, climate change and carbon neutral on motivating walking and cycling,
- estimating valuation of safe road facilities and benefits of walking, cycling, and bus services, which would be useful for project evaluation and led to budget allocation on safe infrastructure for walking, cycling, and bus.

References

1. Ogilvie D, Egan M, Hamilton V, Petticrew M: Promoting walking and cycling as an alternative to using cars: systematic review. Br Med J 2004, 329:763-766B.
2. Pont K, Ziviani J, Wadley D, Bennett S, Abbott R: Environmental correlates of children's active transportation: a systematic literature review. Health Place 2009, 15:827-840.
3. Lee MC, Orenstein MR, Richardson MJ: Systematic review of active commuting to school and childrens physical activity and weight. J Phys Act Health 2008, 5:930-949.
4. Faulkner GE, Buliung RN, Flora PK, Fusco C: Active school transport, physical activity levels and body weight of children and youth: a systematic review. Prev Med 2009, 48:3-8.
5. Davison KK, Werder JL, Lawson CT: Children's active commuting to school: current knowledge and future directions. Prev Chronic Dis 2008, 5:A100.
6. Panter JR, Jones AP, van Sluijs EM: Environmental determinants of active travel in youth: A review and framework for future research. Int J Behav Nutr Phys Act 2008, 5:34.
7. McMillan TE: Urban Form and a Child's Trip to School: The Current Literature and a Framework for Future Research. Journal of Planning Literature 2005, 19:440-456.
8. Tudor-Locke C, Ainsworth BE, Popkin BM: Active commuting to school - An overlooked source of childrens' physical activity? Sports Med 2001, 31:309-313.
9. Sirard JR, Slater ME: Walking and Bicycling to School: A Review. American Journal of Lifestyle Medicine 2008, 2:372-396.
10. McDonald NC, Yang Y, Abbott SM, Bullock AN: Impact of the Safe Routes to School program on walking and biking: Eugene, Oregon study. Transport Policy 2013, 29:243-248.
11. Chillón P, Evenson KR, Vaughn A, Ward DS: A systematic review of interventions for promoting active transportation to school. International Journal of Behavioral Nutrition and Physical Activity 2011; 8:10.
12. Larsen K, Gilliland J, Hess P, Tucker P, Irwin J, He M: The Influence of the Physical Environment and Sociodemographic Characteristics on Children's Mode of Travel to and From School. Am J Public Health. 2009; 99:520–526.
13. Sagaris L, Lanfranco D: Beyond "safe": Chilean "Kool" routes to school address social determinants of health. Journal of Transport & Health 2019; 15.
14. National Association of City Transportation Officials – NACTO (2020) Designing Street for Kids, Global Designing Cities Initiative (GDCI) program, Island Press.
15. Public Health Scotland (2022) Road Space Reallocation Contributes to Improved Health, Public Health and Sustainable Transport Partnership group, https://www.publichealthscotland.scot.

Appendix A – Logistic Regression Analysis

A1 - Perception of road space allocation for two lane road

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	438.596	.075	.117

Classification Table[a]

Observed			Predicted		
			l2_allo		Percentage Correct
			pro car	pro active	
Step 1	l2_allo	pro car	0	96	0.0
		pro active	0	372	100.0
	Overall Percentage				79.5

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	UBU2	2.033	.733	7.691	1	.006	7.634
	UBU3	3.036	1.015	8.939	1	.003	20.821
	Constant	1.058	.120	77.339	1	.000	2.882

a. Variable(s) entered on step 1: UBU2, UBU3.

A2 - Perception of road space allocation for four lane road

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	869.215	.007	.009

Classification Table[a]

Observed			Predicted		
			l4_rello		Percentage Correct
			pro car	pro active	
Step 1	l4_rello	pro car	0	236	0.0
		pro active	0	439	100.0
	Overall Percentage				65.0

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	UBU3	.643	.316	4.138	1	.042	1.901
	Constant	.569	.084	45.821	1	.000	1.766

a. Variable(s) entered on step 1: UBU3.

A3 - Perception of pedestrian crossing for two lane road

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	446.857	.064	.100

Classification Table[a]

Observed			Predicted		
			l2_cross		Percentage Correct
			pro car	pro active	
Step 1	l2_cross	pro car	0	97	0.0
		pro active	0	371	100.0
	Overall Percentage				79.3

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	UBU2	1.302	.619	4.418	1	.036	3.676
	UBU3	1.766	.607	8.465	1	.004	5.848
	Female	.886	.364	5.939	1	.015	2.426
	Constant	.964	.128	56.356	1	.000	2.621

a. Variable(s) entered on step 1: UBU2, UBU3, Female.

A4 - Perception of pedestrian crossing for four lane road

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	870.629[a]	.047	.064

Classification Table[a]

Observed			Predicted		
			l4_cross		Percentage Correct
			pro car	pro active	
Step 1	l4_cross	pro car	0	264	0.0
		pro active	0	411	100.0
	Overall Percentage				60.9

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	UBU2	1.152	.381	9.128	1	.003	3.163
	UBU3	1.629	.389	17.566	1	.000	5.098
	Constant	.262	.085	9.586	1	.002	1.300

a. Variable(s) entered on step 1: UBU2, UBU3.

A5 – Acceptability of 30 kph speed limit

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1169.786	.030	.043

Classification Table[a]

Observed			Predicted		
			Accep_sp30		Percentage Correct
			Not agree	Agree	
Step 1	Accep_sp30	Not agree	760	0	100.0
		Agree	276	0	0.0
	Overall Percentage				73.4

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	Female	.811	.145	31.438	1	.000	2.250
	Constant	-1.322	.094	198.611	1	.000	.267

a. Variable(s) entered on step 1: Female.

A6 – Acceptability of 50 kph speed limit

Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	1353.735	.052	.070

Classification Table[a]

Observed			Predicted		
			Accep_sp50		Percentage Correct
			Not agree	Agree	
Step 1	Accep_sp50	Not agree	427	174	71.0
		Agree	217	218	50.1
	Overall Percentage				62.3

a. The cut value is .500

Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 1[a]	UBU2	.604	.314	3.698	1	.054	1.830
	UBU3	.862	.276	9.775	1	.002	2.367
	Female	.854	.135	39.811	1	.000	2.349
	Constant	-.702	.084	70.611	1	.000	.496

a. Variable(s) entered on step 1: UBU2, UBU3, Female.

Final Report

Research Grant 2021

ATRANS