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School of Transportation Sciences

Master of Transportation Sciences

Master's thesis

An Application of the Gamified E-Learning Platform to Improve Road Safety Education in Indonesia: Case Study Jakarta

Zagita Heryani Putri

Thesis presented in fulfillment of the requirements for the degree of Master of Transportation Sciences, specialization Traffic Safety

SUPERVISOR :

Prof. dr. Davy JANSSENS

CO-SUPERVISOR :

dr. Ariane CUENEN

MENTOR :

De heer Roeland PAUL



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Preface

This document was completed as part of the requirements for Master Thesis which forms part of the Master in Transportation Science at Hasselt University. I selected this topic, which was a road safety education platform developed by IMOB (Instituut voor mobiliteit), because of my interest in applying it in my home country (Indonesia).

I would like to express my gratitude to my supervisory team: Professor Janssens (Supervisor), Dr. Cuenen (co-Supervisor), Dr. Aine (Local Supervisor) and Mr. Paul (Mentor). I would like to thank them for their support and guidance through this process.

I would also like to thank VLIR-UOS scholarship without whom my dream to achieve my master's studies would not be possible. Finally, I would like to thank my family and friends who had been the source of my motivation throughout my master's study.

Summary

Around the world, each year 186.300 children age 0-17 years die from road traffic crashes (WHO, 2015). In the Greater Jakarta Region of Indonesia, 20% of a road traffic crash involving children age 0-17 years old (IRSMS, 2018). Based on the data by IRSMS (2018), children age 9-14 years have the 2nd highest number of reported road traffic crashes among children age 0-17 years in Greater Jakarta Region. One of the reasons is they have more independence as a pedestrian at that age.

An intervention might be needed to provide a safer environment around schools and reduce their road traffic injuries among children. The 5 E's interventions of road safety: Enforcement, Engineering, Education, Encouragement, and Evaluation can improve the safety of road users. Road safety education (RSE) is important for all road users especially for children so they can keep themselves safe. Rose 25 (2005) stated RSE covers three pillars: knowledge, skills, and attitudes.

Route2School e-learning platform that is developed by the Transportation Research Institute (IMOB) of Hasselt University can be seen as the solution since it covers several aspects of RSE such as knowledge and skills. This platform is the first in the world that combines e-learning with gamification elements for RSE programs (Riaz, 2019). Many studies have stated that the gamification element has increase student's motivation. The platform also uses familiar and unfamiliar situations of the road environment as the question in each module because it considers children discrepancies in learning skills and behavior in different situations. It has been developed in Belgium and Vietnam, both with positive effects on students learning.

This research aims to evaluate Route2School as a road safety education method in Indonesia. The study will measure the process and outcome evaluation of the Route2School platform on elementary and junior high school students in Jakarta, Indonesia. The outcome evaluation will be measure through the changes in student's skills, knowledge, and behavior. The skills and knowledge change was measure using the results from the platform and the behavior change was measure using the Theory of Planned Behavior variable in the questionnaire. Meanwhile, the process evaluation will be measure through the process evaluation section in the questionnaire.

It will also compare the results of the questionnaire from students who use the platform and students who did not use the platform. The data collection takes a total of 5 weeks and uses a pre-intervention questionnaire, Route2School platform, and post-intervention questionnaire. Several elements of data collection were changed due to the situation that is caused by COVID-19. The research which is done to the 7th grade private junior high school students in Jakarta shows a positive impact on outcome evaluation for Route2School compares to students who did not use the platform. The teachers and students also give a positive review of the platform.

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1. Introduction

Road traffic injuries are the eighth leading cause of death globally (World Health Organization [WHO], 2018). According to WHO (2018) 1.35 million people are killed in road traffic crashes every year and it is the leading cause of death for children and young adults age 5-29 years. Death from road traffic injury ranks among the top four causes of death for all children over the age of five and 186.300 children age 0-17 years die each year from road traffic crashes around the world (WHO, 2015). 95% of road traffic crash among children occurs in the world's low and middle-income countries (WHO, 2015). Children in low and middle-income countries have a three times higher rate of road traffic death than those in high-income countries (WHO, 2015).

Indonesia, as the fourth largest population in the world, is home to approximately 90 million children that made up approximately 34% of the total population (Indonesian Statistics, 2019). The statistics showed that children at elementary school-aged 5 – 9 years old have reached 23,8 million in 2018. While children age 10-14 in elementary and middle school have reached 22.8 million and age 15-19 in elementary and high school have reached 22.2 million in 2018 (Indonesian Statistics, 2019). Road safety in Indonesia is a serious problem with a reported 31.282 road traffic fatalities in 2016 (WHO, 2018). Indonesia also faces a high growth of motorized vehicles of 13% since 2016 (Indonesian Statistics, 2019). Meanwhile, children (0-17 years old) made up for 20% of a road traffic crash in the Greater Jakarta Region (IRSMS, 2018). Therefore, there is a need for interventions for children, in particular, to provide a safer environment around schools and reduce their exposure to road traffic injuries.

Some interventions can improve the safety of road user which are known as the 5 E's of road safety: Enforcement, Engineering, Education, Encouragement, and Evaluation. Road safety education (RSE) is important for all road users because each responsible for traffic safety, especially for children so they can keep themselves safe. Rose 25 (2005) stated RSE covers three pillars: (1) raising knowledge and understanding of situations and traffic rules, (2) improving skills through exercise and experience, and (3) reinforcing the positive attitudes towards safety of other road users, personal safety, and risk awareness. Sayer & Palmer (1977) stated several considerations such as appropriateness of the program to the children age and teaching method needs to be made in order to be able to use RSE in children

Ben-Bassat & Avnieli (2016) stated one way that is proved to be effective in giving children RSE is through educational programs by educational institutions. The study also stated that children's road safety interventions in schools have been shown in many studies to have a positive impact on children's behavior as car passengers, pedestrians, and bike riders and thus reduce the possibility of them getting injured (Ben-Bassat & Avnieli, 2016). Many countries in the world have road safety education within the formal education system (Dragutinovic & Twisk, 2006). However, in Indonesia, this just happens in 2019, when Indonesia National Traffic Police Corps (INTPC) and Ministry of Education and Culture, implement the dissemination of the traffic education integration model through the mandatory Civics Education Subject at elementary school (www.gaikindo.or.id, 2019). Before 2019, road safety education programs only exist outside the formal education through several socialization and campaign activities by INTPC and Ministry of Education and Culture. The socialization and campaign activities mainly focused on giving knowledge

regarding traffic rules and awareness. Nevertheless, according to Clayton et al. (1995), children needed more than knowledge regarding traffic rules and sheer exposure to traffic to be a safe road user with developed decision-making skills. Children need to learn road skills that are based on their local environment, awareness about the road environments and the strategies needed to cope safely based on the situations (Clayton et al., 1995).

The Transportation Research Institute (IMOB) of Hasselt University has successfully developed a traffic safety e-learning platform called Route2School (Pham, 2019). The platform covers several aspects of RSE such as knowledge, situation awareness, risk detection, and risk management. Thus, children will not only develop knowledge about traffic laws but they also developed decision making skills and behavior. Route2School is also different than other RSE programs since it uses gamification as a teaching method that uses context-relevant footage. This platform is the first in the world that combines e-learning with gamification elements for RSE programs (Riaz, 2019). The footage in the platform is taken from the familiar and unfamiliar situations of the road environment of the children because it considers children discrepancies in learning skills and behavior in different situations. Route2School education platform has been developed in Belgium and Vietnam, both with positive effects on students learning.

The study by Ahsan (2014) on elementary and junior high school students in Bandung Regency (Indonesia) showed that only 2.87% of students said they receive lessons related to road safety by the police. This data revealed how the lessons might be unevenly distributed throughout the school in Indonesia by INTPC. Since Route2School is an e-learning platform, its ability to overcome the limitations of time and place in conventional learning (Utomo et al., 2014). Thus it can solve the problem of uneven RSE in Indonesian schools.

This research aims to focus on applying road safety education using the gamified e-learning platform in Jakarta, Indonesia. Route2School will be adapted based on the situations in Jakarta and use the national language or English based on school preferences. Students in the 4th – 8th grade of elementary and junior high school in Jakarta was chosen as the focus for the study because they have more independence as a child road user and they are the second-highest of the children age group that involves in a road traffic crash in Greater Jakarta.

1.1 Research Area

Jakarta, the capital of Indonesia, is one of the fastest-growing megacities in the world with approximately 9,6 million inhabitants in 2010 (Wismadi et al., 2013). Jakarta have an area of 661.5 km² that is divided into 5 areas (Figure 1) with approximately over than 9 million populations. Jakarta has a strategic role in national development, particularly the economic, political, and socio-cultural structures (Rustiadi, et al., 2015). Situated on Indonesia's most populous island of Java, Jakarta metropolitan areaa becomes the center of the economy with Gross Domestic Product contributed 25.52% in the national economy (Rustiadi, et al., 2015). Indonesia has a tropical climate with an average temperature of 28.7 Celsius degree. There are rains throughout the year; however, it peaks between October-December.



Figure 1. Administrative Map of Jakarta (Source: <https://latitudes.nu/jakarta-city-layout/>)

According to the data of Statistics of DKI Jakarta Province in 2018, the recorded number of motor vehicles in Jakarta is more than 18 million and the motorcycle is the dominant composition or 70% of the total vehicle in Jakarta (13 million). Meanwhile, the rate of car ownership is around 19% of the total vehicle in Jakarta or 3.5 million (Statistics of DKI Jakarta Province, 2019).

Based on the data by Statistics of DKI Jakarta Province (2019) there are 2.284 kindergartens, 2.476 elementary schools, 1.071 Junior High School, and 489 Senior High School in Jakarta. For the school year 2018-2019, there were 817 thousand children in kindergarten, 363 thousand students in elementary schools, 170 thousand students in Junior High schools, and 219 thousand students in Senior High School (Statistics of DKI Jakarta Province, 2019). With the total number of students accounting for more than 15% of the population, they require special attention to education.

1.2 Problem Statement

There is a high number of fatalities in children because of a road traffic crash in Indonesia. Based on the data by IRSMS (2018), children age 9-14 years who are not yet able and legal to ride a motorized vehicle have the 2nd highest number of reported road traffic crash among children age 0-17 years in Greater Jakarta. This happened might be because they have more independence as a pedestrian at that age. Thus intervention such as education is needed in order to be able to reduce casualties among children road users as a pedestrian.

Road safety education for children in Indonesia has been mainly done through socialization and campaign at school with indoor activities and outdoor training with limited area. Most of these programs are only held only for a few days and only focused on giving knowledge regarding traffic rules. Nevertheless, children needed more than knowledge in order to become safer road users. Based on the research by Ahsan (2014), only a few students in Indonesia that have been taught by the police even though they are the one who is responsible to teach it to the children based on Indonesian Law. These can happen because of the limited resources, places and also time in teaching schedules. However, this has resulted in uneven RSE in Indonesian schools.

Route2School, the gamified e-learning platform about traffic safety that is developed by the Transportation Research Institute (IMOB) of Hasselt University can be seen as a solution to these problems. Route2School content covers several aspects of RSE that can help children developed their knowledge and also decision making skills and behavior. Since it's an e-learning platform, it can be implemented without the limitation of resources, places, and time in teaching. Nevertheless, because it never been implemented before in Indonesia, a study about the effectiveness of the program is needed to evaluate the changes in knowledge, behavior, and skills of the target groups intended.

Based on the research by Raftery & Wundersitz (2011) there are two main types of evaluation used to assess program effectiveness: outcome evaluations and process evaluations. Process evaluations are determined by how the program reaches the intended target groups and the effectiveness of the program delivery. Meanwhile, outcome evaluation determines the effectiveness of the program in terms of the desired outcome within a defined population, through changes in behavioral intentions or observed behavior, self-reported attitudes or beliefs, and knowledge. Changes or improvement in behavioral intentions can be predicted through social psychology studies originating from theoretical models such as Theory of Planned Behavior (TPB).

The aim of this research is to measure process and outcome evaluations in order to determine changes in students' knowledge, behavior and skills on road safety because of Route2School intervention. The results of the study will have a clear implication of Route2School and can encourage schools or governments in Indonesia to adapted it in the school curriculum.

1.3 Research Objective and Questions

The main objective of this research is to evaluate the effect of e-learning with gamification as a method of road safety education to students in Indonesia. The study focused on the application of the Route2School education platform to elementary and junior high school students in Jakarta, then measures the outcome evaluation and process evaluation.

Research questions are:

1. What are five most difficult & easy questions from Route2School module?
2. Do students answer more correctly to the questions in the final module compare to the question in each module?
3. How are student badges in each module?

4. Is there any correlation between the time student spent to finished the module with student score?
5. Is there any difference between student's score on familiar and unfamiliar situation?
6. How Route2School affect attitude, subjective norm, perceived behavioral control, intentions, and behavior on students in the control and intervention group?
7. How is student's and teacher's evaluation of the Route2School education platform?
8. How Route2School affect student's knowledge, situation awareness, risk detection, and risk management on road safety in the control and intervention group?

1.4 Research Framework

1.4.1 Scope

- The study will rely primarily on data collected from school in Jakarta Region that is willing to participate in the study
- Students of 4th- 8th grade of elementary and junior high school
- Focus on the outcome and process evaluation of Route2School platform that is collected through online questionnaire

1.4.2 Limitations

- The study will rely on students self-reported behavior
- Research and data collection will take place over a limited time period
- The study will not do behavior observation of the students for before and after interventions
- The study will have limited sample size that is not representative of the student populations in Jakarta
- Elementary students in Indonesia usually did not have emails thus other things are needed to be used in order for them to be able to create an account
- COVID-19 has limited the time and methodology to collect the data

1.5 Structure of the Thesis

The report for the master thesis is structured as follow:

Chapter 1 describes the research area, the problem statement, the research objectives and questions, and the research framework.

Chapter 2 is a literature review. Firstly, this chapter makes an overview of the current trend in road traffic crashes involving children in Jakarta, Indonesia. Secondly, the 5 E's countermeasure of road safety is examined. Thirdly, the discussion focuses on road safety education for children. The next discussion focuses on the evaluation of road safety education. It is important to understand the theory of planned behavior regarding the behavior evaluation of road safety education. Lastly, the e-learning platform and gamification will be discussed.

Chapter 3 is the research methodology. This chapter starts with an overview, studies, and adaptation of Route2School. Next, the measurement instruments were elaborate, the targeted participants were described, and the design and procedure of data collection were detailed.

Chapter 4 is the analysis of the data collected from two different tools. First, the percentages of correct and wrong answers, the mean scores, the number of badges collected, and the mean time of each module are detailed. After that, the data from the questionnaire for demographic and walking habit items, TPB items, process evaluation items, and additional question items will be analyzed.

Chapter 5 is a discussion. This chapter discusses the findings from both measurement tools on process and outcome evaluation.

Chapter 6 is the conclusion of the research and also recommendations for further research.

Chapter 7 is the limitation of the research.

2. Literature Review

2.1 Road Traffic Crash Involving Children in Jakarta

According to the data by WHO (2018) rates of road traffic death in South-East Asia in 2016 (20,7/100.000 population) is higher than the average in the world (18,2/100.000 population). In South-East Asia, 43% or the majority of road user deaths are among riders of motorized two and three-wheeler (WHO, 2018). In Indonesia, there are 31.282 reported road traffic fatalities in 2016 with the rate of road user death 12,2/100.000 population (WHO, 2018).

In 2018 there were 4.156 reported cases of road crashes in Jakarta, with 440 cases resulted in death (Statistics of DKI Jakarta Province, 2019). According to the data by the Integrated Road Safety Management System (IRSMS), the number of road traffic crashes in Greater Jakarta Region approximately reach 7.000 crashes since 2005 (Figure 2). Since 2016 there's an increased number of fatalities that resulted from a road traffic crash.

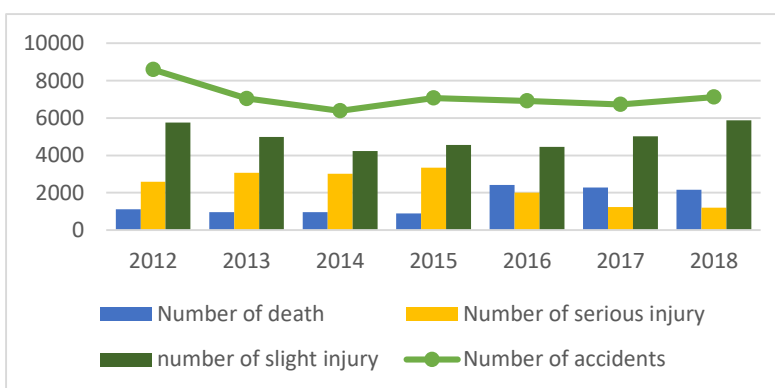


Figure 2. Number of road traffic crashes in Greater Jakarta Region (IRSMS, 2018)

Since 70% of vehicles in Jakarta consist of motorized two-wheelers, almost 70% of road traffic crashes in Greater Jakarta Region also involve a motorized two or three-wheelers (Figure 3). 4 wheelers are the second transport modes that mostly involve in a road traffic crash. A study by Ahsan et al. (2014) showed that for children aged 8-17 years old in Indonesia who participated in the study stated 69% have ridden a motorcycle illegally (without driver license) and even more than 90% participants can do bicycling, only 2% who ride it to school.

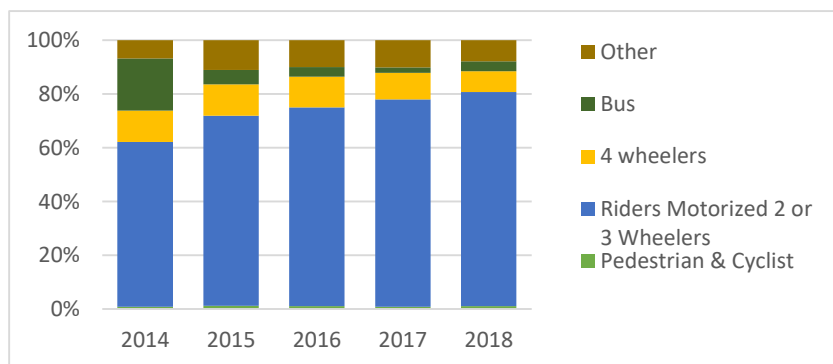


Figure 3. Road traffic crashes by transport modes (IRSMS, 2018)

In the Greater Jakarta region, more than 60% of road traffic crashes involve male road users and female road users only take into account approximately 10% of road traffic crashes (Figure 4). Meanwhile, almost 20% of the gender were unidentified by the police. According to WHO (2015), male children account for nearly twice as many road traffic deaths as female children in the world. This increases risks for male children is due to a tendency for male children, especially adolescents, to take more risks than female children and they have greater exposure to traffic (WHO, 2015).

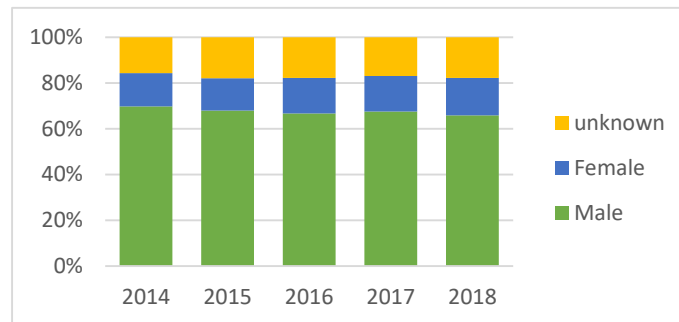


Figure 4. Road traffic crashes by gender (IRSMS, 2018)

WHO (2015) and Indonesia Regulation Law No. 23/2002 article 1 (“Indonesian Law about Child Protection, n.d.) defines children as a person younger than 18 years old. In the Greater Jakarta region children makes approximately 20% of registered road traffic crash data from IRSMS 2015-2018 (Figure 5). It is clearly seen that children crash rates shared almost a quarter of adults’ crash rates in the Greater Jakarta region and it was similarly occurred in each year from 2014 up to 2018. Since the percentage is low, the issue of road traffic crashes among children often neglected in Jakarta, even when WHO has declared this as an important reason for children's death.

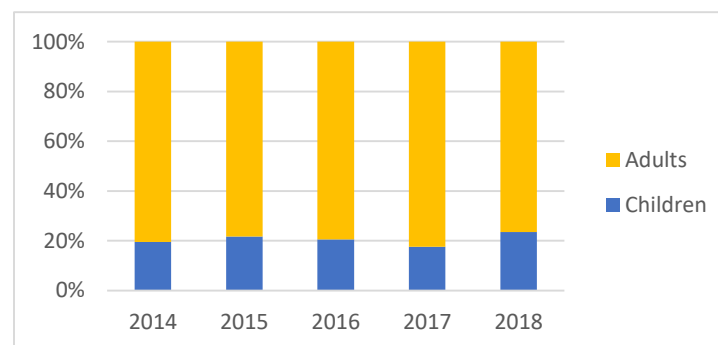


Figure 5. Road traffic crashes among adults and children in Greater Jakarta Region (IRSMS, 2018)

According to the data by IRSMS in 2014-2018 of the Greater Jakarta region, an average of 424 children lost their lives on roads per year and approximately 1 child involve in road traffic crashes per day in Greater Jakarta. Figure 6 represents the number of road traffic crashes involving children from 2014-2018. On average, children 0-4 years old represent around 7% of all road deaths under 18 years, the 5-9 years’ age group represents 6%, the 10-14 years’ age group 23%, and the 15-19 years’ age group represents 61% of average road traffic deaths among children. Over the years, children aged 10-14 in Greater Jakarta Region

have higher road mortality than children aged 0-9. The situation can be explained by a study from Ahsan et al. (2014) conducted in Indonesia that revealed 81% children aged 8-17 years' old who participated in the study were allowed to ride their motorcycle by their parents and 14% of the children said the teachers and school authorities allowed them to do so. The study also showed that 85% of the children said they were taught to ride motorcycles by their parents aged 10-14 years old.

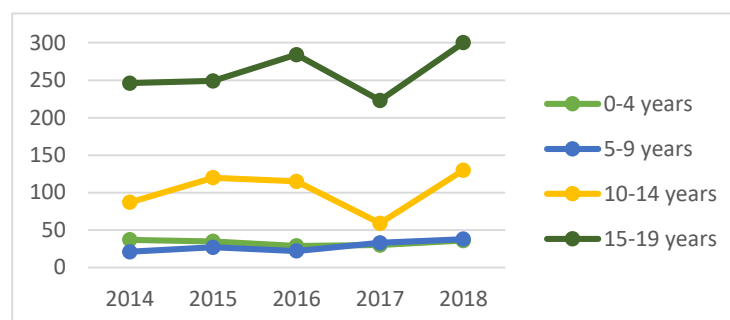


Figure 6. Trend of road traffic crashes involving children in Greater Jakarta Region (IRSMS, 2018)

In conclusion, once the children started to acquire access to powered two-wheelers illegally (age 10-16 years old) or legally (age 17-18), road mortality starts to increase steeply. Research conducted by Pratiwi & Siahaan (2017) in Indonesia indicate that the cause of motorized two-wheeler crashes was always children who ride a motorcycle without a legal driving license. The research also displays that the main cause of road traffic crashes in pedestrian is crossing without a facility.

2.2 5 E's of Road Safety

Road safety problem arises because human is interacting with the physical environment such as roads, cars, buses, and other road users, under complex conditions and with their vulnerabilities. To address road injury problems different countermeasures over different time frames and different fields - Education, Encouragement, Engineering, Enforcement, and evaluation - are needed. United States Safe Routes to School (SRTS) program applied the "5 E's" countermeasure to promote road safety to students and parents ("The "Five E's" of Safe Routes to School", n.d.). The following information explains the countermeasure that SRTS applied:

- **Education:** Teaching students about transportation choices and instructing them in important skills of road safety (how to walk and cycle safely). Education can be done through the in-school curriculum, road user safety assemblies, newsletter blurbs, tips sheets, and send-home flyers.
- **Encouragement:** Organizing special events and activities to promote road safety with students. For example, by holding a schoolwide competition.
- **Engineering:** Improving infrastructure and traffic safety facilities surrounding schools to create safe and accessible walkways and bikeways. Schools and local government agencies work together to determine whether the improvements are necessary to encourage students walking or biking to school safely.

- Enforcement: Partnering with local law enforcement to ensure students obeyed the traffic laws, such as disobeying traffic signals, in the vicinity of schools.
- Evaluation: Monitoring and documenting outcomes (walking and biking rates), attitudes and trends of the implemented countermeasures to check if they are working. Evaluation activities help in setting goals and establishing baseline data for planning another project. However, there needs to be a recognition and acceptance that educational programs take a long time to evaluate the desired behavior and to address relapses. Measuring the effectiveness of behavior change programs or education is not the same as used to evaluate the effectiveness of enforcement or engineering interventions.

2.3 Road Safety Education for Children

2.3.1 Definitions, Aims, and Objectives

Road Safety Education (RSE) is one of the key pillars of road safety “5 E’s” countermeasure. ETSC (2018) defines RSE as the gaining an understanding and transfer of knowledge of traffic situations and rules as well as the improvement and development of skills needed to participate safely in traffic through experience and training. RSE aims to prepare road users to manage the risks in traffic thus facilitate their safety in mobility (OECD, 2004). Rose 25 (2005) as we can see in Figure 7, stated that RSE covers all measures that aim at positively influencing traffic behavior patterns with emphasizes on:

1. Advancement of **knowledge** and understanding of situations and traffic rules;
2. Development of **skills** through experience and training;
3. Strengthening **attitudes** towards personal safety, the safety of other road users, and risk awareness.

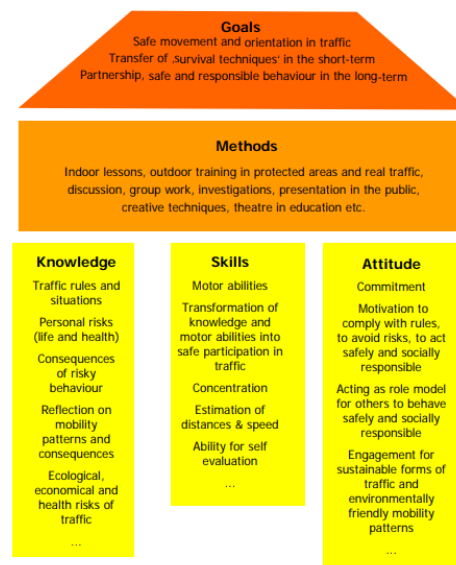


Figure 7. Definition of road safety education (ROSE25, 2005)

OECD, as cited by Dragutinovic & Twisk (2006), stated the RSE objective can be defined as achieving an ideal use of the transportation system with optimum safety for all road users and the ultimate goal of the RSE program is the reduction of the number of casualties and crashes. RSE is used as a countermeasure for all kinds of road safety issues and road user groups from young children to the elderly thus it is a

lifelong learning process (OECD, 2004). However, RSE is often dedicated to young road users since they have cognitive and physical limitations that make them more vulnerable in road traffic than adults (WHO, 2015). Children's cognitive limitations resulting them with lack of skills, knowledge, and attitude to operate safely in traffic environments, and that addressing these deficits will reduce their risk of being injured or killed on or around the road. Road safety education for children was recognized as important by the United Nations through the United Nations' Convention on the Rights of the Child. Furthermore, Article 3 of the UN's 1968 Convention on Road Traffic states that: "contracting parties should take necessary steps to assure systematic and continuous traffic education on all school levels" (OECD, 2004).

RSE for children encourages safe behavior by influencing attitudes and knowledge and providing children with the right strategies and skills to move safely in their environment. Knowledge plays a complementary and positive role in reinforcing and connecting skills and raising awareness and understanding of responsibilities, risks and safe behavior in road traffic. Meanwhile, attitude is important because with focus only on the improvement of skills and knowledge, there will be the risk of overestimation of individual technical ability to behave safely in traffic leads to higher crash risks and unsafe behavior. OECD (2004) stated education contributes to attitudes towards aspects of road safety behavior such as crossing the road, drinking and driving, speeding, etc. Education can also be used to raise consciousness about the safety characteristics of the traffic environment.

Deploying and developing the appropriate skills and developing and understanding positive attitudes to personal safety and the safety of other road users is needed in road safety education. Elliott and Thomson et al. (As cited in OECD, 2004) stated that road safety education programs need to identify clearly the safe behaviors being targeted by:

- Defining the psychological skills and analyzing the task underpinning behavior;
- Determining the level of skills that can be developed in children of different ages;
- Evaluating the impact of training and education and on the performance of these skills.

Road safety education should not be a topic of sporadic single events, however, it needs to be continuous and concept-based interventions. ROSE 25 (2005) recommends three important steps of RSE implementation:

1. Clearly defined goals for clearly identified target groups,
2. Well-defined contents and methods, and
3. Strategies to implement the concept.

2.3.2 Target Groups and Learning Targets

In order to develop appropriate RSE measures, it should be arranged based on the target group according to age. All age groups could benefit from gaining more knowledge, improving their skills and changing their attitude, yet each may face different challenges. Furthermore, each target groups are different on how to identify risk factors and injury prevention.

For children, RSE action must be adapted to the level of maturity and development of the children, as it will help children understand the traffic rules, and to improve their attitude towards road safety. However, children's skills develop at different rates and individual differences can be quite large. OECD (2004) stated some broad conclusions on children's developmental abilities have been prepared on the basis of recent empirical studies:

- Children aged 5-7: Possess a global understanding of danger but still have much to learn about road safety. Lack of the ability to give relevant cues to adequate priority and to know what is irrelevant and relevant to the road crossing task. Show readiness when appropriate training is offered.
- Children aged 7-8: Show the ability to undertake exhaustive visual searches of the road environment and clear improvements in strategic thinking.
- Children aged 8-10: Able to switch between task as there are developmental shifts in their ability to reason casually and understanding or the pedestrian task. Nevertheless, their ability to concentrate is still not improved. Education may help to improve skills that require a focus on crossing task.
- Children aged 11-12: (Thomson et al., 1996) as cited in OECD (2004) stated children in the United Kingdom approach adult levels of performance as pedestrians.

Brake, road safety charity from the United Kingdom, have created guidelines on what road safety education to teach at different age groups from age 2 to 18. The organization recommends RSE education to cover awareness (traffic is dangerous and can hurt), behavior (how to stay safe), and choose how to make a safer choice. Children age 2-7 years can be taught awareness and behavior such as dangerous things to do while walking/cycling on the road (texting and not wearing helmet); danger of speeding and driving while texting; street features (path & pavements are for people and roads are for traffic); hold hands with grown-up when near roads; stop at cross road unless told not to; danger on play on roads; look and listen for traffic to cross safely; read and understood the mean of traffic lights; and to wear bright clothes to be seen in traffic. Children under 8's are ill-equipped to make their own choices; however, it is still important for them to recognize safer choices.

The learning targets of different age group are further defined by Brake as:

- Age 2-5 (early years): development of children's creative and motor skills, language skills, understanding the world around them, and emotional, social, and personal development.
- Age 5-7 (key stage 1): To help ensure them when they are an independent road user, road safety is already well engrained by teaching them knowledge of traffic rules and encouragement to follow them; develop an understanding of the dangers on traffic and how to avoid them.
- Age 7-11 (key stage 2): Develop children's engagement and knowledge of road hazards, risk-taking (things that expose them to danger) and the consequence of it (injury and death).
- Age 11-14 (key stage 3): At this stage, children become more independent road users and more exposed to road risks. RSE is increasingly important. According to Nishuichi (2014) children in junior high school need to have sufficient skills and knowledge to be able to travel along roads

safely by bicycle, to enable them to think about not only their own safety but also that of others, showing consideration for others when traveling on the roads.

- Age 14-18 (key stage 4): Some already thinking about learning to drive and some already able to, thus the targets is to raise awareness about sustainable and safe road use for passengers, drivers, cyclists, and pedestrian, and also help them consider their travel options.

2.3.3 Educational Contents and Methods of Delivery

In elementary schools across Europe, the content is defined in two broad categories about traffic rules and behavior (ETSC, 2019). Clayton et al. (1995) stated that the literature on road user behavior at age 8-11 appears to focus almost exclusively upon road crossing behavior. OECD (2004) stated educational content mostly concentrates on children as pedestrian since children often involve in “dart out” incidents, risk-taking behavior because of themselves (e.g. “playing chicken”), unawareness (e.g. not wearing a seatbelt), or peer pressure (e.g. not wearing a helmet). Risks taking in traffic environments need to be continually managed and assessed by all road users to minimize the crashes on children.

The “dart-out” is attributed to an incident where children did not look in both directions when crossing. Furthermore, children are much more likely to behave because of peer pressure that may lead them to take risks as road users. Risk-taking behavior may allow them to gain acceptance into a particular peer group, to feel a sense of control over their lives, and to oppose authority. Some children may be unaware of the risks; others may deliberately choose to take risks owing to peer pressure. Risk-taking on young people may be a natural part of growing up, but it needs to be managed and continually assessed by all road users to minimize the incidence of crashes. It is important to take into account variations in risk while creating RSE educational content.

The organization also recommend teaching ideas for different age groups:

- Children age 5-7: name different street features (pedestrian, zebra crossing, curb); how small their body size compare to traffic; discuss what to do when their toy is thrown on the road, safe place to play, how helmet keep human safe, and why holding hands with adults in traffic keep them safe.
- Children age 7-11: learn to look and listen to traffic in order to cross safely; discuss the colors of traffic lights and the speed limit in the school area. Brake also developed a powerpoint slides containing discussion for this age that can be used through safety video or online game that will be further discussed:
 - How to cross the road safely: Van der Molen (as cited by Clayton et al., 1995) studies children crossing behavior which is running, stopping, curb delay, and the gap is chosen.
 - How drivers break the rules and put people in danger: driving too fast, distracted, speeding, etc.
 - Roads are shared with other road users and they need to look after themselves.
 - Spot dangerous behavior: cycling without a helmet, crossing the road while texting, talking on mobile while driving, not using a seatbelt, crossing next to a parked car, and playing a ball game in the road.

- Spot safe behavior: using a helmet, holding hands with adults while crossing, crossing at zebra cross.
- Spot road hazards: walk or cycle in the dark/foggy/raining, fast traffic, standing next to large vehicles, a cross between parked vehicles, roads with no pavement.
- Spot road elements that help to stay safe: zebra cross, roads with a low-speed limit, cycle lane.
- Explain why fast traffic is dangerous.
- Children age 11-14: discuss the point of staying safe and taking care of roads through different kinds of road injuries; statistics of road deaths and injuries; the relationship between speed and braking distance; and peer pressure.
- Children age 14-18: discuss road safety features, safer routes, and how to avoid hazards; analyze different modes of transport; and study road casualty data.

Education contents also need to take into account cultural differences, socio-economic, and demographic among children, especially those associated with low literacy and language barriers (OECD, 2004). Assailly (2015) stated there is also a necessity to adapt education to cultural predictors of traffic crash involvement, for example, invulnerability and fatalism feelings in Asia.

OECD (2004) stated the RSE process uses inquiry-based and more learner-centered approaches to teaching and learning, with a greater focus on the development of decision-making and problem-solving strategies and skills. The implementation of road safety education for children mostly done at schools because their primary role is education and they possess appropriate resources (e.g., teachers, classrooms, computers, multi-media facilities, etc.) necessary to deliver road safety education.

There are a variety of road safety education methods in school. Raftery & Wundersitz (2011) and OECD (2004) have studied the effectiveness of different methods of road safety education for children such as:

1. Guest Speakers

commonly utilized RSE tool is the delivery of information by guest speakers such as police officers, firefighters, road safety professionals and individuals involved in a road traffic crash. OECD (2004) stated there is a general consensus in the research that visits from road safety enthusiasts and experts, may have mass appeal but are relatively unsuccessful because RSE should be progressive and planned. The use of experts should increase the credibility of the information, however, this is dependent on the individual's perceptions of, and attitudes towards, the expert in question.

2. Drama and Role Play

crash scenes with children act as emergency personnel and road users involved in the tragedy and consequences of a crash can and provide a sense of realism that cannot be achieved through other means (e.g., video or still images). OECD (2014) stated that this method has been found effective when followed with detailed development, discussion, and follow-up activities. While role-playing as school crossing patrols will encourage them to take responsibility for their own safety. Role-playing and drama may be a particularly effective way to focus on the consequences of actions, beliefs, motivation, and social norms. Nevertheless, there are some concerns regarding children as school crossing patrols because of the risks they may face.

3. Interactive exhibits

(as cited by Raftery & Wundersitz, 2011) the effectiveness of interactive exhibits is usually assessed according to its ability to hold and attract an individual's attention, the inference being that interacting and attending with a display involves cognitive investment and therefore must promote some learning. Assessment of RoadZone (interactive road safety exhibition for 9-14 years olds in Australia) users' road safety knowledge pre- and post-visit revealed that 80% of students had added awareness of at least one new road safety issue.

4. Computer-based training

Use of the internet and computers is standard in many schools and offers access to a variety of road safety education Web sites. Lonero et al. (as cited by OECD, 2004) stated simulation games can modify behavior and attitudes and developed skills. Dragutinovic and Twisk (as cited by Raftery & Wundersitz, 2011) that study Scottish computer software to teach children how to cross the road safely shows that the training program was successful at improving knowledge and that this improvement further influenced behavior. In addition, classroom simulations can introduce children to a variety of road environments than on-site roadside training.

2.3.4 Implementation Strategies

In parallel with the RSE concept, the development of implementation strategies is needed. RSE for children should also target parents, caregivers, and educators. (OECD, 2004) define the stakeholder in children's safety:

- Parents: Serves as important role models and their actions and behavior can influence their children.
- Children: An active presence in traffic.
- Teachers: Serve as role models in school.
- Practitioners: RSE professionals from police departments, education departments, transport & highway departments, etc. Practitioners can work with an institution to develop interventions.
- Drivers: Moral and legal responsibility to protect their children.
- Manufacturers, insurers, and retailers: responsible to ensure that safety education is provided to encourage the appropriate use of safety equipment, such as bicycle helmets, child restraint systems, and seat belts, etc., and that they are accessible and affordable to those most at risk.
- Policymakers: ensure that there is sufficient capacity to deliver road safety education interventions by facilitating implementation, training, development, research, evaluation, and dissemination of good practice.

By identifying each role, the stakeholders responsible for risk management can be identified and thus can develop the implementation of policy strategies. ROSE 25 (2005) stated the role of related stakeholder's implementation strategy would involve:

- To steer and observe the assessment of existing products/projects,
- To act as a center for the exchange of information, know-how and networking (e.g. implementation of a database),
- To steer and guarantee uniform standards in implementation and quality control of RSE.

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

- Indirect or holistic approaches: Strategies that target the cause of problem behaviors in general, for example, problem-solving, risk awareness, and resilience.
- One-time interventions: Programs of short duration that may involve school visits from road safety educators from organizations (e.g., fire services or police). Usually, it utilizes confronting imagery or exhibitions to graphically and realistically portray the consequences of crashes. Other educational methods or tools utilized may include interactive exhibits that simulate or emulate driving-related skills (e.g., reaction time).
- Driver training: Intended to improve young driver's ability to control a motorized vehicle.
- Curriculum or cross-curriculum based: Incorporation of RSE elements into other subjects or specific road safety subjects in the curriculum (e.g., Health, Physics, Physical Education, English, etc.).
- Multi-modal: Programs that supplement education with other strategies, for example, targeted enforcement strategies, encouraging healthier environmentally sustainable travel options, or engineering enhancements to pedestrian infrastructure.

2.3.5 RSE in Indonesia

Law Number 22/2009 on Road Traffic and Transportation in Indonesia provides a legislative framework concerning road traffic and transportation. The law also stated Indonesian National Police Traffic Police Corps (INTPC) is in charge of the responsibility for transport safety and road traffic including traffic education. In Indonesia, there are no policies that required the school to give road safety education to children. However, in 2019, INTPC and Ministry of Education and Culture, implement the dissemination of the traffic education integration model through the mandatory Civics Education Subject at elementary school (www.gaikindo.or.id, 2019).

Furthermore, according to (Anwar, 2010) there are several socialization and campaign activities for children based on that same law, such as:

1. Traffic Safety Pioneer

The traffic units of regional police departments all over Indonesia, the socialization targeted students from elementary school through high school (Figure 8). The socialization aims to develop student awareness and encourage them to become pioneers in traffic safety. The socialization was designed to give knowledge to children and adolescents about unit Regional Traffic Management Centre (RMTS). Activities included introducing unit RMTS to students, explaining how an insurance company works, socializing about traffic safety, and providing educational videos.



Figure 8. Traffic safety pioneers program (Anwar, 2010)

2. Traffic Safety Campaign for Students

Held by Traffic Units of Regional Police Departments, targeting students from kindergarten through high schools in Indonesia. This program was based on Law Number 22/2009 on Traffic and Road Transportation, Law Number 2/2002 on the Indonesian national police, and UN Resolution 64/255, No. 7, for Global Road Safety. The campaign (Figure 9) aimed to encourage cooperation between traffic units and schools to underline the importance of traffic safety on the road, implement a traffic-compliance culture, provide information about discipline on driving for students, socialization about Law Number 22 Year 2009 on Traffic and Road Transportation, and introduce traffic signs and other traffic facilities.



Figure 9. Traffic safety campaign activities for kindergarten students (Anwar, 2010)

3. Socialization by Ministry of Transportation

Aims of the socialization by the Ministry of Transportation is to increase the awareness of students and the public in complying with traffic regulations, building awareness of the children to behave discipline in traffic and building a culture of discipline traffic early with awareness and moral responsibility to improve safety. Ministry of Transportation also created the socialization material for age (Figure 10) 7-12 years old that consist of traffic signs knowledge, pedestrian rules, traveling

with a motorized vehicle, bicycle, and where to play. The material adopted mascot called “Zebra Sahabat Kita” or Friendly Zebra called Zeta.

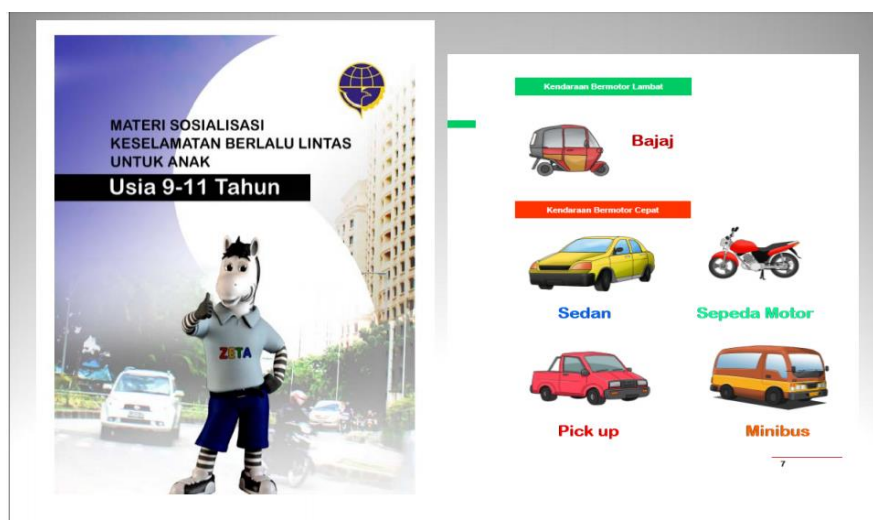


Figure 10. Socialization Material for Children Road Safety in Indonesia (Sitohang, 2013)

A study by Ahsan (2014) regarding knowledge, attitude, and practice for children road safety in Indonesia have been conducted. The research involves 480 students from elementary and junior high school in Bandung regency in Java. 86% of children already received lessons related to road safety. The lessons they learned mostly gave by their parents (24%), teachers (24.5%), parents and teachers (19.43%), and only (2.87%) stated they received it from police officers. The study also showed children already have efficient knowledge on road as a pedestrian, knowledge as street crossers, knowledge as public transport users on the road, and knowledge respondents when driving vehicles. Children already have a good attitude and behavior while walking, biking, motorcycle, private car, and public transportation. In Indonesia, the children stated that the most interesting manner or method in delivering road safety is first through story, second through symbols, and third through the game.

2.4 Evaluations of RSE

In addressing best practices in road safety education, it is necessary to evaluate alternative deliverers and sources of road safety education and to review and establish what works (OECD, 2004). Raftery & Wundersitz (2011) stated comprehensive evaluations are necessary for determining the effectiveness of an RSE program and for providing directions as to how it might be improved. Nevertheless, conducting evaluations of the RSE program is not an easy task. Dragutinovic & Twisk (as cited by Raftery & Wundersitz, 2011) stated evaluators need to understand the program and what type of effects might be expected within the given time frame for program follow-up evaluation and implementation.

Raftery & Wundersitz (2011) stated there are two main types of evaluation used to assess program effectiveness:

- Process evaluations: assess the implementation of the program such as the appropriateness of the program content, the extent to which the program reaches the target audience, and the effectiveness of the program delivery.
- Outcome evaluations: determine the effectiveness of the program in terms of the desired outcome within a defined population. Generally, such evaluations examine changes in behavioral intentions or observed behavior, self-reported attitudes or beliefs, and knowledge.

The first logical idea to measure the effectiveness of the RSE program would be to see if it reduces the prevalence of crashes (Assailly, 2015). However, crashes are rarely taken as outcome measures because they are rare events, therefore, data needs to be collected through huge populations for a reasonably long period of time to show a statistically significant effect of RSE on crashes. Furthermore, crashes can also be influenced by a variety of different factors such as the economy and other countermeasures, and it is not easy to define which factors might be responsible for a change in crash numbers. Raftery & Wundersitz (2011) stated only a few school-based road safety education programs have been evaluated using crashes as an outcome measure.

Assailly (2015) stated there is a need for surrogate measures of the effects of RSE that could be predictive of crashes but easier to obtain such as:

- Safety performance indicators: observed by traffic safety research works as predictors of crashes. This may be in a logical relationship (increase in crash risk is supposed) or empirically tested relationships (increase in crash risk is known), for example, rates of risky street crossing, speeding, drunk driving, etc. Risky behavior can be assessed by self-reports with questionnaires or by observation in real traffic situations, both methods have predictive validity.
- Psychological antecedents of risky behaviors: observed as causal mechanisms by social psychology research works. The example is beliefs, behavioral intentions, attitudes, etc. Social psychology studies originating from theoretical models (health belief model & theory of planned behavior) have shown how they predict dangerous or safe behaviors.

Raftery & Wundersitz (2011) stated RSE evaluations should:

- Based on before and after assessment of variables or behaviors that can be objectively observed and are closely linked to the program objectives or goals.
- Allow sufficient time prior to the program for the “before” measurement to be held. However, often the time before program implementation is too short for a baseline measurement to be planned and take place.
- Include a control and ‘treatment’ group. Ideally, individuals should be randomly assigned to the group to minimize self-selection bias (e.g. more safety orientated individuals might choose to participate in a program), particularly when participation in the program is of a voluntary nature.

Nevertheless, there are only a few RSE evaluations program that conducted all of the above criteria (Raftery & Wundersitz, 2011). This is because:

- When complete populations are targeted, the inclusion of a control group is not feasible
- Randomized trials are expensive and difficult to conduct.

- Lack of resources or expertise necessary to conduct a scientific evaluation.

2.5 Theory of Planned Behavior

Ketphat et al. (2013) stated to this day, the Theory of Planned Behavior (TPB) is considered the best predictor of human behavior since it provides potential predictors of identifying significant factors relating determination. TPB has been described as a more conventional approach to explain the relationship between behavior and attitudes (Poulter & McKenna, 2010). Ajzen stated (as cited in Stead et al., 2004) that TPB posits that behavior is determined by behavioral intention, which is in turn predicted by Attitude to the behavior, subjective norms and perceived behavioral control (Figure 11).

Firstly, Attitude is predicted by instrumental beliefs about the consequences of performing the behavior and weighted by outcome evaluations of the desirability of those consequences. Meanwhile, subjective norms are predicted by normative beliefs about the approval of significant others (e.g family member) on the behavior and weighted by the individual's motivation to comply, this will lead the individual to act in a manner that would meet other's approval. Finally, PBC is the degree in which an individual believes that the behavior is under one's control and it is the product of two sets factors. The first factor is control beliefs which are individual ability to perform or refrain from the behavior in various circumstances and the second factor is control frequency which is how often one is in those circumstances. However, since the performance of behavior can be impeded by factors that are beyond volitional control, perceived behavioral control can also predict behavior directly (Paris & Van den Broucke, 2007).

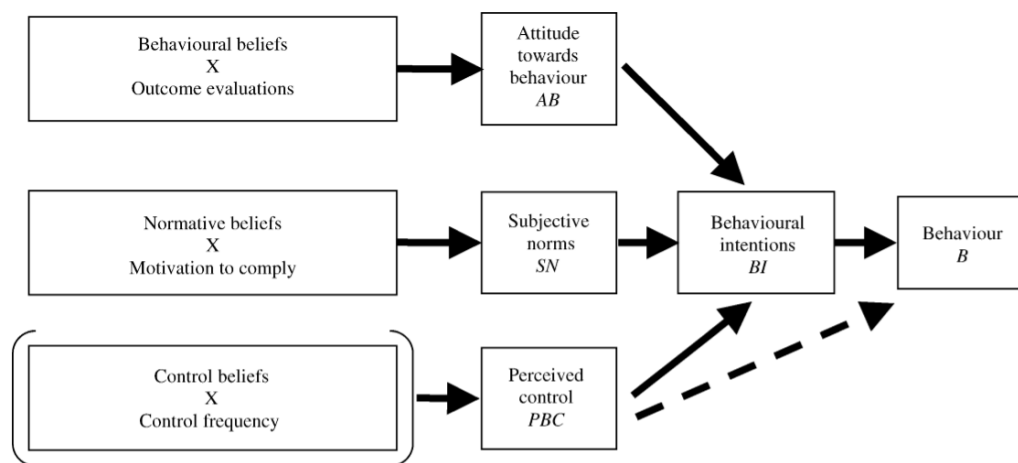


Figure 11. Theory of Planned Behavior (Stead et al., 2015)

TPB has been validated in diverse research domains and is one of the empirically most supported behavioral theories (Brijs, 2014). It has also been widely applied to health behaviors including road safety (Stead et al., 2005). Since RSE programs focus on motivational-attitudinal skills, evaluations are often done with the help of social psychological theories such as TPB (Marki, 2016). Stead et al. (2005) have claimed that the TPB model has great potential to inform the progress of behavior change interventions. Poulter (2010) suggested that assessments of health education interventions should evaluate attitudinal changes

alongside behavior or intention changes in order to determine whether any intervention failure happens because it simply had no effect or results in unintended outcomes. In addition, the study stated, a failure to effect a change in behavior or intention does not essentially mean that there was no change in psychological antecedents to behavior or intention.

2.6 E-Learning Platform and Gamification

E-Learning has become the answer to overcome the limitations of place and time in conventional learning (Utomo et al., 2014). However, the general e-Learning platform faces the lack of user engagement thus making the interaction within the platform not optimal. Deterding et al. (2011) define gamification as “the use of game design elements in non-game contexts”. Gamification is being actively explored in education since games are known to engender motivation and engagement in learning (Dichev & Dicheva, 2017). Utomo et al. (2014) stated the idea of gamified e-Learning is using game design elements to trigger student’s active involvement in the learning process.

According to Werbach & Hunter (as cited by Dichev & Dicheva, 2017) the use of game elements in gamification can be divided into components, mechanics, and dynamics. Components encompass mechanics and dynamics and act as the basic level of the gamification process. It includes virtual goods, achievements, badges, avatars, content unlocking, collections, leaderboards, gifting, points, levels, etc. Mechanics represents to collections of rules that dictate the outcome of interaction within the systems. The mechanic's elements such as rewards, challenges, competition, chance, feedback, cooperation, and resource acquisition, will move users’ actions forward. Dynamics refer to users’ responses to game mechanics. Dynamics, which includes relationships, constraints, narrative, emotions, and progression, refer to the highest conceptual level in a gamified system. For example, badges (components) provide rewards (mechanics) and create a sense of progression (dynamics).

The concept of gamification in education is not new since schools already have several game-like elements. For example, students get grades or “badges” when they complete an assignment and they will get “level up” at the end of every academic year when they perform all (Lee & Hammer, 2011). This situation, in turn, increases students’ motivation in the class (Codish & Ravid, 2014). It would seem that school should already have the concept of gamification. Nevertheless, this environment sometimes still fails to engage students.

Kapp (as cited by Pham, 2019) stated there are two types of gamification: structural and content gamification. Content gamification is the use of gamification elements such as challenges or story elements in order to make the education content more game-like without becoming a game. Content gamification or game-based learning needed more competencies and time to create than structural gamification. The structural gamification refers to the use of gamification elements such as points, levels, badges, and leaderboards, without changes in the content of education thus can increase student engagement. This other type is also called gamification and was an easier and basic approach.

Common elements of structural gamification are points, badges, and levels. Points functions as an achievement, measure of success, status, the form of investment for further progression, or rewards.

Kumar & Khurana (as cited by Pham, 2019) stated there are two types of points used in some educational role-play games: steam points (correspond to in-game currency) and experience points (earned by completing tasks). The level at the beginning tended to be quicker and easier and as progress, it requires more skills and efforts thus act as a sense of progress to players in various game designs. Badges maintain classroom engagement and motivated the students to continue learning by acting as a visual representation of goal achievements.

According to Sillaots (2015) game elements are structured:

1. Challenging Goals

Goals or assignment goals can be seen as game challenges.

2. Play

Course activities can be designed interactively (i.e. using a quiz instead of the test) in order to complete the challenge and achieve the goals. Researchers have found that practical assignments with gamified activities have better results (Sillaots, 2015).

In order for games to be more enjoyable to the users it should provide rich and instant feedback. Feedback is also a very critical element in education. Sillaots (2015) stated studies have shown that positive feedback stimulates students learning. Educators can use continuous feedback in the program through the form of frequent questions and answers, visual cues, and self-paced exercises (Riaz et al., 2019). Feedback can be given at the end of the game or moment by moment.

3. Rules

Game mechanics are generally a complex set of different relationships and objects. It declares how the game environment and players interact with each other. The condition for progression such as what is the pass or fail conditions, how the game is divided into levels, and how the player can earn points, is one part of the core mechanics that can be easily implemented in education. For providing an enjoyable playing experience, the learning content and playing activities should be in balance. Thus game difficulty or levels of the learning activities should be increased during the process. Games are entertaining because they can provide a safe environment for taking risks. Some researchers have shown that risk simulators will decrease real-life traffic risk behavior.

4. Pretended Reality

The game world is an imaginary place created with a story and graphical elements such as characters.

There is an increasing number of research and case studies dealing with gamification and educational contexts (Codish & Ravid, 2014). The study also stated the majority of studies report overall positive results as from adding game elements, however, there are also some studies that have negative results. The difference results can be explained by context and design, but the most important part is personality differences among individuals that are impacted by gamification. Gamification is a psychologically driven approach targeting motivation (Dichev & Dicheva, 2017). The process of teaching using gamification has been reported to have significant beneficial effects on the academic outcomes of students in primary schools (Su & Cheng, 2014).

3. Methodology

3.1 Route2School Platform

3.1.1 Overview

The Route2school education platform was developed by the Transportation Research Institute (IMOB) of Hasselt University (Pham, 2019). This education platform is different from other traffic safety courses since it covers several aspects of road safety education such as knowledge, situation awareness, risk detection, and risk management (see Figure 12). Each aspect was made into different modules and have been developed from three pillars of road safety education: increasing positive attitudes towards road safety, improving skills through training, and increasing knowledge and understanding (Riaz et al., 2018). Riaz et al. (2019) further define each module as follows: (1) knowledge module: evaluate the understanding and knowledge of traffic laws and regulations; (2) situation awareness module: increase awareness about different traffic situations; (3) risk detection module: detect hazards in traffic; and (4) risk management module: responds to a hazard in the given traffic situation.

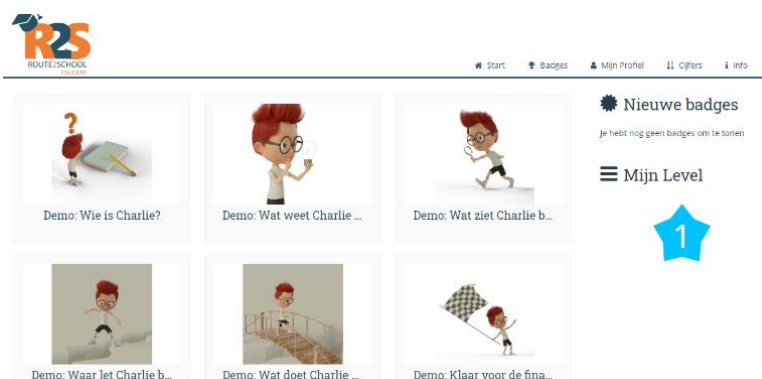


Figure 12. Route2Scool Education Platform's Homepage

The platform is the first in the world that uses context-relevant footage from the target group's perspective for road safety education by capturing pictures and videos of traffic situations (Riaz et al., 2018). The videos and pictures were further divided into the modules and each module consisted of 20 questions. The footage will let the user experience traffic situations to some extent because doing it in real traffic can be difficult or hazardous.

According to Riaz et al. (2019), since research has shown children have discrepancies in learned skills and behavior in unfamiliar situations, questions or footage in the modules were divided equally into familiar and unfamiliar situations. Therefore, the first half of the questions will involve footage from familiar situations. Children need to have training on road safety elements (e.g. crossing) not in their municipality so that they can detect and manage risks in riskier situations or an unfamiliar municipality. Training children on familiar situations is a priority as there is a higher chance of them encountering these situations in the short term and training them in unfamiliar situations can help them to react safely to a

traffic situation in a different location. This concept would be possible to recognize any transfer effects from familiar to unfamiliar situations.

This e-learning platform uses gamification as a teaching method by creating quizzes about traffic situations in students' cities and another city to improve traffic insight in a funny way (Pham, 2019). The platform uses gamification elements such as points (0-100 for each module), performance graphs (to show children how much progress they made in each module), automated feedback, and badges (gold, silver, bronze, and completion badge). A character named Charlie was used as a source of identification factor for students as they could relate to him as a pupil their age on a journey and from school. In the final module or the second measurement, another gamification element which is a timer (15 s) was used for each question in the final module. Figure 13 illustrates the structure of the platform.

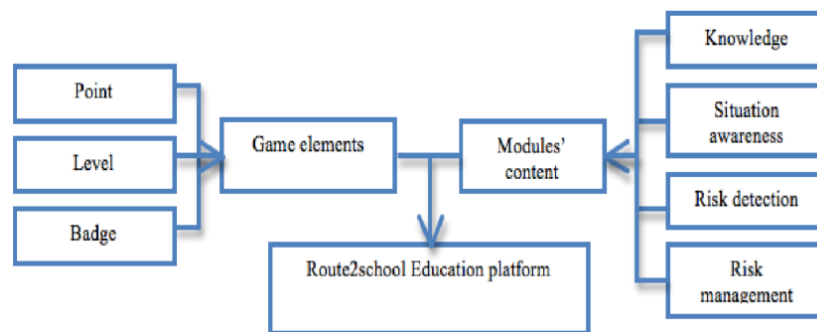


Figure 13. Structure of the Route2School education platform (Pham, 2019)

3.1.2 Studies

There are several studies regarding the route2school education platform. Riaz et al. (2019) studied focused on children (aged 9 to 13 years old who is identified in the literature to be one of the most vulnerable age group in traffic) of an elementary school in Flanders, Belgium. The study uses voluntary participation. In this study, a camera was mounted on the handlebar of the bicycle to have pictures and video footage from a bicyclist perspective as shown in Figure 14.



Figure 14. Example of a traffic situation in the R2S platform (Riaz et al., 2019)

The study by Riaz et al. (2019) results revealed that children performed significantly better in the knowledge module which shows that children already have an acceptable level of knowledge. Children also performed better in familiar situations compared to unfamiliar situations. The study was able to prove that student increases their scores in the second measurement in the module. These results can guide future researchers in the domain of traffic safety among children, although this was only a pilot study.

Hoai (2019) adapted the Route2School education platform to the situation in Vietnam (Ho Chi Minh City) that targeted adolescents (15 – 18 years old) that uses bikes, electric bikes, and mopeds. The research was the first to propose road safety education by the gamification e-learning platform in Vietnam. The familiar situation in the module is Ho Chi Minh City and unfamiliar situations are Bien Hoa City. The quizzes focus on Vietnam traffic rules for the target group and the five main driving issues (dangerous road crossing, bad direction change, poor lane changing, overtaking, and speeding). This study indicates the adaptation of the Route2School education platform resulted in positive effects on students' learning. The research also shows that gamification was useful to measure students' knowledge and skills, find out aspects of skills and knowledge which students still lacked, but also created positive attitudes, motivated, and engaged, for students in learning road safety.

3.1.3 Adaptation of Route2School Education Platform to the Situation in Indonesia

The question mainly focused on Indonesia's traffic rules and road crossing issues because according to the data by WHO (2015), 38% of children injured or killed on the roads worldwide each year are pedestrians. Furthermore, a study by Ahsan (2014) in Indonesia showed that 60 % of students grade 4 – 5th in elementary school and 8 – 9th in junior high school said that they cross the road in any place, without searching for any pelican crossing. Thus, the materials will be more related to pedestrian behavior to cross and also the materials developed by the Indonesia Ministry of Transportation.

The footage for the platform will be collected from the perspectives of the road user and questions will be developed from it. Automated feedbacks will be directly generated based on the answers responded. Game elements such as badges (white, bronze, silver, gold), levels (10 levels), and points (0-100) were maintained in this study. The platform will also be adapted into the Indonesian language. The platform consisted of five modules, with the first 4 modules were divided into a familiar and unfamiliar situation. In this research, the familiar situation is Jakarta City and the unfamiliar situation is Bogor City.

In the platform, at first, the students were asked to hear the Indonesian language audio introduction about the module. Then they can move forward to the first module: "knowledge". The knowledge module will ask "what do you know best?" to test students' knowledge of traffic signs and traffic rules. After they finished the first module they can do the next module: "situation awareness". In the second module, a traffic situation photo was shown in 10 seconds then students will be asked "what do you see best?". When they finished the "situation awareness" module they can move to the "risk detection" module, where they will be asked "What do you pay attention most?" between three objects in a traffic situation photo. Next, they will move to the "Risk Management" module when they finished the third module. In the "Risk management" module students' will have to reveal their skills to manage risks by responding to

the question “what should you do best?”. All of these modules consisted of 10 questions of familiar situations and 10 questions of unfamiliar situations. The last module is called the “finale module” where all of the 20 questions were the combination of all four modules in a familiar situation and they have limited time to answer the question. The results of the platform will be used to measure the knowledge and skills variable on outcome evaluation.

3.2 Questionnaire

The questionnaire was created to identify the outcome and process evaluation of gamification as a method of road safety education (Route2School) to students in Indonesia. The questionnaire was developed for pre-intervention and post-intervention. Both questionnaires consisted of four sections. There are three sections that are the same in both questionnaires.

3.2.1 Demographic variable and walking habit

Students were asked about their genders, areas where they live, and their transport modes to school. This section also included several questions to know student’s habits as a pedestrian in the last two months and only included in the pre-intervention questionnaire. The time two months was chosen to include the time before the lockdown phase because of COVID-19 in Jakarta. The item was worded as “How often do you go out on foot (e.g. walking to a store, to school/tutoring place, or for leisure)?”. The answers were measured on a 4-point Likert scale that ranges from never, occasionally (1-4 times in the last two months), sometime (5-8 times in the last two months), and often (more than 8 times in the last two months).

A further two items also included eliciting information about how often students are accompanied by different types of people when they go out on foot. These items only answered by students who did not answer never on the first questions. The items were measured on a 4-point Likert scale and were: “When you go out on foot, how often are you with adults?” and “When you go out on foot, how often are you on our own?”.

3.2.2 TPB Variable

One of the methods to measure the outcome evaluation is to analyze the changes in behavioral and socio-cognitive variables (Riaz, 2019). The theory of planned behavior (TPB) is used in this study to measure student’s socio-cognitive variables such as attitude, subjective norm, perceived behavioral control, and behavioral intention. The behavior items were not included in the questionnaire since the time between the pre-intervention questionnaire, the Route2School platform, and the post-intervention questionnaire was too short to change behavior. The TPB section is included in the pre- and post-intervention questionnaire. The targeted behavior of this questionnaire is regarding children crossing behavior. One of the examples of crossing behavior that is taken for the questionnaire is crossing the street using pelican crossing.

The TPB section was adapted from Poulter & McKenna (2010) and Elliott (2004). Poulter & McKenna (2010) developed a measurement scale to evaluate road safety educational context aimed at behavioral and attitudinal change for speeding in adolescence aged 15-16 years. Furthermore, Elliott (2004)

developed a questionnaire to measure TPB variables to investigate adolescents (aged 11-16 years) attitudes towards adolescent road user behavior. The steps to construct a theory of planned behavior questionnaire by Ajzen (2006) and Francis et al. (2004) also incorporated. 5-points Likert scale is used to measure this section.

The scale was based on the principle of Theory of Planned Behavior and includes 12 questionnaire items assessing: Attitudes (3 items; for example, “For me crossing the road using pelican crossing is [1: good; 5: bad]”); Subjective norm (3 items; for example, “My friends want me to cross the road using pelican crossing [1: strongly disagree; 5: strongly agree]”); Perceived behavioral control (3 items; for example, “I am confident that I could cross the road using pelican crossing [1: strongly disagree; 5: strongly agree]”); and Behavioral intention (3 items; for example, “I will cross the road using pelican crossing [1: strongly disagree; 5: strongly agree]”).

3.2.3 Additional Questions

This section measures a student's understanding of knowledge, situation awareness, risk detection, and risk management before and after they use the Route2School platform. Therefore, this section is included in the pre and post-intervention questionnaire. It was measure using 4 questions that have the same format from each of the modules in the platform. Although it has the same format it’s not included in the platform.

3.2.4 Process Evaluation from the students and the teachers

3.2.4.1 Student’s Evaluation

This section was created to measure the process evaluation from the students on Route2School platform. There are 19 items in this section and each item was measure using a 5-point Likert Scale. An example of the questions is “Overall, how satisfied were you with Route2School? [1: extremely dissatisfied; 5: extremely satisfied]”; “I would recommend the platform to others [1: strongly disagree; 5: strongly agree]”; and “Will you use Route2School again in the future? [1: never; 5: definitely]”.

Moreover, 2 questions were a multiple answers choice: “Choose 3 features of Route2School that you like the most: Charlie, questions with images of familiar situations, explanation of the answer, badges, levels, web interface design, and audio introduction” and “What would you change in the platform? (you can choose more than 1 answer): Change the audio introduction to written or video introduction; The image size needs to be larger; The question's text needs to be larger; The audio introduction sounds needs to be clearer; Nothing; and others (this is an open-ended answer)”.

3.2.4.2 Teacher’s Evaluation

This section was created to measure teacher’s process evaluation on the Route2School platform that their students have followed. There are 16 items in this section and each item was measure using a 5-point Likert Scale. An example of this questions is “Overall, how satisfied were you with Route2School? [1: extremely dissatisfied; 5: extremely satisfied]” and “Rate the format of work (use of gamification: Charlie, level, badges, and score)” [1: extremely bad; 5: extremely good]”. There’s also the same multiple answers

choice: “Choose 3 features of Route2School that you like the most: Charlie, questions with images of familiar situations, explanation of the answer, badges, levels, web interface design, and audio introduction”. A yes or no questions with texts option regarding whether Route2School will increase student’s knowledge on road safety and advice for Route2School platform was also included

3.3 Participants

The research is conducted among students of elementary and junior high schools in Jakarta (Indonesia). The targeted age was students age 9 – 14 years old. Therefore, school principals of a public and private school in Jakarta were asked about their willingness to register students grade 4th – 8th in the research via email/personal messages in late January 2020 and through school visits in February 2020. To accommodate the e-learning platform, schools were asked whether they have a computer lab and if they did not have it, students had to have their laptops. In March 2020, four schools have stated their willingness to participate in the study.

However, due to the situation of COVID-19 where students have to learn from their own home, two public schools stated they’re unable to accommodate the research because many of their students did not have laptops in their homes. Later in April 2020, one private elementary school stated they’re overwhelmed because of the new online teaching method and have decided to not take part in the study. Thus leaving only one school that is willing to participate in the study. 192 students of 7th grade junior high school students of one of the private schools in Jakarta were registered to participate in the study.

3.4 Design and Procedure

The data was collected at the end of the school year (May – June 2020). There are three stages in the research: pre-intervention questionnaire, Route2School platform, and post-intervention questionnaire. A total of 192 participants were divided into a control and intervention group. Since there is 6 class in the 7th grade, one class (32 students) were randomly chosen as a control group based on the discussion with the teachers.

The initial time plan for the research is three weeks with the first stage (pre-intervention questionnaire) in week 1, the second stage (Route2School platform) in the half of week 1 and week 2, and the third stage (post-intervention questionnaire) in week 3. The time between the pre-intervention questionnaire and the Route2School platform was two days. Meanwhile, the time between the Route2School platform and the post-intervention questionnaire is one week. Nevertheless, because in the second week there are insufficient data collected, the time plan changes to fit the situation.

Due to COVID-19 situation, students did the program in their own house. The instruction for each stage was made via text and video and was sent to the vice principal and IT teacher two days before the stage started. After they conform the clearness of the instructions, they will send it to the students via online group chat that the teachers have with the 7th grade students. Every morning, the data of the number of the students who already did the questionnaire & the platform were monitored and informed to the vice principal who then will inform the homeroom teacher. The homeroom teacher from each class will remind

the students via online class meeting and online class group chat at noon to do the questionnaire & platform. This cycle will continue until sufficient data were collected.

The first stage was started on 3rd May 2020, where the pre-intervention questionnaire link from Qualtrics was distributed. The end of the data collection method from this stage was 16th May 2020 where there are already enough data collected.

After two days the first stage started, the instruction on how to log in through the Route2School platform and how to do the platform is being administered to the students via video and text instruction. This information only distributed to the class that is included in the intervention group. The second stage took the longest time as it lasts for three weeks.

After the second stage finished, the instruction to do the post-intervention questionnaire via a link from Qualtrics is being distributed the next week. The data collection for the post-intervention questionnaire end on 4th June 2020. The process evaluation questionnaire was distributed one month after the post-intervention questionnaire collection was finished.

Two weeks after all of the data collection is finished two teachers who guide the program from the beginning was also asked to fill an online questionnaire regarding the process evaluation for the platform.

4. Analysis

4.1 Data from the platform

160 students are registered in the Route2School platform. 154 students finished the first module and it gradually decreases until there are only 147 students who finished the finale module.

4.1.1 Answer Results

4.1.1.1 Knowledge Module

Table 1 illustrates the correct & wrong answers of 154 students that finished the module about Jakarta City and 153 students that finished the module about Bogor City. On average, the submodule on unfamiliar situations has the highest percentage of the correct answer (87 %) compares to the familiar situations module (85 %).

Table 1. Answer Results from Knowledge Module

Knowledge module	Familiar Situations (Jakarta City)		Unfamiliar Situations (Bogor City)	
	Frequency (%)		Frequency (%)	
	Correct	Wrong	Correct	Wrong
Question 1	148 (96.10 %)	6 (3.90 %)	151 (98.69 %)	2 (1.31 %)
Question 2	120 (77.92 %)	34 (22.08 %)	149 (97.39 %)	4 (2.61 %)
Question 3	129 (83.77 %)	25 (16.23 %)	129 (84.31 %)	24 (15.69 %)
Question 4	110 (71.43 %)	44 (28.57 %)	134 (87.58 %)	19 (12.42 %)
Question 5	148 (96.10 %)	6 (3.90 %)	152 (99.35 %)	1 (0.65 %)
Question 6	121 (78.57 %)	33 (21.43 %)	77 (50.33 %)	76 (49.67 %)
Question 7	149 (96.75%)	5 (3.25 %)	150 (98.04 %)	3 (1.96 %)
Question 8	147 (95.45%)	7 (4.55 %)	147 (96.08 %)	6 (3.92 %)
Question 9	114 (74.03 %)	40 (25.97 %)	103 (67.32 %)	50 (32.68 %)
Question 10	138 (89.61 %)	16 (10.39 %)	146 (95.42 %)	17 (11.11 %)

There are five questions with the highest percentage of the correct answer (99 % – 96 %) and most questions are in the submodule of unfamiliar situations. 4 questions in “Bogor City” submodule with highest correct answer show that students can recognize the means of instruction sign for a pedestrian in question 1; know what to do when you want to cross the street but the color of the pedestrian traffic light is red in question 2; know where to cross the street from an instruction sign for the pedestrian in question 5; and what does it mean for parking prohibition signs for a motorized vehicle in a school safety zone in question 7. In question 7 of familiar situations module, students know that after they cross the street they should stop in a refugee island before they start to cross the street again (Figure 15).



Figure 15. Picture in Question 7 of the Knowledge Module in Familiar Situation

Two of the highest wrong answer percentages are also in unfamiliar situations module. Students still lack understanding regarding what is the pedestrian traffic light color when traffic light color for motorized vehicles is yellow (Figure 16). Most students who choose the wrong answer thought that pedestrian traffic light color was also yellow when traffic light color for the motorized vehicle is yellow. This reveals they have a lack of knowledge that pedestrian traffic light only shows red and green color. Meanwhile, students also think that the end of prohibition traffic signs for the motorized vehicle to speed more than 20 km/h in question 9 as a prohibition sign for the motorized vehicle to speed more than 20 km/h. In question 2 of familiar situations students think it's ok to keep moving forward when there is a prohibition sign for the pedestrian in a sidewalk in questions 2; in question 4 students think that pedestrian crossing warning sign for a vehicle in a school safety zone as a sign for them to cross the street on that very spot when the zebra cross still 100 m behind; in question 9 students think that prohibition to turn left for the motorized vehicle is also applicable to a pedestrian.



Figure 16. Picture in Question 6 of the Knowledge Module in Unfamiliar Situation

4.1.1.2 Situation Awareness Module

The number and percentage of correct and wrong answers to the situation awareness module are displayed in Table 2. 153 students finished the familiar situations submodule and 152 students who finished the unfamiliar situations submodule. The average correct answer in familiar situations (56 %) have a slightly lower number than in unfamiliar situations module (57 %).

Table 2. Answer Results from Situation Awareness Module

Situation Awareness module	Familiar Situations (Jakarta City)		Unfamiliar Situations (Bogor City)	
	Number (%)		Number (%)	
	Correct	Wrong	Correct	Wrong
Question 1	51 (33.33 %)	102 (66.67 %)	82 (53.95 %)	70 (46.05 %)
Question 2	39 (25.49 %)	114 (74.51 %)	107 (70.39 %)	45 (29.61 %)
Question 3	112 (73.20 %)	41 (26.80 %)	110 (72.39 %)	42 (27.63 %)
Question 4	73 (47.71 %)	80 (52.29 %)	50 (32.89 %)	102 (67.11 %)
Question 5	105 (68.63 %)	48 (31.37 %)	93 (61.18 %)	59 (38.82 %)
Question 6	96 (62.75 %)	57 (37.25 %)	109 (71.71 %)	43 (28.29 %)
Question 7	109 (71.24 %)	44 (28.76 %)	98 (64.47 %)	54 (35.53 %)
Question 8	123 (80.39 %)	30 (19.61 %)	91 (59.87 %)	61 (40.13 %)
Question 9	33 (21.57 %)	120 (78.43 %)	77 (50.66 %)	75 (49.34 %)
Question 10	113 (73.86 %)	40 (26.14 %)	52 (34.21 %)	100 (65.79 %)

Questions with the highest percentage of correct answers are in familiar situations submodule. Students can choose objects such as motorcyclists, cars, zebra crossing, auto-rickshaw, cycle lane, bus, traffic sign, pedestrian, and truck. 73.20 % of the students in question 3 of familiar situations submodule able to choose the correct object for situations that are located 1 km from the school (Figure 17).



Figure 17. Picture in Question 3 of the Knowledge Module in Familiar Situation

Wrong answers in this module mainly because students choose an object that was not in the picture, such as traffic light and zebra crossing in question 10 of unfamiliar situations (Figure 18). Out of 5 of the questions with the highest percentage of the wrong answers, 3 are from familiar situations and 2 are from unfamiliar situations.



Figure 18. Picture in Question 10 of Situation Awareness Module in Unfamiliar Situation

4.1.1.3 Risk Detection Module

Table 3 reveal the results of 150 students who finished the risk detection module on familiar and unfamiliar situations. There are around 20 % differences in the average of students who choose the correct answer in unfamiliar situations (84.93 %) and familiar situations (69.20 %).

Table 3. Answer Results from Risk Detection Module

Risk module	Detection	Familiar Situations (Jakarta City)		Unfamiliar Situations (Bogor City)	
		Number (%)		Number (%)	
		Correct	Wrong	Correct	Wrong
Question 1		59 (39.33 %)	91 (60.67 %)	146 (97.33 %)	4 (2.67 %)
Question 2		31 (20.67 %)	119 (79.33 %)	149 (99.33 %)	1 (0.67 %)
Question 3		133 (88.67 %)	17 (11.33 %)	102 (68 %)	48 (32 %)
Question 4		116 (77.33 %)	34 (22.67 %)	88 (58.67 %)	62 (41.33 %)
Question 5		140 (93.33 %)	10 (6.67 %)	143 (95.33 %)	7 (4.67 %)
Question 6		150 (100%)	0 (0 %)	132 (88 %)	18 (12 %)
Question 7		145 (96.67 %)	5 (3.33 %)	145 (96.67 %)	5 (3.33 %)
Question 8		34 (22.67 %)	116 (77.33 %)	92 (61.33 %)	58 (38.67 %)
Question 9		147 (98 %)	3 (2 %)	144 (96 %)	6 (4 %)
Question 10		83 (55.33 %)	67 (44.67 %)	133 (88.67 %)	17 (11.33 %)

5 questions with the highest percentage of correct answers come from familiar and unfamiliar situations. In question 6 of familiar situations submodule, all student (100 %) understands where to pay attention when they want to cross the street using a zebra cross in the curve road. In question 7 & 9 of familiar situations submodule, students understand that they should pay attention to the motorcycle that occupies the sidewalk (96.67 %) and pay attention to vehicles that want to turn when they cross using a zebra cross in a corner (98 %).

In unfamiliar situations submodule, students understand they should pay attention to a cyclist when they walk on the sidewalk (97.33 %) in questions 1, almost all students also understand they should pay attention to the vehicle on the right before crossing using the zebra cross in questions 2 (Figure 19), and students also understand that they should pay attention to the vehicle that parked on the sidewalk (96.67 %) in questions 7.



Figure 19. Picture in Question 2 of Risk Detection Module in Unfamiliar Situation

4 out of 5 questions with the highest percentage of the wrong answer is in familiar situations submodule. Students failed to recognize that they should pay attention to a parked car when they walk in front of a parking vehicle in question 1 of a familiar situation. In question 2 of familiar situations, 79.33 % of the students failed to understand that when they want to cross on an intersection they should pay attention to a turning vehicle instead of the traffic light or traffic sign that was not mean for them (Figure 20). On the same submodule, 44.67 % of the students failed to understand that they should pay attention to motorcyclists that use the zebra cross when they cross using the zebra crossing. In both submodule, students still lack understanding of where to pay attention while using pelican crossing.



Figure 20. Picture in Question 4 of Risk Detection Module in Unfamiliar Situation

4.1.1.4 Risk Management Module

Table 4 display the percentage of the correct and wrong answer of students that finished the risk detection module. In this module, the average percentage of the correct answer in familiar situations (85.30 %) is higher than in unfamiliar situations (79.33 %). 149 students finished both submodules.

Table 4. Answer Results from Risk Management Module

Risk Management module	Familiar Situations (Jakarta City)		Unfamiliar Situations (Bogor City)	
	Number (%)		Number (%)	
	Correct	Wrong	Correct	Wrong
Question 1	149 (100 %)	0 (0 %)	110 (73.83 %)	39 (26.17 %)
Question 2	61 (40.94 %)	88 (59.06 %)	147 (98.66 %)	2 (1.34 %)
Question 3	86 (57.72 %)	63 (42.28 %)	96 (64.43 %)	53 (35.57 %)
Question 4	136 (91.28 %)	13 (8.72 %)	123 (82.55 %)	26 (17.45 %)
Question 5	145 (97.32 %)	4 (2.68 %)	41 (27.52 %)	108 (72.48 %)
Question 6	131 (87.92 %)	18 (12.08 %)	146 (97.99 %)	3 (2.01 %)
Question 7	136 (91.28 %)	13 (8.72 %)	106 (71.14 %)	43 (28.86 %)
Question 8	135 (90.60 %)	14 (9.40 %)	149 (100 %)	0 (0 %)
Question 9	148 (99.33 %)	1 (0.67 %)	145 (97.32 %)	4 (2.68 %)
Question 10	144 (96.64 %)	5 (3.36 %)	119 (79.87 %)	30 (20.13 %)

In both submodules, there are questions that students have a 100 % correct answer. The first one is in question 1 of familiar situations where students show that they understand they should wait before they cross the street and wait again in the refuge island (Figure 21). The second one is in question 8 of familiar situations where students understand to look right and left before crossing. In this module, most students understand to look right and left before crossing (questions 5 & 9 in a familiar situation and questions 2

& 9 in an unfamiliar situation). Most students also indicate that they understand how to operate and cross with pedestrian light in pelican crossing in question 6 of an unfamiliar situation.



Figure 21. Picture in Question 1 of Risk Management Module in Familiar Situation

Most of the incorrect answers from unfamiliar situation submodule in question 3, 5, and 7 are about how to manage to cross the street without a traffic light and zebra crossing. In question 3. In question 3 of the unfamiliar situation where there is no zebra crossing to cross in an intersection, the student failed to understand to look at the vehicle that gives a sign to turn (Figure 22). In question 2 of familiar situations, students lack an understanding of what to do when they want to cross in a busy intersection. In question 3 of familiar situations, students still confused about where to look a one-way street since they think they should check the vehicle from the right and left instead of just to check from where the direction of the vehicle before crossing in question 3 of a familiar situation.



Figure 22. Picture in Question 3 of Risk Management Module in Unfamiliar Situation

4.1.1.5 Final Module

Table 5 illustrates the correct and wrong answers in the final module. The question in the final module is a compilation from familiar situations questions in each module. There are 148 students that answers were recorded from questions 1 – 8 and 147 student's answers were recorded from questions 9 – 20. The average of correct answers in this module is 83.28 %.

Table 5. Comparison of answer results from the final module and each module

Questions in Final Module	Number (%)		Questions in Each Module (Jakarta City)	Number (%)		Differences between 2 nd and 1 st measurement
	Correct	Wrong		Correct	Wrong	
Questions 1	102 (68.92 %)	46 (31.08 %)	Question 2 Knowledge	120 (77.92 %)	34 (22.08 %)	-9 %
Questions 2	121 (81.76 %)	27 (18.24 %)	Question 10 Knowledge	138 (89.61 %)	16 (10.39 %)	-7.85 %
Question 3	140 (94.59 %)	8 (5.41 %)	Questions 5 Knowledge	148 (96.10 %)	6 (3.90 %)	-1.51 %
Question 4	140 (94.59 %)	8 (5.41 %)	Questions 8 Knowledge	147 (95.45%)	7 (4.55 %)	-0.86 %
Question 5	126 (85.14 %)	22 (14.86 %)	Question 7 Knowledge	149 (96.75%)	5 (3.25 %)	-11.62 %
Question 6	23 (15.54 %)	125 (84.46 %)	Question 5 Situation Awareness	105 (68.63 %)	48 (31.37 %)	-53.09 %
Question 7	83 (56.08 %)	65 (43.92 %)	Question 7 Situation Awareness	109 (71.24 %)	44 (28.76 %)	-15.09 %
Question 8	110 (74.32 %)	38 (25.68 %)	Question 10 Situation Awareness	113 (73.86 %)	40 (26.14 %)	0.47 %
Question 9	120 (81.63 %)	27 (18.37 %)	Question 2 Situation Awareness	39 (25.49 %)	114 (74.51 %)	56.14 %
Question 10	97 (65.99 %)	50 (34.01 %)	Question 1 Situation Awareness	51 (33.33 %)	102 (66.67 %)	32.65 %

Question 11	144 (97.96 %)	3 (2.04 %)	Question 10 Risk Detection	83 (55.33 %)	67 (44.67 %)	42.63 %
Question 12	144 (97.96 %)	3 (2.04 %)	Question 1 Risk Detection	59 (39.33 %)	91 (60.67 %)	58.63 %
Question 13	140 (95.24 %)	7 (8.16 %)	Question 9 Risk Detection	147 (98 %)	3 (2 %)	-2.76 %
Question 14	144 (97.96 %)	3 (2.04 %)	Question 6 Risk Detection	150 (100%)	0 (0 %)	-2.04 %
Question 15	135 (91.84 %)	12 (8.16 %)	Question 3 Risk Detection	133 (88.67 %)	17 (11.33 %)	3.17 %
Question 16	132 (89.80 %)	15 (10.20 %)	Question 5 Risk Management	145 (97.32 %)	4 (2.68 %)	-7.52 %
Question 17	139 (94.56 %)	8 (5.44 %)	Question 6 Risk Management	131 (87.92 %)	18 (12.08 %)	6.64 %
Question 18	143 (97.28 %)	4 (2.72 %)	Question 10 Risk Management	144 (96.64 %)	5 (3.36 %)	0.63 %
Question 19	137 (93.20 %)	10 (6.80 %)	Question 8 Risk Management	135 (90.60 %)	14 (9.40 %)	2.59 %
Question 20	134 (91.16 %)	13 (8.84 %)	Question 4 Risk Management	136 (91.28 %)	13 (8.72 %)	-0.12 %

Out of 20 questions, there are 9 questions where students correct answer percentages are higher on the second measurement (final module) compare to the first measurement (answer in each module). The highest increase of correct answer in the final module compare to the questions in each module are in risk detection (58.63%), situation awareness (56.14 %) module. In question 11 of the final module, almost half of the students remember when they are using zebra crossing they need to pay attention to the motorcycle that also uses a zebra cross (Figure 23).

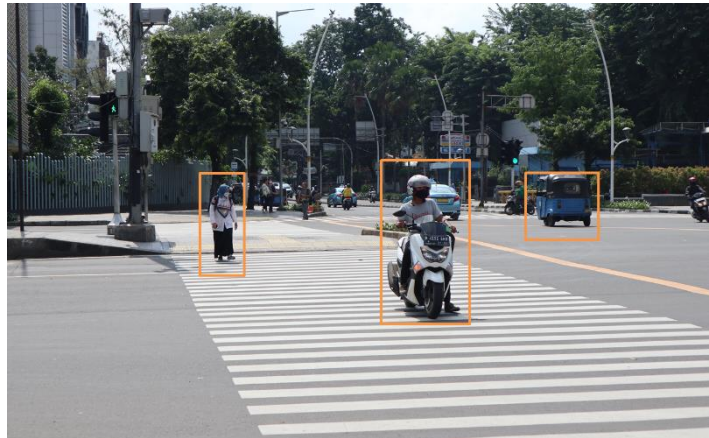


Figure 23. Picture in Question 17 of Final Module

From all the differences, the module where more students get the wrong answers in the final module is in the knowledge module. One example where students get a higher percentage of the correct answer the first time or in question 10 of the knowledge module rather the second time or in question 2 of finale module (- 7.85 %). In this question, more students choose the answers where they have 19 minutes to cross when pedestrian traffic light in pelican crossing is green and showing the number '19' (Figure 24).



Figure 24. Picture in Question 7 of Final Module

4.1.2 The scores

Table 6 displays the mean and standard deviation of student scores in each module. The score for each module range from 0 – 100. Overall, the highest mean score was in the knowledge module (84.67) while the lowest was in the situation awareness module (55.05). The same thing happened in an unfamiliar situation submodule where knowledge module (86.33) has the highest mean score and situation awareness (56.77) have the lowest mean score. Meanwhile, in a familiar situation, the highest mean score was in the risk management module (85.24) and the lowest mean score in the situation awareness module (53.51). Student performed better in unfamiliar situations, $F(1,1114) = (10.94)$, $p < 0.05$, with score of 76.80 in unfamiliar situation and 72.56 in familiar situation.

In risk detection module, student show better performance in unfamiliar situations with $F(1,272) = (113.08)$, $p < 0.05$. Meanwhile in risk awareness student have better performance in familiar situations $F(1,281) = (17.27)$, $p < 0.05$. However, there are no significant difference between the score in familiar and unfamiliar situations in knowledge and situation awareness module.

Table 6. The mean and standard deviation of student score in each module

Module	Mean Score (SD)	Mean Score Familiar Situations (SD)	Mean Score Unfamiliar Situations (SD)
Knowledge	84.67 (17.40)	83.20 (19.65)	86.33 (14.37)
Situation Awareness	55.05 (24.35)	53.51 (23.56)	56.77 (25.18)
Risk Detection	76.67 (15.32)	68.57 (14.32)	85.14 (11.22)
Risk Management	82.12 (13.14)	85.24 (10.80)	78.24 (14.53)
Finale	82.41 (13.03)		

4.1.3 The badges

Badges were one of the elements of gamification in the platform. Table 7 shows the number of badges that were collected by the students. Most students collected the silver badges (44.02 %) than followed by gold (33.59 %), Bronze (13.39 %), and white (9 %). Among the modules, the student got the most gold badges in knowledge modules as 121 gold modules collected. Silver badges were collected the most in risk detection module (101). Meanwhile, the situation awareness module saw the highest number of bronze (70) and white (59) badges being collected.

There are differences in the number of badges collected in each module since the total of students who did the platform gradually decreasing in each submodule. There are more badges collected in unfamiliar situations (406) compare to familiar situations (404). In general, when the number of bronze and white badges in a module is high, the mean score of the module is also lower compare to the other module. On the other hand, when the number of gold and silver badges in a module is high, they have a higher mean score compare to the other module. For example, a situation awareness module with a total of bronze and white badges of 129 (highest compare to the other module) has the lowest mean score compare to the other module (55.05). As the number of gold and silver badges in unfamiliar situations (320) is higher than in familiar situations (291), the mean score in an unfamiliar situation (76.80) is also higher compared to the familiar situation (72.56).

Table 7. The Number of Badges Collected in the Platform

Situation	Module	Badge	Number	Percentages (%)
Familiar situation (Jakarta)	Knowledge	Gold	60	6.59
		Silver	43	4.72
		Bronze	3	0.33
		White	5	0.55
Situation Awareness	Awareness	Gold	3	0.33
		Silver	27	2.96

		Bronze	44	4.83
		White	27	2.96
Risk		Gold	7	0.77
Detection		Silver	59	6.48
		Bronze	26	2.85
		White	4	0.44
Risk		Gold	50	5.49
Management		Silver	42	4.61
		Bronze	4	0.44
		White	0	0.00
Finale		Gold	37	4.06
		Silver	59	6.48
		Bronze	5	0.55
		White	0	0.00
Unfamiliar	Knowledge	Gold	61	6.70
situation		Silver	39	4.28
(Bogor)		Bronze	2	0.22
		White	8	0.88
Situation		Gold	11	1.21
Awareness		Silver	35	3.84
		Bronze	26	2.85
		White	32	3.51
Risk		Gold	45	4.94
Detection		Silver	42	4.61
		Bronze	4	0.44
		White	4	0.44
Risk		Gold	32	3.51
Management		Silver	55	6.04
		Bronze	8	0.88
		White	2	0.22
Total			911	100 %

4.1.4 Time

Table 8 displays the distribution of the time spent by the student to answer each module. The longest mean time student spent in each question is in the risk management module (34 s) and the shortest mean time in a module is in the finale module (10 s). Generally, students spent more time in each question of familiar situations (25 s) compare to unfamiliar situations (23 s). Approximately, students spent 30 minutes working on this module.

In an unfamiliar situation, the student spent less time answering questions in the risk detection module (14 s) and the student spent more time answering questions in the risk management module (33 s). Meanwhile, in a familiar situation students spent more time answering questions in the risk management module (35 s) and less time in the situation awareness module (17 s).

The minimum time student spent on a question is for 1 second in the risk management module. The maximum time student spent on a question is more than 1 hour and it's also in the same module. This large time range between students in each module is because they can do this whenever they want without the supervision of adults (teachers/parents).

To measure whether the mean score and the mean time that students spent on each module are correlated a Pearson's correlation is conducted. The results reveal there are no correlation between the two variables ($r = 0.3$, $n = 9$, $p = 0.433$).

Table 8. Mean Time and Score of Each Module

Module	Mean time	Familiar		Unfamiliar			
		Min. time	Max. Time	Mean time	Min. time	Max. Time	Mean time
Knowledge	0:00:27	0:00:03	0:10:49	0:00:30	0:00:03	0:18:58	0:00:24
Situation Awareness	0:00:18	0:00:04	0:25:37	0:00:17	0:00:03	0:25:09	0:00:19
Risk Detection	0:00:16	0:00:02	0:48:36	0:00:19	0:00:02	0:15:56	0:00:14
Risk Management	0:00:34	0:00:01	1:05:39	0:00:35	0:00:01	1:51:01	0:00:33
Finale	0:00:10	0:00:02	0:00:18	0:00:10			

4.2 Data from the questionnaire

The data from the questionnaire were processed using SPSS. The questionnaire was sent to 7th-grade students at Labschool Kebayoran Junior High School in Jakarta (N = 192). The sample were divided into control (N = 32) and intervention (N = 160) group. One hundred sixty-seven students (86.98 %) finished the pre-intervention questionnaire, Route2School platform, and post-intervention questionnaire. There are control groups (N = 31) that completed the pre- and post-intervention questionnaire and intervention group (N = 136) who completed both questionnaires and also Route2School platform.

4.2.1 Demographic of respondents and walking habit

There are more female students (N = 93) than male students (N = 74) who completed all the stages in the study. Most students (59.3 %) live in South Jakarta or the same municipality where the school is located. 21.6 % of the student live in Tangerang or the satellite city near South Jakarta. Meanwhile, 13.8 % of the student lives in West Jakarta, 3 % of the students live in Central Jakarta, 1.8 % of the students live in other satellite cities, and 0.6 % of the students live in East Jakarta.

Figure 25 displays student transportation mode to school. 81 % of the student shows that most of the student went to school by car, 10 % of the students use motorcycle (private or taxi) to school, and the rest of the students use public transport to school. No students walk or ride a bicycle to school. It might happen as the school in the research is a private school, thus most of the students are being dropped off by their parents using a private vehicle.

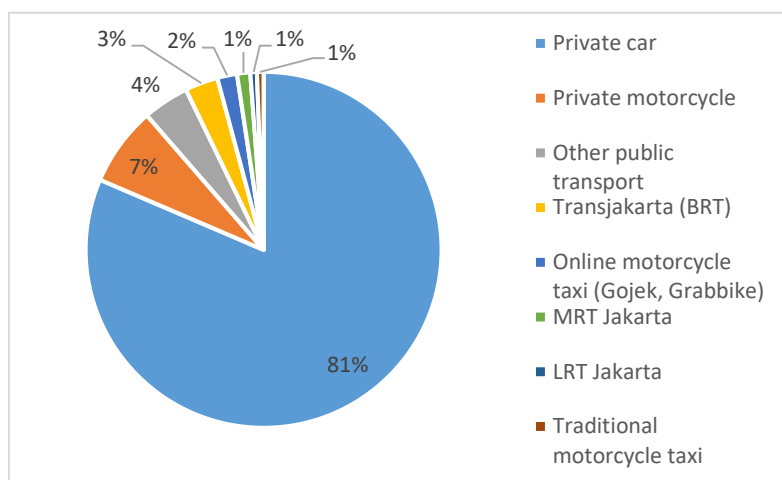


Figure 25. Student Transportation Mode to School Distribution

Students were also asked regarding their walking habits in the last two months or in February and March 2020 (to include the times before COVID-19). From 167 students, only 13 students or 7.8 % stated they never walked outside between February and March 2020. From 154 students, 53.9% stated they have a walk to reach a nearby shop, tutoring place, or for leisure between 1-4 times in the last two months. At the same time, 27.5 % of the student stated they have walked between 5-8 times in the last two months and 10.8 % of the students have walked more than 8 times in the last two months.

Table 9. Students Walking Habit

Frequencies	Walk with their parents (%)	Walk on their own (%)
Most of the time (more than 8 times in the last two months)	16 (10.39 %)	19 (12.34 %)
Often (5-8 times in the last two months)	34 (22.08 %)	40 (25.97 %)
Sometimes (1-4 times in the last two months)	82 (53.24 %)	69 (44.81 %)
Never	22 (14.29 %)	26 (16.88 %)

Those 154 students who answer they have walked in the March and February 2020 were asked again with two questions regarding their companion on walking habit (Table 9). More students agree when they're walking to their destination or for leisure in the last two months, they were accompanied by their parents (132 students) rather than walking alone (128 students). Out of 154 students, 86 were female and 68 students are male. However, there was almost the same amount of percentages between the frequencies of students who walk alone or with their parents. It means their parents already trusted them to walk alone.

Figure 26 shows the comparison for each answer for the question 'If you go out on foot, how often are you accompanied by your parents?' by gender. Female students answer in these questions mostly higher than males. It means when walking they are mostly accompanied by their parents.

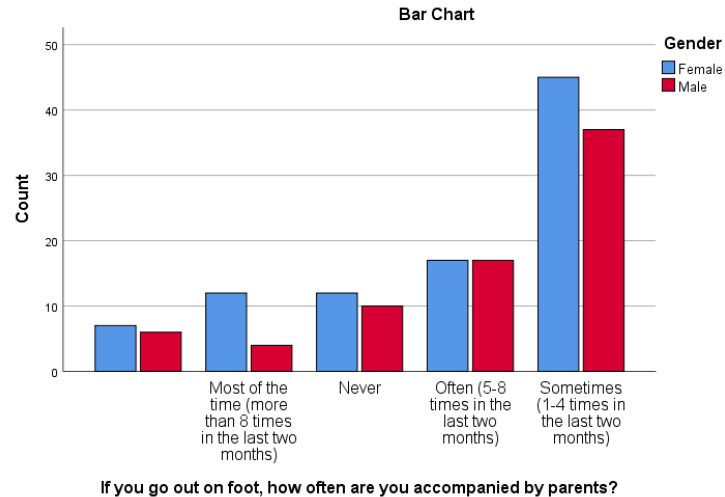


Figure 26. Graph of 'If you go out on foot, how often are you accompanied by your parents?' Answers by Gender

Figure 27 displays the comparison for each answer for the question 'If you go out on foot, how often are you on your own?' by gender. In this part, male answers are higher most of the time, and often answer are higher than females. At the same time, female student answers never go out on foot on their own higher compare to the male student. It means more male students less supervised by their parents.

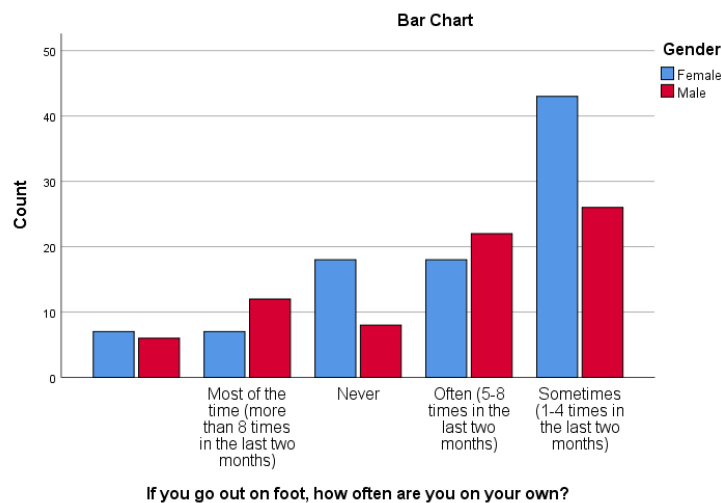


Figure 27. Graph of 'If you go out on foot, how often are you on your own?' Answers by Gender

4.2.3 TPB

There is 12 item based on TPB on both questionnaires, specifically items relating to attitude, subjective norm, PBC, and behavioral intention. All TPB items were measured using five-point scales (scored 1–5). The target behavior in this questionnaire is about safe crossing as a pedestrian by using pelican crossing. The TPB data will use to measure the outcome effect of the Route2School platform.

First, reliability analysis was tested to conduct the internal consistency of each variable. Internal Consistency measures the correlations between items on the same variable that can confirm whether a group of items produce a similar score. It will be calculated by the pairwise comparisons among items or using Cronbach's alpha. The results of the alpha value in each variable are shown in Table 10 and a value of 0.45 – 0.96 was described as acceptable (Taber, 2017).

After that, paired-samples t-tests were measured to measure the difference between the first and second measurements on the socio-cognitive variable. Results display that there was no significant difference between the pre- and post-intervention on the measures related to the subjective norm ($p = 0.51$), perceived behavioral control ($p = 0.28$), and behavioral intention ($p = 0.32$). However, there were significant results on measures related to attitude ($p = 0.01$).

Table 10. Number of items, Cronbach's alpha, mean, standard deviation and p-value

Variable	Number of items	Cronbach's α		Pre-intervention		Post-intervention		p-value pre vs post-intervention
		Pre-intervention	Post-intervention	Mean	(SD)	Mean	(SD)	
Attitude	3	0.737	0.738	4.271	0.534	4.371	0.526	0.013*
Subjective norm	3	0.676	0.839	4.331	0.535	4.295	0.664	0.510
Perceived Behavioral Control	3	0.573	0.797	4.126	0.532	4.188	0.656	0.284
Behavioral Intention	3	0.891	0.912	4.040	0.763	4.102	0.762	0.327

* $p < 0.05$

** $p < 0.01$

Univariate analysis of covariance (ANCOVA) was conducted to test the effects of the Route2School platform on the theory of planned behavior variables ($N = 167$). The dependent variables were the TPB measures from the post-intervention questionnaire. The independent variable in each analysis was condition (0 = control; 1 = intervention). The covariates were the TPB measures from the pre-intervention questionnaire.

Before conducting an ANCOVA the homogeneity-of-regression (slopes) assumption should be tested. The test evaluates the interaction between the independent variable (factor) and covariate in the prediction of the dependent variable. If there's a significant interaction between the factor and covariate, ANCOVA is not meaningful as it indicates the differences in the dependent variable among groups vary as a function

of the covariate. The other assumption that should be tested is the independence of the covariate and the post-intervention questionnaire results of TPB measure. The results show that all the assumptions are met in Table 11.

Table 11. ANCOVA assumptions requirement

Item description (and scale)	Time	r	Slope	
			F	p
Attitude				
For me crossing the road using pelican crossing is (1= Extremely bad; 5= Extremely good)	Pre-intervention (covariance)			
	Post-intervention	0.345**	5.274	0.023
For me crossing the road using pelican crossing is (1= Extremely necessary; 5= Extremely unnecessary)	Pre-intervention (covariance)			
	Post-intervention	0.367**	3.543	0.062
For me crossing the road using pelican crossing is (1= Extremely safe; 5= Extremely dangerous)	Pre-intervention (covariance)			
	Post-intervention	0.499**	0.036	0.849
Subjective norm				
My mom and dad if I cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention (covariance)			
	Post-intervention	0.164*	0.614	0.434
My best friend wants me to cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention (covariance)			
	Post-intervention	0.401**	0.371	0.543
My teachers think I should cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention (covariance)			
	Post-intervention	0.316**	0.004	0.947
Perceived Behavioral Control				
I believe that I can cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention (covariance)			
	Post-intervention	0.322**	0.034	0.853
I'm sure that I can hold my friends' persuasion not to cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention (covariance)			
	Post-intervention	0.068	0.228	0.634
I'm sure I can make the decision to cross the road using the pelican crossing or not (1=strongly disagree; 5=strongly agree)	Pre-intervention (covariance)			
	Post-intervention	0.231**	1.547	0.215
Behavioral Intention				
I want to always cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention (covariance)			
	Post-intervention	0.460**	0.037	0.848
I will try to always cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention (covariance)			
	Post-intervention	0.236**	0.453	0.502

I intend to always cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention (covariance)			
	Post-intervention	0.373**	0.255	0.615

Note: * $p < 0.05$ is significant, ** $p < 0.01$ is very significant

r is correlation; slope is the regression lines between groups

Based on the finding from table 11, ANCOVA analysis can proceed. However, the results of ANCOVA in Table 12, reveal there is no significant effect of the Route2School platform on socio-cognitive variables such as attitude, subjective norm, perceived behavioral control, and behavioral intention on control and intervention group. The means of pre-intervention measures of each variable were high for each condition (control & experimental). It means students' attitude to cross the street using pelican crossing is already positive before learning about road safety in the Route2School platform. Mean score on the subjective norm in pre-intervention showed that students perceived social pressure from their parents, best friends, and teachers to cross the street using pelican crossing. Concerning perceived behavioral control in pre-intervention, mean scores were also high, indicating that in a situation where they have to cross the street as a pedestrian they would inhibit or facilitate their compliance to cross using pelican crossing. Students also have a high mean score on the future intention of using pelican crossing.

Table 12. Mean Score, Standard Deviation, and Effects of TPB Variable on Control and Intervention Group

Item description (and scale)	Time	M (SD)				ANCOVA		
		Control		Intervention		MSE	F (1,164)	p
Attitude	Pre-intervention	4.31	0.58	4.26	0.52			
	Post-intervention	4.43	0.46	4.36	0.54	0.054	0.270	0.604
For me crossing the road using pelican crossing is (1= Extremely bad; 5= Extremely good)	Pre-intervention	4.39	0.56	4.28	0.65			
	Post-intervention	4.61	0.56	4.48	0.61	0.253	0.792	0.375
For me crossing the road using pelican crossing is (1= Extremely necessary; 5= Extremely unnecessary)	Pre-intervention	4.42	0.67	4.48	0.60			
	Post-intervention	4.48	0.63	4.44	0.72	0.115	0.268	0.605
For me crossing the road using pelican crossing is (1= Extremely safe; 5= Extremely dangerous)	Pre-intervention	4.13	0.72	4.03	0.73			
	Post-intervention	4.19	0.65	4.15	0.64	0.001	0.002	0.965
Subjective norm	Pre-intervention	4.35	0.53	4.33	0.54			
	Post-intervention	4.29	0.67	4.30	0.67	0.008	0.020	0.887
My mom and dad if I cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.29	0.64	4.43	0.71			
	Post-intervention	4.32	0.87	4.40	0.73	0.064	0.113	0.737
My best friend wants me to cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.39	0.62	4.21	0.67			
	Post-intervention	4.16	0.86	4.14	0.76	0.105	0.204	0.652

My teachers think I should cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.39	0.67	4.35	0.71			
	Post-intervention	4.39	0.76	4.35	0.76	0.010	0.020	0.889
Perceived Behavioral Control	Pre-intervention	4.29	0.52	4.09	0.53			
	Post-intervention	4.16	0.65	4.19	0.66	0.209	0.507	0.477
I believe that I can cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.55	0.51	4.39	0.55			
	Post-intervention	4.35	0.71	4.40	0.70	0.344	0.771	0.381
I'm sure that I can hold my friends' persuasion not to cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.00	0.82	3.63	0.98			
	Post-intervention	3.94	0.85	3.90	0.89	0.002	0.002	0.962
I'm sure I can make the decision to cross the road using the pelican crossing or not (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.32	0.54	4.24	0.61			
	Post-intervention	4.19	0.70	4.27	0.75	0.259	0.500	0.481
Behavioral Intention	Pre-intervention	4.19	0.65	4.00	0.78			
	Post-intervention	4.11	0.74	4.10	0.77	0.140	0.293	0.589
I want to always cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.03	0.91	3.91	0.87			
	Post-intervention	4.03	0.84	3.98	0.91	0.000	0.000	0.990
I will try to always cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.39	0.56	4.10	0.83			
	Post-intervention	4.19	0.79	4.20	0.73	0.122	0.235	0.629
I intend to always cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.39	0.56	4.10	0.83			
	Post-intervention	4.19	0.79	4.20	0.73	0.184	0.298	0.586

Note: * $p < 0.05$ is significant, ** $p < 0.01$ is very significant

Other analysis also had been done to identify the interaction between socio-cognitive variables and student's gender, living location and their choice of transport modes to school. It was found that there is no significant intervention effect for gender and place of residence. However, there are significant interaction between student's transport mode to school and their attitude $F(7, 158) = 2.79, p = 0.01$; subjective norm $F(7, 158) = 3.72, p = 0.00$; perceived behavioral control $F(7, 158) = 4.45, p = 0.01$; and behavioral intention $F(7, 158) = 7.92, p = 0.01$.

4.2.4 Process Evaluation from the Students and Teachers

Table 13 displays the descriptive statistics of a process evaluation of the Route2School Platform from 136 students. There were 17 items in this scale. In general, the mean of the process evaluation measure was 3.69.

Table 13. Mean and Standard Deviation of Process Evaluation Item

No.	Process evaluation item	Mean	SD
1	Overall, how satisfied were you with Route2School? (1=extremely dissatisfied; 5= extremely satisfied)	3.81	0.87
2	I would recommend the platform to others (1=strongly disagree; 5=strongly agree)	3.88	0.79
3	It was easy for me to understand the questions in the platform (1=strongly disagree; 5=strongly agree)	4.07	0.67
4	I found the 'final module' difficult (1=strongly disagree; 5=strongly agree)	2.59	0.89
5	I found the questions in Jakarta City easier than Bogor City (1=strongly disagree; 5=strongly agree)	3.60	0.94
6	The time investment was too large (1=strongly disagree; 5=strongly agree)	3.21	1.12
7	It was easy for me to access the platform (1=strongly disagree; 5=strongly agree)	3.85	0.90
8	I found the questions about "What should Charlie know?" the easiest (1=strongly disagree; 5=strongly agree)	3.87	0.86
9	I found the questions about "What should Charlie see?" the easiest (1=strongly disagree; 5=strongly agree)	3.24	0.98
10	I found the questions about "Where should Charlie look?" the easiest (1=strongly disagree; 5=strongly agree)	3.40	0.98
11	I found the questions about "How should Charlie react?" the easiest (1=strongly disagree; 5=strongly agree)	3.42	0.88
12	I am familiar with several situations from the questions (1=strongly disagree; 5=strongly agree)	4.11	0.68
13	R2S improve my knowledge of road safety (1=strongly disagree; 5=strongly agree)	4.31	0.69
14	I felt more motivated to study using this method than in class room (1=strongly disagree; 5=strongly agree)	3.65	0.97
15	I can see clearly the question's text & images (1=strongly disagree; 5=strongly agree)	3.98	0.87
16	I can hear clearly the audio in the platform (1=strongly disagree; 5=strongly agree)	4.29	0.59
17	Will you use R2S again in the future? (1=Never; 5= Definitely)	3.58	0.86

Overall, 48.5 % of the students felt somewhat satisfied and 19.9 % of the students felt extremely satisfied with the Route2School platform. Meanwhile, less than 5 % of the students felt dissatisfied with the platform. 75 % of the students stated that they would recommend Route2School to others and only 3.6

% of the students who stated they wouldn't. Furthermore, 59.6 % of the students want to use the Route2School platform again in the future and 31.6 % of the students stated they are not sure whether or not they want to use it again in the future.

90.4 % of the students agree & strongly agree with the statement that the Route2School platform improves their knowledge of road safety. This statement also has the highest mean score (4.31) compared to other statements. 56.6 % of the students agree & strongly agree that they felt motivated to study using gamification in an e-learning platform compared to the teaching method in the class and 35.3 % of the students felt unsure with the statement and 8.1 % of the students disagree & strongly disagree with the statement.

Regarding the platform, 88.7 % of the students stated they can access the platform easily. More than 70 % of the students stated that they can see clearly the question's text & images and more than 90 % of the students stated they can clearly hear the audio in the platform. 86 % of the students stated that they can understand the question in the platform and only 0.7 % of the students do not agree with the statement. Almost half of the students agree that the time investment on the module is too large, meanwhile the number of the students who choose they are unsure (29.4 %) with this statement and disagree (27.3 %) with the statement almost the same.

For each module, 48.5 % of the students agree and 22.8 % strongly agree that the "what should Charlie know?" is the easiest; 34.6 % of the students agree and 7.4 % strongly agree that the "what should Charlie see?" is the easiest; 25.7 % of the students agree and 16.2 % strongly agree that the "Where should Charlie look?" is the easiest, and 37.5 % of the students agree and 9.6 % strongly agree of the students agree that "How should Charlie react?" is the easiest. Meanwhile, 38.2 % of the students disagree and 9.6 % of the students strongly disagree the "final" module is difficult. 54.4 % of the students are agreed & strongly agree that the questions in Jakarta City are easier than Bogor City. Students strongly agree (25.7 %) and agree (62.5 %) that they are familiar with several situations from the question.

After that, students were asked to choose 3 out of 7 features that they liked the most on the platform. Figure 28 shows the three features that they liked the most are badges (77 students); questions with images of familiar situations (68 students); and Charlie (64 students). The 3 features in Route2School from that option that students like the least are audio introduction (30 students); web interface design (54 students); and levels (55 students).

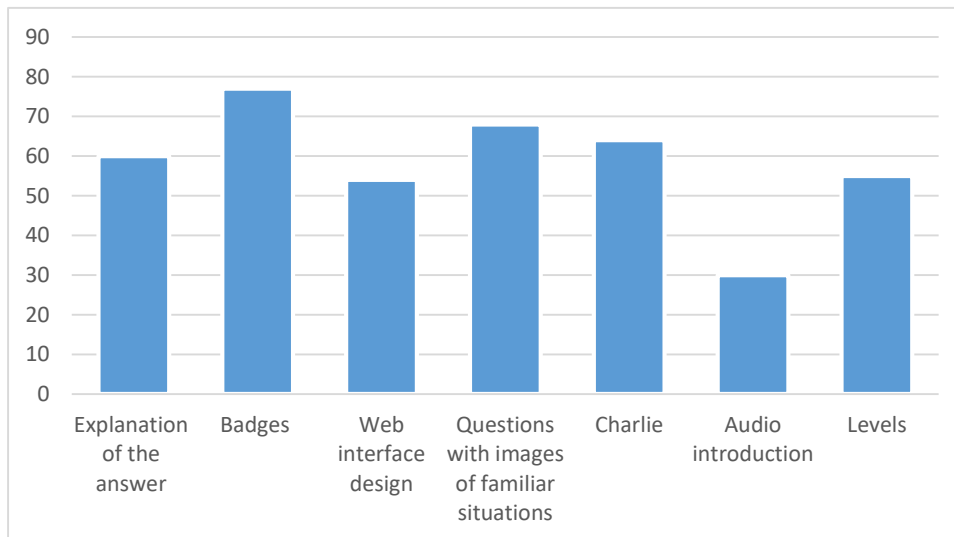


Figure 28. Liked Features of Route2School

Student's opinions were asked regarding what features they would like to change in the Route2School platform (Figure 29). Most students (58) think that nothing should be changed from the platform. However, 31 students would like to change the audio introduction to written or a video introduction and 28 students think that the image size needs to be larger.

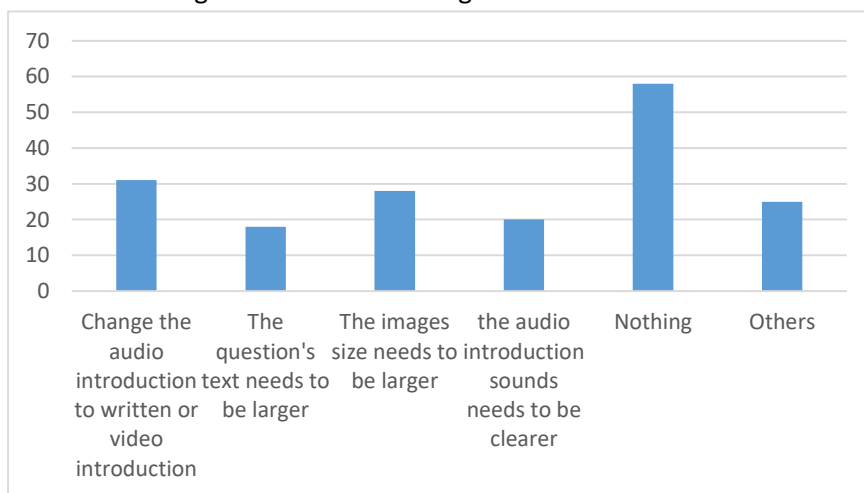


Figure 29. Students Opinion on What Features They Would Like to Change in R2S Platform

25 students who choose the "other" option in the last question, able to share their thoughts in text. There are many different opinions from the students. However, several students have the same opinions: 4 students think that they need a longer time to answer questions in the module of "What should Charlie see?" and 4 students think that they think the module is too much and would like to have a shorter time investment in this platform. One of student opinion that interesting are:

"It is better to create a more attractive Web interface design and UI. It is also better to create an easier way to answer is "where should Charlie pay attention" because I think in that part we can

choose more than one box. Many of my friends have a problem with accessing the platform. I'm not sure because of their hardware or other problem, but I think it's because the UI is unclear. Nevertheless, I want to say thank you because working on this platform is interesting."

Two teachers who acquire the login to the platform and work closely with the students during the data collection were also asked to rate the platform. One of the teachers is the vice-principal and the second is the IT teacher. Both teachers stated they're satisfied with the platform. The teachers also like the use of gamification in the platform, the web interface design, and ease of use. Regarding the materials, they rated good for every module and stated that it is pretty much to have high relevance with the materials that 7th grader in the school need to learn. The timing of the platform to the students in the month of May and during the second semester was also good. They also like that the platform has submodules of familiar (Jakarta City) and unfamiliar (Bogor City) situation.

Both teachers were asked to choose the 3 features in Route2School that stood out and answer Charlie and Web design (text, pictures, & audio). One of the teachers like the explanation of the answer feature and the other like that the platform has questions about the familiar and unfamiliar situation. The teachers stated that the platform might increase students' knowledge regarding road safety and one of the teachers stated:

"The platform makes it easier for the students to understand the traffic sign"

4.2.5 Additional questions regarding road safety

Four additional questions were also asked in the questionnaire to measure students' knowledge, situation awareness, risk detection, and risk management. The questions were about Jakarta City and those questions are not included in the platform. The list of the questions and student answers are shown in Table 14.

Table 14. Additional questions and results

Questions	Time	Control Group		Intervention Group	
		Number (%)		Number (%)	
		Correct	Wrong	Correct	Wrong
You want to go to the building on your right, what are you allowed to do?	Pre-intervention	30 (96.78 %)	1 (3.22 %)	127 (93.38 %)	9 (6.62 %)
	Post-intervention	31 (100 %)	0 (0 %)	129 (94.85 %)	7 (5.14 %)
What do you see best? (choose 4 answers)	Pre-intervention	15 (48.39 %)	16 (51.62 %)	73 (53.67 %)	63 (46.32 %)
	Post-intervention	18 (58.06 %)	13 (41.94 %)	114 (83.82 %)	22 (16.18 %)

Choose one box that you think you should pay attention to	Pre-intervention	23 (74.19 %)	8 (25.81 %)	97 (71.32 %)	39 (28.68 %)
	Post-intervention	22 (70.97 %)	9 (29.03 %)	113 (83.09 %)	23 (16.91 %)
You want to cross using this zebra crossing, what should you do best?	Pre-intervention	17 (54.84 %)	14 (45.16 %)	92 (67.65 %)	44 (32.35 %)
	Post-intervention	24 (77.42 %)	7 (22.58 %)	119 (87.5 %)	17 (12.5 %)

The first question is about knowledge regarding the situation in Figure 30. The correct answer from this question is “cross using the zebra crossing”. In this question, above 90 % of the student answer correctly in the pre-questionnaire of both groups. In the post-intervention questionnaire, there’s still an increase in the correct answers from both groups.



Figure 30. Question 1 "Knowledge" of Additional Questions

In question 2, the students were asked to choose 4 items that they see in a situation in Figure 31. The 4 items that made the correct answer is motorcyclist, traffic sign, car, and pedestrian. This question was about situation awareness and it was delivered to the students in the questionnaire almost the same as in the Route2School platform. Thus the picture and answer are on a different page in the questionnaire. At the pre-intervention questionnaire both control and intervention groups show almost 50% of the students choose the wrong answer. After receiving education on the Route2School platform, the correct answer from students in the intervention group has increased by around 30 %. This question saw the highest increase of correct answers in the post-intervention questionnaire compare to the pre-intervention questionnaire. Meanwhile, in the control group around 50 % of the student still choose the wrong answer in the post-intervention questionnaire.



Figure 31. Question 2 "Situation Awareness" of Additional Questions

The student was asked about risk detection in question 3. From Figure 32, students have to choose one box that they think they should pay attention to. In the pre-intervention questionnaire, around 70 % of the students in both groups choose the correct answer, which is the green box. After learning from Route2School, more students in the intervention group choose the right answer (11 %) and fewer students in the control group that choose the right answer (- 3.22 %). The most chosen wrong answer in the pre- & post-intervention questionnaire was the red box.

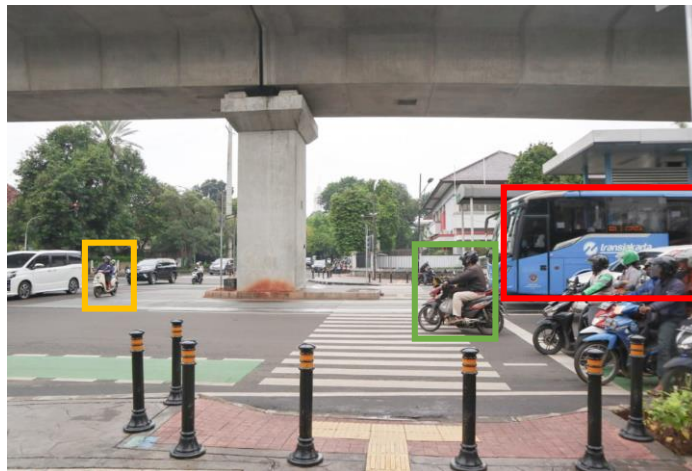


Figure 32. Question 3 "Risk Detection" of Additional Questions

Lastly, the students were asked about the question regarding risk management of what they should do best in a situation in Figure 33. Students have to answer the correct answer which is "Wait and look right for bicycles on the bicycle lane, then see traffic flow from the right and left". In the pre-intervention questionnaire, only 50-60 % of the student in both groups choose the correct answer. Meanwhile, in the post-intervention questionnaire, there's also an increase of 20 % of the students that choose the correct answer in both groups.



Figure 33. Question 4 "Risk Management" of Additional Questions

Both groups saw an increase of correct answer percentages during the pre- and post-intervention questionnaire except for questions regarding risk detection where the percentages of the correct answer in the control group are lower in the post-intervention group. However, when we compare the average of percentages, the intervention group have a higher correct answer (87.32 %) compare to the correct answer in the control group (76.61 %).

5. Discussion

The study focused on the application of the Route2School education platform to elementary and junior high school students in Jakarta, then measures the outcome evaluation and process evaluation. The outcome evaluation was measured using the changes in student's knowledge, skills, and socio-cognitive variable. Meanwhile, the process evaluation was measured using the process evaluation variable in the post-intervention questionnaire. The adaptation on the Route2School platform to Indonesian was focused on the materials regarding pedestrian behavior for children.

160 students were registered in the Route2School platform. The number of students who finished the first submodule in the platform is 154 students. The number decreases slowly in each submodule to only 147 students in the final module. This drop rate of participation could be explained as several student's experience login problems and teachers confirm some of them have an unstable internet connection.

The changes in student's knowledge were measured using the results from the platform and additional questions that were put in the pre- and pro-intervention questionnaire. The platform shows that students have a high mean score on the knowledge module compare to the other module. This could be because schools and Indonesia National Traffic Police only focused on giving knowledge regarding traffic laws through civic subjects rather than skills development.

The other measure of outcome evaluation is by measuring the changes in skills. Student skills could be measure from the situation awareness, risk detection, and risk management module. On the final module or second measurement in the platform, students reveal an increase in correct answer percentages on those modules. This indicates students able to increase their knowledge and skills by learning through the Route2School platform.

The data from the Route2School platform also shows five easiest questions are from knowledge module, risk detection module, and risk management module. Students were able to understand the means of instruction sign for a pedestrian on where to walk and cross, the means of a pedestrian traffic light, the use of refuge island, and the parking prohibition traffic sign in knowledge module. In risk detection module student know where to pay attention to avoid a risk in road traffic when they want to cross the street using a zebra cross in the two-way street, corner, and curve road, they also understand to pay attention to another vehicle (motorcyclist & cyclist) that occupy the sidewalk and pay attention to a parked vehicle when they have to walk in front of it. When answering risk management module students understand how to responds to a situation in traffic such as to look right and left before crossing the street, how to cross the street with the help of refuge island, and how to cross the street using pelican crossing. This is in line with the study by Heinrich & Langsoch (as cited in Dacota, 2012) that reveals primary school children in Europe able to know they have to look left first and then right before crossing the road.

Meanwhile, the five most difficult questions from the platform are from situation awareness module, risk detection module, and risk management module. In the situation awareness module where students need to be aware of several situations in traffic, students mostly choose an object that was not in the picture.

The students also indicate they still don't understand where to pay attention when they want to cross the street on a busy intersection in the risk detection module. During risk management module students still lack understanding in how to respond when they should cross the street in a curve road without a zebra cross. This shows children's skills to concentrate and react in road traffic situations are still limited thus increase their risks on road safety. A study by Wright & Vliestra (1975) also found that children's ability to control their attention is still developing from ages 7 – 14.

Furthermore, the results from 4 additional questions in pre- and post-intervention questionnaire displays that student in both groups already has a high percentage of the correct answer in knowledge questions. This reveals a further indication that students have more understanding of knowledge compare to skills in road traffic. The results also reveal that students in the intervention group have a higher increase in incorrect answers in questions related to skills.

Nevertheless, the results of socio-cognitive variable measure from pre- and post-intervention questionnaire displays that there were no significant intervention effects on the measures of attitude, subjective norm, perceived behavioral control, and intention on both study group. Students held a very favorable attitude, subjective norm, perceived behavioral control, and intention towards crossing the street using pelican crossing thus resulting in a ceiling effect. A study by Zeedyk et al. (2001) also shows that knowledge about road safety would not easily translate into improved behavior in the traffic situation.

Further analysis from the pre- and post-intervention questionnaire also revealed that there is no significant intervention effect on student's socio-cognitive variable measurement on gender and place of residence. Meanwhile, there is a significant intervention effect between student's socio-cognitive variable measurement regarding crossing safely using pelican crossing and their mode of transportation to school. This is supported by the results from Albert and Dolgin (2010) where they stated that there are no differences among gender in children crossing behaviors. As far as the writer knows, no study can explain the reasons why a student in junior high school that uses different modes of transport are significantly affected by road safety education while students with different place of residence do not. Therefore, a theory might be made that since most of the children are still accompanied by adults when walking on the road and none of them goes to school by walking or cycling, thus they have a lack of habit or experience in crossing the street alone. After the intervention, they obtain more positive behavior on crossing the road using pelican crossing and improve their score on socio-cognitive behavior.

Route2School results indicate that students scored a higher mean score in unfamiliar situations as compared with familiar situations in the platform and most of the easiest questions in the platform were also from unfamiliar situations. This might be because even when they receive the questions from familiar situations or in this case Jakarta City, it might not be from the street where they usually pass from their home to school route. Besides, children more than 12 years old able to assess, detect and avoid risks in traffic on unfamiliar situations (Dacota, 2012).

There are no significant differences between familiar and unfamiliar situations in knowledge and situation awareness module. Furthermore, when we take a look at each module student scored a significantly higher score in familiar situations of risk detection module and in unfamiliar situations of risk management module. However, this might be because there are more difficult questions in unfamiliar situation of risk detection module and in familiar situations of risk management.

The process evaluation in the questionnaire will evaluate the effectiveness of gamification in the Route2School platform. The platform uses several game elements such as score, levels, badges, feedback, and the use of the character (Charlie). The score, levels, and badges were used to increase student motivation and engagement on the platform. Badges and levels were given as a reward to create a sense of progression (Dichev & Dicheva, 2017) and the score was given based on students' performance on each module. Levels will increase for all the students at the same time as long as they move forward for each module on the platform. In this research, 70 % of the badges collected were gold and silver badges. Feedback was the same for every student and it was given after they answer each question in the first measurement. The effectiveness of feedback was shown in the increase of correct answer percentages on the finale module.

When students were asked to choose 3 out of 7 features that they liked the most on the platform, two of the features that students choose are gamification elements such as badges and Charlie. This reveals that students enjoy earning rewards and to help the character. However, fewer students choose levels as their favorite features. It might be because levels always increase when they move forward in the platform thus did not make them more motivated to collect them. When they were asked about whether they felt more motivated to study using this kind of method than in the classroom, the student indicates that most of them agree with the statement. Thus it can be said that the gamification elements increase student motivation and kept student's engagement in the platform. These results were compatible with the research by Saran et al. (2018) that stated students were greatly motivated to use the e-learning platform with gamification.

Regarding the questions in the platform students, more students agree that the knowledge module is easy to compare to the situation awareness module, risk detection module, and risk management module. This is in line with the results from the student mean score where they performed better in the knowledge module. When asked if the knowledge module difficult most students disagree with the statement.

Most students strongly agree that they are familiar with several situations in the platform. More students agree that the questions in Jakarta City easier (familiar situation) easier than in Bogor City (unfamiliar situation) even though their mean score is higher and they spent more time on questions from familiar situations. However, this can be explained because students always answer questions from familiar situations before they move to unfamiliar situations. Students might able to pick up some answers from the feedback that are related to questions in familiar situations then applied them in question on unfamiliar situations even when they felt unfamiliar with the situation. Students also show they like the features of questions with familiar situations.

Almost half of the students agree that the time investment of the module is too large even though the approximate time students spent on the platform is 30 minutes. This might be because some students did the module on a different day thus making them felt that the time investment was too large.

Regarding the platform, students stated they can access the platform easily, can see clearly the question's text and images, and can clearly hear the audio, and can understand the questions in the platform. The least favorite features of the platform were audio introduction. When students were asked regarding their opinion on what to change from the platform, most of the students choose to change nothing and some would also like to change the audio introduction to video or written introduction.

Overall students felt satisfied with the platform and would recommend the platform to others. They also felt that Route2School improve their knowledge of road safety and would like to use it again in the future. The vice-principal and IT teacher who guide this research in the school also give positive reviews for the platform. They also rate the material to be relevant for 7th-grade student and the timing of the platform being given to the student was right. The teacher also agrees that the Route2School platform improves the student's knowledge of road safety.

The demographic questions also reveal that even when students live in the same area as the school, they mostly went to school by car. There are no students who walk or ride a bike to school. Most students also stated that they rarely go out as pedestrian before the COVID-19 situations. This indicates a low exposure that traffic as a pedestrian. Nevertheless, low exposure to a traffic situation does not mean they have a lower risk of fatality (OECD, 2004). It was also explained that children's pedestrian level of exposure also connected with the country's infrastructure and adult companion when walking. Nevertheless, most female students were accompanied by their parents when they act as a pedestrian while male students did not. OECD (2004) results might explain these results, as there is some evidence of a gender correlation on road safety behavior where male children took more risks than female children.

6. Conclusion and Recommendation

This is the first road safety education method that uses gamification on e-learning that is introduced in Indonesia. The results of this study reveal the adaptation of Route2School has resulted in improved skills and knowledge of road safety on 7th-grade students in Jakarta that have to use the platform. However, the platform did not have a positive effect on socio-cognitive variables such as attitude, subjective norm, perceived behavioral control, and behavioral intention that influences behavior. Research might explain this situation as it stated that knowledge might not be easily translated into behavior.

Students who have followed the platform and teachers who were involved in giving information to the students regarding the platform gave positive process evaluation of the gamified e-learning platform. Gamification proves to be one of the favorite features by the students and positively influences student's motivation on the platform.

These observations could prove useful to school, parents, Indonesia National Police Corps, and the Ministry of Transportation to focus on developing skills on children's road safety, in addition to teaching knowledge. It also proves that Route2School as a successful teaching method of road safety education. Route2School shows that it can help students develop the skills and knowledge needed in road safety while experiencing road traffic situations without causing them harm.

The findings such as the input from the students to what feature should be changed in the platform, such as introducing a video animation or written text in the introduction can become an important element in improving several features in Route2School in the future. Making the platform more compatible to mobile phones could also increase the potential use from students and teachers in Indonesia since most people have mobile phones but not laptop or computer. Meanwhile, the questions in the platform that can be categorically divided into difficult and easy questions, can be included in the learning target or education content for students age 12 – 13 years in Indonesia.

Recommendations for future research are to implement a different type of question's difficulties in the platform. Introducing more personalized feedback on the platform might also change the results in the finale module. Longer time between the pre-intervention questionnaire, the implementation of the platform, and the post-intervention questionnaire might apply to future research. This also includes an exploration of what effect it has on the final module when each module is done on a different week. Future studies should also include different types of schools (private and public) and different grade or age. Finally, a study regarding the effect of student travel mode to school and their behavior when crossing the street alone should also be done.

7. Limitations

Firstly, due to COVID-19, the research was limited to be only conducted on 7th-grade students of one of the private junior high schools in Jakarta. The initial plan of the study was to implement Route2School on 4 schools that consisted of 2 elementary and 2 junior high schools in Jakarta. It will also include private and public school in Jakarta. However, one of the private schools stated they are overwhelmed by the online learning situation and withdraw from the study. Meanwhile, the problem with public schools in Jakarta that was going to participate in the study was many of their students did not have laptops in their homes. Therefore, the sample size is not representative.

Secondly, COVID-19 has also impacted the way the platform experiences should have felt by the students. The initial plan was for the students to do the pre-intervention questionnaire in the first week, knowledge and situation awareness module in the second week, risk detection and risk management in the third week, finale module in the fourth week, and post-intervention questionnaire in the last week. The method of doing the module in the platform on a different week was never been done in research regarding Route2School before and it's the initial plan of this research want to explore.

Thirdly, data collection was also obstructed because this is the first time students have to do online learning situation from school and most of them is still adapting to the situation. At the time of data collection, students also have some preparation to do for their online examination at the end of May. The long time plan of the research might add some burden to their schoolwork and thus they give more importance to do those rather than finishing the platform. Thus, the data collection needs a long time to take to make the results more sufficient.

In addition, most students in junior high school in Indonesia did not have any personal email. Thus has created an issue when registering them on the platform. Most students forgot to change their password after the first login even though a written instruction is already given. This might be because when we usually the first login into a platform we created the password. Future research regarding the login issue should be taken into account.

8. Annex

8.1 Questionnaire items

8.1.1 Sociodemographic and Walking Habit Questionnaire Section

Please answer all the following questions as they describe you by choosing the relevant answer.

Questions	Answer
1.	What is your gender? 1. Male 2. Female
2.	Where do you live? 1. South Jakarta 2. Central Jakarta 3. West Jakarta 4. East Jakarta 5. North Jakarta 6. Tangerang 7. Depok 8. Bekasi
3.	What transportation modes did you usually use to go to school? 1. Car 2. Bicycle 3. Walking 4. Transjakarta 5. MRT Jakarta 6. LRT Jakarta 7. Other public transport 8. Private motorcycle 9. Online motorcycle taxi (Gojek, Grab) 10. Traditional motorcycle taxi 11. Taxi
4.	How often do you go out on foot (e.g. walking to a store, to school/tutoring place, or for leisure) 1. Never 2. Occasionally (1-4 times in the last two months), 3. Sometime (5-8 times in the last two months) 4. Often (more than 8 times in the last two months)
5.	When you go out on foot, how often are you with adults? 1. Never 2. Occasionally (1-4 times in the last two months), 3. Sometime (5-8 times in the last two months) 4. Often (more than 8 times in the last two months)
6.	When you go out on foot, how often are you on our own?" 1. Never 2. Occasionally (1-4 times in the last two months), 3. Sometime (5-8 times in the last two months)

	4. Often (more than 8 times in the last two months)
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8.1.2 TPB Variable

The following questionnaire is adapted from Ajzen, I. (2006). Constructing a theory of planned behavior questionnaire.

It also considers the following research:

Poulter, D. R., & McKenna, F. P. (2010). Evaluating the effectiveness of a road safety education intervention for pre-drivers: An application of the theory of planned behaviour. *British Journal of Educational Psychology*, 80(2), 163–181. <https://doi.org/10.1348/014466509X468421>

Elliott, M. A. (2004). The attitudes and behaviour of adolescent road users : An application of the theory of planned behaviour. Retrieved from <https://trl.co.uk/sites/default/files/TRL601%282%29.pdf>

The questionnaire is designed to identify how you feel about crossing the street with pelican crossing. Please answer all of the questions in this questionnaire as honestly as you can. **This is not a test about road safety.** This questionnaire will not affect your school grade. Read each question below carefully. After each question there will be 5 choices. You need to choose one of the choices to show your answer. Here is an example:

For me crossing the road using pelican crossing is:

(please choose one answer)

- Extremely positive
- Positive
- Uncertain
- Negative
- Extremely Negative

Here, you choose the word “Extremely positive”, the more you think it is a positive thing to cross the road using pelican crossing. If you choose “Extremely negative”, the more you think it is a negative thing to cross the road using pelican crossing. If you are not sure, or you think that crossing the road using pelican crossing is neither a positive thing or a negative thing, or that it is as equally positive as it is negative, then you would choose the choice in the middle.

Examples of Pelican Crossing in Jakarta



Attitude		
1.	For me crossing the road using pelican crossing is	(1: bad; 5: good)
2.	For me crossing the road using pelican crossing is	(1: unnecessary; 5: necessary)
3.	For me crossing the road using pelican crossing is	(1: dangerous; 5: safe)
Subjective norm		
4.	My dad and mom ... of me to cross the road using pelican crossing	(1: strongly disagree; 5: strongly agree)
5.	My friends want me to cross the road using pelican crossing	(1: strongly disagree; 5: strongly agree)
6.	My teachers expect me to cross the road using pelican crossing	(1: strongly disagree; 5: strongly agree)
Perceived Behavioral Control		
7.	I am confident that I could cross the road using pelican crossing	(1: strongly disagree; 5: strongly agree)
8.	I am confident that I can resist my friends' persuasion to not cross the road using pelican crossing	(1: strongly disagree; 5: strongly agree)
9.	It would be entirely up to me whether or not I cross the road using pelican crossing	(1: strongly disagree; 5: strongly agree)
Behavioral Intention		
10.	I want to cross the road using pelican crossing	(1: strongly disagree; 5: strongly agree)
11.	I will cross the road using pelican crossing	(1: strongly disagree; 5: strongly agree)

12.	I intend to cross the road using pelican crossing	(1: strongly disagree; 5: strongly agree)
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8.1.3 Process Evaluations Variable

8.1.3.1 Students

The questionnaire is designed to identify how you feel about the Route2School education program that you have followed in the last few weeks. This questionnaire will not affect your school grade. Please read each statement below carefully, and then decide whether you agree or disagree with the statements. Please pick the answer of your choice for each question.

Questions		Answer
1.	Overall, how satisfied were you with Route2School?	(1=extremely dissatisfied; 5=extremely satisfied)
2.	I would recommend the platform to others	(1=strongly disagree; 5=strongly agree)
3.	It was easy for me to understand the questions in the platform	(1=strongly disagree; 5=strongly agree)
4.	I found the 'final module' difficult	(1=strongly disagree; 5=strongly agree)
5.	I found the questions in Jakarta City easier than Bogor City	(1=strongly disagree; 5=strongly agree)
6.	The time investment was too large	(1=strongly disagree; 5=strongly agree)
7.	It was easy for me to access the platform	(1=strongly disagree; 5=strongly agree)
8.	I found the questions about "What should Charlie know?" the easiest	(1=strongly disagree; 5=strongly agree)
9.	I found the questions about "What should Charlie see?" the easiest	(1=strongly disagree; 5=strongly agree)
10.	I found the questions about "Where should Charlie look?" the easiest	(1=strongly disagree; 5=strongly agree)
11.	I found the questions about "How should Charlie react?" the easiest	(1=strongly disagree; 5=strongly agree)
12.	I am familiar with several situations from the questions	(1=strongly disagree; 5=strongly agree)
13.	R2S improve my knowledge of road safety	(1=strongly disagree; 5=strongly agree)
14.	I felt more motivated to study using this method than usual class room method	(1=strongly disagree; 5=strongly agree)

15.	I can see clearly the question's text & images	(1=strongly disagree; 5=strongly agree)
16.	I can hear clearly the audio in the platform	(1=strongly disagree; 5=strongly agree)
17.	Choose 3 features of Route2School	<ol style="list-style-type: none"> 1. Charlie 2. Question with images of familiar situations 3. Explanation of the answer 4. Badges 5. Levels 6. Web interface design 7. Audio introduction
18.	What would you change in the platform? (you can choose more than 1 answer)	<ol style="list-style-type: none"> 1. Change the audio introduction to written or video introduction 2. The image size needs to be larger 3. The question's text needs to be larger 4. The audio introduction sounds needs to be clearer 5. Others, ... 6. Nothing
19.	What would you change in the platform? (you can choose more than 1 answer)	(1= Never; 5 = Definitely)

8.1.3.2 Teachers


The questionnaire is designed to evaluate the Route2School education program that your student has followed in the last five weeks. This questionnaire will not affect teacher performance. Please read each statement below carefully.

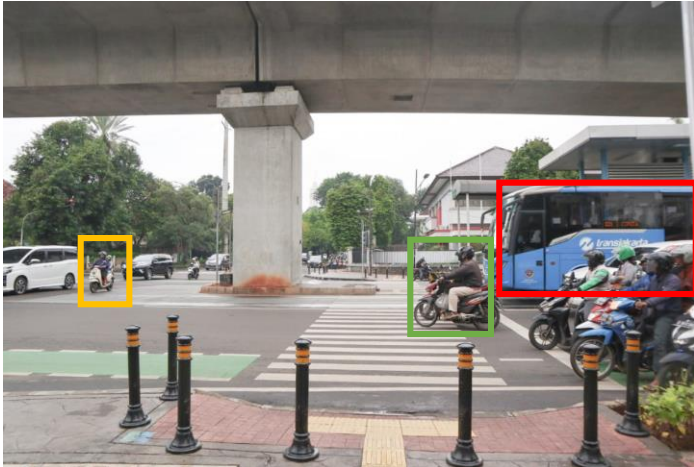

Questions		Answer
1.	Overall, how satisfied were you with Route2School?	(1=extremely dissatisfied; 5=extremely satisfied)
2.	Format of work (use of gamification: Charlie, level, badges, and score)	(1=extremely bad; 5=extremely good)
3.	Web display (text, picture, and audio)	(1=extremely bad; 5=extremely good)
4.	Ease of use	(1=extremely bad; 5=extremely good)

5.	Relevance of Route2School material to 7 th grade student	(1=extremely bad; 5=extremely good)
6.	Route2School delivery time (in the month of May)	(1=extremely bad; 5=extremely good)
7.	Material on familiar situation submodule and unfamiliar situation module	(1=extremely bad; 5=extremely good)
8.	Material on "What should Charlie know?" module	(1=extremely bad; 5=extremely good)
9.	Material on "What should Charlie see?" module	(1=extremely bad; 5=extremely good)
10.	Material on "Where should Charlie look?" module	(1=extremely bad; 5=extremely good)
11.	Material on "How should Charlie react?" module	(1=extremely bad; 5=extremely good)
12.	Material on "How should Charlie react?" module	(1=extremely bad; 5=extremely good)
13.	Material on "Finale" module	(1=extremely bad; 5=extremely good)
14.	Choose 3 features of Route2School	<ol style="list-style-type: none"> 1. Charlie 2. Question with images of familiar situations 3. Explanation of the answer 4. Badges 5. Levels 6. Web interface design 7. Audio introduction
15.	Did you think that Route2School increase student's knowledge on road safety to students?	<ol style="list-style-type: none"> 1. Yes, ... 2. No, ...
16.	Did you have any advice for Route2School platform?	<ol style="list-style-type: none"> 1. No, ... 2. Yes, ...

8.1.4 Additional questions sections

Questions	Answer
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<p>1.</p>	 <p>You want to go to the building on your right, what are you allowed to do?</p>	<ol style="list-style-type: none"> 1. Cross using the zebra crossing 2. Turn back to look for another place to cross 3. Cross following the yellow line
<p>2.</p>	<p>Look carefully at the photo. Then you must choose the 4 things that you see in the photo by clicking on the available answers on the next part.</p>  <p>What do you see best? (choose 4 answers)</p>	<p>What do you see best? (choose 4 answers)</p> <ol style="list-style-type: none"> 1. Motorcyclist 2. Traffic sign 3. Car 4. Traffic light 5. Zebra crossing 6. Pedestrian

3.	<p>You want to cross using this zebra crossing, what should you pay attention now?</p> 	<ol style="list-style-type: none"> 1. The orange box 2. The green box 3. The red box
4.	<p>You want to cross using this zebra crossing, what should you do best</p> 	<ol style="list-style-type: none"> 1. Wait and look right for bicycles on the bicycle lane, then see traffic flow from the right and left 2. See the flow of traffic from the right and left before crossing 3. You don't need to look at the vehicle from the right and left before crossing

8.2 Analysis

8.2.1 Teacher's Process Evaluation Mean and Standard Deviation

The results of teacher's (N = 2) evaluation of the platform.

Questions	Mean	SD
1. Overall, how satisfied were you with Route2School?	4.50	0.71
2. Format of work (use of gamification: Charlie, level, badges, and score)	4.50	0.71
3. Web display (text, picture, and audio)	4.00	0.71
4. Ease of use	4.50	0.71
5. Relevance of Route2School material to 7 th grade student	5.00	0.00
6. Route2School delivery time (in the month of May)	4.50	0.71

7.	Material on familiar situation submodule and unfamiliar situation module	4.50	0.71
8.	Material on "What should Charlie know?" module	5.00	0.00
9.	Material on "What should Charlie see?" module	5.00	0.00
10.	Material on "Where should Charlie look?" module	5.00	0.00
11.	Material on "How should Charlie react?" module	5.00	0.00
12.	Material on "How should Charlie react?" module	5.00	0.00
13.	Material on "Finale" module	5.00	0.00

8.2.2. Mean Score, Standard Deviation, and Effects of TPB Variable on gender

Item description (and scale)	Time	M (SD)				ANCOVA		
		Female		Male		MSE	F (1, 164)	p
Attitude	Pre-intervention	4.29	(0.49)	4.24	(0.59)	0.137	0.689	0.408
	Post-intervention	4.41	(0.46)	4.32	(0.60)			
For me crossing the road using pelican crossing is (1= Extremely bad; 5= Extremely good)	Pre-intervention	4.31	(0.64)	4.28	(0.63)	0.196	0.615	0.434
	Post-intervention	4.54	(0.52)	4.46	(0.69)			
For me crossing the road using pelican crossing is (1= Extremely necessary; 5= Extremely unnecessary)	Pre-intervention	4.53	(0.54)	4.39	(0.68)	0.371	0.870	0.352
	Post-intervention	4.52	(0.56)	4.36	(0.84)			
For me crossing the road using pelican crossing is (1= Extremely safe; 5= Extremely dangerous)	Pre-intervention	4.04	(0.64)	4.05	(0.83)	0.033	0.105	0.746
	Post-intervention	4.17	(0.58)	4.15	(0.72)			
Subjective norm	Pre-intervention	4.34	(0.53)	4.32	(0.54)	0.398	1.003	0.318
	Post-intervention	4.34	(0.63)	4.23	(0.70)			
My mom and dad if I cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.38	(0.67)	4.43	(0.72)	0.187	0.330	0.566
	Post-intervention	4.41	(0.80)	4.35	(0.71)			
My best friend wants me to cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.29	(0.62)	4.18	(0.71)	0.283	0.551	0.459
	Post-intervention	4.20	(0.77)	4.07	(0.780)			
My teachers think I should cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.37	(0.72)	4.34	(0.69)	0.656	1.276	0.260
	Post-intervention	4.42	(0.66)	4.28	(0.85)			
Perceived Behavioral Control	Pre-intervention	4.14	(0.52)	4.11	(0.55)	0.002	0.008	0.927
	Post-intervention	4.23	(0.63)	4.14	(0.69)			
I believe that I can cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.42	(0.54)	4.42	(0.55)	0.254	0.570	0.451
	Post-intervention	4.43	(0.71)	4.35	(0.69)			
I'm sure that I can hold my friends' persuasion not to cross the road using the pelican	Pre-intervention	3.70	(0.93)	3.70	(1.00)	0.045	0.057	0.811
	Post-intervention	3.92	(0.85)	3.89	(0.93)			

crossing (1=strongly disagree;
5=strongly agree)

I'm sure I can make the decision to cross the road using the pelican crossing or not (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.29	(0.58)	4.22	(0.63)			
	Post-intervention	4.32	(0.69)	4.18	(0.78)	0.656	1.274	0.261
Behavioral Intention	Pre-intervention	4.14	(0.52)	4.11	(0.55)			
	Post-intervention	4.23	(0.63)	4.14	(0.69)	0.224	0.094	0.759
I want to always cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.00	(0.77)	3.85	(1.00)			
	Post-intervention	4.03	(0.79)	3.93	(1.01)	0.038	0.061	0.806
I will try to always cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.18	(0.66)	4.11	(0.94)			
	Post-intervention	4.24	(0.67)	4.15	(0.82)	0.211	0.407	0.524
I intend to always cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.11	(0.71)	3.95	(0.99)			
	Post-intervention	4.13	(0.81)	4.11	(0.88)	0.063	0.102	0.750

Note: * p < 0.05 is significant, ** p<0.01 is very significant

8.2.3. Mean Score, Standard Deviation, and Effects of TPB Variable on living location

Item description (and scale)	Time	M (SD)								ANCOVA		
		Central Jakarta		South Jakarta		West Jakarta		Tangerang		MSE	F (7,158)	p
Attitude	Pre-intervention	4.13	(0.18)	4.30	(0.53)	4.14	(0.60)	4.29	(0.54)	0.509	2.749	0.010
	Post-intervention	3.60	(0.98)	4.40	(0.45)	4.19	(0.57)	4.49	(0.53)			
For me crossing the road using pelican crossing is (1= Extremely bad; 5= Extremely good)	Pre-intervention	4.40	(0.55)	4.28	(0.66)	4.30	(0.56)	4.33	(0.68)	0.408	1.295	0.256
	Post-intervention	4.00	(1.22)	4.52	(0.58)	4.39	(0.58)	4.61	(0.55)			
For me crossing the road using pelican crossing is (1= Extremely necessary; 5= Extremely unnecessary)	Pre-intervention	4.20	(0.84)	4.49	(0.60)	4.26	(0.75)	4.53	(0.51)	0.981	2.442	0.021
	Post-intervention	3.40	(1.82)	4.46	(0.56)	4.26	(0.62)	4.64	(0.76)			
For me crossing the road using pelican crossing is (1= Extremely safe; 5= Extremely dangerous)	Pre-intervention	3.80	(0.45)	4.12	(0.67)	3.87	(0.87)	4.00	(0.79)	0.502	1.653	0.124
	Post-intervention	3.40	(1.14)	4.23	(0.53)	3.91	(0.79)	4.22	(0.68)			
Subjective norm	Pre-intervention	4.47	(0.38)	4.36	(0.55)	4.12	(0.60)	4.36	(0.45)	0.453	1.149	0.335
	Post-intervention	3.93	(0.83)	4.38	(0.51)	4.09	(0.60)	4.20	(0.97)			
My mom and dad if I cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.40	(0.55)	4.41	(0.73)	4.26	(0.69)	4.47	(0.61)	0.387	0.678	0.691
	Post-intervention	4.00	(0.71)	4.45	(0.64)	4.26	(0.54)	4.31	(1.12)			
My best friend wants me to cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.60	(0.55)	4.31	(0.65)	3.96	(0.77)	4.17	(0.61)	0.514	1.006	0.429
	Post-intervention	4.00	(0.71)	4.26	(0.62)	3.91	(0.79)	3.94	(1.09)			
My teachers think I should cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.40	(0.55)	4.36	(0.76)	4.13	(0.76)	4.44	(0.50)	0.585	1.141	0.340
	Post-intervention	3.80	(1.10)	4.43	(0.63)	4.09	(0.73)	4.36	(0.99)			
Perceived Behavioral Control	Pre-intervention	4.13	(0.38)	4.19	(0.54)	3.97	(0.50)	4.06	(0.53)			

	Post-intervention	3.87	(0.56)	4.21	(0.57)	4.12	(0.50)	4.18	(0.92)	0.391	0.953	0.468
I believe that I can cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.40	(0.55)	4.46	(0.52)	4.39	(0.50)	4.31	(0.62)			
	Post-intervention	4.20	(0.45)	4.46	(0.61)	4.26	(0.54)	4.28	(1.00)	0.269	0.594	0.760
I'm sure that I can hold my friends' persuasion not to cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	3.80	(0.45)	3.73	(1.04)	3.61	(0.72)	3.67	(0.96)			
	Post-intervention	3.40	(0.89)	3.87	(0.90)	3.87	(0.69)	4.06	(0.92)	0.934	1.204	0.304
I'm sure I can make the decision to cross the road using the pelican crossing or not (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.20	(0.45)	4.36	(0.56)	3.91	(0.67)	4.19	(0.58)			
	Post-intervention	4.00	(0.71)	4.28	(0.66)	4.22	(0.60)	4.19	(1.01)	0.411	0.790	0.597
Behavioral Intention	Pre-intervention	3.87	(0.18)	4.14	(0.74)	3.61	(0.84)	4.06	(0.74)			
	Post-intervention	3.73	(0.43)	4.11	(0.70)	3.87	(0.68)	4.24	(0.96)	0.512	1.079	0.379
I want to always cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	3.60	(0.55)	4.01	(0.89)	3.57	(0.84)	4.00	(0.86)			
	Post-intervention	3.40	(0.55)	4.03	(0.85)	3.61	(0.84)	4.17	(1.00)	0.807	1.296	0.255
I will try to always cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.00	(0.00)	4.26	(0.76)	3.70	(0.97)	4.17	(0.74)			
	Post-intervention	3.80	(0.45)	4.20	(0.67)	4.09	(0.67)	4.28	(0.97)	0.352	0.671	0.696
I intend to always cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.00	(0.00)	4.14	(0.81)	3.57	(0.99)	4.00	(0.83)			
	Post-intervention	4.00	(0.71)	4.10	(0.81)	3.91	(0.79)	4.28	(0.97)	0.548	0.889	0.517

Note: * $p < 0.05$ is significant, ** $p < 0.01$ is very significant

8.2.4. Mean Score, Standard Deviation, and Effects of TPB Variable on transport mode to school

Item description (and scale)	Time	M (SD)										ANCOVA		
		Private motorcycle		Online Motorcycle		Other Public Transport		Private Car		Transjakarta		MSE	F (7,158)	p
Attitude	Pre-intervention	4.39	(0.57)	4.67	(0.58)	4.33	(0.58)	4.26	(0.54)	4.40	(0.37)	0.516	2.790	0.009**
	Post-intervention	4.50	(0.51)	3.89	(0.51)	4.19	(0.50)	4.38	(0.51)	4.67	(0.41)			
For me crossing the road using pelican crossing is (1= Extremely bad; 5= Extremely good)	Pre-intervention	4.58	(0.52)	5.00	(0.00)	4.43	(0.53)	4.28	(0.64)	4.40	(0.55)	0.541	1.752	0.101
	Post-intervention	4.75	(0.45)	4.67	(0.57)	4.43	(0.53)	4.50	(0.61)	4.80	(0.45)			
For me crossing the road using pelican crossing is (1= Extremely necessary; 5= Extremely unnecessary)	Pre-intervention	4.50	(0.52)	4.33	(1.15)	4.43	(0.79)	4.47	(0.60)	4.60	(0.55)	2.271	6.589	0.000**
	Post-intervention	4.58	(0.52)	4.00	(1.00)	4.14	(0.69)	4.48	(0.64)	4.80	(0.45)			
For me crossing the road using pelican crossing is (1= Extremely safe; 5= Extremely dangerous)	Pre-intervention	4.08	(0.67)	4.67	(0.58)	4.14	(0.69)	4.02	(0.73)	4.20	(0.45)	0.448	1.461	0.185
	Post-intervention	4.17	(0.58)	3.67	(0.58)	4.00	(0.58)	4.17	(0.64)	4.40	(0.55)			
Subjective norm	Pre-intervention	4.52	(0.47)	4.44	(0.71)	4.10	(0.85)	4.34	(0.52)	4.47	(0.51)	1.324	3.724	0.001**
	Post-intervention	4.25	(2.36)	4.00	(0.58)	3.81	(1.12)	4.34	(0.58)	4.60	(0.55)			
My mom and dad if I cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.67	(0.49)	5.00	(0.00)	4.14	(0.69)	4.39	(0.71)	4.60	(0.55)	1.234	2.314	0.028*
	Post-intervention	4.17	(1.53)	4.67	(0.58)	3.86	(1.46)	4.41	(0.67)	4.80	(0.45)			
My best friend wants me to cross the road using the pelican crossing (1=strongly	Pre-intervention	4.33	(0.49)	4.00	(1.00)	4.00	(1.00)	4.26	(0.64)	4.40	(0.55)	1.439	3.060	0.005**
	Post-intervention	4.08	(1.08)	3.67	(0.58)	3.57	(1.62)	4.20	(0.67)	4.20	(0.84)			

disagree; 5=strongly agree)														
My teachers think I should cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.58	(0.52)	4.33	(1.15)	4.14	(1.07)	4.37	(0.68)	4.40	(0.55)	1.564	3.335	0.002**
	Post-intervention	4.50	(1.17)	3.67	(0.58)	4.00	(1.15)	4.40	(0.69)	4.80	(0.45)			
Perceived Behavioral Control	Pre-intervention	4.11	(0.77)	4.67	(0.33)	4.05	(0.56)	4.14	(0.52)	3.80	(0.61)	1.592	4.453	0.000**
	Post-intervention	4.08	(1.15)	4.44	(0.51)	3.95	(0.36)	4.21	(0.61)	4.40	(0.68)			
I believe that I can cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.42	(0.52)	5.00	(0.00)	4.29	(0.49)	4.43	(0.54)	4.20	(0.45)	1.036	2.473	0.020*
	Post-intervention	4.25	(1.22)	4.67	(0.58)	4.14	(0.69)	4.41	(0.66)	4.60	(0.55)			
I'm sure that I can hold my friends' persuasion not to cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	3.58	(1.31)	4.33	(0.58)	3.71	(0.76)	3.71	(0.96)	3.00	(1.22)	2.500	3.540	0.001**
	Post-intervention	3.92	(0.99)	4.33	(0.58)	3.71	(0.49)	3.95	(0.85)	4.00	(1.00)			
I'm sure I can make the decision to cross the road using the pelican crossing or not (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.33	(0.49)	4.67	(0.58)	4.14	(0.69)	4.26	(0.60)	4.20	(0.45)	1.895	4.165	0.000**
	Post-intervention	4.08	(1.24)	4.33	(0.58)	4.00	(0.00)	4.28	(0.71)	4.60	(0.55)			
Behavioral Intention	Pre-intervention	4.33	(0.62)	4.22	(0.69)	3.86	(0.72)	4.06	(0.76)	3.93	(0.98)	2.913	7.920	0.000**
	Post-intervention	4.31	(1.16)	3.67	(0.58)	3.81	(0.92)	4.15	(0.67)	4.53	(1.04)			
I want to always cross the road using the	Pre-intervention	4.08	(0.67)	4.00	(1.00)	3.71	(0.76)	3.95	(0.86)	4.20	(0.84)			

pelican crossing (1=strongly disagree; 5=strongly agree)	Post-intervention	4.17	(1.19)	3.67	(0.58)	3.57	(0.98)	4.04	(0.82)	4.40	(1.34)	2.781	5.196	0.000**
I will try to always cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.50	(0.67)	4.33	(0.58)	3.86	(0.90)	4.17	(0.79)	3.80	(1.10)	2.869	6.937	0.000**
	Post-intervention	4.50	(1.17)	3.67	(0.58)	4.14	(0.69)	4.22	(0.68)	4.80	(0.45)			
I intend to always cross the road using the pelican crossing (1=strongly disagree; 5=strongly agree)	Pre-intervention	4.42	(0.52)	4.33	(0.58)	4.00	(0.82)	4.05	(0.85)	3.80	(1.10)	3.365	6.844	0.000**
	Post-intervention	4.25	(1.14)	3.67	(0.58)	3.71	(1.38)	4.18	(0.72)	4.40	(1.34)			

Note: * $p < 0.05$ is significant, ** $p < 0.01$ is very significant

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