Can gamified e-learning improve traffic knowledge & skills of Vietnamese adolescent riders?
A pilot test study

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Content

1. Introduction

1.1. Road safety education and e-learning

In Vietnam, education is a top priority for policy makers, as can be derived from Article 35 of the current constitution.

The basic educative strategy for adolescents is to "develop an ability to predict risks and have safe travel habits" *(Ministry of Transport of Vietnam, 2010)*. This means that adolescents should be able to timely detect and recognize risks in traffic and manage them adequately.

Traffic safety education for adolescents aims to teach adolescents to improve their attitudes and abilities to be well prepared for potential hazards on the road and avoid hazards by assessing traffic environments and road conditions.

The design of educational tools would be useful for promoting not only the avoidance of risky behaviours, but also a generalized awareness of road safety issues *(Useche et al., 2019)*

Many studies that evaluated different programs showed success in promoting (awareness of) road safety *(Cuenen et al., 2016; Floreskul et al., 2016; Glendon et al., 2014; Markl, 2016; Twisk et al., 2014)*
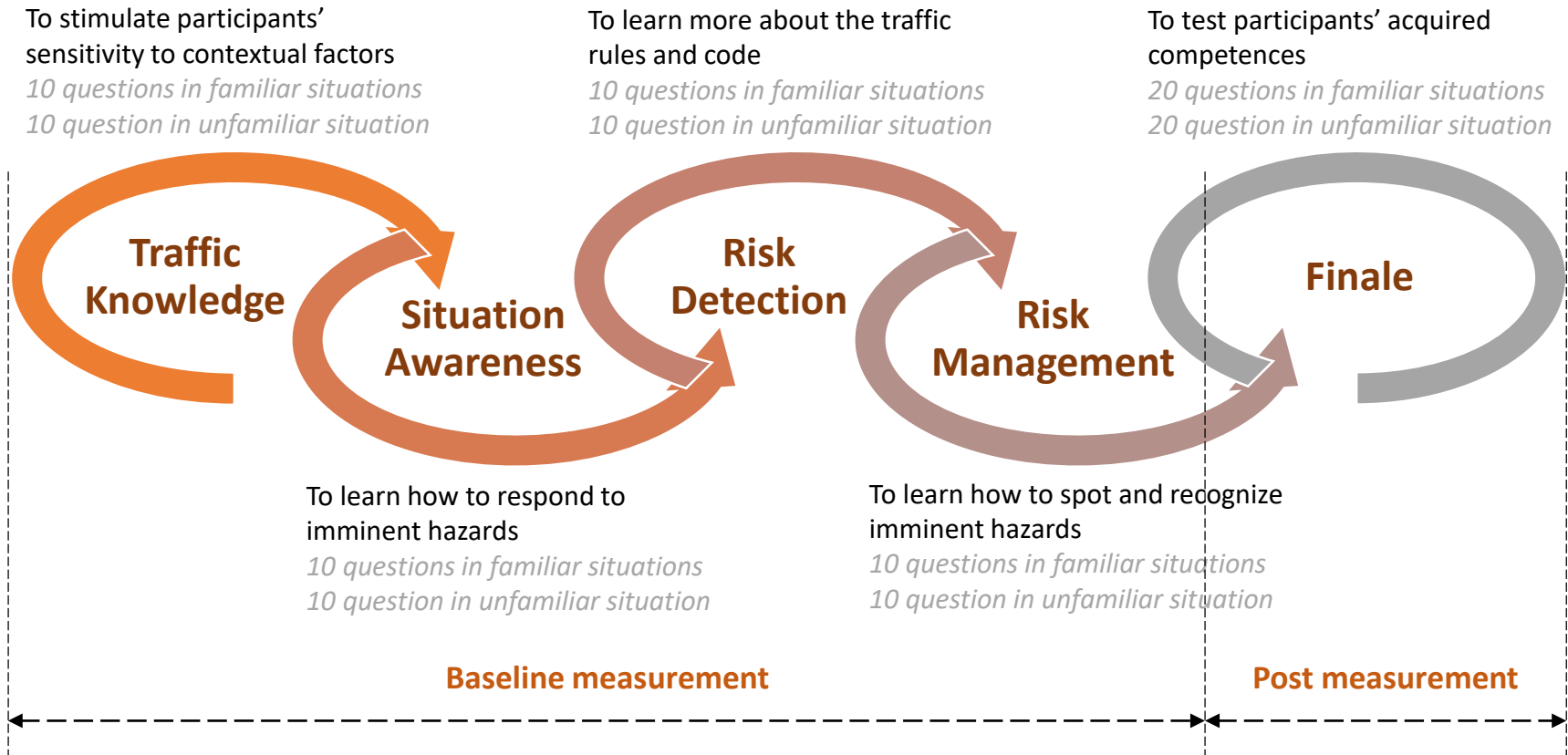
1. Introduction

1.2. The Route2school platform

This study will focus on the use of the Route2school e-learning platform (https://research.route2school.org) developed by IMOB - Transportation Research Institute (http://www.uhasselt.be/imob).

Route2School (R2S) is an innovative e-learning platform meant to improve traffic understanding of participants so that they can deal better with traffic situations. Users will not only learn about the overall traffic context, but be exposed as well to real traffic situations.

For this study, a version specifically tailored to the Vietnamese context was developed. The platform includes multiple choice questions, hotspot questions and 360-degree virtual reality questions.
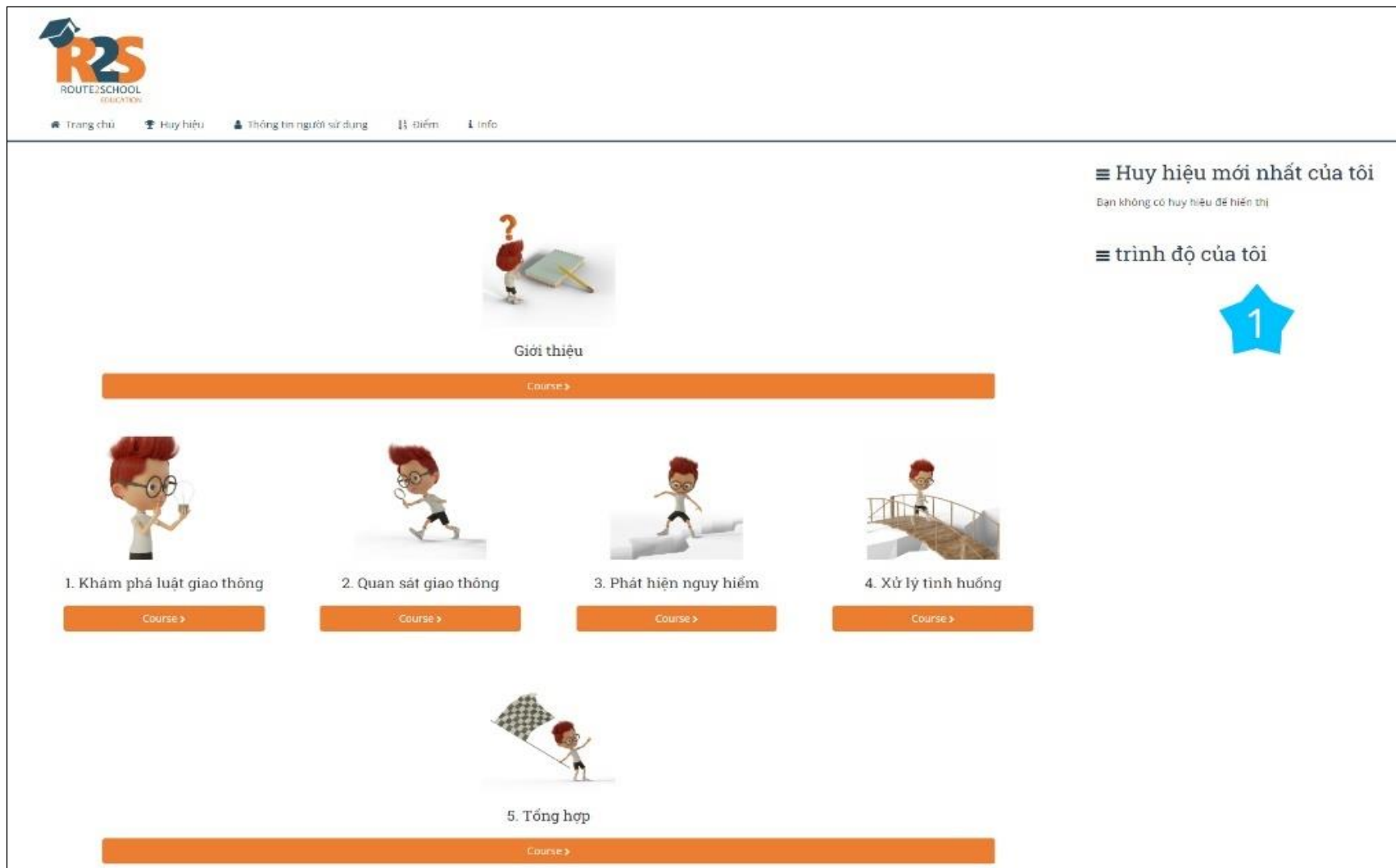
1. Introduction

1.2. The Route2school platform

To stimulate participants'
sensitivity to contextual factors
10 questions in familiar situations
10 question in unfamiliar situation

To learn more about the traffic
rules and code
10 questions in familiar situations
10 question in unfamiliar situation

To test participants' acquired
competences
20 questions in familiar situations
20 question in unfamiliar situation

**Traffic
Knowledge**

**Situation
Awareness**

**Risk
Detection**

**Risk
Management**

Finale

To learn how to respond to
imminent hazards
10 questions in familiar situations
10 question in unfamiliar situation

To learn how to spot and recognize
imminent hazards
10 questions in familiar situations
10 question in unfamiliar situation

Baseline measurement

Post measurement

*Note: familiar situations (i.e. based on the city where participants live)
          unfamiliar situations (i.e., from other cities)*

1. Introduction

1.2. The Route2school platform

1. Introduction

1.2. The Route2school platform

6. Điều khiển xe gắn máy đi trên đoạn đường này, bạn:

○ Bắt buộc quay đầu xe

☒ ◉ Được phép quay đầu xe hoặc rẽ trái

☑ ○ Được phép quay đầu xe nhưng không được phép rẽ trái

QCVN 41:2019/BGTVT quy định biển báo hiệu giao thông chỉ dẫn chỗ quay xe: biển chỉ dẫn vị trí được phép quay đầu xe kiểu chữ U nhưng không cho phép rẽ trái, trừ các xe được quyền ưu tiên theo Luật Giao thông đường bộ.

1. Introduction

1.2. The Route2school platform

The R2S platform consists of gamification aspects including levels, badges, and cups.
- You begin your learning at level 1 and you reach level 10 once you have finished all the modules.
- You can win a badge per module. The shape of the badge depends on the module type you have finished, and the colour of the badge is dependent on the scores you have earned.
- You can earn a badge in the shape of a cup when you have finished the final module.

2. Objectives and research questions

This study aims to evaluate the effectiveness and user experience of an e-learning platform meant to improve safety-related knowledge and skills of Vietnamese adolescent riders. The following research questions will be addressed:

- **Research question 1**: Is there a statistically significant increase in scores from baseline measurement to post-measurement?

- **Research question 2**: Is there a statistically significant difference in scores across the different modules offered by the platform?

- **Research question 3**: Is there a statistically significant difference in scores comparing familiar situations (i.e. based on the city where participants live) with unfamiliar situations?

- **Research question 4**: Is there a statistically significant difference in scores comparing males with females?

- **Research question 5**: Which exercises/questions do participants find most difficult?

- **Research question 6**: How did participants experience the use of the e-learning platform?

3. Methodology

3.1. Study design, sampling and recruitment

A convenience sampling approach was adopted with voluntary participation after informed consent and confidential and anonymous data treatment.

The primary target group were high-school students (aged 14-17) in Ho Chi Minh City.

The research team approached the administration of a high school in Ho Chi Minh City. After presenting the purpose as well as basic information related to the research, the administrators agreed to allow the application of the R2S program to students of two grade 10 classes. The research team had direct contact with the students through the support of form teachers.

In total, 69 participants subscribed to the program of which 60 completed at least half of the program, and 47 completing all modules.

3. Methodology

3.1. Study design, sampling and recruitment

Demographic sample composition

	Frequency (N=47)	Percent (%)
Gender		
Male	22	46.8
female	25	53.2
Vehicle usually used		
Bicycle	6	12.8
E-bicycle	4	8.5
Motorcycle<50cc	9	19.1
Motorcycle>50cc	28	59.6
Self-riding experience		
Under 1 year	32	68.1
1 to 3 years	12	25.5
Over 3 years	3	6.4
Learnt a road safety e-learning before		
Yes	6	12.8
No	41	87.2

3. Methodology

3.2. Data collection protocol

About the R2S platform

WEEK 1

Participants received a short demo-presentation about the R2S platform.

Participants registered and created accounts at school while working in computer classes.

Learning with the R2S platform

WEEK 2 - 6

Participants received a deadline of five weeks to complete all modules.

They were instructed to contact the research team (via mobile phone) in case they encountered problems.

Evaluation questionnaire

WEEK 7

The questionnaire focussing on background characteristics and user experience was administered.

Form teachers collected participants' completed questionnaires and sent them to the research team.

Data was collected during the first trimester (i.e., September - December) of the 2020-2021 school year.

3. Methodology

3.3. Data analysis

Data were analysed using SPSS (IBM Statistics version 24).

- Paired-sample t-test (Research question 1)

- Repeated measure ANOVA (Research question 2,3)

- One-way ANOVA (Research question 4)

- Descriptive statistics (Research question 5,6)

All statistical tests adopted an Alpha level of .05.

4. Results and Discussion

Research question 1: Is there a statistically significant increase in scores from baseline measurement to post-measurement?

Module	Mean scores (SD)		
	Baseline measurement	Post measurement	Change
Traffic knowledge	63.40 (15.22)	74.47 (20.30)	+11.07***
Situation awareness	42.13 (27.74)	67.66 (24.87)	+25.53***
Risk detection	65.11 (23.02)	74.47 (18.04)	+9.36**
Risk Management	69.79 (28.85)	75.74 (23.57)	+5.95
Total	60.11 (16.60)	73.09 (14.24)	+12.98***

* $p < .05$; ** $p < .01$, *** $p < .001$

In each module, mean scores for the post-measurement were higher than those of the baseline measurement.

The change in scores for the risk management module was not statistically significantly different.

4. Results and Discussion

Research question 1: Is there a statistically significant increase in scores from baseline measurement to post-measurement?

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Total	60.11 (16.60)	73.09 (14.24)	+12.98***

$* \ p < .05; \ ** \ p < .01, \ *** \ p < .001$

This shows that giving results and explaining answers right after each question has an outstanding advantage in improving participants' knowledge and skills in traffic, or at least helping participants to learn and remember the rules and traffic situations outlined in the platform.

Feedback has proven to be helpful and to help to answer related questions better *(Krause et al., 2009, Vasilyeva et al., 2008)*.

4. Results and Discussion

Research question 2: Is there a statistically significant difference in scores across the different modules offered by the platform?

Modules	Mean scores (SD)		
	Total	Familiar situations only	Unfamiliar situations only
Traffic knowledge	61.60 (11.98)	62.98 (15.59)	60.21 (13.43)
Situation awareness	52.34 (21.16)	53.62 (24.09)	51.06 (25.22)
Risk detection	68.40 (17.07)	69.36 (21.61)	67.45 (18.11)
Risk management	72.77 (18.90)	73.83 (21.52)	71.70 (19.71)
Finale	73.09 (14.24)		

There were significant differences among the modules in mean scores ($F(3) = 19.235$, $p < .001$)

Scores (ranging from 0-100) were highest for the risk management module followed in decreasing order by the risk detection module, the traffic knowledge module, and lowest scores for the situation awareness module.

4. Results and Discussion

Research question 2: Is there a statistically significant difference in scores across the different modules offered by the platform?

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Finale	73.09 (14.24)		

The lowest scores were recorded for the situation awareness module, which proves that participants have a lot of trouble in scanning traffic environments.

Novice or inexperienced riders often have weak scan traffic environments *(Liu et al., 2009)* or even underestimate certain traffic hazards *(Brown and Groeger, 2007)* which significantly contribute to slow response to hazards.

4. Results and Discussion

Research question 3: Is there a statistically significant difference in scores comparing familiar situations (i.e. based on the city where participants live) with unfamiliar situations?

Modules	Total	Mean scores (SD)	
		Familiar situations only	Unfamiliar situations only
Traffic knowledge	61.60 (11.98)	62.98 (15.59)	60.21 (13.43)
Situation awareness	52.34 (21.16)	53.62 (24.09)	51.06 (25.22)
Risk detection	68.40 (17.07)	69.36 (21.61)	67.45 (18.11)
Risk management	72.77 (18.90)	73.83 (21.52)	71.70 (19.71)
Finale	73.09 (14.24)		

Higher scores were recorded for familiar situations in each of the four modules. However, there was not a statistically significant difference in scores comparing familiar situations with unfamiliar situations ($F(1) = 1.319$, $p > .05$).

This result is not consistent with the study of *Riaz et al. (2019)*, who applied the R2S platform to 44 elementary school pupils in Belgium.

4. Results and Discussion

Research question 4: Is there a statistically significant difference in scores comparing males with females?

Gender difference in score increment from baseline measurement to post-measurement

Gender	Traffic knowledge Score change	F	Situation awareness Score change	F	Risk detection Score change	F	Risk management Score change	F	Finale Score change	F
Male	+15.45	2.518	+30.91	1.340	+6.36	0.737	+8.18	0.306	+15.23	1.873
Female	+7.20		+20.80		+12.00		+4.00		+11.00	

$* p < .05; ** p < .01, *** p < .001$

There was not significantly significant gender difference in score increment between the baseline and post measurements

4. Results and Discussion

Research question 4: Is there a statistically significant difference in scores comparing males with females?

Mean scores and standard deviations (SD) for male and female participants for the five modules

Gender	Modules	Mean scores (SD)		
		Total	Familiar situations only	Unfamiliar situations only
Male	Traffic knowledge	60.23 (12.10)	60.45 (14.95)	60.00 (13.80)
	Situation awareness	60.45 (19.75)	62.27 (21.59)	58.64 (23.96)
	Risk detection	73.64 (15.05)	75.91 (17.09)	71.36 (19.83)
	Risk Management	76.82 (19.00)	77.27 (22.29)	76.36 (20.60)
	Finale	80.45 (10.46)		
Female	Traffic knowledge	62.80 (12.00)	65.20 (16.10)	60.40 (13.38)
	Situation awareness	45.20 (20.08)	46.00 (23.98)	44.40 (24.85)
	Risk detection	63.80 (17.69)	63.60 (23.78)	64.00 (16.07)
	Risk Management	69.20 (18.47)	70.80 (20.80)	67.60 (18.32)
	Finale	66.60 (14.12)		

Except for the results recorded in the traffic knowledge module, males tend to perform better than females through scores in most modules.

4. Results and Discussion

Research question 4: Is there a statistically significant difference in scores comparing males with females?

Gender difference in scores across the different modules

Gender	Traffic knowledge Mean scores (SD)	F	Situation awareness Mean scores (SD)	F	Risk detection Mean scores (SD)	F	Risk management Mean scores (SD)	F	Finale Mean scores (SD)	F
Male	60.23 (12.10)	.534	60.45 (19.75)	6.857*	73.64 (15.05)	4.151*	76.82 (19.00)	1.939	80.45 (10.46)	3.370***
Female	62.80 (12.00)		45.20 (20.08)		63.80 (17.69)		69.20 (18.47)		66.60 (14.12)	

* $p < .05$; ** $p < .01$, *** $p < .001$

Different from that significant differences between genders were found for the situation awareness module, the risk detection module, and the finale module.

4. Results and Discussion

Research question 4: Is there a statistically significant difference in scores comparing males with females?

Gender difference in scores between familiar and unfamiliar situations

Gender	Familiar situations		Unfamiliar situations	
	Mean scores (SD)	F	Mean scores (SD)	F
Male	69.00 (11.00)	3.512	66.59 (14.93)	3.370
Female	61.40 (15.93)		59.10 (13.05)	

$* p < .05; ** p < .01, *** p < .001$

Gender difference in score among difficult questions

Gender	Mean score (SD)	95% Confidence Interval for Mean		Levene Statistic	F
		Lower Bound	Upper Bound		
Male	41.74 (20.36)	32.71	50.76	3.861	8.762**
Female	26.18 (15.60)	19.74	32.62		

$** p < .01$

Males performed better than females in answering difficult questions

4. Results and Discussion

Research question 4: Is there a statistically significant difference in scores comparing males with females?

Males often showed better performance than females in all modules of the platform.

This is similar to the results demonstrated in many previous studies.
- The study of *Dong (2018)* presented that males were more confident than females when answering situation awareness questions.
- Males also have a stronger expression of positive perception of e-learning than females *(Ong and Lai, 2006)*.

4. Results and Discussion

Research question 5: Which exercises/questions do participants find most difficult?

Proportion of students giving correct answers for each question

Question	Traffic Knowledge Familiar situation	Traffic Knowledge Unfamiliar situation	Situation Awareness Familiar situation	Situation Awareness Unfamiliar situation	Risk Detection Familiar situation	Risk Detection Unfamiliar situation	Risk Management Familiar situation	Risk Management Unfamiliar situation
1	51.1	89.4	55.3	51.1	48.9	80.9	74.5	74.5
2	57.4	51.1	31.9	21.3	44.7	89.4	63.8	78.7
3	70.2	19.1	51.1	57.4	61.7	93.6	57.4	93.6
4	76.6	76.6	63.8	63.8	85.1	38.3	63.8	89.4
5	57.4	51.1	29.8	55.3	80.9	68.1	76.6	91.5
6	55.3	31.9	57.4	29.8	85.1	57.4	91.5	61.7
7	40.4	74.5	74.5	55.3	74.5	74.5	85.1	53.2
8	44.7	53.2	61.7	55.3	66.0	57.4	76.6	59.6
9	85.1	74.5	59.6	66.0	61.7	48.9	74.5	53.2
10	91.5	80.9	51.1	55.3	85.1	66.0	74.5	61.7

Caption: Proportion of students giving correct answers (%)

While the risk management module has no questions that are considered difficult, difficult questions are spread out evenly in the other three modules.
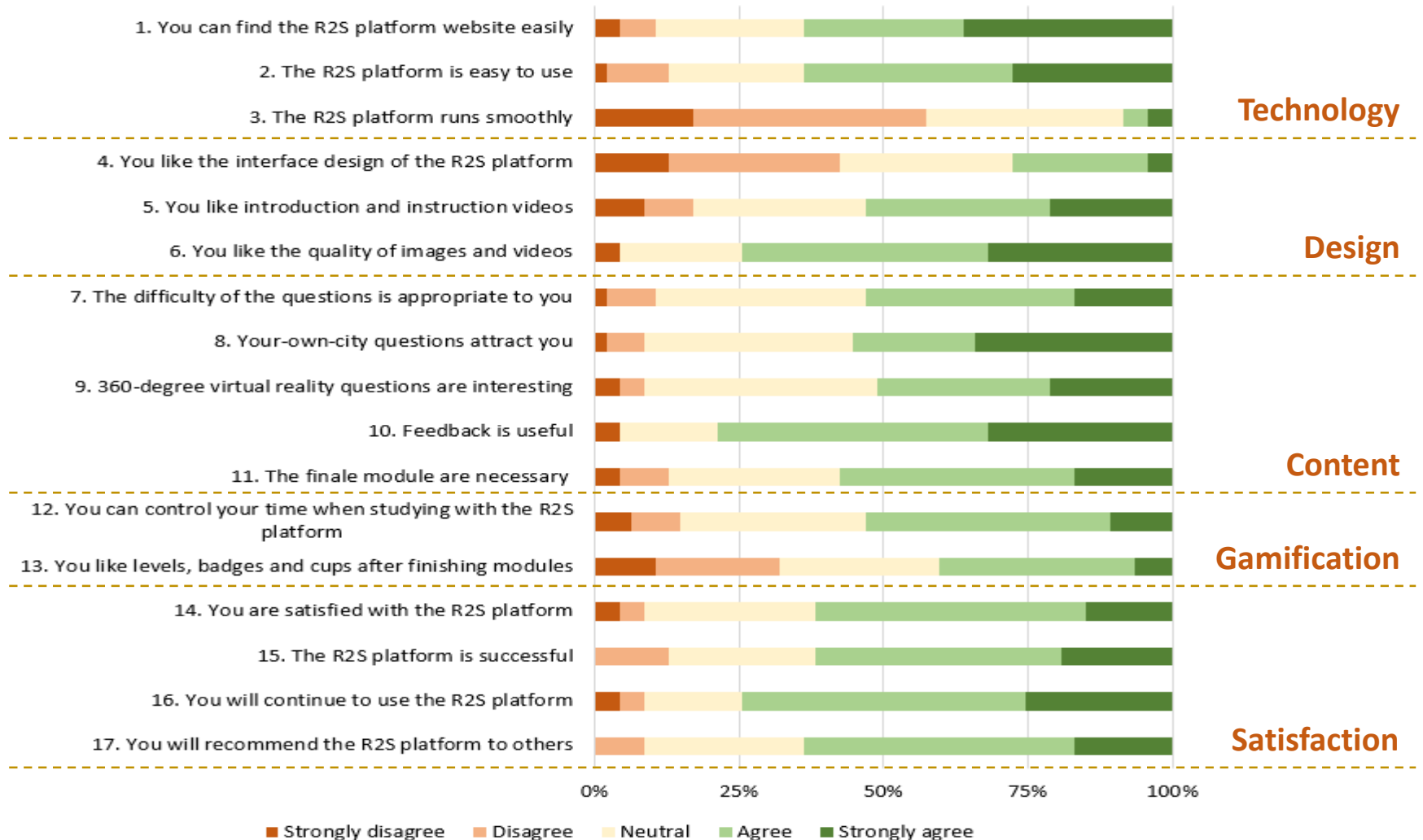
4. Results and Discussion

Research question 5: Which exercises/questions do participants find most difficult?

- For the traffic knowledge module, there are quite a few participants who update new information when there is a change in traffic laws. For example, the fine for 'going red light' violations is only 100,000 - 200,000 under the old law and the fine amount at present is 600,000 - 1,000,000 (according to Decree No. 100/2019).

- For the situation awareness module, the 360-degree virtual reality questions cause a lot of difficulties for participants to give correct answers.

- For the risk detection module, the difficult questions are often those with more than one hazard, and that is difficult for participants to choose which is the most potential hazard being able to lead to a traffic crash. The following studies need to focus more on situations with multiple threats at a time to give participants more experiences to improve their ability to handle situations when encountering similar external situations. This is especially meaningful for complex transport environments like Ho Chi Minh city.

4. Results and Discussion

Research question 6: How did participants experience the use of the e-learning platform?

Survey results (bar chart) grouped by category:

Technology
1. You can find the R2S platform website easily
2. The R2S platform is easy to use
3. The R2S platform runs smoothly

Design
4. You like the interface design of the R2S platform
5. You like introduction and instruction videos
6. You like the quality of images and videos

Content
7. The difficulty of the questions is appropriate to you
8. Your-own-city questions attract you
9. 360-degree virtual reality questions are interesting
10. Feedback is useful
11. The finale module are necessary

Gamification
12. You can control your time when studying with the R2S platform
13. You like levels, badges and cups after finishing modules

Satisfaction
14. You are satisfied with the R2S platform
15. The R2S platform is successful
16. You will continue to use the R2S platform
17. You will recommend the R2S platform to others

Legend: Strongly disagree · Disagree · Neutral · Agree · Strongly agree

5. Limitation and future research

- The small sample size (N = 47) did not represent the population in future assessments. However, these results presented the potential of the platform in improving traffic safety-related knowledge and skills.

- For many objective reasons related to participant acceptance and the busy school schedule, this study was only accessible to 15-16-year-old participants. Future research should be expanded to a variety of age groups to have a better overview of the effectiveness of the platform.

- Program implementation time should also be considered for future research. In the current study, participants had one month from start to finish, but participants were allowed to access the platform whenever they wanted instead of being allowed to do modules weekly. This also made it difficult to assess the frequency of program participation and the extent to which participants' knowledge and skills improve over time.

6. Conclusion

This study can be seen as the first study to investigate the potential of online traffic education in Vietnam.

With a combination of outstanding features including gamification, educational technologies, and realistic learning materials, the platform is expected to significantly improve traffic safety for adolescent riders who are considered the most vulnerable road users in Vietnam.

THANK YOU!

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Any Questions ?

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