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Research paper

Evaluation of Four Wheeled Vehicle Student Driver Adaption's on Right & Left Steering Wheel Through the User Experience Approach

Inaki Maulida Hakim[1*], Ferdiansyah Pratama Putra[2*]

[1,2]Department of Industrial Engineering, Faculty of Engineering, Universitas Indonesia, Depok, Indonesia
**Corresponding author E-mail: inakimaulida.hakim@yahoo.co.id; anchapratama21@gmail.com*

Abstract

The high level of activity that people carry out daily encourage the need for high mobility in the fulfillment of these activities. Vehicles can help to ease people in doing activities so that one's activities can run effectively and efficiently. Every vehicle produced by a vehicle company has a difference in terms of features and systems that are in it, so it causes the vehicle users to have to adapt. In addition, there are other differences in driving position. So this study aims to evaluate the adaptation of four-wheeled vehicle student driver in Indonesia on the right-steering and left-steering vehicle through the user experience approach. This study focus on what factors can influence the adaptation of driver to vehicle differences and differences in driving position. Evaluation is done by giving task to the respondent at the beginning of the drive, during drive and at the end of the drive by looking at the safety factor on activity being done. The methods used are performance metrics, Single Ease Question (SEQ) questionnaire and Questionnaire for User Interface Satisfaction (QUIS). Based on results of the research, there are some errors and time used for respondents in adapting. So in an effort to correct from the error, additional information is given where the information can be useful in adapting.

Keywords: *User Experience; Safety Driving; Performance Metric; SEQ; QUIS; Manufacturing*

1. Introduction

Indonesia is the fourth most densely populated country in the world. Indonesia is right behind China, India and United States of America as the most densely populated country in the world. With Indonesia having the fourth most dense population it goes straight with the growth in number of vehicles in Indonesia. This growth can be seen from the dense roadway at a certain time. Manufacturers of motor vehicles are vying to offer vehicles that can meet the requirements according to the state of the market, so that these vehicle manufacturers can dominate the intended market. Vehicles are very influential on human interests today. Vehicles, especially private ones are very influential in one's mobility in doing activities. Road Safety Association (RSA) said that the factors needed in driving are rules, skill and attitude. These factors become very important because driving is not just for yourself but it affects other people and surrounding environment. There is still very little awareness about the safety of driving on the community, this can be seen from the many accidents experienced by drivers due to lack of awareness of safety and security factors.

Motor vehicle accidents are caused by the human factor itself, in addition to vehicle and environmental factors. Errors caused by the human factor itself can be said as Human Error. Consciously or unconsciously, Human Error attaches to us so that we often do because it is used and considered a trivial thing. Examples of Human Errors that are considered trivial for the driver include using a mobile phone while driving, violation of traffic signs such as doing a reverse in a place that is not allowed, driving above a predetermined speed, overtaking from the wrong side.

According to Tingting Zheng [12] in his research on using security, awareness, attention, caution, concentration, calm on the relationship to safety in a person's driving attitude. So this research is conducted by using vehicle Laboratory Manufacturing System at Department of Industrial Engineering University of Indonesia, laboratory vehicle used in this research is Toyota Vios with driving position on the left side. So in the use of these factors used by researchers in conducting research in the form of evaluation of adaptation to the user of four-wheeled vehicle through the approach of user experience, where the safety factor becomes the foundation to see whether there are obstacles in security and safety issues for driver who adapt to newly used vehicles, in this case driving position also affects in adaptation. This study uses two different types of vehicle driving position but with the state of the same features. So this research can provide a guidance on the difference between driving position between the left and right steering wheel, then can be used as a guide for drivers who will drive in different positions to avoid unnecessary mistakes.

2. Literature Review

User experience (UX) is a science that began to develop in the era of 19th century machinery until the early 20th century. UX was spearheaded by Frederick Taylor and Henry Ford in his research on the efficiency of interaction between workers with equipment that is the earliest example that builds the foundation of UX today. In a general sense, behavior is all actions that living beings do and basically behaviors can be observed through attitudes and actions. But behavior can also be potential, namely in the form of knowledge, motivation, and perception. A person's driving behav-

ior can be said to be good if it meets some requirements. American Society of Safety Engineers (ASSE) defined Occupational safety as a field of activity aimed at preventing all types of accidents that are related to the environment and work situation. Safety Driving itself is a safe driving technique. While the driving technique is done to avoid accidents that occur due to other drivers or external factors called defensive driving. Performance is all the things that users do in interacting with the product. This includes measuring the extent to which users can successfully complete a task or series of tasks. Performance metrics consists of 3 types, among others: Task success is part of the most widely used performance metric. By measuring how effectively the user can complete a set of tasks; Time on task is a common performance metric to measure how much time it takes to complete a task; Errors reflect user-generated errors during tasks. Single Ease Question (SEQ) is a short questionnaire that assesses whether a product, system or service is easy to use in performing tasks using a likert scale. Questionnaire for User Interaction Satisfaction (QUIS) is a subjective user satisfaction measurement questionnaire on the human-computer interface aspect. Human errors are intentional or unintentional and can occur due to the existence of errors in human. Human error cannot be predicted when it happens, but human error can be prevented and counted, this includes by using SHERPA method. SHERPA (Systematic Human Error Reduction and Prediction) is a method to analyze the occurrence of human error with input hierarchy of basic level task.

3. Methods

The respondents of this research are representation of four wheel drive user. Tom Tullis [10], said that in a usability study it is only required as many as 5 respondents to find 80% problems. For testing on different user groups, no amount is required. It is recommended to test 3-4 people from each group (Nielsen, 2000). The study involved 10 respondents with different criteria. For selection and stages in conducting research as follows: In this study the number of male and female respondents is the same that is as much as 5 each man and woman. Have different driving frequencies in a week. This is done in order to know the diverse results of various types of drivers. Using the right and left wheel vehicles of Toyota Vios as Research Objects. The research was conducted in the surrounding area of the Universitas Indonesia Campus, Depok by surrounding as much as 1 round of lap starting from the University Stadium and ending back in the same position. The respondents never drive in a left-handed car, with each respondent having different driving frequencies in a week and a driver's license. Respondents are invited to the main spot of this research that is in the stadium and given direction about research. Respondents perform the given tasks. These tasks include driving preparation (turning on the vehicle, turning on the air conditioner, turning on the radio), while driving (taking a climb test, lap testing, roundabout test) and when arriving at the destination (when parking and turning off vehicle features). After performing the tasks Respondents are given a questionnaire divided into 3 sections, namely part 1 self data, part 2 task along with SEQ questionnaire and part 3 questionnaire of user interface satisfaction (QUIS) questionnaire. Conducting interviews about experiences during driving and narrating constraints or difficulties faced when adapting. Respondents start and end perform tasks on the start and end commands to ease the time-study process. Recording is done using a camera.

4. Results and Discussion

Processing is done by taking into account the average respondents of the study by comparing the drive between the left and right steering wheel. Hypothesis testing is performed to see if there is a significant effect on the success rate of completing the task scenario. The average success rate of 100% for the respondents who drive using the vehicle between the left and right steering wheel. The resulting data has no different mean values, so no statistical hypothesis test is required. The second stage is to look at the evaluation of the time.

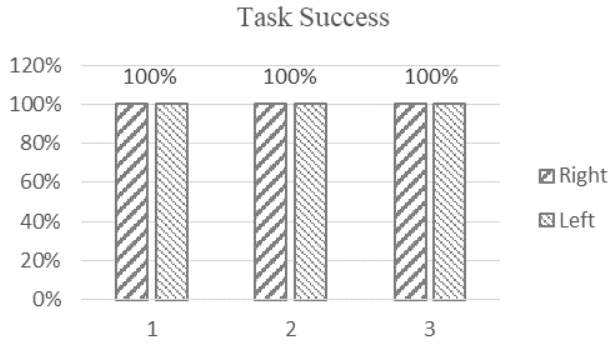

Figure 1: Graph of Data Processing Task Success.

In the early stage respondents were given the task to start driving, the tasks contained at this stage include turn on the vehicle, turn on the air conditioner and turn on the radio.

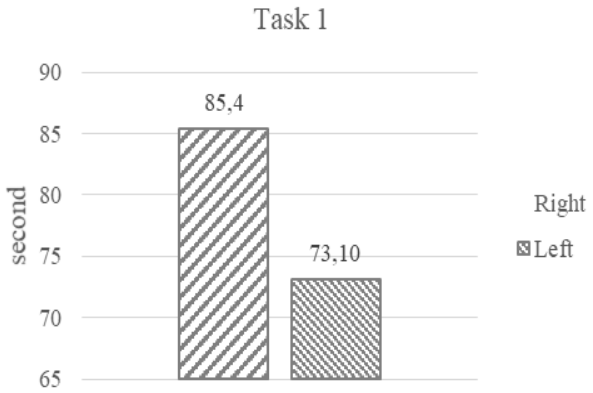

Figure 2: Graph of Data Processing Time on Task 1.

In the second stage respondents were given the task to driving and then divided into some tasks, such as climb test, roundabout test, change the lanes test.

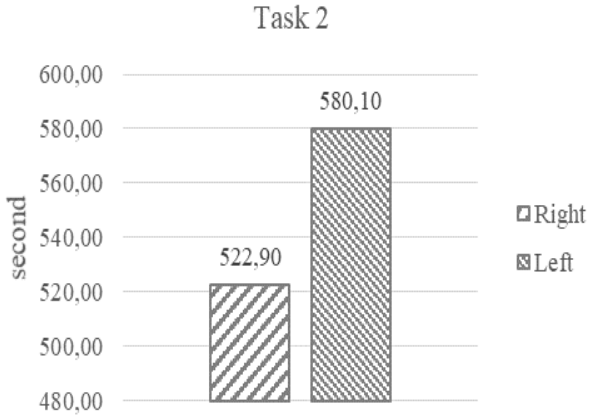

Figure 3: Graph of Data Processing Time on Task 2.

After respondents driving the car, they are doing the final stage. The final task is parking test.

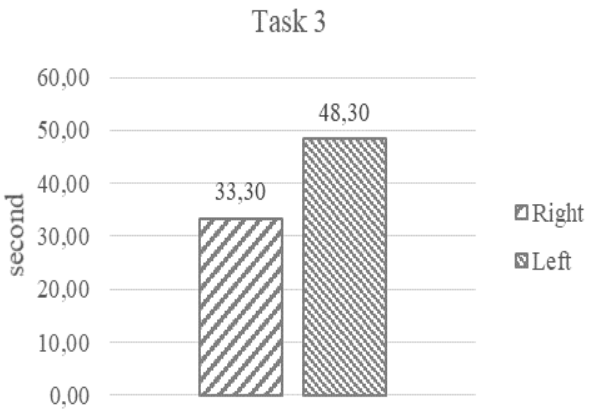

Figure 4: Graph of Data Processing Time on Task 3.

To see the significant of the resulting difference can be done by doing significant test, that is independent test of sample t-test. In conducting independent test the previous t-test sample needs to be tested for normality of data to be processed and this is tested using Minitab software assistance. The following hypothesis applies to both task scenarios used because it has the same test form. The hypothesis in this significant test is as follows, the hypothesis 0 (H0) is rejected and hypothesis 1 (H1) is accepted The p-value values for task preparation, driving and parking are 0.335; 0.000; 0.001. This shows that task 1 has p-value > alpha (α) so it can be interpreted that there is no significant time difference in different driving position. While tasks 2 and 3 have p-value < alpha (α) and can be interpreted that there is significant time difference at different driving position. The third stage is to look at the evaluation of the error. Error is an activity performed by the respondent by not performing the task given appropriately or if an error occurred. Error occurs almost entirely due to human factor. In the early stage respondents were given the task to preparation before driving. The preparation divided into some task, such as turn on the vehicle, turn on the air conditioner and turn on the radio.

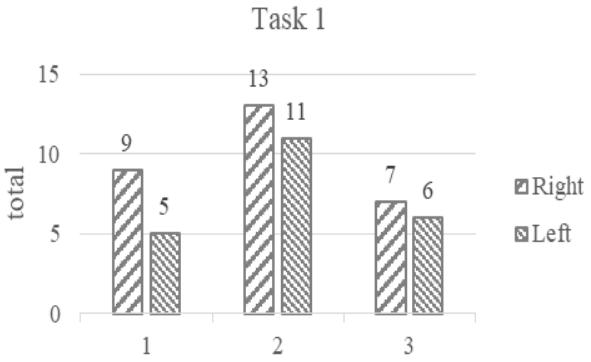

Figure 5: Graph of Data Processing Error Task 1.

In the second stage respondents were given the task to driving and supported to another tasks, such as change the lanes test, climb test, roundabout test, change the radio channel.

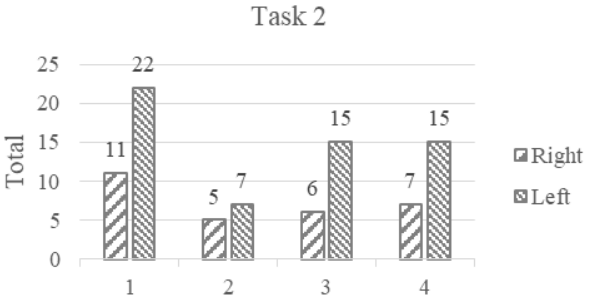

Figure 6: Graph of Data Processing Error Task 2.

In the final stage respondents were given the task to park the car, knowledge test about the car feature and turn off the feature such as turn off the car, air conditioner and radio.

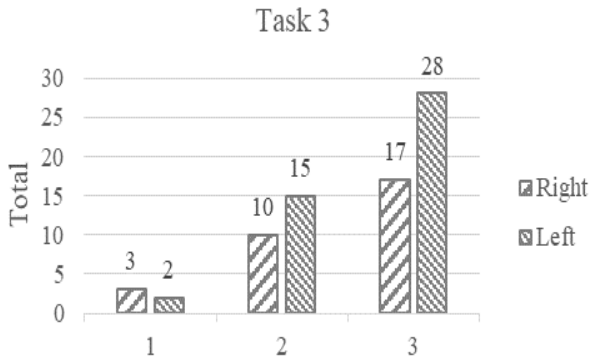

Figure 7: Graph of Data Processing Error Task 3.

The p-value values for task 1 subtask 1, 2 and 3 are 0.315; 0.697 and 0.773; task 2 subtask 1, 2, 3 and 4 are 0.003; 0.470, 0.001 and 0.063; task 3 subtask 1, 2 and 3 are 0.628; 0.126 and 0.091.
As for task that have a smaller p-value than the $\alpha = 0.05$ it can be interpreted that there are significant differences of errors in both groups. Single-Ease Question is a self-assessment questionnaire to measure the difficulty of task by the respondents. The scenarios are preparation, driving, climb test, parking, knowledge, turn off the features. SEQ p-value obtained for each scenarios are 0.2143, 0.0091, 0.3447, 0.0312, 0.5708, 0.5453. It can be concluded that for driving and parking scenarios there are significant differences for both groups of

respondents and as for the others there are no significant differences for both groups of respondents. From the non-parametric test results obtained a p-value of 0.1736. With a p-value > a = 0.05, then it can be concluded that there was no significant difference of QUIS rating from both groups. Systematic Human Error Reduction and Prediction Analysis (SHERPA) method is used to help analyze the number of errors that occur for all three task scenarios.

Table 1: SHERPA Method analysis

Task Error	Error Mode	Error Description	Consequence	Recovery	P	C	Remedial Strategy
Task 1. Preparation							
1	I1	Failed to turn on the vehicle	Unable to proceed	Immediate	M	!	Adding information how to turns on the vehicle
2	A6	Failed to turn on the AC	Unable to proceed	Immediate	L		Customize the look of the button
2.1	A6	Failed to set the temperature	Temperature, wind and mode does not fit	Immediate	L		Display design easier
3	A6	Failed to turn on the radio	Unable to proceed	Immediate	L		Display information more easily
3.1	A10	Wrong push button	Not running as desired	Immediate	L		The corresponding key indicators
Task 2. Driving							
1	A9	Do not wear safety belts and drive unsafe	There will be a warning about the installation of safety belt	Immediate	H	!	Read the driving guide
2	A10	Do not change the gear position	Will not be strong through climbs	Immediate	M	!	Read the driving guide
3	A9	Not giving signal sign	Can harm around	Immediate	H	!	Read the driving guide
Task 3. End of driving							
1	A10	Do not look around	Can harm around	Immediate	M		Driving adaption
2.1	A6	Failed to turn off the AC	Unable to proceed	Immediate	L		Clear information
2.2	A6	Failed to turn off the radio	Unable to proceed	Immediate	L		Clear information
2.3	A10	Failed to turn off the vehicle	Unable to proceed	Immediate	L		Display design easier

From the list of mistakes made by the respondents the causes of the error is determined. One of the factors that influence the occurrence of error because there is a difference between the right wheel and the left wheel steering. The difference becomes significant when the driver who wants to drive a new vehicle in its position will experience adaptation with the differences found in both positions of the vehicle.

This research was done by respondents driving with the right steering wheel first and then using left steering wheel. This research resulted in a 100% success rate in performing tasks assigned by researchers. The obstacle to this success is the need for adaptation time and mistakes made in learning a new system. In the early stage there is a time difference where the experiment using the left steering wheel is faster than using the right steering wheel. The time difference when driving and parking takes longer while using the left steering wheel compared to the right steering wheel. This study also looks at the error factor. Errors are almost largely due to human factors. Errors frequently occur during the use of the left steering wheel, it happens because of differences in positioning features and different ways of driving than usual.

Where on the first stage of driving experiments there are fewer errors and quicker time when using the left steering wheel than the right steering wheel, this is due to the better adaptation from respondents during the second experiment than the first.

5. Conclusion

This study has a purpose to evaluate user experience (UX) adaptation of four-wheeled vehicle student driver in Indonesia on the right-steering and left-steering vehicle. This research is done by giving task to respondent and doing measurement with performance metrics. Performance metrics consist of several basic types such as task success, time on task, errors, learnability. The tasks assigned to the respondents are divided into 3 stages: the first stage includes turn on the vehicle, turn on the air conditioner, turn on the radio; The driving stage includes change lane test, climb test, roundabout test, and change of radio channel test; final stage includes parking, knowledge tests and turn off the feature tests. In support of this research questionnaires include SEQ (Single Ease Question) is a questionnaire that can see what difficulties experienced by respondents and used QUIS questionnaire, this questionnaire aims to assess an interface whether it can be tailored to the circumstances of the driver. This research provides guidelines regarding the difference in driving position between the right wheel and left wheel steering, and it also can aid driver to avoid unnecessary mistakes by including safety factor.

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