AUTO-SHIFT APPLICATION PILOT (ASaP) CONTROL SYSTEM: AN INNOVATION PROJECT FOR A STUDENT DRIVER FRIENDLY AND SAFER DRIVING VEHICLE

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ABSTRACT

The facilitation of effective driving lessons is the preoccupation of every Technical Vocational Education (TVE) institution offering a driving competency program. It is observed that with one steering wheel driving unit, the driving lessons are delayed since both student driver and driving instructor will take turns positioning in the same steering wheel during demonstration and application of driving competencies. Likewise, the safety of both student driver and driving instructor is at stake since the driver instructor's control of the student driver's manipulation of the steering wheel and pedals is done only through verbal instruction. This development study aimed to innovate an Auto-Shift Application Pilot (ASaP) control system for a driver student-friendly and a safer driving vehicle. ASaP controls the functioning of the two sets of steering wheels and two sets of pedals, respectively, for the student driver and driving instructor to facilitate teaching-learning of car driving competencies. Using quantitative and qualitative descriptive design, test and evaluation of the functionality and aesthetic design of ASaP control system were conducted to 5 driver instructors and 15 student driver respondents. Results showed that ASaP control system is functional in its set-up and needs enhancement in its aesthetic design. It is recommended that this ASaP control system be installed in a manually transmitted school driving vehicle for a student driver-friendly and safer school driving lessons.

Key Words: ASaP Control System, Invention, Innovation, Technical Vocational, Cor Jesu College, Digos City, Philippines.

INTRODUCTION

To have a car driving knowledge and skill is very important. It facilitates time management in reaching destinations, accomplishing works, and attending appointments. It makes it easy for one to have personal control and autonomy over his/her specified reasons for driving, especially when the situation calls for it as the only option for independent mobility. Also, it is one of the requirements for most jobs in the country.

Yet, the acquisition of car driving knowledge and skills must be indicated by an approved professional driver's license, which shows the actual driving capacity and passing the driver's national qualification competency. This then implies that before anyone can drive, he/she must have to undergo training either formally in a technical vocational school (TECHVOC) or informally in one's observations and experiences.

In the case of Cor Jesu College, all college students are enrolled in the driving program and formally attending driving lessons as part of their curriculum. In other words, it is compulsory and one of the requirements for graduation prescribed by the institution. Consequently, since students are flocking to enroll in the driving program, the observation of the schedule for quality driving instruction and quality driving skill development is a challenge.

Meanwhile, in support of ascertaining one's worth of possessing a car driver's license, the Department of Transportation and Communication (DOTC), through Memorandum No. 2011-25, required that before any driver for public utility vehicle (PUV) can drive, he/she must undergo training in the Technical Education and Skills Development Authority (TESDA) schools or any accredited institution to get a certification of training and TESDA assessment (Ramirez, 2015). This provision implies that a driving program with TESDA standard, aside from ensuring safety of the public, is needed to cater to a big number of enrollments in the said driving program.

Moreover, to maintain TESDA standard in a driving program means conservatively utilizing the appropriate time scheduled for quality driving instruction and quality driving skill development. More often than not, however, the standard is sacrificed because of the accepted means and methods for the driving program. One of the factors observed in this case is the available driving unit of Cor Jesu College, which has only one steering wheel and one set of pedals for the trainee. However, the school also come up with a driving unit with two (2) sets of fixed parallel steering-wheel and two (2) sets of fixed parallel pedals for driver instructor and student driver respectively. With one steering-wheel car driving unit, the driving lessons and skill development are delayed for two reasons: 1) There is a fear of getting an accident on the part of the student driver due to the possibility of not driving appropriately; and 2) Both driver instructor and student driver still need to take turns in positioning in the same steering-wheel and pedals in demonstrating (driver instructor's function) and applying driving competencies (student driver's assimilation). Also, with two (2) sets of fixed parallel steering-wheel and two (2) sets of fixed parallel pedals, taking turns in positioning and manipulating in the same steering-wheel in demonstrating and applying driving competencies may be addressed. Still, the fear of getting an accident on the part of the student driver due to the possibility of misdriving or distraction remains. This observed factor then suggests a modification of the means and methods to be employed in a driving program. Thus, the Auto-Shift Application Pilot (ASaP) control system is introduced. This innovation project addresses the obstruction of facilitating quality driving instruction and quality driving skill development for student drivers. It also anticipates prevention of getting an accident while learning how to drive.

Theoretical Framework

The ASaP control system was anchored on Alexander & Pulat's ergonomic principle of "fitting the task to the man," which objective is the enhancement of employee's comfort and well being along with the concern of human and organization performance (Morgan, 2003). In other words, it is about fitting the work to the man instead of fitting the man to work for human safety and productivity (Animashaun & Odeku, 2014; Pheasant & Haslegrave, 2018). Similarly, the ASaP control system is an electro-mechanical device that can be used to transform a car driving unit as student driver-friendly, and safer driving vehicle since the design of its steering wheel and pedals are conforming to the student driver's capacity and confidence in practicing and learning in driving. The driving unit, as well as the driving learning task, fits in the student driver's capabilities and limitations (Liu, 2007; Mallon, 2010) as a beginner.

Conceptual and Technical Description

The Auto-Shift Application Pilot (ASaP) Control System is an electro-mechanical system recommended for the double steering wheel and the double set of pedals driving unit with manual transmission. It is composed of electronic, electrical solenoid switch and disengaging mechanical gear. It will be installed on the student driver's steering wheel shafting, as well as in the pedals. In the operation of the ASaP control system, the driving instructor's steering wheel and pedals will serve as a capacitive sensing input device that will electrically activate or deactivate the ASaP control box. At the moment that the car driving unit is near to get an accident due to the student driver's misdriving or distraction the driver instructor will immediately hold his steering wheel and step on the pedals, and automatically disable the steering wheel and pedals of the student driver. Likewise, when the car driving unit goes back to its normal situation, and the student driver recovers from distraction and fear, the driving instructor will press the auto-engage button switch to give the student driver access of his steering wheel and pedals and start driving practice again. And at the moment that the two steering wheels are synchronized, the driving instructor will release his steering wheel and pedals to give the student driver full control of the driving vehicle for his/her driving lessons (see Figure1).

Figure 1: Technical Design

Cor Jesu College TechVoc Education Institute, Digos City, Philippines, like other driving institutions all over the world, has devised a driving unit with two (2) sets of fixed parallel steering-wheel and two (2) sets of the fixed parallel pedal. However, the problem of uncontrollable dangerous direction or crash may be run after by a distracted student driver since both sets of steering-wheels and pedals are fixed, and their flexibility is dependent only on the listening ear of the student driver from the instruction of the instructor. It is in this context that the present research and development on Auto-Shift Pilot (ASaP) control system is seen as an appropriate innovation. It is a system that can be used in transforming the already existing driving unit with a manual transmission, devised with two (2) sets of fixed parallel steering-wheel and two (2) sets of fixed parallel pedals into a student driver-friendly driving vehicle and a safer driving unit.

Objectives of ASaP Control System

The purpose of this research and development of ASaP control system is to innovate a student driver-friendly and safer driving vehicle. Specifically, it will address the following problems: 1) the taking of turns by both driver instructor and student driver in positioning and manipulating in the same steering-wheel and pedals of a driving unit during the demonstration and application of driving competencies, 2) the student driver's fear of getting accident due to the possibility of misdriving a driving vehicle with two (2) sets of fixed parallel steering-wheel and pedals, 3) the possibility of reducing the risk of getting an accident while on car driving training, 4) easy acquisition of driving competencies or development of driving skills, and 5) the presentability and acceptability of the aesthetic design of the innovation project.

Significance of ASaP Control System

The output of this research and development project would be significant to the following, namely: 1) student drivers, with this innovation project they would be able to acquire the confidence of becoming professional drivers as they can acquire the driving competencies easily; 2) driving instructors, through the innovation project they would be able to facilitate driving instructions with ease since they are confident about the safety of their student drivers during training; 3) driving school, with the innovation project they would be able to train many student drivers and increase their revenue because of the facilitative design of the project. Likewise, in the wider context, through the innovation project the; 4) Land Transport Office, would become confident about the appropriateness of issuing professional driver's license to the applicants from the said driving schools; and 5) the interested public, the project would become their benchmark for their own research and development project in the future.

DEVELOPMENT OF THE ASAP CONTROL SYSTEM

This chapter covers the working components, supplies and materials, construction procedures, tools and equipment used, and production cost of the present research and development project.

ASaP Working Components.

The following are the component parts of the ASaP Control system: (1) ASaP

Main Control, (2) ASaP SPWheTr-TS, (3) ASaP-PTr-FS, (4) ASaP Power Relay, (5) ASaP SWheTe-Act, (6) ASaP PTe-Act, and (7) Other Sub Components.

1. ASaP Main Control. It is composed of electronic components, pilot light indicators, switches, and 12 volts source. Its function is to control the operation of all of its input and output auto-switches and devices and can be monitored through its signal LED indicators (see figure 2).

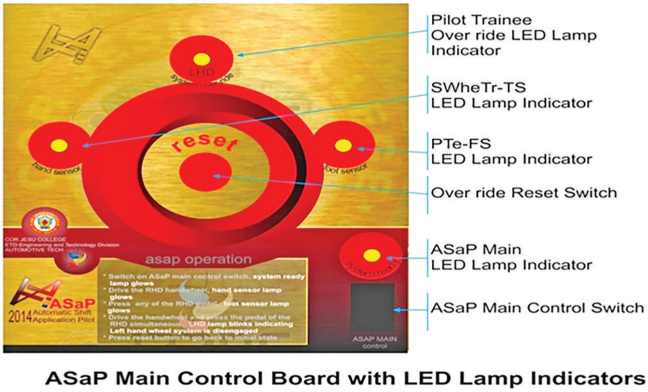

Figure 2. Steering wheel trainer touch sensor

2. **ASaP SWheTr-TS.** It is a Steering wheel trainer touch sensor input device. It is composed of NE555 IC, capacitor, resistor, power relay, and sensing pad. Here, the sensing pad is installed on the trainer's steering wheel to activate the *ASaP SWheTr-TS* when touched by the bare human hand. This activation then causes the release of capacitance discharge, agitates electrons within the sensing pad to flow electronic current to *SWheTr-TS* electronic system, activatesNE555 IC to allow generated voltage to trigger its power relay which is then ready to energize ASaP Power Relays soon as the ASaP PTr-FS is switched on. This *ASaP power* relay is dependent on the simultaneous activation of the control relay of the two ASaP sensors (see figure 3).

Figure 3. ASaP SWheTr-TS

3. **ASaP-PTr-FS.** It is a pedal trainer-foot switch sensor input device. It is a mechanical footswitch device, which is dependent on the pressure of the trainer's foot to control the relay switch operation (see figure 4).

Figure 4. Pedal Trainer Foot Switch

4. **ASaP Power Relay.** It is an electro-magnetic switch that needs electric power to close its switch contact. This device is controlled simultaneously with SWheTr-TS and PTr-FS sensor to control ASaP SWheTe and ASaP PTe-Act actuators. (see figure 5).

Figure 5. Electro-magnetic Switch

5. **ASaP SWheTe-Act.** It is a steering wheel trainee actuator, which is an electrical power-operated output device. It is composed of the enclosure, solenoid switch 1, and mechanical powered coupling. Solenoid actuates its coupler to override the control of the trainee's steering wheel and transfer the control to the instructor's steering wheel. (see figure 6).

Figure 6. ASaP SWheTe-Act

6. **ASaP PTe-Act.** It is a pedal trainee actuator, which is an electrical power-operated output device. It is composed of the enclosure, solenoid switch 2, and mechanical paralleled powered latch (MPL). Solenoid 2 actuates MPL to override trainee's pedals control and transfer the control to the trainer's pedals (see Figure 7).

Figure 7. ASaP PTe-Act - Pedal Trainee Actuator

Other Sub Components

These are the necessary connecting components that can make the major components synchronized and functional. These include: 1) Solenoid Switch 1, 2) Movable Steering Coupler, 3) Solenoid Switch 2, and 4) Movable Pedal Latch.

1. Solenoid Switch 1 is a combination of a coiled cylinder and movable shafting (actuator rod/switch). It is also called as an electro-magnetic jack, that once energize, its rod moves inward with tremendous electrical power, pulling the *MSC-Movable Steering Coupler* to disengage the steering wheel of the trainee (see Figure 8).

Figure 8. Solenoid Switch

2. Movable Steering Coupler. It is the state of the art solid metal tapered slotted rotatable coupling. Its function is to connect/disconnect the steering rod and steering wheel (see Figure 9).

Figure 9. Movable Steering Coupler

3. Solenoid Switch 2. It is a combination of a coiled cylinder and a paralleled movable shafting (actuator rod/switch). It is also called an electromagnetic-jack that once energized its rod moves inward/outward with tremendous electrical power, pulling the *Movable PedalLatch-MPL* to disable the trainer's pedal (see Figure 10).

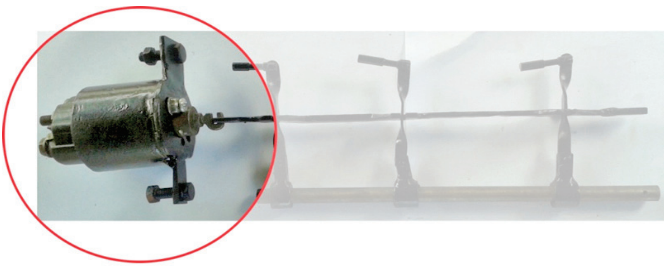

Figure 10. Solenoid Switch 2

4. Movable Pedal Latch. It is an inventive latch system, which is composed of powerful mechanical pushed-spring and tapered pins that are in engaged position so that once the solenoid actuates; latch will be pulled and trainee's pedal will be disengaged (see Figure 11).

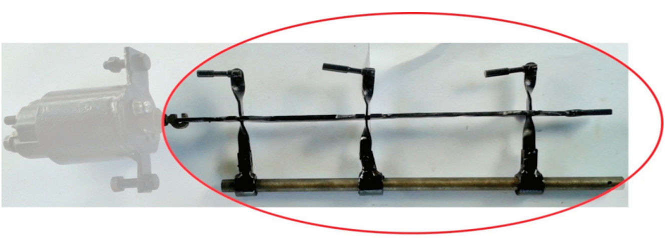

Figure 11. Movable Pedal Latch

Supplies and Materials

Table 1 shows the list of supplies and materials needed for the construction of the innovation project.

Table 1
List of Supplies, Materials and Cost for the ASAP

Description	quantity	Unit	Unit cost php	Total cost php
Steel plate 8ft x4ft	½	sheet	1,500.00	750.00
Round bars 3/16” diameter	2	length	140.00	280.00
Angle bars 1”x1”	2	length	380.00	760.00
Steering wheel	2	pc	800.00	1,600.00
Rack and pinion steering gear box	1	pc	1,200.00	1,200.00
Front suspension assembly multicab	1	pc	5,000.00	5,000.00
Square tube 2”x3”x6ft	½	length	470.00	235.00
Welding rod	50	pc	15.00	750.00
Automotive wires #16	10	meter	22.00	220.00
Brake light switch	3	pc	160.00	480.00
Brake master assembly	1	pc	280.00	280.00
Chain	2	length	40.00	80.00
Sprocket	2	pc	35.00	70.00
				TOTAL - 11,705.00

As displayed in Table 1, the innovation project only costs PhP11,705.00. Among the materials needed, only the steering wheel, rack and pinion steering gearbox, and front suspension assembly multicab materials have a thousand amounts. While the first two materials cost PhP2,800.00, the latter costs PhP5,000.00. This means that the innovation project is very much affordable.

List of Tools and Equipment

Table 2 shows the list of tools and equipment and their functions, to be used for the construction of the innovation project.

Table 2
List of Tools and Equipment and their Functions

Name of Tools and Equipment	Functions
Hacksaw	For the cutting of metals
Flat File	Metal sharp ages remover
Long Nose Pliers	For holding objects during fabrications
Pull-Push Rule	Measuring the dimensions of the project
Ruler	Measuring the distances between equipment and devices

Micrometer Caliper	Measuring small dimensions of the workpiece
Hummer	For pounding
Adjustable Wrench	For tightening and loosening nuts
Drill Press	For drilling holes
Electric Hand Drill	For drilling holes
Lathe Machine	For facing and threading
Welding Machine	For solidification of metals

As shown in Table 2, tools and equipment needed for the construction of the innovation project are very basic since they are the required instruments for an ordinary automotive shop. This implies that the innovation project can easily be done, and the researcher would be hustle free.

Construction Procedures

The procedure in constructing the research project is displayed by the figure. This includes the preparation of two (2) assemblies of the steering wheel, fabrication of pedals, preparation of two (2) assemblies of pedals, construction and preparation of the chassis, the physical set-up of ASaP Control System, and the final output of the innovation project.

Figure 17. Preparation of 2 Assemblies of Steering Wheel

Figure 18. Fabrication and Preparation of Pedals

Figure 19. Preparation of 2 Assemblies of Pedals

Figure 20. Construction and Preparation of the Chassis

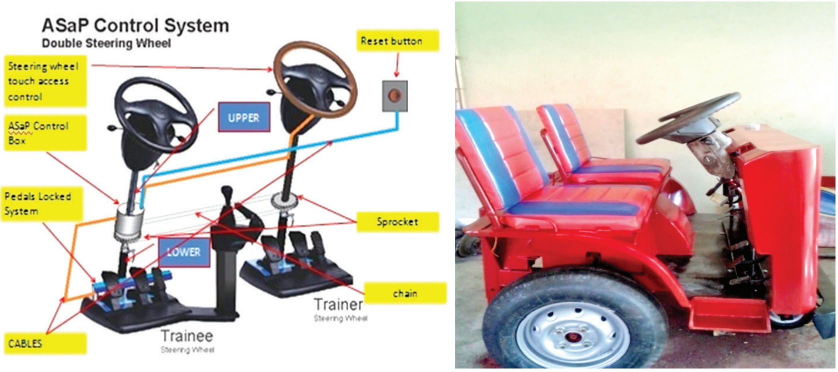

Figure 21. The Physical Set-up of ASAP Control System Project

Figure 22. The Functional ASAP Control System Invention

The figures showed above tell the doability of the innovation project. This implies that when ingenuity is coupled with diligence and industry, any innovation projects can easily be constructed.

TEST AND EVALUATION OF THE FUNCTIONALITY AND AESTHETIC DESIGN OF ASAP CONTROL SYSTEM

This section presents the purpose of test and evaluation, the method of test and evaluation, respondents/participants, research instrument, data gathering procedure, and the results of the tested and evaluated ASaP Control System.

Purpose of the Test and Evaluation of ASaP Control System

The purpose of this test and evaluation was to determine the desired functionality and aesthetic design of ASaP Control System. Specifically, it sought answers to the following questions: 1) Does the taking of turns by both driver instructor and student driver in positioning and manipulating in the same steering-wheel and pedal of a car-driving unit during the demonstration and application of driving competencies can be addressed? 2) Does the student driver's fear of getting an accident due to the possibility of misdriving a car-driving unit with two (2) sets of fixed parallel steering-wheel and pedal can be eliminated? 3) Does the risk of getting an accident while on car driving training can be reduced? 4) Does the acquisition of driving competencies or development of driving skills can be easily facilitated? And 5) Is the ASaP Control System competitive in its aesthetic design?

The Method of Test and Evaluation

As an innovation project, ASaP Control System employed a developmental research design, which involves situations in which the product-development process is analyzed and described, and the final product is evaluated (Richey; 1994; Richey, Klein, & Nelson, 2004). This research design systematically tests and evaluates the functionality and the aesthetic design of the innovation project that must meet the criteria of internal consistency and effectiveness through the facilitation of descriptive research design as its technique and tool.

For the purpose of testing and evaluating the functionality of the present innovation project, this developmental research employed a descriptive research design, which can be both quantitative and qualitative in nature (AECT, 2001). The descriptive research design involves the collection of quantitative information that can be expressed in numerical form and the gathering of qualitative information that can be grouped into themes or patterns (AECT, 2001). Also, while a quantitative descriptive research design requires numerical data, the descriptive qualitative design requires textual data (AECT, 2001; Williams, 2007). Moreover, while the former design answers questions in the laboratory or through written surveys, the latter answers questions in the real world and natural setting (Bossman & Rallis, 2017).

Respondents/Participants of the Developmental Study

The respondents/participants of the study were the five (5) invited driver instructors from the driving schools of Digos City and fifteen (15) student drivers of Cor Jesu College-Technical Vocational Education Institute (CJC-TVEI). They were chosen as respondents/participants of the study using purposive and convenient sampling techniques. Purposive sampling technique was used to get participants who can appropriately give information (Creswell, 2009) on the observable facts of the innovation project. In the same manner, a convenient sampling technique was also employed since the study considered the present CJC-TVEI driving students who can easily be gathered (Creswell, 2007) for quantitative and qualitative evaluations of the present innovation.

Research Instrument

The instrument used in the testing and evaluation of the functionality and the aesthetic design of ASaP Control System was a prepared questionnaire with quantitative survey questions and a space for the participants' qualitative data of evaluation. For the quantitative interpretation of the data in testing and evaluating the functionality of the innovation project, the following rating scale was used:

Range	Description	Descriptive Interpretation
4.20 – 5.00	Strongly Agree	Highly Functional
3.40 – 4.19	Agree	Functional
2.60 – 3.39	Undecided	Moderately Functional
1.80 – 2.59	Disagree	Slightly Functional
1.00 – 1.79	Strongly Disagree	Not Functional

In the same manner, the following rating scale was used for the quantitative interpretation of the data in testing and evaluating the aesthetic design of the innovation project.

Range	Description	Descriptive Interpretation
4.20 – 5.00	Strongly Agree	Highly Competitive
3.40 – 4.19	Agree	Competitive
2.60 – 3.39	Undecided	Moderately Competitive
1.80 – 2.59	Disagree	Slightly Competitive
1.00 – 1.79	Strongly Disagree	Not Competitive

Likewise, for the qualitative interpretation of the data in testing and evaluating the functionality and the aesthetic design of the ASaP Control System, the following method of the suggested by Tudy and Tudy (2018), which was pattered from the method by Colaizzi (1978).

Significant Statements of the Participants	Participant's Code	Formulated Meanings	Recurring Themes

Data Gathering Procedure

The present research and development study had the following procedures and processes: 1) invitation letters were sent to the identified five (5) driver instructors in Digos City to participate in testing and evaluating the ASaP Control System; 2) A letter was also sent to the CJC-TVEI Program Head of the Driving Program requesting him to provide fifteen (15) student drivers as participants of the test and evaluation of the innovation project; 3) the participants were gathered in the area where the researcher oriented them to manipulate the innovation project in order to test and evaluate its functionality and aesthetic design; 4) The questionnaires were distributed to the participants to rate the innovation project as well as to give their comments about the said project, and 5) then the answered questionnaires were retrieved for analysis and interpretation.

Analysis and Interpretation

This section deals with the analysis and interpretation of the data gathered from the developmental study. Analysis and interpretation are presented according to the test and evaluation of the functionality and aesthetic design of the innovation project. This developmental study then used survey questionnaires for quantitative analysis and interpretations and utilizing comments of the respondents below the said questionnaires for qualitative analysis and interpretations. On one hand, the presentation on the functionality of the ASaP Control System covers the three sub-problems of the developmental study, specifically: the taking of turns by both driver instructor and student driver in positioning and manipulating in the same steering-wheel and pedals of a driving unit during the demonstration and application of driving competencies; the student driver's fear of getting accident due to the possibility of misdriving a driving vehicle with two (2) sets of fixed parallel steering-wheel and pedals; the reduction of the risk of getting an accident while on car driving training; and easy acquisition of driving competencies or development of driving skills.

On the other hand, the presentation on the aesthetic design of the ASaP Control System covers the competitive level or the presentability and acceptability of the innovation project. The presentations are systematically arranged in the two headings, namely: the quantitative presentation of the functionality and aesthetic design of the innovation project and the qualitative presentation of the innovation project's functionality and aesthetic design.

The Quantitative Presentation of Functionality and Aesthetic Design. Displayed in Table 3 and 4 are the quantitative data pertaining to the functionality and aesthetic design of the ASaP Control System based on the test and evaluation of the professional driver respondents and student driver respondents.

Table 3 shows the ratings of the five driver instructor respondents on the functionality and aesthetic design of the ASaP Control System. Driver instructor respondents' ratings revealed that the ASaP Control System is highly functional, with a mean score of 4.46 and moderately competitive with a mean score of 3.36.

Table 3: The Quantitative Data on the Functionality and Aesthetic Design of the ASaP Control System According to the Driver Instructor Respondents

Driver Respondent	Rating on Functionality	Descriptive Interpretation	Rating on Aesthetic Design	Descriptive Interpretation
1	4.5	Highly Functional	3.2	Moderately Competitive
2	4.66	Highly Functional	3.6	Competitive
3	4.0	Functional	3.2	Moderately Competitive
4	4.5	Highly Functional	3.6	Competitive
5	4.66	Highly Functional	3.2	Moderately Competitive
Mean	**4.46**	**Highly Functional**	**3.36**	**Moderately Competitive**

Likewise, Table 4 shows the student driver respondents' rating on the functionality and aesthetic design of the ASaP Control System. As displayed, the ASaP Control System got a mean score of 4.43 for its high level of functionality and 3.5 for its level of competitiveness in aesthetic design.

Table 4: The Quantitative Data on the Functionality and Aesthetic Design of the ASaP Control System According to the Student Driver Respondents

Driver Respondent	Rating on Functionality	Descriptive Interpretation	Rating on Aesthetic Design	Descriptive Interpretation
1	4.5	Highly Functional	3.6	Competitive
2	4.6	Highly Functional	3.8	Competitive
3	4.5	Highly Functional	3.6	Competitive
4	4.6	Highly Functional	3.6	Competitive
5	4.0	Functional	3.6	Competitive
6	4.5	Highly Functional	3.2	Moderately Competitive
7	4.6	Highly Functional	3.2	Moderately Competitive
8	4.0	Functional	3.6	Competitive
9	4.5	Highly Functional	3.6	Competitive
10	4.0	Functional	3.6	Competitive
11	4.6	Highly Functional	3.2	Moderately Competitive
12	4.6	Highly Functional	3.6	Competitive
13	4.5	Highly Functional	3.6	Competitive
14	4.5	Highly Functional	3.6	Competitive
15	4.5	Highly Functional	3.6	Competitive
Mean	**4.43**	**Highly Functional**	**3.5**	**Competitive**

Furthermore, it is shown that while both driver instructor and student driver respondents rated the ASaP Control System as highly functional, they differ in their rating on the ASaP Control System's aesthetic design. While the driver instructor respondents rated it as moderately competitive with the mean score of 3.36, the student driver respondents rated it competitive with a mean score of 3.5. However, it is noticeable that their different ratings belong to the scale range that needs improvement. Thus, while the functionality of the ASaP Control System is assured, the enhancement of its aesthetic design is considered.

The Qualitative Presentation of Functionality and Aesthetic Design. Displayed in Table 5 are the thematically analyzed qualitative data pertaining to the functionality and aesthetic design of the ASaP Control System based on the written evaluations of the driving instructor and student driver participants. Results of the thematic analysis revealed three (3) main themes, namely: the functionality of the ASaP Control System, the presentability of the ASaP Control System, and its proper placement.

Functionality of the Project. One of the common responses in both written and verbal responses of the driver instructors and student drivers was on the functionality of the project. First, they said that many students could be accommodated for driving training by this innovative project since both instructors and students do not need to exchange seats. Both steering wheels and pedals are functioning according to their respective purposes. Because of this innovation, the purpose of safety is ensured. The practice of driving is far from an accident, and it can build confidence in the apart of the student driver. In fact, one of the participants said:

> "Kay layo man sa disgrasya ang pagpractice sa pagdrive ma arisgado moeskuela ang estudyante (Driver 1)."
> (Since the driving practice is far from an accident many students would be encouraged to take driving lessons.)

Also, according to the responses, the sensor of the driving instructor's steering wheel and pedals are sensitive that can easily incapacitate the student driver's steering wheel and pedals and making the training of driving far from an accident. It added to the functionality of the project. In short, this innovative project can easily facilitate the acquisition of driving competencies. This was expressed by one participant who shared:

> "Dali rang ma driver and estudyante kon iinstall ang project sa driving unit (Student Driver 5)."
> (It is easy fora student to become a driver when this project is installed in the driving unit).

These participants' evaluations imply that the ASaP Control System can really serve the purpose for which it is being made, which is making a driving vehicle student driver-friendly and safer school driving unit. This result conforms to Alexander & Pulat's ergonomic principle of "fitting the task to the man" instead of fitting the man to work for human safety and productivity (Animashaun & Odeku, 2014); Pheasant & Haslegrave, 2018).

Presentability of the Project. The innovation project needs improvement, especially the arrangement of wirings and some electronic devices inside the prototype, the participants suggested. It was noted that the prototype was assembled but would be later installed in a real vehicle. However, the prototype itself needs improvement in its appearance. Specifically, a student driver suggested:

> "Mayo kon hapsayon ang mga wirings sa sulod sa project (SD9)."
> (It is good to arrange the wirings and some electronic devices of the project properly).

From these evaluations of the participants, it can be deduced that the innovation project needs improvement in its aesthetic design to become more competitive. This result is result is related to the findings of Barata and Nevado (2014), Brondoni (2015) and Whaley (2009) about considering the improvement of project's aesthetic design for competitiveness as very important since the design is linked to the performance of the project and design is connected to highly promising and sustainable innovation.

Proper Placement of the Project. Since it was just a prototype, the participants wanted to have it installed in a real vehicle. They would like to test it and see its real functionality. One student driver commented:

> Nindot kon modagan unta ning gibutangan sa project (SD5)."
> (It is good if the project is installed in a running driving vehicle).

This suggestion implies that the functionality of the innovation project makes it appropriate to be installed in the manually transmitted school driving unit. In other words, it is a confirmation that the innovation project works for its intended purpose (Lemley, 2016). This suggestion of the participants then coincides with the nature of prototyping, which is to demonstrate a system or project to discover issues as well as to plan for the use or implementation of the prototyped project (Prototype, 2012; Udell, 2013).

From these three themes mentioned, it can also be gleaned that the ASaP Control System is useful, practical, and can really serve the purpose for which it is being made. However, its aesthetic design needs improvement, and its installation in the real driving vehicle with manual transmission is advisable.

CONCLUSION AND RECOMMENDATION

The conclusions were formulated from the findings of the developmental study, and the recommendations were made to help improve the ASaP Control System project.

Conclusion

Results of the test and evaluation made by the professional driver and student driver respondents confirmed that ASaP Control System is functional that can address: 1) the taking of turns by both trainee and trainer in positioning and manipulating in the same steering-wheel and pedals of a driving unit during the demonstration and application of driving competencies, 2) the trainee's fear of getting accident due to the possibility of misdriving a driving vehicle with two (2) sets of fixed parallel steering-wheel and pedals, 3) the possibility of reducing the risk of getting an accident while on car driving training, 4) the easy acquisition of driving competencies or development of driving skills. However, while the innovation project is seen useful, practical, and can really serve the purpose for which it is being made, the innovation project is seen as less competitive in its aesthetic design.

Moreover, the results of the test and evaluation made by the professional driver and student driver respondents suggested enhancement of the ASaP Control System for public acceptability. The respondents observed that the innovation project is less presentable to the public when it is displayed.

Lastly, as indicated in the test and evaluation of the ASaP Control System, it is recommended by the professional driver and student driver respondents that this innovation project is installed in a school driving vehicle with manual transmission.

Recommendations

Taking into account of the results of the developmental study, the following recommendations were made: 1) the innovation project's aesthetic design and physical set-up must be improved to make it more presentable and acceptable to the public; 2) the innovation project must be installed in the manually transmitted school driving vehicle for a student-friendly and safer driving unit; and 3) the further explorations on the application and installation of the innovation project in an automatically transmitted school driving vehicle. Also, it is recommended that other innovation projects that observe the ergonomic principle of "fitting the work to the man rather than fitting the man to the work" for human safety and productivity can be developed.

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