Users' Experiences of Using a Metacognition-Based Digital Automotive Fault Diagnosis Worksheet: a Mixed Methods Study

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Abstract: Metacognition concept could help students for learning how to learn during their learning activities. An automotive fault diagnosis activity, as an activity in automotive vocational education, requires students to use their high-order thinking to find the vehicle fault and repair it without having trial and error steps. A metacognition-based digital automotive fault diagnosis worksheet could help students scientifically with a metacognition concept by knowing their self-cognition and regulating it. This study aims to gain students' perspectives after using the digital worksheet based on a metacognition concept for automotive fault diagnosis. Those perspectives are based on the worksheet's strengths and weaknesses so that several items that need to be revised could be determined afterward. A sequential model QUAN-QUAL of mixed methods was used in this study. A questionnaire for exploring the usability, ease of use, ease of learning, and satisfaction of the students was used in this quantitative study. A qualitative study would follow this to clarify the findings from the previous one about the strengths, the weaknesses, and the items that need to be revised by having a focus group interview. The data analysis technique for the quantitative study was descriptive quantitative; meanwhile, in the qualitative one, the thematic analysis was used to analyze the data from the focus group interview. The findings of this study stated that the levels of usability, ease of use, ease of learning, and students' satisfaction with using the digital worksheet are at high levels. Students said that the strengths of the worksheet are; 1) coherent, 2) easy to understand, 3) easy to conclude, 4) easy to access whenever and wherever 5) easy to learn, 6) detailed steps, 7) simple view, 8) interesting view, and 9) eye-catching. Then, the weaknesses are; 1) several instructional words are hard to be understood, 2) several instructions need to be clear about what students need to do, and 3) taskbar color needs to be adjusted. Based on those weaknesses, several texts of the instructions need to be revised to make them easier to be understood by students. Also, the taskbar color must be adjusted to make a comfortable view.

Keywords: metacognition concept, automotive fault diagnosis, users' experiences, strengths, weaknesses, USE Questionnaire, focus group interview.

1 Introduction

Learning activities play an essential role in equipping students with desired skills. Every learning activity in education should have a specific objective that needs to be achieved. In vocational education, learning activities facilitate students acquiring relevant skills needed by industries. It is mainly because vocational education aims to facilitate students' transition from school to the workplace [HSWZ17], so the students need to master workplace competencies during their learning activities [AbSK19, Goug10, Rösc13]. Therefore, these activities should be created and developed in such a way to facilitate students to succeed in mastering competencies that workplaces need effectively.

Generally, vocational education is an educational type that focuses on preparing students for working life [Rösc13]. All educational programs of vocational education need to pay attention to what workplaces need. The teaching and learning activities should be in original forms related to the students' future working life [PWCH16]. Consequently, the vocational education curriculum needs to be adjusted from time to time to improve the relevance between the curriculum and the workplace's competencies [Hiim17, MaSu20, UtMu20]. By conducting high-quality vocational learning, the students will have meaningful skills to work after graduation. Ultimately, the unemployment phenomenon could be reduced gradually.

In Indonesia, in the context of this research, the quality of human resources and the unemployment phenomena still become issues that need attention. The United Nations Development Programme (UNDP) report shows Indonesia's human resources occupy ranked 107 of 189 countries [Undp20]. The rank is categorized into a middle-low level of human resource quality. Furthermore, there are almost ten million Indonesian people unemployed [Bada20]. Of that number, 27,26% are unemployed people from vocational education graduates. This data is contrary to the objective of vocational education since this education should be the solution to the unemployment problems. Those data mean that the quality of Indonesian human resources, particularly vocational education, still needs improvement.

Vocational education in Indonesia is divided into middle school and higher education [Indo03]. The vocational education graduates at the middle school level will occupy jobs at the same level as the operator in the workplace. Meanwhile, the graduates from vocational education at the higher education level will be in the analyst position [Indo12]. Especially at the middle school level, Indonesian vocational education institutions have many problems. Irrelevant curriculum, low quality of graduates, low quantity and quality of vocational teachers, outdated vocational practice infrastructures, and cooperation with industries are the problems [Sito16]. Moreover, the students achieved low scores in the 2019 national examination in the field of vocational expertise [Kemd19]. Furthermore, the quality index of the Indonesian vocational

teachers is in a low category and still needs improvement [SuNB16]. Additionally, the graduates could not meet the requirements of what the workplaces need [LaSA17]. Hence, it could be concluded that the quality of Indonesian vocational education at the middle school level still needs improvement. Ultimately this education could contribute to reducing unemployment phenomona in Indonesia.

Improving the quality of vocational teachers could be one of many ways to improve the quality of vocational education. It is because teachers are the key figures with many significant roles in education [Bran16]. They are the best players in the success of students' learning [CAGO17] and students' development [Tuğr13]. Also, many studies proved that they are the key to improving the students' academic achievements [BoFM10, BoKi05, Frye11, KKBR13, MiRM17, West11, YDLS07]. Based on their educational roles, qualified vocational teachers could improve the quality of vocational education. Vocational teacher education, in this case, holds this duty since this education produces vocational teacher candidates. This teacher education focuses on delivering two elements; the subjects and the technique to teach the subjects [Kenn99]. Therefore, one way to improve the quality of vocational teachers could be by improving the teaching and learning activities in vocational teacher education.

Several studies have been conducted to improve the quality of teaching and learning processes for prospective vocational teachers. Firstly, in 2015, the entrepreneurship learning model was developed to improve life skills for prospective vocational teachers [Husa15]. Secondly, at the beginning of 2019, technological skills in vocational teaching and learning became necessary to develop the learning model for equipping those skills for prospective vocational teachers [NPMN19]. Furthermore, the e-learning model [TPMM20], learning model for teaching explaining skills [FiDS21], learning model for teaching efficacy and teaching skills [PMUS20], and modifying the industrial internship model for prospective vocational teachers [GAHM20] were developed. Those studies are examples of previous studies developing teaching and learning models for prospective vocational teachers.

Although there are some studies, there is little attention to the learning model that accommodates the concept of metacognition for prospective vocational teachers. Metacognition is a concept of learn-how-to-learn, which is one of the essential skills for conducting sustainable learning [UzHü11]. This skill is necessary since vocational teachers must stay updated with the development of science and technology in the workplace [AbSK19, DiHa16, HuTa14, NSSK20, NuZa19, SuDe19]. They need to deliver relevant competencies that workplaces need to their students so that the students will be able to work in particular jobs.

This study is a part of a comprehensive study of developing a metacognition-based digital automotive fault diagnosis worksheet. This digital worksheet accommodates metacognition as the concept of learn-how-to-learn and problem-solving ability as the

main needed competencies of automotive vocational education in Indonesia. It is expected that by using this digital worksheet, the students will be able to solve the problems in an automotive context and could get experiences about how to learn something. Those skills are essential to becoming automotive vocational teachers.

This academic paper presents the findings of users' perspectives after using the metacognition-based digital automotive fault diagnosis worksheet. The findings are necessary to make the digital worksheet better before going to be implemented in the teaching and learning processes. Selected students as users are invited to use this digital worksheet, fulfill the provided questionnaire, and give opinions during a focus group interview.

2 Methods

A sequential QUAN-qual model of mixed-method approaches was used in this study to gain users' perspectives after using a web-based application of a metacognition-based digital automotive fault diagnosis worksheet. The quantitative study used a questionnaire survey as the data collection method. Meanwhile, a focus group interview was used in the qualitative study to clarify the findings of the quantitative one. The clarification is based on the web-based application's strengths, weaknesses, and items that need to be revised.

This study invited six students in the 6^{th} semester of automotive vocational teacher education in Indonesia. The participants should be students in the 6th semester because they must have sufficient background knowledge and skills before conducting automotive fault diagnosis activity.

2.1 A Questionnaire Survey

The quantitative study uses a questionnaire as the instrument to gather the needed data. A questionnaire adapted from the study of Arnold M Lund in 2001 [Lund01] was used to explore the usability level of the developed web-based application. This questionnaire's name is the Usefulness, Satisfaction, and Ease of Use (USE) questionnaire [Lund01]. This questionnaire has 30 questions with 7 Likert scales with agreement ratings ranging from strongly disagree to agree strongly. This questionnaire consists of 4 comprehensive variables: usefulness, ease of use, ease of learning, and satisfaction.

A descriptive quantitative analysis adapted from the study of Arnold M Lund in 2001 [Lund01] was used to analyze the questionnaire data. The analysis was based on

usefulness, ease of use, learning, and satisfaction. Based on the quantitative results, the qualitative interpretation was determined afterward.

2.2 A Focus Group Interview

This study used a focus group interview as the qualitative approach for exploring the strengths, weaknesses, and items from the web-based application that need to be revised. A protocol for conducting this focus group interview was created based on the guidelines from Steinar Kvale in 2011 [Kval11]. There are three main questions in this protocol which are; 1) what are the strengths? 2) what are the weaknesses? 3) which items need to be revised?.

The thematic analysis technique adapted from the study of Asley Castleberry and Amanda Nolen in 2018 [CaNo18] was used. This analysis was based on the themes of strengths, weaknesses, and items that need to be revised. There were five stages in the thematic analysis which are; 1) compiling for transcribing the interview, 2) disassembling for coding the transcription, 3) reassembling for categorizing based on the determined themes, 4) interpretation for writing the analytical conclusion, and 5) concluding for answering to the specific questions.

3 Findings

This study is a sequential QUAN-QUAL mixed-method study, so there are two perspectives of the research findings; quantitative and qualitative. The quantitative findings were achieved from the USE Questionnaire and the qualitative ones from a focus group interview. The questionnaire quantitatively assessed the usefulness, ease of use, learning, and satisfaction. Meanwhile, the focus group interview was used to qualitatively assess the digital worksheet's strengths and weaknesses.

3.1 The Finding of a Questionnaire Survey

USE Questionnaire is a seven Likert scale questionnaire that could assess the level of usefulness, ease of use, ease of learning, and satisfaction after using the digital worksheet. Firstly, the usefulness aspect could be assessed by questions 1-8. Secondly, the ease of use aspect could be assessed by questions 9-19. Thirdly, the ease of learning aspect could be assessed by questions 20-23. Lastly, the satisfaction aspect could be assessed by questions 24-30. The scores of the Likert scales are ranged from 1 up to 7. Below is the table of the average score of every participant in every aspect.

Participant	Aspects' Scores (Max 7.00)			
	Usefulness	Ease of Use	Ease of Learning	Satisfaction
1	5.00	5.36	4.50	5.00
2	6.25	6.00	6.00	6.00
3	7.00	6.64	6.50	6.29
4	7.00	6.82	7.00	6.86
5	6.75	6.91	7.00	7.00
6	6.13	6.27	5.50	6.00
Average in Total Score	6.35	6.33	6.08	6.19

Table 1: Average score of every participant in every aspect

3.2 The Finding of a Focus Group Interview

This focus group interview assessed the digital worksheet's strengths and weaknesses. There were five stages for analyzing the data from the focus group interview.

Compiling

Compiling was the first stage of analyzing the data from the focus group interview. This stage is a stage for making a transcription during the 9-minutes interview. There were two main questions which are; 1) what are the strengths? 2) what are the weaknesses that need to be repaired?. The transcription results in 748 words in Bahasa Indonesia.

Disassembling

Disassembling is a stage of analysis to notice the transcription result's strengths and weaknesses. Below is the table that explains the results of this stage.

Participants	Opinions from the Focus Group Interview
1	*The advantages are that it is coherent and easy for me to understand the process; in the end, I can remember what the results were, and it was easy to conclude. Then the drawback may be the use of words that are difficult to understand and confusing.*
2	*The advantage is that it is website-based and easy to access. This website is coherent, so you can get an overview of the diagnosis process. However, there is a drawback, in my opinion, to every instruction in the process. The words are quite difficult to understand.*
3	*The advantages are quite good because it makes it easier for us to learn anywhere, anywhere. Moreover, for the shortcomings, in my opinion, maybe in terms of what it has called, from the drawbacks, maybe in terms of the problem, sir, understand the problem and*

	explain again, sir.
4	*The advantage is that in terms of appearance, it is simple. However, in that simplicity, it is what makes the first impression and feeling of the user not complicated or elaborate like that. Then the drawback is there is one word that I think needs to be improved.*
5	*The appearance is very attractive and eye-catching. However, on the other hand, it was difficult to understand, especially in the analysis section of self-reflection.*
6	*The first advantage is that this platform is detailed and coherent. The second one has its characteristic: the website can be accessed. Then the appearance of this website or this platform is simple and not too, not too crowded. Then the drawback may be that the color in the taskbar that indicates the command may be darkened again.*

Table 2: The opinions on the digital worksheet's strengths and weaknesses based on every participant's perspective

Reassembling

Reassembling stage is a stage for categorizing the transcription result from the interview into themes or aspects; strengths and weaknesses. Below is the explanation table of this stage's findings.

Aspects	Participants	Opinions from the Focus Group Interview
The Strengths	1	*Coherent, easy to understand the process and remember what the results are, easy to conclude*
	2	*Easily accessible, get an overview of the diagnostic process.*
	3	*Easy to learn anywhere*
	4	*Simple appearance, not complicated, not long*
	5	*It looks attractive, eye-catching*
	6	*Detailed, coherent, accessible, simple appearance and not too crowded*
The Weaknesses	1	*Words are hard to understand and confusing*
	2	*Instructions are quite difficult to understand*
	3	*The question needs to be clarified*
	4	*Words need to be fixed*
	5	*The words are hard to understand*
	6	*The colour in the taskbar is darkened*

Table 3: The opinions on the digital worksheet's strengths and weaknesses

Interpreting

The interpreting stage is a stage to build an analytical conclusion from the previous stage data to find the answers to the digital worksheet's strengths and weaknesses.

Aspects	Answers
The Strengths	1) coherent, 2) easy to understand, 3) easy to conclude, 4) easy to access whenever and wherever, 5) easy to learn, 6) detailed steps, 7) simple view, 8) interesting view, and 9) eye-catching.
The Weaknesses	1) several instructional words are hard to be understood, 2) several instructions need to be clear about what students need to do, and 3) taskbar color needs to be adjusted to make a comfortable view.

Concluding

This concluding stage is the last stage of the thematic analysis. This stage provides the answers to the interview questions based on the result of the previous stage. Based on the analyzed data, it could be concluded that the digital worksheet's strengths are coherent, detailed steps, easy to understand, learn, conclude, and access whenever and wherever, interesting, simple view, and eye-catching. Meanwhile, the weaknesses of the digital worksheet are that several instructions need to be revised to make easy understanding, and the taskbar color needs to be adjusted to make a comfortable view.

4 Discussion

Vocational teaching and learning include theoretical learning in classrooms and hands-on activities with practical learning in workshops. Practical learning contains work instructions to guide students to do particular jobs. These jobs are provided by vocational education programs to equip students with relevant skills that will be valuable for their future working life. This statement means that the activities in the jobs of vocational education should be relevant to needed competencies in the workplace [Goug10, Rösc13]. Therefore, the practical learning activities in vocational education play an important role in achieving the educational objectives.

Educational media and technology could improve the quality of teaching and learning. Teachers should use technology in their teaching and learning activities to help them achieve their learning objectives [KöJG20]. Students could learn better if guided by something they could use to help them understand how to do the jobs. Educational media and technology could be "the something" as the learning tools to help students achieve learning objectives. Hence, this technology would benefit educational teaching and learning activities [HaAE20].

This digital worksheet is a learning tool to help students understand the process of automotive fault diagnosis. This tool avoid students from having trial and error steps during the diagnosis process. Students are forced to diagnose the faults in the vehicles scientifically with many stages. The stages of the digital worksheet are based on the metacognition concept, which is a learn-how-to-learn concept. This concept must be implemented in prospective vocational teachers' teaching and learning activities. This concept is highly important because learn-how-to-learn is an essential skill for conducting sustainable learning [UzHü11]. They are needed to conduct sustainable learning during their future work activities as vocational teachers to stay updated along with many things that happen in the workplace. Ultimately, they could provide meaningful teaching and learning activities for their students that are relevant to the need of the workplace.

Before implementing the digital worksheet, it is necessary to ask the students as the users to know the strengths and the weaknesses. The data of those aspects could be the materials for making the digital worksheet better for teaching and learning activities to achieve the learning objectives. This study assessed the digital worksheet's usability, ease of use and learning, satisfaction, strengths, and weaknesses. The worksheet's level of usability, ease of use and learning, and satisfaction are high. Furthermore, this digital worksheet has many strengths after students try to use this. However, several weaknesses need to be paid attention to. There are two aspects of the weaknesses: the instruction texts and the color of the taskbar. Those aspects need to be considered in developing the digital worksheet to be effectively used in teaching and learning.

5 Conclusion

The findings stated that the levels of usability, ease of use, ease of learning, and the satisfaction of using the digital worksheet are high. Coherent, detailed steps, easy to understand, learn, conclude, and access whenever and wherever, interesting, simple view, and eye-catching are considered to be the strengths of this digital worksheet. However, 2 aspects which are the weaknesses, the instructional texts and the taskbar color, need to be revised and adjusted to improve the digital worksheet.

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