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The development of educational media based on the flipped classroom model on practical lesson in vocational education

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Abstract. Practical lessons in vocational education have been being got much attention from practitioners because of its importance. Additionally, the required 21st-century skills nowadays should be accommodated by educational programs so as to produce graduates that could survive. The aims of this study are to understand the required learning activities that students need to do in order to prepare their practical lesson, to produce educational media based on the flipped classroom model in the practical lesson and to examine the feasibility of the educational media. This is a Research and Development (R&D) study that used the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model. The result of this study is the learning activities including accessing the sources of knowledge, looking at simulation videos, and exercising the quiz. In addition, there is developed media based on the flipped classroom model covered in an online learning management system that contains fundamental articles, simulation videos, job sheet, and quiz. Besides, the level of feasibility of the educational media is in good category that means the educational media is feasible to be used in that practical lesson.

1. Background

The Indonesian government has been concerning the development of education since the 4th amendment of the Indonesian constitution in 2002, said that 20% of the national budget will be used in the educational area [1]. A kind of education that the government recently paid much attention to is vocational education. This education concerns to prepare their students to be able to work in their future life [2]. In order to improve this educational program, the president of Indonesia declared the presidential instruction for the revitalization of vocational schools in Indonesia in order to improve the quality and the competitiveness of Indonesian human resources [3]. This instruction is addressed to several ministries, the leaders of relevant institutions, and governors. This instruction strengthens the efforts of the Indonesian government to make qualified educational programs and produce qualified human resources eventually.

Traditionally, the purpose of vocational education is preparation for working [4]. However, this purpose becomes more broadly nowadays. Vocational education is one of the educational institutions that have a significant impact on the effort of improving human resources. By improving the quality of vocational education, it will tend to improve the quality of human resources that will reduce unemployment phenomena. Besides, the vocational education could also support national economic performance [5]. Therefore, improving the quality of vocational education could not improve only on human resources but also on national economic performance.



Besides, industrial revolution 4.0, ASEAN Economic Community, and the required 21st-century skills are the challenges that educators face nowadays. They should provide educational programs to their students in order to equip them with several competencies so as to deal with those challenges. Students should learn a lot of sources related to the fundamental knowledge with the use of a huge number of technologies so that they could get deep meaning what they learn [6]. This means the students should be familiar with several technologies nowadays to become like their friends to explore a lot of science that they need. In other words, this phenomenon forces educators to facilitate learning activities with technologies.

As an ASEAN Economic community has an agreement for a single market among ASEAN countries [7], the biggest challenge is providing skilled workers as a required global market so that they could compete with the workers from other countries. Skilled workers could be produced from qualified educational programs. Additionally, required 21st-century skills such as communication, collaboration, critical thinking, and creativity should also be facilitated in teaching and learning processes by educational institutions. Eventually, all of the existed challenges should be paid attention to by educators so as to create suitable and relevant models of teaching and learning processes.

The model of teaching and learning processes that nowadays become popular is a flipped classroom model. This model combines in-class activities and out-class activities with an integrated system to maximize the teaching and learning process. This model becomes attractive because of using several teaching aids and internet resources like videos, audios, articles, and so on [8]. Some characteristics of the flipped classroom model are a change in the use of in and out of class time, emphasizing active learning, collaboration, and problem-solving, pre-post class activities, and the use of technology especially video [9]. Therefore, the flipped classroom model is known as student-centered learning because this model forces students to be more active than the teachers [10].

Bloom's taxonomy that consists of six categories covering remembering, understanding, applying, analyzing, evaluating and creating is the aspects of the development process of the flipped classroom model. In other words, those categories should be paid attention to while developing content in the flipped classroom model [11]. Flipped classroom model uses remembering and understanding as to the basics of out-class activities and the others are in-class activities [10]. Based on that analysis, educators should choose wisely which materials that they want to share with their students in out-class activities. This is very important to make sure that students will learn easily to the materials because the students will get the opportunity to access the materials according to their learning styles [12].

Vocational education as an educational type that concerns to prepare students in order to be ready to do specific jobs could not be separated from practical lessons in the teaching and learning process. In order to do practical lessons well, students should have introductory knowledge that becomes their guidance to do the jobs in practical lessons. In some vocational education institutions (e.g. Engineering Faculty, Universitas Negeri Yogyakarta) have limited time for practical lessons so that in some cases, students cannot master the learning outcomes perfectly in each practical lesson. Automotive engineering education, faculty of engineering, Universitas Negeri Yogyakarta has a duration of 2 hours of each practical lesson. This causes insufficient time for them to gain the learning outcomes. Additionally, the theoretical lessons that guide the practical lessons are conducted in the same semester. Therefore, this leads to insufficient knowledge that students have in order to conduct practical lessons because sometimes the theoretical lessons come after practical lessons.

Based on those phenomena, a flipped classroom model is suitable to solve those problems in order to equip students with sufficient knowledge before conducting practical lessons. Moreover, this model could increase the students' learning and value [13], students' engagement [14], students' performance [15], knowledge, and learning experience [16]. Therefore, this model is thought to be able to overcome the occurred problems in vocational education.

2. Research Method

The aim of this research is to develop feasible instructional media for supporting students learning activities like preparation of practical lessons in automotive fields. Therefore, research and

development study was conducted as the approaches to this research. This study used the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) model to develop instructional media. ADDIE model consists of the Analysis phase, Design phase, Development phase, Implementation phase, dan Evaluation phase [17]. The development phases can be seen in Figure 1.

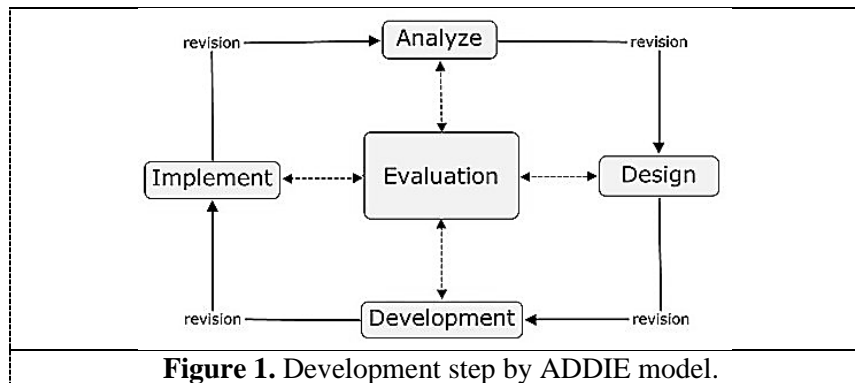


Figure 1. Development step by ADDIE model.

Based on the development model, each step of the study can be explained below:

2.1. Step 1. Need analysis

Need analysis step determined the need for students' pre-course activities, types of developed media, and instructional media content used to support flipped classroom in engine management system course. This step was done by conducting a Focus Group Discussion among electrical practice lecturers.

2.2. Step 2. Designing media

This stage was carried out by creating learning activities for students.

2.3. Step 3. Developing media

The product development stage involves several experts and potential users as material or feedbacks in its development.

2.4. Step 4. Product implementation

This step involves all of the students in the engine management system's practical lesson. The flipped classroom model was implemented on the course. Therefore, the developed media was used to flipped learning instruction. After the course finished, all the students gave feedbacks about the instructional media.

2.5. Step 5. Product evaluation

The evaluation product step was conducted to know about the feasibility of the developed media for supporting the flipped classroom. The media feasibility can be determined by the experts' judgment and the users' responses. The data was obtained by questionnaires.

Data obtained from further research subjects have been analyzed using quantitative descriptive analysis techniques to test the level of product eligibility. The obtained value of data then is compared with a table of eligibility criteria that have been determined. The media eligibility criteria can be seen in Table 1.

Table 1. Product eligibility criteria.

No	Score (4 scales)	Score (8 scales)	Eligibility grades
1	1,00–1,75	1,00–2,75	Very unworthy
2	1,76–2,50	2,76–4,50	Less feasible
3	2,51–3,25	4,51–6,25	Feasible
4	3,26–4,00	6,26–8,00	Very feasible

3. Result and Discussion

3.1 Result

3.1.1 Material Requirement before Practicum

In this study, flipped learning media is presented on two practice topics, namely: (1) On-Board Diagnosis using Malfunction Indicator Lamp (MIL) and (2) analyzing damage using a scanner. The results of the FGD (Focus Group Discussion) with several experts, the types of media that must be presented are; (1) Introduction/description of the topic to be practiced, (2) Printed material, in the form of a worksheet or practicum module, (3) Presentation on material to be practiced theoretically, (4) Video of theoretical explanations and video tutorials, (5) Articles in accordance with the topic of practice, (6) Tests / quizzes as a prerequisite for practice, and (7) Practical report assignments collected after conducting practical lessons. While the material that must be published in the learning media based on FGD with several lecturers supporting the courses is as follows.

Table 2. The composition of the contents have been mastered before practice.

OBDD using MIL	Data analysis using the scanner
Function of MIL	The function of the EMS scanner
Diagnostic Link Connector (DLC)	Scanner fitur
Procedures for accessing malfunction code with MIL	Procedures of preparation and accessing DTC by the scanner
DTC interpretation related to engine malfunction	DTC interpretation and erasing DTC using scanner
Erasing DTC from the engine control system	Viewing engine current data on scanner monitor.

3.1.2 Development Product Result

The development of product design in this research is in the form of online-based learning media that can support the preparation of students before attending EMS practice learning. The following are the results of product development on besmart e-learning systems.

15. Deteksi dan analisis kerusakan engine dengan scanner

Salam Otomotif... Semangat pagi. Semoga kabar Anda senantiasa sehat dan baik.

Saat ini perkembangan kendaraan semakin canggih, bahkan pengendara dimanjakan dengan fitur-fitur kendaraan untuk kenyamanan, keamanan, serta kemudahan lainnya. Selain itu, untuk menjamin kendaraan dalam kondisi normal, sistem kontrol kendaraan telah dilengkapi dengan fitur self diagnosis melalui on board diagnosis. Hebat bukan, kerusakan pada sistem kontrol dapat terdeteksi dini dan memberitahukan kepada pengendara untuk segera membawanya ke bengkel. Di bengkel, teknisi dapat dengan mudah mendapatkan data-data kerusakan menggunakan unit scanner. Nah, bagaimana penggunaan scanner untuk mengakses data kerusakan tersebut? Bagaimana tindak lanjutnya?

Sesi ini akan membicarakan tentang Deteksi DTC dengan scanner serta penanganannya.

Selamat belajar!

MATERI

Untuk membantu menguasai materi praktik pada minggu ini, silakan Anda pelajari beberapa materi berikut ini.

Materi 1: Jobsheet- Menganalisis DTC menggunakan scanner dan penanganannya

Silakan pelajari Jobsheet berikut ini. Setelah mempelajari Jobsheet ini, Anda akan memahami tentang penggunaan scanner untuk menganalisis DTC.

Materi 2: Presentasi mengenai Deteksi DTC dengan scanner dan penanganannya

Sistem management engine secara standar telah memiliki fitur on board diagnosis yang membantu mekanik dalam mendiagnosa kerusakan sistem. Kerusakan sistem EMS disimpan pada memori ECU dalam bentuk kode diagnosis kerusakan (DTC). Untuk mengakses kode tersebut, mekanik dapat menggunakan bantuan scanner. Presentasi ini akan menyajikan tentang penggunaan scanner untuk mendeteksi DTC serta penanganannya. Klik pada lambang speaker untuk mendengarkan penjelasan dosen.

Materi 3: Presentasi - Menganalisis kerusakan EMS dengan scanner

Materi 3: Artikel Penggunaan scanner untuk mengakses DTC

DTC merupakan kode kerusakan yang disimpan dalam ECU ketika sistem kontrol EMS terdapat permasalahan. Bagaimana penggunaan scanner untuk mengakses kerusakan tersebut? Temukan jawabannya pada makalah ini.

Cara menggunakan scanner EFI - ini contoh materi yg dapat didownload di website lain

Materi 4: Video Penggunaan scanner pada sistem kontrol kendaraan

Video ini akan menampilkan tutorial penggunaan scanner untuk mendeteksi DTC pada sistem kontrol kendaraan, serta bagaimana menghapus DTC dari ECU menggunakan scanner. Setelah melihat video ini, Anda akan dapat mempraktikkannya secara mandiri saat praktik. Selamat menyaksikan!

Video - Penggunaan scanner pada EMS

TES PRASYARAT PRAKTIK

Anda telah mempelajari materi untuk mendukung praktik pada minggu ini. Apakah Anda sudah benar-benar menguasai materi tersebut? Kerjakan tes berikut ini sebagai syarat Anda mengikuti praktik EMS minggu ini!

TUGAS LAPORAN PRAKTIK

Anda telah melaksanakan praktik sesuai Jobsheet pada minggu ini. Sebagai pertanggungjawaban, buat laporan praktik sesuai ketentuan berikut ini!

Laporan Praktik Individu

Figure 2. Flipped classroom layout on Be-smart e-learning.

3.1.3 Flipped Classroom Media Feasibility Test Results

The results of the flipped classroom educational media that have been developed are then evaluated by product worthiness. The feasibility of the product is seen from the opinion of experts in the field of online learning media development, namely Mrs. Andian Ari Anggraeni, M.Sc. (expert e-learning media developer for Online Learning Systems/SPADA Minister of Research, Technology, and Higher Education). In general, the results of validation from experts can be seen in the following table.

Table 3. Flipped classroom media validation results.

Items	Score	Remarks
Mean	7,67	Very feasible
Maximum score	8	
Minimum score	6	

According to the validation results that have been shown in Table 3, we can state that the developed educational media for supporting learning classroom is very feasible. Almost all aspects of the media reached a positive score based on expert responses. However, there were some suggestions from the expert to make the media better. Therefore, the suggestions had been considered to revise the developed media. The expert suggestions can be seen in the following table.

Table 4. Expert suggestions and the follows up

Expert suggestions	Revision
Learning management system design needs to be improved in graphic quality	Changing some pictures with high resolution.
The tutorial video should be designed in HD quality	Changing the tutorial video with better quality and high resolution

After the expert validation, the developed educational media also be responded to by students who use that media. The students' responses to the developed media were viewed in Table 5.

Tabel 5. Students responses to the developed product

Aspects	Mean	Remarks
Display	6,67	Very good
Content quality	6,68	Very good
Functions	6,64	Very good
Technical quality	6,96	Very good
Mean	6,74	Very good

3.2 Discussion

Flipped classroom model is a model that has a positive impact to the students during their learning activities based on a huge number of research [13], [14], [15], [16]. Especially in vocational education that has theoretical lessons and practical lessons, this model could help educators to conduct practical lessons because those activities need sufficient knowledge related to the practical materials. The flipped classroom, in this case, will guide the students' pre, during, and post of practical lessons. In order to reach the effectiveness of conducting the flipped classroom model, the educational media that will be used has to be a feasible one. This study has three results which are (1) the educational media types that students need, (2) the educational media, and (3) the feasibility of that educational media.

The first material that students need is a description of the topic to be practiced. This is necessary for learning activities because of this description consists of competencies that students need to master. Based on the detail of competencies that appear in flipped classroom educational media,

students could prepare themselves related to all of the materials that they need to master the competencies before conducting practical lessons.

The second material is the guidance for practical lessons. This is a printed document that usually called a job sheet. This document will guide the students during their practical lesson activities because of this document that covers step by step that students have to do. Besides, this document also contains the specifications that needed during several adjustments in practical lessons.

The third, fourth, and fifth materials are materials that consist of presentation files, videos, and articles that students must learn before conducting practical lessons. This material will equip students with basic knowledge before they do their practical lessons. By having this knowledge, practical activities will be done effectively. Therefore the sixth material which is the quiz is needed to ensure that students have already learned the third, fourth, and fifth materials.

After conducting a practical lesson, educators should have data from students so that they could give feedback to students in order to improve the quality of the next practical lessons. Therefore, the seventh material is needed to become a data collector that educators could use it to give feedback.

All of these seven materials are contained in an e-learning system called Be-smart. Students could access this system whenever and wherever they want so as to prepare themselves before conducting practical lessons. This system has been examined by experts and also users and has a level of feasibility in good category that means the educational media is feasible to be used in that practical lesson. By having this learning system that is used with the flipped classroom model, the practical lesson in limited time can be done effectively.

4. Conclusion

According to the data analysis and the previous discussions, we can conclude that (1) some requirement learning activities that have students done before coming to the engine management system practical lesson including accessing the sources of knowledge, looking at simulation videos, and exercising the quiz, (2) the developed media based on the flipped classroom model for supporting engine management system practical lesson covered in an online learning management system that contains fundamental articles, simulation videos, job sheet, and quiz, and (3) the level of feasibility of the developed educational media is in good category that means the educational media is feasible to be used in that practical lesson.

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