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Learning Innovations During the Pandemic COVID-19 for Teaching of Automotive Industrial Management

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ABSTRACT

Pandemic outbreaks of infectious diseases caused by the corona virus (COVID-19) has required the students to study from home at Universitas Negeri Medan, and the learning adaptation by using online learning become a choice. This study aims to develop innovative learning for the teaching of Automotive Industrial Management through the provision of learning resources that can be used by students during the COVID-19 pandemic. The research was conducted in second semester of 2019-2020 academic year. Research includes developing innovative learning resources, followed by standardization and implementation for blended learning. Learning innovation is carried out by providing innovative teaching materials supplemented with multimedia for the subject of Automotive Industrial Management, then packaged in softcopy. Standardization of teaching materials is done using expert lecturers. Implementation of learning is done with involvement of 61 students in two parallel classes. The results showed that a standard and innovative learning resources have been successfully developed according to the needs of achieving the competencies required by automotive engineering students. Lecturer respondents gave excellent assessment to the developed teaching materials. The implementation results showed that the learning resource has effectively been used students from home as a supplement to online teaching. The developed learning material motivate students to learn to achieve their competencies. Students' knowledge and skills have developed, where learning outcomes obtained from both, the portfolio of submitted assignment and evaluation score, are all very good. The learning innovations developed were very suitable for teaching students on Automotive Industrial Management during the COVID-19 pandemic.

Keywords: Learning innovation, Pandemic COVID-19, Industrial management, Students outcomes

1. INTRODUCTION

Pandemic outbreaks of infectious diseases caused by the corona virus (COVID-19) have brought changes to the teaching system in tertiary institutions, including at Universitas Negeri Medan [1,2]. Students are required to study from home as recommended by the Indonesian government. Thus, lecturers and students at university must also adapt learning to the pandemic COVID-19 situation by using online learning. Although learning must be done from home (according to Indonesian government recommendations), competency targets must be achieved through learning [3,4]. This situation is a big challenge for lecturers as lecturers and students, namely the teaching and learning process must continue without being face-to-face on campus, student knowledge and skills must be developed, and learning outcomes must be achieved as outlined in the

curriculum targets. The pandemic COVID-19 condition has forced lecturers to make efforts to maximize the potential of students to learn, through learning innovations [5-7]. Learning innovation is one of the choices to overcome problems that require students to learn from home. Learning innovations are carried out to provide learning resources that can facilitate student learning optimally, support online learning, and empower students to be motivated to actively learn to fulfill their skills and knowledge [8,9].

Various attempts have been made to optimize student learning optimally to improve learning outcomes, including the application of new teaching and learning models, methods and strategies, implementation of innovative learning, fulfillment of learning resources, use of blended learning, provision of learning media and multimedia, and assignments [10-

13]. Choosing an appropriate teaching and learning strategy is very necessary for technical teaching, because in general it demands improvement in the area of knowledge and skills [14-16]. Most of the learning strategies above are carried out in the classroom, in the laboratory, or outside the classroom during normal times face to face learning. Learning activities that does not involve the presence of lecturers and students are still dominated by online learning [17-20]. Online learning has proven to be effective in tertiary education, especially for the delivery of knowledge, because students already have a level of maturity and independence of learning. Online learning will be more effective if there are supporting learning resources available that can be used by students to make students can study independently without being limited by time and place. Hence, the students can repeat their lessons according to their needs. To fulfill the health protocol, online learning must be implemented during the COVID-19 pandemic. Thus, lecturers must provide learning innovations to meet the learning needs of students. This is what underlies the research team conducting research in providing innovative learning resources for students that can be used to support blended learning. The purpose of this research is to develop an innovative learning through the provision of learning resources that can be used by students during the COVID-19 Pandemic for the teaching of Automotive Industrial Management. This innovative learning model is suitable to meet the government's recommendation to only learn from home during the COVID-19 pandemic.

2. METHOD

2.1. Population and Research Samples

The study population was students in the Automotive Engineering Education Study Program, Faculty of Engineering, Universitas Negeri Medan. The research sample is consisted of 61 students in two parallel classes, those are total sample that become the responsibility of the research team as appointed lecturers to deliver the course. Descriptions of the population and research sample are summarized in Table 1.

2.2. Research Procedure

Research procedures are included the development of an innovative learning resources, standardization of learning package, and implementation for blended learning in the teaching of Automotive Industrial Management followed the procedures described in the references [21,22]. Learning innovations were carried out to provide learning resources that could be used for teaching Automotive Industrial Management during the COVID-19 pandemic time. Innovation is carried out by providing comprehensive and innovative teaching materials in accordance with the demands of competencies needed in the field of Automotive Industrial Management. Furthermore, standardization of the teaching materials was carried out by using of expert lecturers, namely the lecturers who have experience in teaching Automotive Industrial Management for undergraduate students. The standardization component carried out following the standard teaching material criteria set by the National Education Standards Agency (Badan Standar Nasional Pendidikan, BSNP) in Indonesia. The standardization process is carried out by providing a draft of learning resource (along with its supporting devices), and an assessment questionnaire that will be filled in by expert lecturers in accordance with the quality conditions of the teaching materials developed. Respondents' opinions on the components of teaching materials are used by the research team as input to improve and develop teaching materials until standard innovative learning resources are obtained.

The next stage is the implementation of learning resources in the teaching of Automotive Industrial Management online during the COVID-19 pandemic. Teaching materials from the development are distributed to students online, followed by the delivery of teaching materials using SIPDA Unimed facilities also online. Every implementation of learning is conducted by Quiz to students who relate to the material being taught, aiming to measure student mastery of the material taught during online lectures. In the middle of the semester and at the end of the semester, an objective formative examination is conducted to measure student learning outcomes. Assignments to students are also done online in accordance with the government's recommendation to learn from home, and are

Table 1. Population and research samples in the Study Program in Automotive Engineering Education, Faculty of Engineering, Universitas Negeri Medan in Semester II 2019/2020 academic year

No	Study Program	Number of students	Parallel classes (selected class)	Selected sample class	Short description of the Study Program
1	Automotive Engineering Education (Term 2016-2017)	32	1 (1)	32	Major in Engineering Education
2	Automotive Engineering Education (Term 2018)	45	2 (1)	29	Major in Engineering Education
	Total	77	2	61	

accompanied by a timetable for gathering assignments. Task assessment is assessed subjectively, while learning outcomes (quiz and formative) are assessed objectively, the overall value is converted to a 0-100 scale.

3. RESULT AND DISCUSSION

3.1. Learning Resources for Automotive Industrial Management

Teaching material for Automotive Industrial Management courses has been developed to meet a standard and innovative learning resource. The development of teaching materials is carried out by compiling teaching materials in accordance with the syllabus that has been determined by the Lecturer Field Study Group (*Kelompok Dosen Bidang Kajian*, KDBK) in the Automotive Engineering Education Study Program. Furthermore, the content of teaching materials is enriched by providing and comparing the learning contents of several standard learning sources (Industrial Management textbooks), until a complete teaching material is obtained for the Automotive Industrial Management course [23,24]. The composition of the Sub-topics, a brief description of the teaching material, and the competency targets to be achieved in lectures on each material are summarized in Table 2. Learning resources for Automotive Industrial Management courses consisted of eight sub-subjects. All sub-subjects are taught to students for one semester. The sub-topics

of Automotive Industrial Management compiled in the learning resource package are consisted of: (1) Management Concepts, (2) Organizational Basics, (3) Introduction to Industrial Management, (4) Production Planning and Supervision, (5) Location and Layout Strategy, (6) Product and Service Design, (7) Maintenance Management, and (8) Human Resources and Work Design. Each of the sub-subject is structured systematically, supplemented by enrichment of material, examples of questions and cases of relevant Industrial Management, hyperlinks to online learning resources, and ends with questions. Learning resource packages are packaged in softcopy format, each sub-subject is compiled separately, and integrated on the website at Universitas Negeri Medan.

3.2. Standardization of Learning Resources for Automotive Industrial Management

Innovative learning resources developed for Automotive Industrial Management have been standardized using expert lecturers. Respondents' opinions on the quality of teaching materials are summarized in Table 3. Lecturers' assessments of learning resources resulting from innovations are classified as very good ($M = 3,75 \pm 0,44$). All components raised in the question about the quality of learning resources are in the very good category, namely on a scale of 3.63 - 3.88 (very good category). These results confirm that the learning resources developed in

Table 2. Description of teaching materials in the Automotive Industrial Management course, and the target competencies to be achieved by students

No	Sub-subject	Description of teaching materials	Target Competencies/ Learning objectives
1	Management Concepts	The contents of the material in this sub-topic are (1) Definition, function, scope of management, (2) Management theories	Students are able to explain and apply management concepts
2	Organizational Basics	The contents of the material in this sub-topic are (1) Organizational concepts and principles, (2) Organizational structure	Students are able to explain the basics of organization
3	Introduction to Industrial Management	The contents of the material in this sub subject are (1) Production function, (2) Production system, (3) Production process	Students are able to explain the introduction to industrial management
4	Production Planning and Supervision	The contents of the material in this sub-topic are (1) The function and purpose of production planning, (2) The function and purpose of production supervision	Students are able to analyze and apply production planning and supervision
5	Location and Layout Strategy	The contents of the material in this sub-topic are (1) Strategies for manufacturing and service industry locations, (2) Strategies for office layout, storage warehouses and work cells, (3) Material handling equipment	Students are able to analyze and determine location and layout strategies
6	Product and Service Design	The contents of the material in this sub-topic are (1) Selection of products and services, (2) Development of products and services	Students are able to analyze and design product and service designs
7	Maintenance Management	The contents of the material in this sub-topic are (1) Reliability, (2) Maintenance policy, (3) Maintenance system	Students are able to apply maintenance management
8	Human Resources and Work Design	The contents of the material in this sub-topic are (1) Work planning, (2) Work measurement, (3) Ergonomics	Students are able to know, analyze and measure HR and work design

this study are appropriate to be used as teaching material used by undergraduate program students in the study program of Automotive Engineering Education. This learning resource has been packaged attractively and meets the criteria set by BSNP. Thus this learning

Table 3. The opinions of lecturers to the components of learning resources of Automotive Industrial Management

No	Standard criteria and short description of the components of the questions	Respondents' opinion* (M±Sdv), L (n=4)
1	The Content: the depth, accuracy and appropriateness of the contents of learning materials of Automotive Industrial Management	3.88±0.35
2	The Extension: the availability of illustrations, case examples, contextual examples in teaching materials	3.75±0.46
3	The Depth: The contents of learning material is presented systematically, (introduction, main contents, contextual examples, cases and drills), and the hyperlinks to trustworthy web sites	3.63±0.52
4	The Design: The layout, illustrations, pictures, tables and figure are presented interestingly to motivate the students for independent learning.	3.67±0.52
5	The Language: The text is arranged simple with scientific messages, easy to learn, easy to understand, the symbol and formulas are presented correctly	3.83±0.35
Average		3.75±0.44

*Assessment criteria: (4) is very good, (3) is good, (2) is poor, and (1) is very poor

resource can be implemented in online learning from home during the COVID-19 pandemic for Automotive Industrial Management teaching.

3.3. Implementation of learning resource for teaching of Automotive Industrial Management

The Automotive Industrial Management lectures are conducted online in accordance with government recommendations to learn from their respective homes, with the aim to break the chain of transmission of the corona virus that is endemic in Indonesia and around the world. Innovative learning resources are provided to students to support the online learning when the lectures are carried out online. Assignments are given to students after the online lecture is complete. This assignment must be done by students independently and collected online as well. The types of independent assignments undertaken and collected by students have been assessed, and the average scores obtained by students in each class are summarized in Table 4. These results indicate that students can do their assignments very well. Most of students submit assignments on time. The average score value of the task portfolio is $M = 84.94 \pm 11.02$, which is classified as very good. Consecutively the average value of student assignments for Class A ($M = 75.97 \pm 18.18$) and Class B ($M = 93.90 \pm 3.86$), were all classified as very good. These results are very encouraging because all assignments (total of 5 assignments) reported by students have fulfilled the requirements in the assessment of the format, content and the skills achieved by students.

Assessment of learning outcomes is the main target of the implementation of innovative learning resources in online learning. The results are summarized in Table 5. The results showed that the average final learning outcomes ($M = 87.12 \pm 6.44$) were classified as very good. The final scores of these learning outcomes,

Table 4. Students learning outcomes for the task (assignment) on the teaching of Automotive Industrial Management

No	Type of assignment	Achievement score (M±Sdv)		
		Class (A)	Class (B)	Average
1	Task 1: Write a short article about the introduction to the production function, the production process, and the production system as a preliminary learning material that will be discussed at the next meeting	75.16±15.83	94.31±2.67	84.74±9.25
2	Task 2: Make a brief article about forecasting in production planning	61.41±27.19	93.72±4.28	77.57±15.74
3	Task 3: Submit answers to questions related to location and layout strategies	80.91±17.71	93.62±5.70	87.27±11.71
4	Task 4: Students are assigned to look for examples of each type of machine maintenance	79.44±19.70	93.69±5.66	86.57±12.68
5	Task 5: Students are assigned to make a critical analysis of topics related to Automotive Industrial Management	82.94±10.48	94.17±0.97	88.56±5.73
Average		75.97±18.18	93.90±3.86	84.94±11.02

respectively, are the average scores obtained by students from Quiz ($M = 78.46 \pm 5.07$), midterm scores ($M = 89.90 \pm 7.29$), and final semester exam scores ($M = 84.56 \pm 13.76$). It can be stated that almost all students get good learning outcomes and have achieved the competencies required for the Automotive Industrial Management course.

Table 5. The summary of student learning outcomes in the teaching of Automotive Industrial Management

No	Type of assessment (formative test)	Achievement score (M±Sdv)		
		Class (A)	Class (B)	Average
1	Quiz score	70.47±2.65	86.45±7.48	78.46±5.07
2	Midterm exam	89.85±6.63	90.45±7.94	89.90±7.29
3	Final exam	82.03±18.93	87.08±8.59	84.56±13.76
4	Total score	83.28±9.74	90.96±3.14	87.12±6.44

4. DISCUSSION

Innovative learning resources for Automotive Industrial Management courses have successfully been developed in accordance with the needs of engineering students, to be used as a support material for blended learning, namely face-to-face lectures and online learning [25-27]. Some teaching materials were still delivered face-to-face in February (before COVID-19 Pandemic period), while most of the teaching material was delivered online due to the spread of the corona virus outbreak which required learning to be done at home during the pandemic COVID-19. Students and lecturers are required to conduct online learning activities from home. These results illustrate that the innovative learning resources developed have been assessed by expert lecturers, and the quality of learning resources is classified as very good [28].

The implementation of these learning resources in online learning is very effective in guiding students to learn on their own from home during the COVID-19 pandemic period. Although students learn from home, it turns out they can still achieve the competencies required by the KKNI-based curriculum that has been implemented at Universitas Negeri Medan. All students can complete their assignments on time. When learning is done online, no complaints have been received from students. Students have no difficulty in completing assignments given in Automotive Industrial Management lectures. The average subjective value of the assignments obtained by students is relatively high. However, there is a slight difference in the average

value of assignments obtained in different classes, namely the value of assignments obtained by class A ($M = 75.97 \pm 18.18$) lower than the value of assignments obtained by class B ($M = 93.90 \pm 3.86$). The same pattern was also found for student achievement on average learning outcomes obtained on quiz and formative examinations. The learning outcomes obtained by students in class A ($M = 83.28 \pm 9.74$) lower than the value of learning outcomes obtained by class B ($M = 90.96 \pm 3.14$). However, both of these classes have achieved relatively good learning outcomes. The learning outcomes obtained by students are derived from the contribution of implementation of an innovative learning resource that is applied when learning from home. These results are almost the same as those obtained by other researchers who use innovative learning that can improve student learning outcomes and competence [29-30].

5. CONCLUSION

Learning innovations for providing innovative learning resources have been done well to obtain standard learning resources which are used to help students learn from home during the COVID-19 pandemic. Learning resources for Automotive Industrial Management courses consist of 8 sub-subjects. The teaching materials are arranged in a systematic manner, complete, and integrated with media and multimedia, available in soft copy to support blended learning, especially for the online learning during the COVID-19 pandemic. Teaching material has been standardized by experts, and declared to be suitable for undergraduate engineering students. The results showed that innovative learning resources were very effective in helping students learn from home, as well as helping lecturers in implementing online learning during the COVID-19 pandemic. Students' knowledge and skills are well developed through online assignments and learning, which are supported by the availability of innovative learning resources. Students succeed in achieving their competence in the field of Industrial Management, which is indicated by the achievement of student grades on assignments and formative examinations. Student learning outcomes based on the subjective value of the task portfolio ($M = 84.94 \pm 11.02$), and the objective value of the formative exam ($M = 87.12 \pm 6.44$) are both classified as very good. Innovative learning resources have proven to be very effective in helping students to complete their given tasks and the assignments can be reported on time, and at the same time improving their learning outcomes. It is recommended that other courses can implement innovative learning to support the implementation of blended learning, because it has been proven to be able to improve the knowledge and skills, and at the same time meet the achievement of competencies.

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