

The Development Of Learning Media Based On Collaborative Discovery Learning And Problem Based Learning In Instructional Design

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Abstract. The aim of this study is to develop learning media based on discovery learning and problem based learning to improve learning outcomes of instructional design, to find out the feasibility of collaborative discovery learning and problem based learning media on learning outcomes of instructional design, and to find out the effectiveness of learning media based on discovery learning collaboration and problem based learning on student learning outcomes of instructional design. The methods of this research is Research and development methods using R & D Borg and Gall, with odd semester 2019/2020 students who take instructional design courses in mechanical engineering education and automotive engineering education courses. The results of the study show that: the learning media developed are appropriate to be used in learning design learning, effective learning media can improve learning outcomes of instructional designs, and there are differences in learning outcomes of student instructional designs, and superior learning outcomes of student instructional designs using developed learning media.

Keywords : learning media, collaboration, discovery learning, problem based learning, instructional design

1. Introduction

The instructional system design as known as an organized procedure that includes the steps of analyzing, designing, developing, implementing and evaluating instruction. It refers to the notion of being micro and macro because it has implications for the system approach and the steps that must be followed in the system approach. In that definition also explained about the analysis step which includes the formulation process of what will be learned; the development step has implications for the writing and compilation process, or the production of learning materials; while the implementation step refers to the use of materials and strategies according to the context; and the last step is the assessment process is the process of determining the accuracy of learning.

The Various problems in the learning process of learning design courses in mechanical engineering and automotive engineering education are students didn't understand and plan well the function and role of learning design as an important part of the learning process to be carried out. Student preparation is required to be able to understand the learning design well. This concern is compounded by the theory learning patterns which are generally dominated by

lectures and do not empower students. The lack of media used makes it difficult for students to digest abstract concepts to be translated into abilities in Measuring.

Through this learning design course, learning media is developed based on discovery learning and problem-based learning. Dahar and Siregar [1] state that Content Knowledge is scientific knowledge that should be mastered by instructors include facts, concepts, principles, laws, and theories. The development of science and information technology or science and technology becomes a challenge that must be faced by prospective teachers by prioritizing their abilities. This is certainly a challenge for graduates of their primary education in the Faculty of Engineering to improve the quality and ability to compete with others in the current MEA Era. The various problems above require immediate resolution so that the quality of graduates produced can be maintained. Problem-based learning and discovery learning that are collaborated in the development of instructional media is one of the most suitable learning alternatives applied in accordance with the characteristics of the problems that occur. Judging from the limitations of the facility and considering the characteristics of the students concerned, print and non-print learning media are the most effective media. This is based on the condition that the majority of mechanical engineering education has computer facilities and the means of presentation. Thus, the development of learning media based on discovery learning collaboration and problem based learning to improve learning outcomes of learning design courses is very important.

1.1 Instructional Design

Instructional design is a procedure that consists of analyzing, designing, developing, implementing and assessing learning outcomes [2]. Stated by Morisson, Ross & Kemp [3] who defines learning design as a systematic design process to create more effective and efficient learning and make learning activities easier, based on what we know about theories learning, information technology, systematic analysis, research in education, and management methods.

Gagne [4] said that Instructional Systems Design (ISD) is a process of creating learning systems. The ISD contains a systematic and systemic process, which includes everything that can be documented, the application can be imitated, and the results can be predicted. Reiser and Dempsey [5] define instructional design as "a systematic process used to develop education and training programs consistently and reliably". It was further stated that learning technology was creative and active; is a system whose elements are interrelated and synergy to be effective.

Rothwell [6] explains the new things about learning design. He said that the design of learning is not just about creating learning, such as formulating goals, determining topics, determining learning strategies, evaluating learning outcomes and others. More broadly, the main purpose of learning design is to solve human performance problems.

Reiser & Dempsey [7] defines instructional design as "a systematic process used to develop education and training programs consistently and reliably". It was further stated that learning technology was creative and active; is a system whose elements are interrelated and synergy to be effective.

1.2 Instructional Systems Design

We understand that a system consists of several interrelated components or elements and each has the function of achieving the goals of the system. In the context of learning, Gagne in Suparman [8] said that the learning system is a set of events that affect students so that the learning process occurs. Based on this view the purpose of the learning system is the occurrence of learning processes in students so that the main concern of the learning designer is how to strive for learning activities to be effective and efficient? To realize this expectation, the search

related to learning system components becomes extremely important.

Reiser & Dempsey [9] suggested that instructional design is dynamic, and cybernetic meaning that the elements can be changed and communicate or work together easily. The characteristics of interdependence, synergy, dynamics, and cybernetics are needed in order to have an effective instructional design process. In addition, instructional design is centered on learning, oriented towards main objectives, including meaningful performance, including measurable results that are self-correcting and empirical as well as collaborative efforts.

1.3 Instructional Design Models

Instructional Design Models are known to use certain approaches. Namely: ADDIE Model, ASSURE Model, Dick and Carey Model, PPSI Model, AT and T Model, Degeng Model, Instructional Development Model (MPI), Gerlach and Ely Model, Kemp Model, ISD Model, and others.

Learning planning in terminology is planning and learning. Planning from the word plan, namely making decisions about what must be done to achieve goals. Planning is a process and way of thinking that can help create the expected results [10]. Planning as a process to determine where to go, and how to get to that place most effectively and efficiently [11]. Meanwhile, according to Terry [12] that planning is determining the work that must be carried out by the group to achieve the goals that have been determined.

Learning planning there are four main elements that must be possessed in every learning plan, namely; (1) there are objectives to be achieved; (2) the existence of strategies to achieve goals; (3) resources that can support; (4) implementation of each decision. The basis for learning planning is to improve learning. This effort is carried out with the following assumptions: Improving the quality of learning, learning is designed with a systems approach, learning design refers to how a person learns, learning designs are referred to individual students, learning designs must be referenced to goals, and learning designs are directed at ease of learning.

The Importance of Learning Planning, Deshimer [13] states that human nature has the ability and choice to create according to his views. Every human being lives in groups that are interconnected with one another so that forever requires coordination in carrying out various activities. Learning is a purposeful process. Learning is the process of working together. Learning is a complex process. The learning process will be effective when utilizing the various facilities and infrastructure available including utilizing various learning resources.

Learning planning in lectures makes it a task for students to carry out activities, including: Preparation of lesson plans is the initial activity of the entire learning process. The lesson's plan is done by teacher, long before the implementation of learning by referring to the syllabus that is prepared based on core competencies and basic competencies. In this context, the teacher is no longer required to compile the syllabus. The teacher is obliged to only prepare lesson plans that will be implemented in the learning process. The lesson plans need to be prepared in a comprehensive and systematic manner that leads to interactive learning, inspiring, fun, challenging, motivating students to actively participate, and providing sufficient space for the growth of initiatives, creativity, and independence in accordance with the talents, interests, and development of good students physical or psychological.

1.4 Learning Media

The concept of media is developed, and the design of the media in this study. According to Richey, media research should place more emphasis on the design and development of research itself [14]. This definition emphasizes that research related to the media should be more focused on comparisons with existing media. In the design of learning systems, the media

usually describes the steps or procedures that need to be taken to create effective, efficient, and interesting learning activities [15]. So a media in the development of learning is a systematic process in the design, construction, utilization, management, and evaluation of learning systems. There are three components in the development of instructional media, namely: (1) learning conditions; (2) learning methods; and (3) learning outcomes. Learning conditions include learning characteristics in the form of objectives and learning barriers and student characteristics. Learning methods include how to organize learning materials, delivery strategies and management of activities. While learning outcomes include the effectiveness, efficiency, and attractiveness of learning for students [16].

Based on the constructivism paradigm about learning, the principle of media mediated instruction occupies a strategic position to realize optimal learning. The optimal learning inventory is one indicator to realize optimal student learning outcomes. Optimal learning outcomes are also a reflection of quality educational outcomes. Quality education requires the resources of teachers who are able and ready to play professionally in the school and community environment [17] [18] [19]. In the era of rapid development of science and technology today, teacher professionalism is not enough just to be able to teach students, but also must be able to manage information and the environment to facilitate students' learning activities [20]. The concept of the environment includes a place of learning, methods, media, assessment systems, and facilities and infrastructure needed to package learning and arrange tutoring to facilitate student learning.

In general, the media is a tool to convey information or messages from one place to another. The media is used in the communication process, including teaching and learning activities. According to Santyasa [21], the learning process contains five components of communication, namely the teacher (communicator), learning material, learning media, students (communicant), and learning objectives. So, learning media are all things that can be used to channel messages (learning materials), so that it can stimulate students' attention, interests, thoughts, and feelings in learning activities to achieve learning goals. Learning media is an integral component of the learning system. That is, learning media cannot be separated from the learning process. Without learning media, the learning process cannot occur. Every teaching and learning process requires the selection and use of at least one medium to convey learning.

1.5 The Development of Media Learning Based on the collaboration of Discovery Learning and Problem Based Learning (DL-PBL)

According to Chaeruddin [22], there are several reasons why the media can enhance the quality of the learning process, namely: (1) clarifying the teaching material delivered by teachers (2) providing real experiences to students; (3) stimulating participants, students have a dialogue with themselves. In achieving learning objectives, the role of assistive devices or teaching aids plays an important role because the teaching aids material are easily understood by students [23]. Based on some of the opinions above, the understanding of learning media is a tool used to channel messages in the learning process so that it can stimulate students' thoughts, feelings, and interests to achieve the expected goals.

The Research conducted by Sugianto [24], the application of ICT-based learning media through the joyful learning model is needed to channel messages so that they can help overcome these problems. This study aims to identify the media, produce media, evaluate the validity, effectiveness, and practicality of ICT-based biology learning media through a joyful learning model.

Problem Based Learning is an effective approach to teaching high-level thinking processes with problem-oriented situations, including learning how to learn. According to Santyasa in

Ghofur [25], PBL is a strategy or approach that is designed to help the learning process by the steps contained in the problem-solving pattern that starts from the analysis, plans, solutions, and assessments inherent in each stage. PBL is not structured to assist teachers in conveying a lot of information but the teacher as a problem presenter, questioner, and facilitator.

According to Dasna [26], PBL should be used in learning because: (1) with PBL meaningful learning will occur. Students who learn to solve a problem then they will apply the knowledge they have or try to find out the knowledge needed. This means that learning is in the context of application concepts. Learning can be more meaningful and can be expanded when students are faced with situations where the concept is applied; (2) in PBL situations, students integrate knowledge and skills simultaneously and apply them in relevant contexts. That is, what they do in accordance with the real situation is no longer theoretical so that problems in the application of a concept or theory they will find at once during learning takes place; and (3) PBL can improve critical thinking skills, foster student initiative in work, internal motivation to learn, and can develop interpersonal relationships in group work.

DL-PBL learning model collaboration in the development of print and non-print learning media to provide convenience in the learning process of learning design courses greatly determines the quality of student learning outcomes. DL-PBL Collaboration in Learning Design (S1) Courses in Mechanical Engineering Education consists of 6 (six) stages of learning including (1) stimulation (stimulation/stimulation) by Orientating students to the problem; (2) problem statement (statement/problem identification) by Organizing students to study; (3) data collection followed by assisting independent and group investigations; (4) Data processing by verifying; (5) develops and presents the work; and (6) generalization (draw conclusions / generalizations) and Analyze and evaluate the process of overcoming the problem.

2. Method

This research is research and development consists of three stages, namely pre-media development, media development and media application where the research refers to the Borg & Gall R&D cycle [27], with a modified description and aligned with the actual research goals and conditions.

The research was conducted at the Mechanical Engineering Education Study Program and Automotive Engineering Education at UNIMED in Odd Semester 2019/2020. Both individual trials, small group trials, and main trials are conducted at Unimed. At the development stage of instructional media, targeting in this case are lecturers, learning experts, experts in study fields, and students who assess learning media that have been developed based on criteria, as follows: (1) Evaluation of learning experts (expert judgment) is determined based on expertise it has, (2) evaluators who carry out evaluations are determined based on the ability of lecturers with the classification of experts in the field of study.

This research uses research and development methods, carried out directly by collecting descriptive data that is processed and the analysis of inductive data. The implementation of this research follows the steps: (1) preliminary survey, (2) planning; learning media, learning strategies, learning methods, learning media, (3) media validation, (4) media trials and (5) media revisions.

The Data collection in research and development is grouped into three, namely preliminary studies, development, and validation tests. In each stage of the study selected specific data collection techniques by their respective goals. In the preliminary study, questionnaire /

questionnaire, observation, and documentation techniques were chosen, in addition to a literature review. In general, thirdly, these techniques are used together and complement each other.

The data analysis technique in this research and development uses qualitative and quantitative descriptive analysis. All data collected was analyzed using descriptive statistical techniques that were quantitatively separated by categories to sharpen the judgment in concluding, reducing data, displaying decision making data and verifying. Analysis of the data in this research and development is explained in three, namely the preliminary study, development and validation stages. In the validation stage, the significance and effectiveness of the results of the application of the media were analyzed using a quantitative (quasi-experimental) approach, by comparing the results in the experimental (control) group and the control group, under conditions before and after application. Quantitative analysis through trials conducted with the pretest-posttest and t-test analysis.

Statistic Hypothesis:

Ho: $\mu_1 = \mu_2$ and Ha: $\mu_1 > \mu_2$ Where:

μ_1 = the average of student learning outcomes taught using learning media based on DL-PBL collaboration.

μ_2 = the average of student learning outcomes by drawing technique and AutoCAD taught based on PBL

Ho = There is no differences in students learning outcomes that is taught by using DL-PBL collaboration based learning media and students who are taught with PBL.

Ha = There is differences in students learning outcomes that is taught by using DL-PBL collaboration based learning media and students who are taught with PBL.

3. Results and Discussion

3.1. Results

Based on product evaluation through a series of trials and revisions that have been made, the learning media based on DL-PBL collaboration in the subject of this learning design is valid. The trial was carried out with six stages, namely: (1) validation of material experts, (2) validation of learning designs, (3) validation of instructional media experts, (4) individual trials, (5) small group trials, and (6) tests try limited field.

Table 1. Learning Media Assessment Learning Design in Small Group Trials Regarding Quality of Learning Material Learning planning

No.	Indicators	M 1	M 2	M 3	M 4	M 5	Total	%	Criteria
Material Presentation									
1.	Clarity of material	5	5	5	5	4	24	96	Very Good
2.	Clarity of instructions learning	4	4	5	5	4	22	88	Very Good
3.	Ease of understanding learning	5	5	5	4	4	23	92	Very Good
4.	Speed of order of presentation	4	5	5	4	5	23	92	Very Good
5.	Adequacy of exercise	5	5	5	5	5	25	100	Very Good
6.	Clarity of feedback	4	5	4	5	5	23	92	Very Good
7.	Help students learning with programs	5	5	4	5	5	24	96	Very Good

No.	Indicators	M 1	M 2	M 3	M 4	M 5	Total	%	Criteria
Aspects									
1.	The interest of the screen display	5	5	4	5	5	24	96	Very Good
2.	Text Readability	5	5	4	5	4	23	92	Very Good
3.	Image quality and animation	5	5	4	5	4	23	92	Very Good
4.	Color composition	5	5	4	5	4	23	92	Very Good
5.	Navigation	4	5	5	5	5	24	96	Very Good
6.	Carrying capacity of music	4	5	5	4	5	23	92	Very Good
7.	Interaction	4	4	5	5	5	23	92	Very Good

The Results of Data Analysis of Individual Trial, Small Group and Field Trial

Table 2. The Individual Trial Against Collaboration-based learning media DL-PBL Learning Design

No	Category	% Average	Criteria
1	Aspects of learning materials Quality	82	Very Good
2	Aspects of technical/display Quality	85,7	Very Good
Average		82,85	Very Good

Table 3. The Individual Trial Against Collaboration-based learning media DL-PBL Learning Design

No	Category	% Average	Criteria
1	Aspects of learning materials Quality	82	Very Good
2	Aspects of technical/display Quality	85,7	Very Good
Average		82,85	Very Good

Table 4. Small Group Trial Against Collaboration-based learning media DL-PBL Learning Design

No	Category	% Average	Criteria
1	Aspects of learning materials Quality	92,57	Very Good
2	Aspects of technical/display Quality	89,71	Very Good
Average		91,14	Very Good

Table 5. Field Trials Are Limited To Collaboration-Based Learning Media DL-PBL Learning Design

No	Category	% Average	Criteria
1	Aspects of learning materials Quality	90	Very Good
2	Aspects of technical/display Quality	95,70	Very Good
Rata-rata		92,85	Very Good

The Data of Student Learning Outcomes Without Using Interactive Problem-Based Learning Media

Table 6. Frequency Distribution of Student Pretest Values Learned Without learning media based on DL-PBL collaboration

No	Score	Fi	Xi	Fi.Xi	Xi ²	Fi.Xi ²
1	23,00-35,00	1	35	35	1225	1225
2	36,00-47,00	6	43	258	1849	11094
3	48,00-72,00	14	60,37	845,18	3644,54	51023,51
4	73,00-85,00	6	72,25	433,5	5220,06	31320,37
5	86,00-97,00	3	90,66	271,98	8219,24	24657,71
Total		30		1843,7		119320,6

The Data of Student Learning Outcomes using learning media based on DL-PBL collaboration

Table 7. Frequency Distribution of Student Pretest Values Learned by Using Collaboration-based learning media DL-PBL

No	Score	Fi	Xi	Fi.Xi	Xi ²	Fi.Xi ²
1	68,12-70,10	2	65	130	4225	260
2	70,10- 76,40	1	70	70	4900	70
3	76,40-83,96	2	80	160	6400	320
4	83,96-91,88	12	87,5	1050	7656,25	12600
5	91,88-100	13	95,1	1236,3	9044,01	16071,9
Total		30		2646,3		29321,9

The Difference of Average Student Learning Outcomes

Table 8. The Average Difference Test Results of Two Parties

Class	N	Average value	DK	t _{count}	t _{table}
Pretes	30	62,4			
			58	41,6	2,04
Postes	30	90			

In the calculation of the average difference test of two parties obtained t_{count} is greater than t_{table} , it can be concluded that there are differences in average student learning outcomes using learning media based on DL-PBL collaboration. The average value of student learning outcomes using DL-PBL collaboration-based learning media is better than student learning outcomes without using DL-PBL collaboration-based learning media.

3.2. Discussion

DL-PBL collaboration-based learning media on the development of DL-PBL collaboration-based learning media on learning design courses that have been developed by taking into account aspects of learning and the media as the principles of learning message design. The research development of DL-PBL collaboration-based learning media conducted is directed to produce a DL-PBL collaboration-based learning media for students in mechanical engineering and automotive engineering education programs that are used to improve the learning process and student competencies. Therefore, in the process this research is carried out by beginning a preliminary study, then designing learning media, validating products and conducting products and making revisions and improvements based on validation data analysis

from material experts, learning design experts and learning media experts, followed by individual trials, trials try small groups and field trials so that learning media are produced that are suitable for use in accordance with the characteristics of the field of study and students as users.

The benefits obtained from the use of instructional media are concepts that are presented easily learned, understood, and systematically. DL-PBL-based collaborative learning media provide opportunities for students to learn according to their respective speeds, learn faster and not cause boredom respectively, faster and not cause boredom because it is equipped with pictures and animations and varied practice questions. This collaborative learning media based on DL-PBL can also be used as an alternative learning media both classically and individually. Furthermore, Krisnawati's research [28] showed a percentage increase in student learning outcomes from pre-test to post-test by 40.27%. Multimedia learning products developed are effective for learning based on an increase in the percentage of pre-test to post-test. The research proves that the application of interactive learning media can improve student learning outcomes and according to indicators of success. The difference is that the results of other studies conducted by Proyambodo, Antuni, and Sari [29] show that multimedia learning has also proven to be effectively used as a source of independent learning by students and has better performance compared to classes without treatment. data from the trial results can be seen that the average value of student learning outcomes in the treatment class is 78.29 greater than the control class that is 73.92. Besides that in the control class as many as 18 students (48.65%), fewer than the treatment class as many as 27 students (77.14%). Students produce an average value of 75.57 greater than the control class that is 49.49 and as many as 20 students can achieve the above learning outcomes of 72, while in the control class only 1 student.

The results obtained are by the theory of discovery learning model learning. Discovery learning according to Rohani [30] is "a learning model that requires students to discover principles or relationships that were previously unknown to them which are the result of their learning experiences that have been carefully and carefully arranged by the teacher". Discovery learning has the meaning that students as subjects in the learning process. Students have the basic ability to develop optimally according to their abilities. The lecturer is only as a facilitator and guide students to provide stimuli that can challenge students to feel involved in the learning process. Lecturers provide opportunities for students to find their information and knowledge based on the results obtained through their observations. So students can find principles or relationships that were previously unknown to them through their learning experiences that have been carefully and carefully arranged by the teacher. In addition to these theories, the results obtained in this study are also in line with the results of research relating to the discovery learning model of learning that has been done previously.

Research on the development of collaborative learning media based on DL-PBL, after testing a problem-based interactive learning media, was only conducted in a limited trial with a sample of 30 students. Extensive trials were not conducted so that the possibility of extraordinary factors still influenced the results of the study. Therefore the sample in the study must be large in number so that the research results can be realized. Besides that, students and lecturers' readiness to use learning media based on DL-PBL collaboration is different from the previous learning media. Unpreparedness of lecturers in using learning media can be overcome by explaining about learning media and its use. Whereas students' unpreparedness can be overcome by giving learning media interactive problem-based learning media so that it can be used as an independent learning tool to improve student competency and student learning outcomes.

Students who become research subjects cannot be tightly controlled, so the possibility of

different study time and learning experiences in each subject beyond the treatment given during the learning process can affect student abilities. To overcome this limitation, it is necessary to pay attention to the use of more samples, further tight control is needed on the sample so that there is no bias when the sample is out of treatment.

4. Conclusion

The conclusions of the results and discussion above of this study as follows:

- a. The results of the assessment by material experts, media experts and learning design experts in each aspect of the overall assessment are determined by the average score in their respective categories. The results of the development of learning media based on DL-PBL collaboration can improve students' learning outcomes, so it is worth developing.
- b. The results of the material expert validation on the aspect of content/material feasibility, learning media based on DL-PBL collaboration that have been made are included in the very feasible criteria. The results of the validation of media experts on the feasibility of media aspects, learning media based on DL-PBL collaboration that have been made are included as feasible. The results of the design expert validation on the aspect of media feasibility, the design of problem-based interactive learning media, including the criteria, are very feasible. At the individual trial stage the DL-PBL-based collaborative learning media showed very good. Furthermore, in the small group trial stage, the DL-PBL-based collaborative learning media shows very good categories. The results of field testing give the result that learning media based on DL-PBL collaboration is included in very good criteria. This media is appropriate to be used as a learning medium. Furthermore it can be concluded that the learning media based on DL-PBL collaboration on the learning planning material that has been developed, is included in the very well to be used as a learning media based on DL-PBL collaboration
- c. The results of calculations using the t test on differences in student learning outcomes using collaborative learning media based on DL-PBL show that the average value of students before using learning media was 62.4 and after using collaborative learning media based on DL-PBL increased by 90.5. Furthermore, based on the results of the analysis using the test formula $t_{count} > t_{table}$ ($41.6 > 2.045$) so that it can be concluded that there are differences in average student learning outcomes using problem-based learning media

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