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DEVELOPMENT OF DIGITAL LEARNING MEDIA COURSES OF ENGINEERING MATHEMATICS USING CREATIVE-PRODUCTIVE LEARNING STRATEGIES

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ABSTRACT

The development of learning strategies is needed as part of improving the quality of education. In this study, the development of Creative-Productive (CP) learning strategies in Engineering Mathematics courses was used as an effort to understand the field of mechanical engineering. The approach applied uses research & development (R&D) methods to develop and validate products. Data collection techniques used by distributing questionnaires. The stages in this research, namely: planning and formulation of learning objectives; creation and development of Engineering Mathematics learning materials with CP learning strategies; and formative evaluation by material, media, and instructional design experts as well as one-to-one evaluation of students, small groups, and field trials. In this R&D, digital teaching materials are feasible and effective in learning engineering mathematics by using PC learning strategies. Where 84.43% was declared eligible by the validator and 90.08% was declared eligible in the field test assessment with the "strongly agree" category. The average value of student learning outcomes, which is 75.35%, is able to exceed the Minimum Completeness Criteria value on the effectiveness of digital learning media. 90% were declared eligible in the field test assessment with the "strongly agree" category that the media could be applied in engineering mathematics learning.

Keywords
Digital learning media, Engineering Mathematics, creative-productive learning strategies

INTRODUCTION

Digital learning media can make learning activities more effective, efficient, and interesting which aims to make it easier for students to achieve optimal learning goals. Well-designed learning by taking into account the conditions and choosing the right learning strategies will improve the quality of learning and by itself will improve student learning outcomes. The development of digital learning media in this study was carried out systematically starting from identifying, developing, and evaluating materials and strategies to achieve learning objectives. Joyce and Weil (2016) reveal that learning development is a plan or pattern that can be used for the curriculum (long learning material), designing learning materials, and delivering learning inside and outside the classroom. Then Miarso (2011) stated that the development of learning materials in the area of educational technology requires a systematic and systemic approach, which is carried out in a coherent and comprehensive or comprehensive manner.

Currently, technological devices have spread widely regardless of their economic, social, educational, and so on. In line with the study of learning technology, the penetration of the use of technology media as a support for learning activities is increasingly open. Good learning can be supported by a conducive learning atmosphere and good communication between lecturers and students. This needs to be supported by the use of the facilities and infrastructure that have been provided, such as digital learning media.

The development of digital learning media in this study was carried out systematically so that it was linear with learning objectives and according to

MERDEKA BELAJAR learning, where the stages of research carried out were identification, development, and evaluation of materials and strategies. At first, the Creative-Productive learning strategy (CP) was called the strata strategy, then with various modifications and development of this strategy, it was called the CP learning (PKP Dikti Learning Development Team, 2015).

In applied mathematics there are computational, business, engineering, and social. Applied Mathematics is the application of mathematics related to various fields of knowledge to solve concrete problems. Applied mathematics is the science needed to calculate everything that requires a formula. In this discussion, we will discuss engineering mathematics in applied mathematics.

In engineering mathematics uses theory to solve concrete problems in engineering, allowing explanation, analysis, and forecasting of phenomena where experiments, surveys, and observational studies are in the solution of phenomena in engineering. Applied Mathematics in principle contains applied analysis, mostly differential equations, approximation theory, applied probability, etc. Applied Mathematics is also related to the development of Newtonian physics and other fields.

Learning strategies by prioritizing creativity and productivity help improve learning outcomes and skills of students who take the "Engineering Mathematics" course. Creative thinking signifies students to the concepts learned in Applied Mathematics in solving design process problems in engineering, so that students are expected to be able to develop their understanding of the problems they face. The stages for creative learning include orientation, exploration, interpretation, and re-creation.

The general competencies possessed after studying digital learning materials for the Engineering Mathematics course that will be developed are: students are expected to have broad insight, deep appreciation, and skills in analyzing values and processes in developing student characteristics in the field of engineering design and calculation.

Improving the quality of learning is in line with the selection of appropriate learning strategies, so it is necessary to design and adjust it properly by paying attention to learning conditions. That is, efforts to improve the quality of learning design will affect student learning outcomes. Learning strategies by prioritizing creativity and productivity are expected to help improve learning outcomes and learning effectiveness taking the "Engineering Mathematics" course.

Digital learning media can be in the form of a combination of writing, images (static and dynamic), audio, video, animation, and other technological touches with the aim of increasing student understanding of the material provided. The addition of these elements to the media as a visualization of expression and better understanding. The purpose of using digital technology in the learning process is to make communication easier for students in accessing information and ideas contained in the media. So that we get a better way of delivering information and ideas to students in understanding the material and concepts of Engineering Mathematics (Abdulrahaman. 2020).

Regarding the problems that have been described, this study aims to obtain an alternative pattern of developing digital learning media in the "Engineering Mathematics" course using CP learning strategies to increase students' understanding of the field of mechanical engineering.

Methods

This research seeks to develop digital learning media using CP learning strategies. The development of learning media used refers to R & D, namely the adaptation development model of the Borg and Gall development model which aims to develop and validate products with learning planning on Dick & Carey's media development.Regarding the problems that have been described, this study aims to obtain an alternative pattern of developing digital learning media in the "Engineering Mathematics" course using CP learning strategies to increase students' understanding of the field of mechanical engineering.

To assess the products that have been developed, this development uses a data collection instrument, namely a questionnaire sheet. Questionnaire sheets used as instruments in this study were: (1) questionnaire sheets for material experts, (2) questionnaire sheets for media experts, (3) questionnaire sheets for learning design experts, (4) questionnaire sheets for students. At the data analysis stage, quantitative descriptive analysis was used where all the data collected were analyzed by statistical techniques which were separated by quantitative categories. This is done so that it is considered in depth in drawing conclusions. The qualitative data statement used is very poor, less, moderate, and very good then converted into qualitative data with a value scale of 1 - 4. The results are then averaged and then the quality of learning media usage is determined.

To prove the results of the application of the learning system before and before the use of digital learning media with the CP learning strategy, a T-test was carried out.

Results and Discussion

In carrying out the process of developing digital learning media for engineering mathematics courses using CP learning strategies. The initial process of this research and development is the existing potential seen from the existence of facilities and supporting resources that can be developed for digital-based print media with CP learning strategies. Whereby referring to these characteristics, CP learning strategies are assumed to be able to motivate students in carrying out various activities so that they feel challenged to complete their tasks creatively.

Discussion of Product Development Results

The development of digital learning media in engineering mathematics courses using CP learning strategies is carried out based on the stages as contained in the research procedure or has followed the research steps. Collecting data to support the results of the study that will be used in designing products to be developed. The next step is to conduct a feasibility test or validation by a predetermined expert, namely media expert, learning design, and material expert. Then the learning media development products are developed while still paying attention to the principles of design and learning.

Table 1. Average Percentage of Expert Validation Assessment Results on Digital Learning Media.

No.	Aspect	Average Percentage	Category
1.	Material Expert Validation	82.00%	Strongly agree
2.	Learning Design Expert Validation	84.17%	Strongly agree
3.	Media Expert Validation	87.14%	Strongly agree
Average Amount		84.43%	Strongly agree

Table 2. Average Percentage of Trial Assessment Results on Digital Learning Media

No.	Aspect	Average Percentage	Category
1.	Individual Trial	86.41%.	Strongly agree
2.	Small Group Trial	91.08%	Strongly agree
3.	Field Trial	92.75%	Strongly agree
Average Amount		90.08%	Strongly agree

Based on table 1, the results of the validation of digital learning media development products are declared feasible with a percentage of 84.43% and are declared eligible to be continued in field trials. Further to the trial stage, it obtained a percentage of 90.08%, where digital learning media in the Engineering mathematics course was declared feasible to be used for learning using CP learning strategies. Both results can be seen in Table 1 and Table 2.

This research is directed to produce a product, namely digital technology learning media used by students in understanding the material so that changes in results are needed as a sign of an

increase in student competence and an improvement in the learning process. Some of the uses and benefits of using digital learning media that are felt by students in Engineering Mathematics courses using CP learning strategies, namely:

1. Ease of understanding the material because the planning and presentation of concepts is more systematic.
2. Learning media gives students the opportunity to learn according to the speed of each individual, for example, learning ability.
3. Learning is faster and more interesting so that it does not cause boredom because basically in engineering mathematics uses theory to solve concrete problems in engineering, allows explanation, analysis, and forecasting of symptoms were experiments, surveys, and assessments of observations in solving symptoms in engineering. Therefore, the selection of appropriate learning strategies can influence students in learning. By favoring the learning characteristics of the Engineering course, CP learning strategies can invite students to think abstractly into innovative and creative thinking patterns.

Therefore, the role of the media has great potential to stimulate students to respond well to learning. For this reason, learning media provide learning resources that can help the role of lecturers in enriching students' insights. Discussion of Product Effectiveness Test Results

Table 3. Output Normality of Pretest and Posttest with Kolmagorov Smirnov Test

No.			**Pretest**	**Posttest**
1.	N		36	36
2.	Normal Parameters	Mean	53.82	75.35
		St. Deviation	18.376	14.011
3.	Most Extreme Differences	Absolute	.125	.101
		Positive	.114	.093
		Negative	-.125	-.101
4.	Kolmogorov -Smirnov Z		.753	.607
5.	Asymp. Sig. (2-tailed)		.622	.854

Table 4. Paired Samples Statistics

No.			Low	High	Mean	Median	N	Std. Deviation	Std. Error Mean
1.	Pair 1	Pretest	25	87.5	53.82	50	36	18.376	3.063
		Posttest	50	100	75.35	75	36	14.011	2.335

Table 5. Paired Samples Correlations

No.			N	Correlation	Sig.
1.	Pair 1	Pretest & Posttest	36	.961	.000

Table 6. Paired Samples Test

No.			Paired Differences					t	df	Sig. (2-tailed)
			Mean	Std. Deviation	Std. Error Mean	95% Confident Interval of The Difference Lower	Upper			
1.	Pair 1	Pretest & Posttest	-21.528	6.240	1.040	-23.639	-19.416	-20.700	35	.000

The data obtained can be seen that the score of learning outcomes obtained the lowest value of 25 and the highest score of 87.5, the average value of 53.82, mode 50, median 50, and standard deviation 18.38. To see student scores, interval classes are used, namely the value between absolute frequency, namely the number of students who have learning outcomes, and relative frequency, namely the percentage of learning outcomes. Based on the data in Table 4, it is known that the value of the learning outcomes of engineering mathematics using the CP learning strategy obtained the lowest score of 50 and the highest score of 100, the average value of 75.35, mode 75, the median of 75, and standard deviation 14.01. To see student scores, interval classes are used, namely the value between absolute frequencies, namely the number of students who have learning outcomes,

A data analysis requirements test was conducted to determine the parametric statistical test of the research hypothesis. Testing the prerequisites of data analysis was carried out by testing the normality of research data with the Kolmogorov Smirnov test using the SPSS (Statistical Product and Service Solution) application, which is an application program that is useful for analyzing statistical data. The provisions in the Kolmogorov Smirnov test are where the probability or

significant level generated from the data is greater than 0.05 then the data is normally distributed, otherwise if the significant level generated from the data is less than 0.05 then the data is not normally distributed (Santoso, 2014). The results of the normality test of the pretest (before using the media) and posttest (after using the media) data with the Kolmogorov Smirnov test on the SPSS 20 application were n=36.

Hypothesis testing is done by conducting a t-test of research data using the SPSS application called the Paired Sample T-Test. The provisions in the Paired Sample T-Test test using the SPSS application are where the probability or Sig. (2-tailed) generated from the data is less than 0.05 then there is a significant difference between the learning outcomes in the pretest and posttest data, on the contrary, if the probability is resulting from data greater than 0.05 then there is no significant difference between learning outcomes in pretest and posttest data (Santoso, 2014).

The results of learning Mathematics Engineering before using digital learning media using CP learning strategies are smaller, namely, 53.82%. ¬¬The results of learning mathematics Engineering after using digital learning media using CP learning strategies are 75.35%. Based on the results of the Paired Sample test and the value of the product effectiveness calculation, it was found that Ho was rejected and Ha was accepted.

Based on Table 4, after the use of digital learning media with the CP learning strategy was applied, there was an increase in the average learning outcomes of Engineering Mathematics, which reached 75.35. While the results of learning Mathematics Engineering before using digital learning media using CP learning strategies were 53.82. This data proves that digital learning media using CP learning strategies is feasible and effective to use in improving student competency skills.

The use of digital learning media by using CP learning strategies allows students to more easily understand the steps in solving problems in learning. In addition, digital learning media is very practical, easy to carry by students anywhere for independent study because this media has an electronic nature so that it can be opened anywhere and on electronic devices that are now and in the present time being needed by students or all students to support the learning process. online.

Conclusion

The results of expert validation for the feasibility of digital learning media in courses using CP learning strategies that were developed were concluded with an average percentage of 84.43% with the criteria of "strongly agree" that the media developed was feasible to be tested and used. Then at the trial stage for the feasibility of digital learning media for the developed subjects, it was concluded with a percentage of 90.08% with the criteria of "strongly agree" that the developed media was suitable for use in engineering mathematics learning.

The digital learning media developed by the researcher is effectively used as a learning medium for students in engineering mathematics learning with CP learning strategies, because the average value of student learning outcomes, which is 75.35%, is able to exceed the minimum completeness criteria.

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