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Development of Interactive Learning Multimedia Based on Problem-Based Learning to Improve Students' Learning Achievement in The Subject of Lathe Machinery Engineering in Grade XII of National Vocational School Berbah

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ABSTRACT: This research aims to: determine (1) effectiveness, (2) feasibility, (3) produce interactive learning multimedia, (4) determine the application of interactive learning multimedia, and (5) determine the increase in student learning achievement after using interactive learning multimedia based on problem-based learning in lathe machining engineering subjects for class XII students majoring in Machining Engineering at National Vocational School Berbah. This research uses research and development. The development model that will be used in this research is ADDIE, which consists of the Analysis, Design, Development, Implementation, and Evaluation. The experimental design used was a pretest-posttest control group design. Based on the research results, it was concluded that: (1) The product was developed using articulate storyline 3 and contained the syntax of the problembased learning model and indicators of achievement of competency in learning lathe machining techniques, (2) The results of material expert validation were in the Good category (64), results media expert validation is in the Very Good category (86), it can be concluded that the product in this study is said to be suitable for use in terms of material and media, (3) Based on the results of individual trials, Good results were obtained (64.67), group trials Small results obtained Good (63.9), and field trials obtained Good results (62.53), it can be concluded that the product in this research is said to be practical, (4) Based on the evaluation results in class XII lathe machining engineering subjects for the experimental class there was a percentage increase of 53% (60.24 - 81.12), while in the control class there was a percentage increase of 20% (40.60 - 52.70), so it can be concluded that the percentage increase in learning achievement for the experimental class was greater than that of the experimental class. control. Based on the results of the development, it is recommended that productive machining teachers can use this learning media for learning activities and during the learning process teachers continue to accompany their students in learning.

KEYWORDS: Multimedia interactive learning, Problem-based learning, Achievement in lathe machining engineering subjects.

I. INTRODUCTION

The demands of 21st-century education require the development of both hard and soft skills to enable students to enter the workforce and compete with other countries (Martini, 2018). The Assessment and Teaching for 21st-Century Skills (ATCS) and Partnership for 21st-Century Skills outline four key elements within the 21st-century learning framework. They identify the competencies and skills essential for success in work and life: 'The 4Cs'—communication, collaboration, critical thinking, and creativity—that will be taught within the context of core subjects and 21st-century themes (Trisdiono, 2013; Kendra, 2020).

21st-century skills are a key expectation within the Merdeka curriculum, although not all schools have implemented it yet due to numerous factors influencing its implementation. With the existing curriculum, teachers are required to have broader insight accompanied by technology, because with the rapid development of technology, everything will become very fast, and one day human power will be reduced because everything is controlled by increasingly sophisticated technology (Martini, 2018).

The Lathe Machining Engineering subject is part of the competencies that must be possessed by students majoring in Machining Engineering. In the process of learning these competencies, there is a problem, namely the low understanding of students towards the learning delivered by the teacher which results in low student learning achievement in the Lathe Machining Engineering subject so that alternative solutions are needed in delivering the Lathe Machining Engineering subject with interactive learning methods and learning media and are expected to increase student interest and learning achievement in the Lathe Machining Engineering subject. The Lathe Machining Engineering learning process has so far prioritized the product rather than the process, students need to be given sufficient understanding and knowledge before making the product, with interactive learning media it is hoped that it can improve student learning achievement, especially in the knowledge aspect. Teachers provide less guidance and

opportunities for students to conduct broader questions and answers. In other words, students are not treated as active and creative students because teachers do not act as facilitators, guides, and motivators in the Lathe Machining Engineering learning process proportionally.

In fact, based on interviews with productive machining engineering teachers at Berbah National Vocational School, students face difficulties in completing lathe machining engineering learning materials. This relates to the achievement of both knowledge and psychomotor/skills in lathe machining engineering. Consequently, students still experience difficulty in solving lathe knowledge problems, even though these problems are categorized as routine. This is evidenced by the average midterm exam score of 12th-grade students, which falls below the minimum completion criteria, which is related to students' understanding of lathe machining engineering knowledge, which is related to psychomotor/skill abilities.

The need to develop varied teaching methods to stimulate student activeness in the teaching and learning process using 21st-century skills. An alternative is the use of innovative learning media and models. Effective learning must be balanced with teachers' ability to master the learning media, models, and materials presented. Teachers are expected to improve skills, particularly in lathe machining engineering, by being more creative and innovative using currently evolving learning methods and strategies.

The results of direct observations conducted by researchers at Berbah National Vocational School, researchers found that the use of learning media was not optimal. In the teaching and learning process, teachers used conventional learning models, but in discussing certain materials, supporting learning media was needed. Because the use of learning media was not optimal, students were not able to express the concepts of the material being studied. At the school, facilities and infrastructure already support the use of computer-based media such as LCDs and the use of e-learning with Google Classroom but have not been utilized optimally. In addition, it must be supported by a learning model that actively involves students in multimedia-based learning, which results in the implementation of the learning model not being optimal.

According to Regulation of the Minister of Education, Culture, Research, and Technology (Permendikbudristek) of the Republic of Indonesia Number 16 of 2022 concerning process standards, the learning models prioritized in the implementation of the Independent Curriculum are inquiry-based learning, discovery learning, project-based learning, and problem-based learning (Kemendikbudristek, 2022). Based on these learning models, problem-based learning prioritizes active student involvement in solving problems presented by the teacher (Marjuki, 2020).

The researcher's rationale for choosing the problem-based learning model is that students can explore, discover, and solve their own knowledge from problems presented by the teacher, which in turn can improve learning achievement in lathe machining techniques.

The impact of technological advancements on the learning process is the enrichment of learning resources and media, such as textbooks, modules, films, videos, television, the web, and so on. Therefore, the availability of these learning media requires professional teachers to facilitate students in learning activities (Daryanto, 2016). Therefore, these learning media can facilitate students' understanding and thinking skills, especially regarding lathe machining techniques.

Interactive multimedia can be defined as a supporting tool in the world of communication and education, interconnected with each other, presenting sound, graphics, animation, and text in an integrated manner (Tatik & Edi, 2017). Russell states that interactive multimedia is a type of media capable of displaying visuals with text, images, audio, video, and animation (Ismah & Riski, 2016).

Interactive multimedia is a subset of media, defined as tools and materials that combine words (such as printed or spoken text) and images (such as illustrations, animations, or videos) (Amir et al., 2018).

Seeing the various challenges inherent in teaching lathe machining techniques in schools, researchers were interested in conducting research related to these issues. The research aimed to develop interactive multimedia learning based on problem-based learning to improve student achievement in lathe machining techniques for grade XII students at SMK Nasional Berbah.

II. RESEARCH METHODS

This research employs a research and development (R&D) approach. Setyosari (2015, p. 214) states that the R&D method is a procedure used to develop and validate an educational product. The purpose of this R&D is to produce a product in the form of interactive learning media based on problem-based learning to improve student achievement. Sanjaya (2015, p. 131) states that one of the products of R&D in education is learning media for various subjects, both printed and nonprinted.

This research design will refer to three stages: 1) Preliminary stage, 2) Development stage, and 3) Testing stage.

The development model used in this research is ADDIE, which consists of Analysis, Design, Development, Implementation, and Evaluation. This development model can serve as a reference in producing effective products because its stages contain detailed components (Suryani et al., 2018).

The data collection used in testing the effectiveness of media on learning achievement, namely, tests (pretestposttest) are used to determine student learning achievement before and after learning activities are provided by utilizing the use of interactive learning multimedia based on problem-based learning.

The data analysis technique used to analyze the effectiveness of interactive multimedia learning based on problembased learning on improving student achievement is inferential statistical data analysis. Inferential statistical analysis uses a t-test that has been pre-tested, consisting of normality and homogeneity tests.

III. RESEARCH RESULTS AND DISCUSSION

This study uses interactive multimedia learning based on problem-based learning as the findings of researchers in interactive learning based on problem-based learning and has been described above, this study was conducted using the ADDIE model development design and the Pretest-Posttest Control Group Design experimental design. This research procedure begins by using the ADDIE model. The ADDIE model consists of analysis, design, development, implementation, and evaluation. The ADDIE model is systematically structured so that its implementation is sequential, each stage refers to the previous stage which goes through revision or improvement. In this case, it is in line with (Cahyadi, 2019) The ADDIE development process requires several expert team tests, individual research subjects, limited scale or large scale (field) and revisions to perfect the final product so that even though the development procedure is shortened, it already includes the testing and revision process so that the product developed has met the criteria for a good product, empirically tested and there are no more errors.

The first stage is analysis, which consists of needs analysis, student characteristics analysis, and curriculum analysis. The needs analysis was obtained from the results of an interview with one of the productive/practical machining teachers at SMK Nasional Berbah, who stated that they had never developed their own interactive learning multimedia and students still had difficulty understanding lathes contextually. Analysis of student characteristics shows that based on age, students have the possibility and opportunity to develop their own knowledge and understanding. Therefore, student achievement at this stage can learn independently and in the use of learning technology, students will be better off seeing and experiencing for themselves how to operate the technology through independent exploration rather than just being told by the teacher. Curriculum analysis shows that the curriculum used by SMK Nasional Berbah is a curriculum with adjustments to basic competencies and indicators for achieving interactive learning multimedia. Meanwhile, based on the results of the analysis, one of the learning models that can improve learning achievement in lathe machining techniques is the problembased learning model.

The second stage is design. This stage consists of the learning program steps, where researchers design interactive learning multimedia adapted to the syntax of problem-based learning. Furthermore, the product framework is developed. At this stage, researchers create product designs, including flowcharts, storyboards, use case diagrams, and activity diagrams, which serve as guidelines for the development stages. The interactive learning multimedia design combines text, images, audio, and video. The design process is supported by several software programs, with the primary medium being Articulate Storyline 3 and supporting media including PowerPoint and Google Forms.

The third stage is development. This stage consists of product creation and validation. This product development has resulted in the development of interactive learning multimedia products with the assistance of Articulate Storyline 3. This interactive learning multimedia product consists of a start and login scene, a main menu scene, a guide scene, a competency scene, a material scene, a practice question scene, a summary scene, an evaluation scene, a bibliography scene, and an author scene. This product was developed by integrating the components or syntax of the problem-based learning model, which consists of orienting students to problems, organizing students to learn, guiding individual and group investigations, developing, and presenting work results, analyzing and evaluating (Fathurrohman, 2015).

The syntax of the problem-based learning model is contained in the scene, including competency, material, practice questions, and evaluation. Furthermore, this development product has also integrated indicators from complex lathe machining techniques contained in the practice questions and evaluation scenes. Interactivity in the form of practice questions in this learning multimedia aims to encourage students to be more active in learning activities and as independent simulation material. This is in accordance with Daryanto (2010) who describes multimedia learning as (1) Having more than one convergent media, for example a combination of audio and visual elements; (2) being interactive, in the sense of having the ability to accommodate user responses; (3) being independent, namely providing convenience so that users can use it without guidance from others.

This development product was validated by material experts and media experts. The assessment of this development product was based on the media quality that needs to be considered according to Walker and Hess (Arsyad, 2016), which includes: content and objective quality, instructional quality, and technical quality. The results of the validation by material experts showed that the average aspect of content and objective quality was 30.00 with a classification of "Good", the average aspect of instructional quality was 34.00 with a classification of "Good" and the average total score was 64.00 with a classification of "Good" in terms of material. Meanwhile, the results of the validation by media experts showed that the average aspect of content and objective quality was 42.00 with a classification of "Good", the average aspect of technical quality was 44 with a classification of "Good", and the average total score was 86.00 with a classification of "Very Good" in terms of media. Based on the results of the product validation, it is known that the development product is declared suitable for use in terms of material and media.

Furthermore, the product that has been declared feasible is then tested in individual trials, small group trials, and field trials, to determine the quality of the product's practicality based on the results of the student response questionnaire. The results of the student response questionnaire in the individual trial showed that the average aspect of content quality and objectives was 25.33 with a classification of "Good", the average aspect of technical quality was 39.33 with a classification of "Good", and the average total score was 64.67 with a classification of "Good", in the small group trial it was known that the average aspect of content quality and objectives was 26.0 with a classification of "Good", the average aspect of technical quality was 37.9 with a classification of "Good", and the average total score was 63.9 with a classification of "Good", and for the field trial it was known that the average aspect of content quality and objectives was 25.13 with a classification of "Good", the average aspect of technical quality was 37.40 with a classification of "Good", and the average total score was 62.53 with a classification of "Good" in terms of practicality of use. The product is said to be practical from student responses if the average score based on the ideal assessment criteria for student responses is at least good (Santi & Santosa, 2016). Based on the results of the trial validation, the development product was implemented in the experimental class at the implementation stage.

Implementation Stage, this stage has two classes that are used as research subjects, namely the experimental class and the control class. The experimental class is a lathe machining technique learning class that applies interactive learning multimedia development products. The implementation of learning in the interactive learning multimedia experimental class has stages in accordance with the problem-based learning model, namely orienting students to problems, organizing students to learn, guiding individual and group investigations, developing, and presenting work results, analyzing and evaluating (Fathurrohman, 2015).

Meanwhile, the control class is a lathe machining technique learning class without implementing interactive learning multimedia development products. The experimental class and the control class, both before and after the implementation of the learning, students were given tests, namely a pretest, a test before the implementation of the learning and a posttest, a test after the implementation of the learning. The test questions were conducted to determine the improvement in learning achievement in the lathe machining technique subject from both the experimental and control classes. This aims to be able to compare the effectiveness of the two classes where one of them uses media and the other does not. In addition, the pretest and posttest test instruments were tested on students and the results showed that the test instruments were valid and reliable.

The effectiveness results were obtained from the pretest and posttest results of students in both the experimental and control classes. The pretest results of students from the experimental and control classes were used to determine the initial abilities of students through three tests, namely the normality test, the homogeneity test, and the t-test. The results of the normality test from the pretest and posttest values were known to have a significant value > α value meaning H0 was accepted and a significant value < α value meaning H0 was rejected, so it can be concluded that the pretest data of the experimental and control classes were normally distributed. Meanwhile, the results of the homogeneity test calculation with the Levene's test, the pretest value was known to be 0.006 <0.05, the significant value > α value meaning H0 was accepted, it can be concluded that the pretest results of the experimental and control class learning achievement were not homogeneous, while for the posttest value, the test value was 48.9> 0.05, the significant value > α value, meaning H0 was rejected and H1 was accepted so it can be concluded that the posttest results of the experimental and control classes had homogeneous variances. Based on this, the media effectiveness test was carried out using the t-test: Two-Sample Assuming Unequal Variances. The results of the pretest t-test of the experimental class and the control class obtained a value of 0.023 < 0.05. So, it can be concluded that there is a significant difference between students in the experimental class and the control class. While the posttest t-test of the experimental class and the control class obtained a value of 0.0001 < 0.05. So, it can be concluded that there is a significant difference between students in the experimental class and the control class.

The results of the increase in student learning achievement were obtained from the average pretest and posttest of the experimental class and the control class which were determined based on the increase in the N-gain score. For the experimental class it was 53% and for the control class it was 20%. The results of the experimental class gain test were obtained, and the results of the control class gain test were obtained so that it can be concluded that the percentage increase in student learning achievement in the experimental class was greater than the increase in student learning achievement in the control class. Based on these test results, it can be said that the product has been effectively used to improve student learning achievement. Although the results of the increase in the experimental class and the control class were not very different significantly due to the constraints of this study, namely in the submission of exercises and assignments that were not on time causing plagiarism between students. This is proven by the research of Nurul et al (2020) the use of learning media can improve student learning outcomes.

The fifth and final stage of this research is the evaluation stage. At this stage, the researchers comprehensively evaluated the data related to product quality. Based on the evaluation results, it was found that the product the researchers developed was of acceptable quality, practical, and effective for use in teaching lathe machining techniques.

IV. CONCLUSION

(1) The product was developed using interactive learning multimedia in the form of articulate storyline 3 and has included the syntax of the problem-based learning model and indicators for achieving learning competencies in lathe machining techniques. (2) The

results of the validation by material experts are in the "Good" category (64), the results of the validation by media experts are in the "Very Good" category (86). Thus, it can be concluded that the product in this study is said to be suitable/valid for use in terms of material and media. (3) Based on the results of individual trials, "Good" results were obtained (64.67), small group trials, "Good" results (63.9), and field trials, "Good" results were obtained (62.53). Thus, it can be concluded that the product in this study is said to be practical based on the results of the individual trial questionnaire, small group trials, and field trials. (4) Based on the results of the assessment/evaluation about lathe machining techniques for class XII for the experimental class, there was a percentage increase of 53% (60.24 - 81.12), while in the control class, there was a percentage increase of 20% (40.60 - 52.70). Therefore, it can be concluded that the percentage increase in learning achievement of the experimental class is greater than the increase in learning achievement of the control class.

V. CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

VI. FUNDING STATEMENT

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