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Learning of Basic CNC Programming in Vocational High School (SMK) with Integrated Mach3mill Prototype Media

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Abstract

This research aims to: (1) Develop CNC learning media using Mach3Mill Prototype Integrated which is valid, practical and effective criteria to achieve basic competency in CNC subjects. (2) Analyze the effectiveness of the learning media Mach3Mill Prototype Integrated to increase learning motivation and achievement of basic competencies in CNC subjects. (3) Analyze the differences in the competencies of students who use video learning media compared to the competencies of students who use the learning media Mach3Mill Prototype Integrated. This research is a research and development (R&D) using the product effectiveness testing method [1]. Data was collected using a validated questionnaire. The results showed that the CNC learning media using Mach3Mill Prototype Integratedwas valid, practical and effective. Result data Pre-test (before using the media Mach3Mill Prototype Integrated) 68.8 and result data post-test (after the use of the media Mach3Mill Prototype Integrated) 78.2. There was a significant increase in learning outcomes for students who were taught using the media Mach3Mill Prototype which was Integrated proven with a value of Zhitung (949,000) greater than the price of Ztable (1.96).

Keywords: Mach3Mill, CNC, Learning Media, Basic CNC Programming

1. Introduction

Learning achievement is the ability, knowledge, and skills possessed by students [2]. Media is one of the factors that support the success of the learning process in schools [3]. The results of Aisyah and Singgih's research on subjects Computer Numerical Control (CNC) found that the learning methods used were less effective as evidenced by the learning achievements the low [4]. Survey results in several industries, conventional machines have been replaced using CNC machines [5]. Therefore, vocational students especially machining techniques must be able to run CNC machines.

Mastery of competence about CNC is very important for students because CNC can make a part quickly. With CNC machines, complex workpieces can be made easily in large numbers [4].

Basic CNC Programming is one of the productive subjects of grade XI majoring in machining engineering. Based on data from CNC teachers, the achievement of students' basic competencies is low. Observation results indicate that it is caused by incomplete learning. Unfinished learning is due to the minimal number of learning hours [6]. The teacher must be clever in using learning methods so that the material can be conveyed in full. The use of video-based learning media students gets a better understanding [7]. In other studies, the use of computer simulations will give students a focus on learning [8]. The use of interactive multimedia can also increase learning motivation and learning outcomes [9]. Other studies have shown that the use of Flash software makes it easier for students to receive knowledge compared to traditional PPT teaching models [10].

2. Research method

The research method used is the research and development (R&D) method. R&D is a research method used to produce certain products and test the effectiveness of these products [1]. R&D research is analytic so it can test the effectiveness of these products [11]. In this study the following stages are used: (1) Identification of problems, (2) Data Collection, (3) Development and Implementation, (4)

Product Validation, (5) Product Revision, (6) Product Trial, (7) Product Revision, (8) Usage Trial, (9) Product Revision, (10) Evaluation.

The study was conducted at Muhammadiyah Mungkid Vocational School which addressed at Jl. Blabak Baths, Mungkid, Magelang. The study was conducted in the 2017/2018 school year in March 2018. Subjects in this study were all students of grade XI in the Mechanical Engineering expertise program, with 128 students. Research is carried out on the Basic CNC Programming subjects.

Data collection techniques used in this study were observation, questionnaires, and tests. Observations made to determine the learning process. Development is carried out by testing the product's feasibility and the effectiveness level of the media. The test is used to determine differences in student learning outcomes before and after getting treatment (treatment). The data analysis technique that will be used is quantitative analysis. The data was obtained from the validator assessment questionnaire and class tests. The assumptions were examined which consisted of tests of normality, tests of homogeneity and tests of hypotheses.

3. Results and discussion

3.1. Identification of problems

From the observations, known to many students do not focus when learning. Students fall asleep in class. Learning takes place boring, resulting in students busy playing mobile (HP). The learning method used is the lecture method. Learning is unidirectional. Low student activity. Low student motivation.

3.2. Data collection

Data will be collected from the population covering four grades XI TPM 1, 2, 3, 4. Each grade consists of 32 students. The total population is 128 students. The sampling technique used is random sampling. The number of samples is equal to the total population. The research subjects were divided into two groups, with 64 students as the experimental class and 64 students as the control class. The experimental class was taught using Mach3Mill Integrated Media Prototype. The control class is taught using video-based learning media. The type of data obtained is qualitative and quantitative data [12].

3.3. Design planning

Integrated Mach3Mill Prototype Media is a learning media designed to overcome the limitations of facilities and infrastructure for Vocational Schools. Integrated Mach3Mill Prototype Media can make the material delivered optimally. The media combines two different software, namely CNC programming software and software for planning or design. The programming software used is Mach3. Design software is AutoCAD. Both of this software were chosen because they are easily accessed and understood by everyone.

Mach3 is a CNC software that runs on a Windows OS platform. Mach3 functions to process data/computing into a CNC system controller. AutoCAD is a computer application that is used to design images and design in the field of techniques developed by Autodesk.
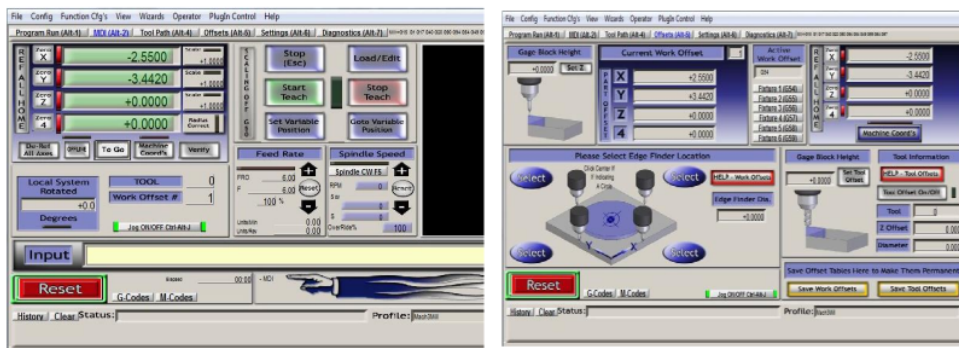

Figure 1. Main display of Mach3Mill

3.4. Product validation

Validation is carried out by media experts by two lecturers and one Computer Network Engineering teacher. The results of media validation show that it is known that the results of the validation of the integrated Mach3Mill media prototype obtained from the validator indicate valid criteria. Validation was carried out by material experts by two lecturers and one Machining Engineering teacher. The results of the integrated Mach3Mill prototype material show valid criteria. The results of the data analysis of the validation results are based on the validation questionnaire of the teaching participants (students) by three students of Grade XI of Machining Techniques showing valid criteria.

3.5. Product revision

It is known that the results of the validation of the material experts, media experts, and students show valid criteria. From these data, it can be concluded that the integrated Mach3Mill Prototype media is feasible to use without making product revisions. Judging from the content of the material, the integrated Mach3Mill Prototype media is by the basic competencies that students must master. In terms of media feasibility, it is known that the integrated Mach3Mill prototype is easy to understand.

3.6. Product trial

Product Trial is conducted by using the integrated Mach3Mill Prototype as a learning medium for teaching a total of 6 students. The trial of this product aims to find out whether the Mach3Mill integrated Prototype media is applicable for use as learning media. If this media is applicable or easy to use by the teacher, then it can proceed to the next step, namely the trial use. If the integrated Mach3Mill Prototype media is difficult to use for teaching or is called not applicable, then a product revision is carried out. Revisions are made based on the results of product trials.

From the results of product trials conducted, it is known that the integrated Mach3Mill Prototype is easy to use for teaching. The integrated Mach3Mill prototype can make the learning process more structured. The integrated Mach3Mill prototype can make the learning preparation process shorter. So there is no need to revise the product.

3.7. Product revision

Known Mach3Mill integrated Prototype Product is easy to use and applicable for learning media. The data was obtained from the results of product trials conducted by applying the integrated Mach3Mill Prototype media to teach as many as 6 students. So there is no need revise the integrated Mach3Mill Prototype. The integrated Mach3Mill prototype is ready to be carried out for the next stage of research, namely the trial use.

3.8. Trial usage

Field trials were conducted on 10 December 2018 to 2 March 2019 for 12 meetings. The trial was conducted at Muhammadiyah Mungkid Vocational School in grade XI TPM with 124 students. The population is divided into 2 to be the control class and the experimental class. Data from the results of the use of the test in the form of pre-test and post-test values will be analyzed using the homogeneity test and normality test.
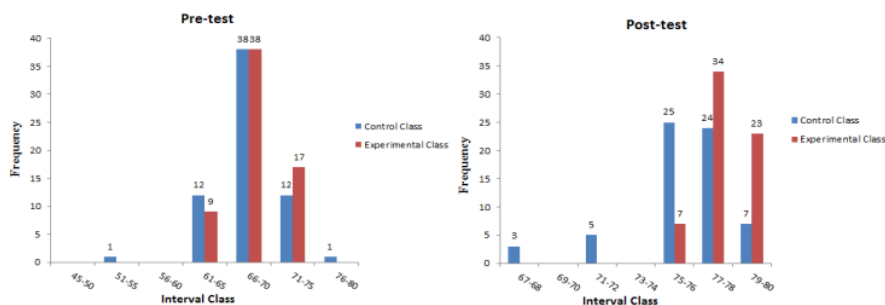

Figure 2. Pre-test and Post-test

Data from the trial results were analyzed using SPSS 16.00 software. Data analysis performed was a normality test, a homogeneity test, and a hypothesis test. The normality test results show a significance value of 0,000. When compared with the significance level, it is 0,000 <0.05. This means that the data is not normally distributed so the hypothesis test uses a non-parametric test (U-Test). Homogeneity test results showed a significance value of 0.716. When compared with the significance level, 0.716> 0.05. This means that the control class and homogeneous experimental data.

Based on the non-parametric test (U-Test) Mann-Whitney produced a significance value of 0,000. Significance value is smaller than the probability value of 0.05, it can be concluded that "Hypothesis is accepted". There are differences in learning outcomes of CNC basic programming between the control class and the experimental class.

. Product revision

There is a difference between the post-test of the experimental group and the control group. It is known from the statistical calculation results that there are significant differences from the results of the post-test of the control group and the experimental group. Students who use Integrated Mach3Mill Prototype media get higher learning outcomes than before getting treated compared to students who use visual video media. The percentage of completeness shows that the control class and experimental class have improved. The value of students who use the Mach3Mill Integrated Prototype media is higher than that of students using visual video. It can be concluded that the media can effectively improve student learning achievement. Then there is no product revision.

3.10. Evaluation

The Mach3Mill Integrated Prototype Brief Guide is designed with a combination of red and gray colors and is equipped with the Mach3 and AutoCAD logos to attract users to read it. The cover design is intentionally made simple but elegant and can attract the user's attention. In the module not yet equipped with foreign vocabulary so that using difficulties in understanding foreign terms contained in the module or guide, researchers add foreign vocabulary to the beginning of the module or a brief guide to the prototype Mach3Mill.

The image illustrations on the module are made as closely as possible with the appearance contained in the Mach3 software and AutoCAD software. The material is arranged coherently by the flow of the use of Integrated Mach3Mill Prototype media. In general, the use of Integrated Mach3Mill Prototype media is made easy and practical by reading the material in the module. The language used in writing material is easily understood by students, so students are quickly able to use the Mach3Mill Integrated Prototype media without help from educators.

4. Conclusion

Media Mach3Mill Prototype Integrated meets valid, practical and effective criteria. The media is Mach3Mill Prototype Integrated designed to foster students' creativity and activity. Integrated Mach3Mill Prototype Media is a flexible media because this media combines two software namely Mach3Mill and AutoCad. So that the media can be used optimally, the learning strategy used is Team-Based Learning. The application of the media is carried out by dividing students into several groups. Each group is required to make a product with their creativity, starting from designing, making G-CODE, to inputting G-CODE into Mach3Mill. The results of the study prove that this media can allow students to innovate without being influenced by the teacher.

Students who are taught using Mach3Mill Prototype media have higher learning achievement compared to students who are taught using visual video. This is evidenced by hypothesis testing Mann-Whitney's result Zhitung (949,000) is greater than Ztabel (1.96) (Zhitung>Ztabel). This means that there are significant differences between the learning outcomes of the control class and those of the experimental class.

In the learning process, the teacher should interact with students. Interaction between teachers and students makes students not ask questions related to material that they have not understood. Teachers are advised to use this Integrated Mach3Mill Prototype media in the learning process. Integrated Mach3Mill Prototype Media can motivate students to be active and responsible during the learning process. Integrated Mach3Mill Prototype Media can improve student learning outcomes.

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