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# The Effectiveness of Using Practicum-Based Algorithm and Programming Module on Cognitive Learning Outcomes of Mathematics Education Students

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**Abstract**

This study aimed to 1) analyze the effect of using practicum-based Algorithm and Programming modules on cognitive learning outcomes of Mathematics Education students, and 2) analyze the effectiveness of practicum-based Algorithm and Programming modules in improving the cognitive learning outcomes of Mathematics Education students. The learning outcomes in question were in the form of a pretest and posttest. The learning outcomes in question are in the form of a pretest and posttest. The subjects of this study were the second semester students in class 02 of Mathematics Education Study Program Universitas Tidar in the even semester of the 2019/2020 academic year who were selected with the *cluster random sampling technique*. The research design used was *pre-experimental* with the form of *one group pretest-posttest design*. This study used instruments in the form of observation sheets, interview guidelines, and tests. The data analysis techniques used were the prerequisite test (normality), the Wilcoxon test, and N-Gain. The results showed that there was a significant effect of the use of practicum-based Algorithm and Programming modules on the cognitive learning outcomes of Mathematics Education students and the use of practicum-based Algorithm and Programming modules was effective in improving the cognitive learning outcomes of Mathematics Education students. The results of the calculation of the N-Gain value showed that there was an increase in the results of the pretest and posttest of 0.7742 which is included in the high category and in the percentage of 77.42% is included in the category of effective interpretation.
Keywords: cognitive, effectiveness, learning outcomes, module

## INTRODUCTION

The life of the globalization era in the future is full of very complex problems and challenges, so education must be able to prepare a generation that is able to answer the challenges and problems faced, namely preparing a generation that has personality and is able to solve various problems faced. The learning process in educational units must be held interactively, inspiring, fun, and challenging, motivating students to participate actively and providing sufficient space for the initiative, creativity, and independence in accordance with the talents, interests, and physical and psychological development of students (Directorate of Learning and Student Affairs, 2014).

The learning process that is widely practiced today is mostly in the form of face-to-face delivery (*lecturing*), or unidirectional delivery, even learning materials are generally arranged not following the taxonomy of the knowledge dimension to be achieved and the correct cognitive process dimension (Directorate of Learning and Student Affairs, 2014). As a result, during the lecture process, students find it difficult to follow or capture the essence of the learning material.

Learning outcomes are important in learning because they are used to measure

success in learning activities (Dreyøe et al., 2018). According to Azizah (2017), learning outcomes are one indicator of the success of the teaching process, because good student learning outcomes can indicate whether learning materials can be absorbed properly. One of the factors that can affect learning outcomes is activity (Kuncoro, Suyitno, & Sugiharti, 2014). Activity is an action that is both physical and mental, which acts and thinks as a series that cannot be separated (Sardiman, 2004). Successful learning must go through various kinds of activities, both physical and psychological activities, so that students are more active to achieve learning goals.

The low learning outcomes of students can be influenced by several factors, including those that come from within the students and outside the students themselves (Widyawati, 2017). In addition, in general, in lectures, the learning process is still controlled by lecturers, who have a tendency to lead students to their goals (Makur & Fedi, 2018). Especially in the Algorithm and Programming course which is a combination of theoretical and practical material, where if students only listen to explanations from lecturers without playing an active role in learning, the lectures will be meaningless. In other words, current learning is still dominated by educators or *teacher-centered learning* (Haryoko, 2009; Puadi & Habibi, 2018). In this regard, it can be argued that in lectures it is necessary to create a pleasant learning environment (Trinova, 2012; Sriyana & Sinarso, 2018). In addition, learning for each subject should be carried out in an atmosphere of mutual acceptance and respect, familiar, open, and warm between students and educators. Thus, we need teaching material that is in accordance with the characteristics of students, not too difficult to understand, and in accordance with the demands of the curriculum.

The Algorithm and Programming course is a compulsory subject for second-semester Mathematics Education students. This course consists of 3 credits, which are integrated within 150 minutes of theoretical learning and practicum. Learning equipped with a practicum requires more activity time than learning without a practicum. Students need additional time to prepare activities in the form of studying preliminary material, doing pretest, doing practice, answering questions, concluding practicum activities, and doing posttest.

Based on the results of observations and interviews with students and lecturers, the implementation of learning activities carried out by direct learning is not optimal. In direct learning, communication is carried out only in one direction, namely, students only listen and pay attention to lecturers and students do not play an active role in the learning process, so learning objectives have not been achieved optimally. As a solution to this problem, a teaching material was developed in the form of a practicum-based Algorithm and Programming course module for Mathematics Education students.

The developed module has met the valid criteria based on the validation results of media experts and material experts and practical criteria based on student response questionnaires. Furthermore, it will be analyzed the effectiveness of using this practicum-based Algorithm and Programming module in learning in relation to student cognitive learning outcomes. Thus, the purpose of this study is to 1) analyze the effect of using practicum-based Algorithm and Programming modules on cognitive learning outcomes of Mathematics Education students, and 2) analyze the effectiveness of practicum-based Algorithm and Programming modules in improving the cognitive learning outcomes of Mathematics Education students.

## METHOD

This research used a descriptive quantitative method. The research design used was *pre-experimental* in the form of *one group pretest-posttest design.* This study only involved one experimental class without a control class. This design compared the

situation before and after being given treatment, by comparing the pretest and posttest scores. The research design can be seen in Table 1 below.

Table 1. Experimental Research Design
*One Group Pretest-Posttest*

| Group | Pretest | Treatment | Posttest |
|---|---|---|---|
| Experiment | $O_1$ | X | $O_2$ |

The stages of research activities are designed based on the design in Table 1. The first stage of this experiment is to give a pretest to students. The next stage is to give treatment to students in the form of applying the Algorithm and Programming module based on practicum in learning. The stages of the experimental activity ended by giving a posttest to the students.

The research was carried out at the Mathematics Education Study Program at Universitas Tidar in the even semester of the 2019/2020 academic year with 27 students as the subject of the second semester of class 02 students. The sampling technique used cluster random sampling. The dependent variable in this study was the student's cognitive learning outcomes in the Algorithm and Programming course. While the independent variable in this study was the use of the Algorithm and Programming Module based on practicum.

This study used an instrument in the form of a test to measure the effectiveness of using the module on student learning outcomes in the Algorithm and Programming course. Data on students' initial cognitive abilities were obtained through a pretest, while data on cognitive learning outcomes after being given treatment with independent variables were obtained through posttest. From this data, then data analysis was carried out to see whether there was a significant effect or difference in the dependent variable before and after the independent variable treatment was carried out. In addition, pretest and posttest scores were also used to see the effectiveness of learning as a result of the treatment of independent variables.

Hypothesis testing of the influence of independent variables on the dependent variable was carried out using the Paired Sample T-Test. This test is used to compare the results of the posttest to the results of the pretest. The assumption test required before testing the hypothesis is the normality test, using the Shapiro-Wilk test. Paired Sample T-Test can be carried out if the data is normally distributed. If it is not normally distributed, hypothesis testing is done using nonparametric statistics in the form of the Wilcoxon test. Hypothesis testing and assumption testing were carried out with the help of SPSS 26. The $H_0$ of this study was that there was no significant average difference between students' cognitive learning outcomes at the pretest and posttest.

The effectiveness of using the Algorithm and Programming module based on practicum can be seen from the calculation results of the N-Gain value (normalized gain). The formula for calculating the N-Gain value is presented in Formula 1, while the criteria for the N-Gain value can be seen in Table 2. Furthermore, the category of effectiveness interpretation based on the N-Gain value can be seen in Table 3.

$$Gain\ Score = \frac{(\%\ postest\ mean\ score - \%\ pretest\ mean\ score)}{(100\% - \%\ pretest\ mean\ score)} \quad (1)$$

Table 2. Criteria for N-Gain Score

| Result of Gain Score $< g >$ | Criteria |
|---|---|
| $< g > > 0.7$ | High |
| $0.7 \geq < g > \geq 0.3$ | Medium |
| $< g > < 0.3$ | Low |

Source: Hake (1999)

Table 3. Interpretation Category Effectiveness Gain

| Percentage (%) | Interpretation |
|---|---|
| < 40 | Ineffective |
| 40 – 55 | Less effective |
| 56 – 75 | Quite effective |
| > 76 | Effective |

Source: Arikunto (in Arini, 2016)

## RESULTS AND DISCUSSIONS

This study aims to analyze the effectiveness of the Algorithm module and Practical-based programming on student cognitive learning outcomes of 27 students who took the Algorithm and Programming course in the even semester of the 2019/2020 school year. This experimental activity produces data in the form of pretest and posttest results. The pretest aims to determine the level of students' understanding of the material being studied before using the practicum-based Algorithm and Programming module. At the end of the lesson, a posttest is given to determine the level of student understanding after using the module in learning. The previously tested test questions have been validated by the lecturer in Algorithm and Programming courses.

### Effect of Application of Practicum-Based Algorithm and Programming Module

This experimental research begins with giving a pretest and ends with the implementation of a posttest, using 10 multiple choice questions. The results of the two tests were then processed to analyze the effect of the independent variable on the dependent variable. The results of descriptive statistical calculations from the results of the pretest and posttest are presented in Table 4 below.

Table 4. Descriptive Statistical Data of Pretest and Posttest Results

| Type of test | $\bar{X}$ | $X_{max}$ | $X_{min}$ | S |
|---|---|---|---|---|
| Pretest | 55.18 | 77.5 | 22.5 | 10.4103 |
| Posttest | 89.35 | 100 | 67.5 | 7.3574 |

In Table 4 it can be seen that the mean of the pretest is lower than the posttest. This shows that descriptively there is a difference in the average cognitive scores of students at the pretest and posttest after giving the practicum-based application of the Algorithm and Programming module. However, this has not been able to show a significant effect of implementing the module in learning on improving student learning outcomes. Furthermore, to determine the significant effect between the two variables, a hypothesis test was conducted using the Paired Sample T-Test on the results of the pretest and posttest.

The hypothesis test can be carried out if the assumption test or prerequisite test has been met, namely the data must be normally distributed. If the data is not normally distributed, then the hypothesis test can be done using the Wilcoxon test. Normally distributed data can be seen from the normality test, whereas in this study the Shapiro-Wilk normality test was used. The results of the normality test can be seen in Table 5 below.

Table 5. Results of the Shapiro-Wilk Normality Test

| Group | Statistics | Df. | Sig. |
|---|---|---|---|
| Pretest | 0.949 | 27 | 0.198 |
| Posttest | 0.871 | 27 | 0.003 |

The results of the normality test in Table 5 show the value of Sig. from the pretest group, which is 0.198, is greater (> ) than 0.05, so it can be concluded that the students' initial ability data during the pretest were normally distributed. While the value of Sig. of the posttest group, which is 0.003, is smaller (< ) than 0.05, it is concluded that the student learning outcomes data during the posttest are not normally distributed. Thus, the statistical test can be continued with the Wilcoxon test. The results of hypothesis testing from pretest and posttest data are summarized in Table 6 below.

Table 6 Wilcoxon Pretest and Posttest

| | |
|---|---|
| Z | -4.546[b] |
| Asymp. Sig. (2-tailed) | .000 |

a. Wilcoxon Signed Ranks Test
b. Based on negative ranks

Based on the Wilcoxon test results in Table 6, it is known that Asymp.Sig (2-tailed) is 0.000. Because 0.000 is smaller than (<) 0.05, it can be concluded that $H_0$ is rejected and $H_1$ accepted. It means that there is a significant average difference between students' cognitive learning outcomes at the pretest and posttest, so it can be concluded that there is an effect of

using practicum-based Algorithm and Programming module on student cognitive learning outcomes.

**Effectiveness of Application of Practicum-Based Algorithm and Programming Module**

The effectiveness of using the Algorithm and Programming module based on practicum on learning outcomes can be determined by calculating the N-Gain value (normalized gain). The results showed that there was an increase in students' cognitive learning outcomes, in this case, the results of the pretest and posttest, after implementing the module in the learning process. The results of the calculation of the N-Gain value are presented in Table 7 below.

Table 7. Results of N-Gain Pretest and Posttest

| Type of test | $\bar{X}$ | $X_{max}$ | $X_{min}$ | <g> | % |
|---|---|---|---|---|---|
| Pretest | 55.18 | 77.5 | 22.5 | 0.7742 | 77.42% |
| Posttest | 89.35 | 100 | 67.5 | | |

The data in Table 7 shows that the pretest and posttest N-Gain values are 0.7742. Based on Table 2, the N-Gain value is included in the high criteria. The results of this study indicate that there is an increase in the average value of the pretest with the value of the posttest. Furthermore, based on Table 3, the N-Gain gain of 77.42% is included in the category of effective interpretation. Thus, it can be concluded that the use of practicum-based Algorithm and Programming modules is effective for improving student cognitive learning outcomes. The increase in cognitive learning outcomes is in accordance with the results of research conducted by Wahyuningtyas and Sulasmono (2020) which concludes that the use of learning media can improve student learning outcomes, which is due to the use of media will involve students creatively in the learning process to develop their thinking skills so that there is an increase student learning outcomes. This is in line with the research results of Hafsah, Rohendi, and Purnawan (2016) that the application of learning media in the form of e-modules can improve learning outcomes. E-modules can increase students' learning motivation and mastery, with learning mastery reaching 86.70% (Zaharah & Susilowati, 2020).

## CONCLUSION

Based on the results of research and data analysis conducted, it can be concluded that 1) there is a significant effect of the use of practicum-based Algorithm and Programming modules on cognitive learning outcomes of Mathematics Education students, and 2) the use of practicum-based Algorithm and Programming modules is effective in improving cognitive learning outcomes of Mathematics Education students, with the results of the calculation of the N-Gain value there is an increase in the pretest and posttest results of 0.7742 which is included in the high category and in the percentage of 77.42% included in the category of effective interpretation. The suggestions from the results of this study are 1) the results of this study can be used as a reference for relevant research related to the use of learning media, and 2) for further research, the control class can be used as a comparison of the use of this learning media.

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