The influence of improved engineering mechanic module in vocational high school

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Abstract. The purpose of this study was to determine the influence of learning resources of engineering mechanics modules on student learning outcomes in mechanics subjects in vocational high school (VHS) 1 Sedayu. This study used an experimental method with a non-equivalent control group design. Experimental research designs used are pre-experimental designs, true experimental designs, factorial experimental designs, and quasi-experimental designs. The sample used was class X TP A as a control group and X TP C as an experimental group. The results of this study indicate that there is a significant increase in achievement in the experimental group students after using improved learning media.

1. Introduction
Vocational education is an educational institution that has a strategic role in directly supporting the orientation of national development, especially in preparing the skilled and educated workforce needed by the world of work. The quality of graduates of education is very closely related to the process of implementing the learning that is applied in an educational institution.

Vocational high school (VHS) 1 Sedayu has a vision of being a school with faith and piety, science and technology and noble character and environment. The mission of Sedayu Vocational School 1 are realizing a school life full of faith and piety so that people become intellectuals with noble character and Indonesian personality, improve academic achievement by considering the background of ability and willingness to continue to tertiary institutions, providing experience of practical skills by growing the spirit of entrepreneurship so that graduates are able to compete in all fields (science and technology), instill a sense of responsibility of all citizens for order, security, and comfort of the school, foster awareness of environmental management that is healthy, beautiful, and clean. Based on observations at VHS 1 Sedayu conducted during the Field Experience Practices (FEP) in July-September and interviews with Mechanical Mechanics teachers as well as some students, the learning process in the classroom is still not running optimally. The average value of students in the class which is less than the Minimum Completeness Criteria (MCC), is one of the problems that exist in VHS 1 Sedayu. There are some problems found in the school, such as limited learning media, teachers do not take advantage of instructional media, students are guided by only a few sheets of paper with material obtained on the internet. In addition, there is a low motivation of students during the learning process of Mechanical Mechanics in the classroom, because students only record the material delivered by the teacher makes it difficult for students to understand the material being taught and also their abilities are difficult to develop. Many students do not have laptops so it is difficult to provide computer-based Mechanical Mechanics material. This also prevents students from learning
independently at home. The lack of teaching and learning facilities in the classroom, i.e. projectors and electric power sources, makes it difficult for teachers to implement computer-based learning media.

Instructional technology or media for learning-teaching process give the tools in engaging the learners powerfully when the learning process happen. It enhance the effectiveness of communication greatly. If it is properly designed, skillfully produced and effectively used, it will have great influence on teaching & learning because it produces impact of save time, increase interest, hold attention, clarify ideas, reinforce concepts add tone prove a point, and aid memory [1]. The instructional-aids assist educators to transmit the knowledge in an impressive way giving diversity to classroom teaching and making learning more effective [2]. Learning media application should not only unique but also be guided by general principles of learning and the context in which these principles are employed. In order to make teaching and learning process more effective and interesting, media programs are designed for instructional use [3].

There is a research conducted by Tiwan [4] which examines the application of modules in learning Basic Engineering Materials, as a medium of learning in an effort to improve the learning process in the Department of Mechanical Engineering Education, Yogyakarta State University. The study was conducted with a research and development (R&D) research approach. Place of research in the Department of Mechanical Engineering Education, Yogyakarta State University. The time of the study began in May-November 2009. The research respondents were lecturers of Basic Engineering Materials and students of the class of 2009. Data collection used questionnaire instruments and test results of learning. The results showed that the Writing of Basic Technical Materials Module was developed from the curriculum and syllabus of Basic Engineering Materials courses that had a structure consisting of cover pages, introductions, subject titles, competency standards, basic competencies, learning objectives, learning activities, answer keys and bibliography. Module writing is the process of compiling learning materials that are systematically packaged so that they are ready to be studied to achieve competencies or sub-competencies. The stages of writing the basic engineering material module include the analysis of module requirements, drafting, testing, validation, revision, and production. Modules that have been made could be accepted by supporting lecturers and students in either category. There are differences in learning achievement between groups that are given a module and groups that are not given a module. The student group that was given the module had better achievement.

Danang Ardianto [5] has also implemented modules on learning to read Technical Drawing in the mechanical engineering department of VHS Muhammadiyah Prambanan. This quasi-experimental research took class X TPB as a learning experiment class with modules and class X TPE as a control class. The test method used is collecting data, while the test grids and test items are used as instruments. A T-test is applied to analyze data. In this study, there were significant differences between the experimental group learning outcomes using the technical drawing module and the group control with conventional learning. Learning using technical drawing modules also affects technical drawing subjects with basic competencies in understanding mechanical engineering drawings. The effect of the module in terms of the minimum completeness criterion value (MCC) is 73. The average learning outcomes in the experimental group is 77.7. The decision is declared influential if the achievement of average learning outcomes is higher than the value of the minimum completeness criteria that must be achieved.

In accordance with the results of Nova Avianto's research [6] who developed the Basic Engineering Mechanics module for class X using the type of research and development (Research and Development or R & D) used to produce certain products, and testing the effectiveness of these products through the process of validating the product and filling out a questionnaire. Based on the results of the study it can be concluded that the learning module of Mechanical Mechanics has been produced for Class X of the Mechanical Engineering Department at VHS Muhammadiyah 1 Bantul developed using a 3-D development model namely define, design, and develop. Define phase is constructed by the front end analysis phase, student analysis, task analysis, concept analysis and formulation of learning objectives. In the design stage (design), there are the preparation of reference
benchmark tests, format selection, and initial design. The next stage of the development process is the validation of the device by experts and development trials. It is also showed that the level of feasibility of the Engineering Mechanics learning module produced is determined by 3 product studies, such as the results of the assessment conducted by the material expert and the teacher obtain a score of 61 and are categorized as very feasible. An assessment by a media expert received a score of 70 and was categorized as very feasible, while the response of students gained a score of 61.44 and was categorized as very feasible. Based on the data obtained, it can be concluded that the Class X Mechanical Engineering module is fit to be used as a learning media for students in VHS Muhammadiyah 1 Bantul.

A researcher [7] has stated that each mathematical concept could be understood better if it is presented with a concrete learning media. Mathematical concepts, including engineering mechanics subject, could be easier to understand by using learning media. The effort in creating the learning media will help the students in understanding abstract mathematical concepts in the process of learning by contextualizing the subjects in accordance with environmental conditions [8]. The other researcher [9] reveals that the involvement of students in learning process and interaction with surrounding have made learning process itself more effective. In addition, research conducted by [10] showed that the use of learning media could motivate the students to learn mathematic subjects.

Based on the research results that have been outlined, the use of instructional media is very influential in the learning process. Learning media can facilitate interaction between teacher and student, so the process of delivering messages delivered by the teacher can be conveyed effectively and the learning process will become more interesting. Learning media can build students to gain knowledge, skills, or attitudes during the learning process.

Interactive media in the form of module learning resources has become the choice as an effective learning method. The use of interactive media is expected to change students' motivation towards learning and make students able to learn independently. However, it is often found that a teacher who is not able to utilize interactive learning media in the form of the module properly. As long as the learning media is not fully used by students, the media is only used by teachers in the learning process. In addition, in making learning media the criteria that should be contained in these media are often ignored.

In order to continue the research that has been done by Nova Avianto who has developed the Engineering Mechanics module and has fulfilled all the aspects and learning media criteria, researchers will apply the learning media in the form of the Mechanical Mechanics module at VHS 1 Sedayu. This module is expected to help students more optimally absorb the material being taught. In addition to being able to help students to learn independently, this module also helps teachers carry out the learning process to the full and can improve student learning outcomes at VHS 1 Sedayu.

2. Method

The method used in this study is an experimental research method because this research treats or manipulates variables. In the experimental method can be interpreted as a method used to look for the effect of certain treatments on others under controlled conditions. The research was conducted at VHS 1 Sedayu. This research was conducted in December 2016 until January 2017. The sample used in this study was two classes from class X of the VHS N 1 Sedayu welding technique expertise program, namely class X TPA and TPC. The two classes, one class grouped into an experimental group (X TPC) and one class as a control group (X TPA). The number of students of X TPC class is 28 students and X TPA class is 29 students.

The procedures in this research were studying the problem and formulating a theoretical basis, developing instruments, conducting data collection, assessing the results of respondents' answers, conducting data analysis, and conclusioning. In this study, data were collected using documentation and tests. The documentation technique aims to obtain written data about the state of the research subject in the form of a list of student names, number of students and other data that will be used for research purposes. Whereas the multiple-choice test instrument was 25 items with four answer
choices, the measurement scale of each item got a score of 1 if the answer was correct and 0 if the answer was wrong.

The analysis tool technique used to describe data consists of mean (average), median (middle value), mode, and group variation through standard ranges and deviations. The analysis requirements test consists of homogeneity test (equation 1) and normality test (equation 2). Hypothesis testing in this study uses a comparative two samples in the form of intervals or ratios.

Homogeneity test
\[ F = \frac{\text{Largest variance}}{\text{Smallest variance}} \] \hspace{0.5cm} (1)

Normality test
\[ X^2 = \sum \frac{(f_o-f_h)^2}{f_h} \] \hspace{0.5cm} (2)

Where:
- \( X^2 \) = Chi-Square
- \( f_o \) = Observed frequency
- \( f_h \) = Expected frequency

3. Result and Discussion
Student achievement scores of both the experimental group and control group, before and after treatment can be seen in table 1. It could be seen that the students’ score after treatment is increasing compared to before treatment.

| Statistics          | Before treatment score (experimental group) | After treatment score (experimental group) | Before treatment score (control group) | After treatment score (control group) |
|---------------------|---------------------------------------------|--------------------------------------------|---------------------------------------|---------------------------------------|
| Mean                | 41.14                                       | 71.43                                      | 41.11                                 | 66.62                                 |
| Median              | 40                                          | 72                                         | 40                                    | 68                                    |
| Modus               | 44                                          | 76                                         | 44                                    | 72                                    |
| Standard deviation  | 8.13                                        | 8.19                                       | 8.48                                  | 8.76                                  |
| Maximum score       | 56                                          | 88                                         | 56                                    | 88                                    |
| Minimum score       | 24                                          | 56                                         | 24                                    | 48                                    |

The homogeneity test was conducted in order to find out if samples taken from the population come from the same variant. The variance homogeneity test technique used the \( f \) test. Value \( f \) calculation results are consulted with \( f \) table prices at a significant level of 5%. If the \( f \) calculates \( \leq f \) table, then the variant is homogeneous. From table 2 it appears that the calculated significance value is greater than the significance level of 5% or (Sig. Value> 0.05), it can be concluded that the before treatment and after treatment data both the experimental group and the control group can be said to be homogeneous.

| Data                              | \( f_h \) | \( f_t \) | Variance |
|-----------------------------------|-----------|-----------|----------|
| Before treatment (experimental and control group) | 1.01      | 1.88      | homogenous |
| After treatment (experimental and control group) | 1.57      | 1.88      | homogenous |
| Before and after treatment (experimental group) | 1.1       | 1.88      | homogenous |
The normality test was conducted in order to determine whether or not the distribution of data is normal. Data requirements are normally distributed if the Sig. obtained from the calculation results is greater than the alpha level of 5% or Sig. > 0.05. Based on Tables 3 it could be seen that the experimental group and the control group have the value of Chi-Square calculated before treatment and after treatment ($X^2_h$) < ($X^2_t$). It could be concluded that the data are all normally distributed.

| Class   | Treatment | $X^2_h$ | $X^2_t$ | Distribution |
|---------|-----------|---------|---------|--------------|
| Experimental | Before    | 6.06    | 11.07   | Normal       |
| Experimental | After     | 6.56    | 11.07   | Normal       |
| Control   | Before    | 6.14    | 11.07   | Normal       |
| Control   | After     | 4.18    | 11.07   | Normal       |

Hypothesis testing was conducted based on the results of the research and test requirements analysis that has been done. Hypothesis testing of student achievement obtained from before treatment and after treatment scores as shown in Table 4. Based on the after treatment hypothesis testing of the experimental group, a t-test of 15.22 was obtained with a significance level of 0.05. Thus, the test result shown that there is a significant increase in learning outcomes in the experimental group after being given a learning treatment.

| Data                                      | t-calculated | t-table | Significance | Note                      |
|-------------------------------------------|--------------|---------|--------------|---------------------------|
| Before treatment (experimental and control group) | -0.02        | 2.021   | 0.05         | Ho accepted and Ha rejected |
| After treatment (experimental and control group) | 2.14         | 2.021   | 0.05         | Ho accepted and Ha rejected |
| Before and after treatment (experimental group) | 15.22       | 2.021   | 0.05         | Ho accepted and Ha rejected |

In order to find out whether there are differences in student learning outcomes before being given treatment using learning media by comparing the percentage of graduation rates to the Minimum completeness Criteria (MCC) of 70 for the experimental and control groups. The following are the results of the experimental group. Based on Table 5, the experimental group before treatment of 28 student test takers i.e. 0 students or 0% students graduated and 28 students or 100% did not pass or did not meet the MCC, with the acquisition of the highest value of 56 and the lowest value of 24 and an average of 41.14. It could be said that for the before treatment scores, there are no students who have met the MCC. Then the experimental group was being given a learning treatment by using instructional media in the form of Engineering Mechanics modules on magnitude subjects, unit systems, forces, and moments. Out of the 28 students, there were still 12 students or 42.86% who had not met the MCC score with the lowest after treatment score of 56 of the 12 students, while the others had met the MCC value.

The learning outcomes of the control group students who have been given a pretest/ before treatment and posttest/ after the treatment of learning without the media or conventional shown in Table 5. Based on the table, it could be seen that the MCC score is set for 70. From the pretest results of the control group of 29 students, there is no student or 0% pass and 29 students or 100% did not pass or did not meet the MCC. After being treated with learning in the conventional way, where posttest scores were obtained from 29 students, there were still 16 students or 55.17% of students who did not meet the MCC scores and the highest score was 88 obtained by 1 student.
Table 5. The comparison between student’s score and minimum completeness criteria (MCC) score

| Class            | Treatment | Students Qty. | Minimum completeness criteria score: 70 |
|------------------|-----------|---------------|----------------------------------------|
| Experimental     | Before    | 28            | Pass: 0 student, Fail: 28 students     |
|                  | After     | 28            | Pass: 0%, Fail: -100%                  |
| Control Group    | Before    | 29            | Pass: 0%, Fail: -100%                  |
|                  | After     | 29            | Pass: 0%, Fail: -100%                  |

4. Conclusion

Based on the results conducted, it can be concluded that there was an increase in learning achievement in the control group students who were taught without the media or conventional learning, with the acquisition of the before treatment average value far greater than the average after treatment score. In addition, there was a significant increase in achievement in the experimental group students after being treated learning using the Engineering Mechanics learning media.

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