

Module for the Subject of Statistics Based on the Higher Order Thinking

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ABSTRACT

This research aimed at examining the feasibility and effectiveness of the module of statistics in college. The type of this research is research and development using Borg & Gall model that consists of nine stages: theoretical studies, pre-survey study, model design evaluation, validation, limited try out, revision, product try out, product perfection, and limited dissemination. The subjects of this study were 41 undergraduate students of Technology Education, Faculty of Educational Sciences. Validation test were carried out by material experts and media experts using Aiken's Validity. Based on the result of Aiken V, all of the items were categorized as feasible. The reliability test through Alpha Cronbach presented that the material and were categorized as good. The module was proved to be effective based on the increased score from pre-test to post-test. The result of the homogeneity proved to be homogenous and the normality test showed that variable distribution was normal. The findings of this study presented that the module of statistics is feasible and effective to be used.

Keywords: *module, statistics, higher order thinking*

1. INTRODUCTION

For some college students, statistics course is what hinder them for completing their study since it is somehow labeled as a difficult subject that it makes the weary. [1]. College students consider statistics as next-level-mathematics. Due to their unpleasant experience of learning mathematics during high school or even before their get to formal education, their perception on statistics is influenced negatively [1].

Though, as we know, statistics has been taught in high school within mathematics subject and also implemented in the real life, yet statistics still somehow trigger anxiousness among the college students. [2],[1]. This is because statistics requires high accuracy and precision as any fallacy in the calculation would affect the result of analysis and ruin the research. [3].

Such situation usually occur when the students have negative experience in doing mathematical exercises, then it influence their attitude towards any subject or courses related

to calculation like mathematics and statistics when they grow older [4]. This issue in learning mathematics may be caused by the curriculum, teaching method, students, or the combination of them [4].

Mathematics is the subject closest to real life and applicable in any field of science. However, the teaching and learning method tend to be procedural followed with training and practice. As the consequence, students become passive and unable to think mathematically. Additionally, the students find it difficult to comprehend mathematics due to the teacher's lack of ability and the absence of mathematics laboratory. Teachers also merely act as the source of information and prioritize questions/exercises that requires memorization [5].

In order to make statistics more interesting, lecturers are suggested to create learning innovations, such as making Higher Order Thinking (HOT) based Student Teaching Material (STM) that is composed by the order of analysis,

synthesis, and evaluation. This would help motivate the students to learn further.

The development of STM in the form of statistics module is covered in the research of technology of education since the development of module is classified as creating.. In other words, it is related to study/research to provide learning facilities and improve working competence by creating the correct teaching material. Student Teaching Material (BAM) should be developed based on the research and practice in composing the material, creating the situation and learning condition, as well as the whole related learning aspect. [6].

Module is one of teaching materials that contains a set of materials that composed sistematically, portraying the whole set of competence the students should master. Module allows the students to learn competence orderly and systematically, hence they could accumulatively comprehend all the competence wholistically and integratedly. Furthermore, it is mentioned that module serves as: 1) the guidance for teachers or lecturers during the teaching process and as the substance of competence that should be taught to students. 2) the guidance for students during the learning process, along with the substance of competence that should be mastered by students, and 3) the tool of evaluation learning achievement. Module is a set off material constructed systematically in order to create the proper environment/condition for students to learn. [7] Module is a book made for students to learn independently without the teacher's direct guidance, therefore it should at least contains : 1). Learning instruction (student/teacher instruction), 2). Competence that needs to be achieved, 3). Material content, 4). Supplementary information, 5). Practices, 6). Work instruction, it could be in the form of Working Sheet , 7). evaluation, 8). Feed back for the evaluation result. A modul is considered to be good when students can utilize it easily.

Thinking skill is required for students to learn statistics. By using thinking skill, students are trained to solve problems in the current situation or in the future. Thinking skill is categorized in to two category, those are Lower Order Thinking Skill (LOTS) and Higher Order Thinking Skill (HOTS); both are parts of the cognitive field. [8] [9]. In developing HOTS learning, teacher should not only involve the students in learning to achieve 'comprehension', but students should also be able to apply, analyze, synthesize, and evaluate while processing the information. That is because HOTS is thinking skill that does not only require remembering or memorizing information [10].

The science of statistics expect the students to think using HOTS; not only understanding data and formula, but also analyzing, concluding, and evaluating a problem using statistics calculation. On the other hand, remembering, understanding, and evaluating is classified as Lower Thinking Skill. HOTS deals about the ability to implement knowledge, skill and values of logic, reflection, problem solving, decision making, innovation, and creation. [11]

Based on the observation conducted by the researcher on statistic course, students still could not optimally using HOTS and tend to think using LOTS. This is because lecturer, during the course, only giving trivial questions that does not require HOTS. Thus, they only sit, listen, and write. Students had lack of exposure in analyzing, evaluating and creating. So far, students could easily complete the exercises given to them since it only involved memorizing or remembering formula. When they were faced with a more complex exercises, they tend to find it difficult to solve.

2. METHOD

This study is a descriptive qualitative and quantitative study that is conducted to examine the effectiveness of statistics module for students in the third semester. It took place in Educational Technology Study Program, Unesa. In this research, two classes are involved in the research. Class A acts as the experiment class and class B as the control class. Class A receive the lecture by utilizing the statistics module, while the class B only receive regular lecture. The subject of this research are selected through simple random sampling. This choice is taken since the researcher consider that the population is homogenous, [12]. The sample of research for experiment class consists of 30 students, while control class consist of 25 students.

Validity test is conducted using Aiken's validity. One is considered to have high validity when it could present accurate data that correctly portray the measured variable accordingly [13]. Meanwhile for reliability test, a measurement is deemed reliable when the relatively same results gained after measuring the same subject group and same aspect to be measured for several times. The reliability test is carried out using alpha Cronbach [13].

Before the module is compiled, the researcher is ought to identify the main issue in statistics subject learning by undergoing the following stages: , 1) the preliminary survey is done to find out the practice of teaching of Statistics in the TP major. Information is gained from the observation, documentation and interview, 2) model design is needed to create the module prototype that will be used for the subject of statistics, (3) the validation for the module prototype before it is tested is done by the expert (expert judgement). The validity test used Aiken's Validity. Meanwhile, the validators are: a)media validation by the expert of teaching media consisting of 4 lecturers, having no less than master degree, b)content validation by the expert of statistics consisting of 4 lecturers, having no less than master degree, (4) limited testing here is used as the facility in gaining the empirical data about the degree of quality for the module. The limited test is directed to 3 students (5) revision or improvement for the module prototype based on the information from the limited testing, (6) extended testing upon the module for the subject of statistics with the material that is done to more students (7) finalization of the product or the revision that is done after the

module gained the scoring from the extended testing by the students, so that it is gained the final product.

3. RESULTS AND DISCUSSION

The validation result from the expert judgement upon the scoring instrument of the material in media and module, as well as from the students are as follow: the scoring of the teaching module instrument from the material expert used the the Aiken validity test. The scoring for the instrument is done by the expert judgement that consists of 4 raters and Number Rating Categories (c) = 5, Lower Limit = 0.88 and Upper Limit = 0.94

The Score of Aiken Validity for the scoring of teaching module by the material expert is in the level between Lower Limit and Upper Limit, even some items are located above the Upper Limit. Thus, all items on the instrument is classified as valid. [14] mentioned that “if the item obtains a score of 0.79 or more, it is maintained”. Which means that the Aiken score $V \geq 0.79$ is the standard score that must be achieved.

According to [15], the coefficient of reliability for Alpha Cronbach is between 0 and 1. The Alpha coefficient can be classified to have a high reliability if the score is close to 1. [15] made a practical rule in the following: “ $\alpha > 0.9 =$ very good; $\alpha > 0.8 =$ good; $\alpha > 0.7 =$ acceptable; $\alpha > 0.6 =$ in question; $\alpha > 0.5 =$ bad; and $\alpha < 0.5 =$ unacceptable.”

The scoring instrument for the material is tested to 5 lecturers of the State University of Surabaya. The result presented that the score is 0.817, that is classified as good.

The scoring of the teaching module instrument by the Media Expert using Aiken validity test. The instrument scoring is done by the expert judgement that consists of 4 assessors and Number of Rating Categories (c) = 5. Based on the table of Aiken V, it is gained that Lower Limit= 0.88 and Upper Limit= 0.94.

The Validity Score of Aiken to the teaching module scoring by the expert media is in between the Lower Limit and the Upper Limit, even some items are in the level of Upper Limit. Thus all the items on the instrument is considered valid.

The scoring instrument of the media is tested to 5 lecturers of the State University of Surabaya. Based on the test, it is found that the coefficient of reliability of Cronbach Alpha is 0.710, which is considered acceptable.

The instrument scoring for the teaching module for the students used the Aiken validity. The scoring of the instrument is done by the expert judgement that consists of 5 assessors and the Number of Rating Categories (c) = 5. Based on the table of Aiken V, it is gained that Lower Limit = 0.80 and Upper Limit = 0.90.

The instrument scoring of the statistical module by 10 bachelor students of TP with 23 questions, it is gained that the approval percentage is 97.91%. The module for the subject of Statistics is said to be suitable to the target if the level of approval is $>70\%$ so that it can be concluded that the module for the subject of Statistics is accurate with the target and deserved to be used for the subject.

In order to identify the effectiveness of the statistics module, the analysis technique of quasi experimental group is needed to be done. It requires the data from experiment class and control class that is collected using pre-test and post-test control group design. The design of the research is presented in Table 1.

Table 1. Research Design

Experiment class	O	X ₁	O ₁
Control class	O	X ₂	O ₁

Note:

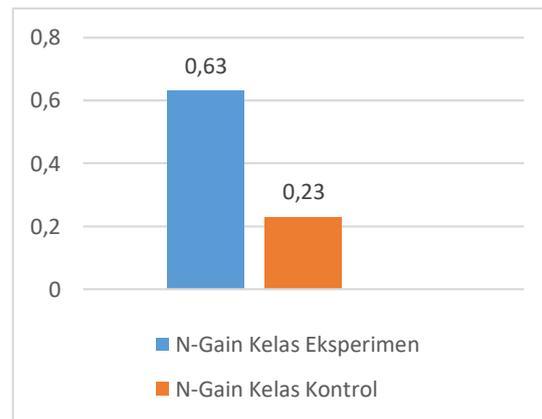
X = Treatment given (media CAI)

O1 = Score of *pretest* (before treatment)

O2 = Score of *posttest* (after treatment)

To identify further the difference between pre-test and post test result in the experiment and control class, it could be seen in Figure 2 below

Figure 1. Average Result of Pretest and Posttest



Based on the figure 1, it can be inferred that N-Gain of Pre-test and post-test result in the experiment class is .63 which categorized as adequate, while the N-Gain in control class is .23 and considered as not adequate. Hence it is clear that there is a quite significant difference between experiment class and control class regarding the students’ learning achievement.

Table 2. Category of N-Gain Effectiveness Interpretation

Percentage (%)	Interpretation
< 40	Not Effective
40 – 55	Less Effective
56 – 75	Fairly Effective
>76	Effective

The result of t-count is 2.628 while t-table = 1.68. Since the score of t-count > t-table, then it can be concluded that there is a significant difference between the score of pre-test and post-test. It means, the module of statistics is very effective to be used.

The homogeneity test for the pre-test and the port-test is gained that the F-count is 1.88 with the F-table is 4.08. since the $F\text{-count} \leq F\text{-table}$ ($1.88 \leq 4.08$), then it can be concluded that the data presented are homogeneous. Output Test of Normality, it is presented that the Significance (Sig) value in Kolmogorov-Smirnov for the N-Gain of experiment class is about 200 and for control class is 93. Since the Sig. value for both class is higher that 05, then it is considered that the data used in this research are normally distributed. Hence, the requirement for independent sample t-test has been fulfilled. It is gained that the significance score (sig) Based on Mean is $.110 > .05$ so that it can be concluded that the variant of posttest group of experiment class and posttest of control group is same or homogeneous.

The effectiveness of statistics module is indicated from the improvement on students' learning achievement as seen from the N-Gain analysis. Based on figure 2, the average of N-Gain in control class is 23 and it is considered low or not adequate, while the N-Gain in experiment class is 63 and classified as fair or adequate. The significant improvement on N-Gain from control class to experiment class is affected by several characteristics required in module, those are: a) self-instructional, b) self-contained, c) stand alone, d) adaptive, and e) user friendly. The usage of language that is simple, easy to understand, and utilize general terms that commonly used are the attempt to make it user-friendly [17].

Independent learning is a learning activity without any help from other individual to diagnose the learning need, formulate/ determine the learning goal, identify the learning sources, and self-evaluate the result of the learning [7].

4. CONCLUSION

Based on the result of the research and the discussion, it can be concluded that module of statistics can increase the learning result of the bachelor students of Curriculum and Educational Technology, module of statistics can be announced deserved to be used, and module of statistics can be announced effective to use.

Suggestion for the future researcher, the findings of this research may be developed further as the sole of a more thorough study, for example changing the subject from college students to learners from other level of education such as elementary school, junior high school, senior high school, vocational high school and the equivalent. Furthermore, the study may not only focus on the effectiveness of statistics module as teaching material but also other discipline of science such as Natural Science, Social Science, etc. Finally, the objective could also be leveled up, not only to improve the learning achievement, but also improving Higher Order Thinking (HOT).

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