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Learning With Higher Order Thinking Skills for Basic Statistics Subject

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ABSTRACT
The purpose of this study is to determine the HOTS learning model that is most suitable for the learning process of Basic Statistics Subject. This research method is descriptive research and continued with quantitative research. Based on the literature, the discovery / inquiry learning model and the drill learning model give no different results. While the learning model Project-based Learning is not suitable for use because the tasks are given in the Basic Statistics Subject. The results of this quantitative study are the learning outcomes of students taught with the Problem-based Learning model better than the drill learning model. So from the three HOTS models proposed, it can be concluded that the most suitable learning model for Basic Statistics Subject is the Problem-based Learning model.

Keywords: *Drill, Discovery, Inquiry, Problem, Project*

1. INTRODUCTION

Every year, Indonesia always participates in the Program for International Student Assessment (PISA) competition which is carried out by the Organization for Economic Cooperation and Development (OECD). Even though Indonesia has never received unsatisfactory results, at least this activity can spur Indonesia's spirit of improving Indonesian education. The results of the PISA announcement on December 3 2019, Indonesia ranked 72 out of 78 countries surveyed. In the Science category, Indonesia ranks 70th out of 78 countries. While in Mathematics, Indonesia is ranked 70th out of 78 countries surveyed.

All components of the nation are trying to improve the quality of Indonesian education from various fields, among others: improving learning media [1], creating new learning models [2], increasing ability and respect for the teaching profession [3]. Indonesia is trying to improve this rank by making questions Higher Order Thinking Skills (HOTS) in the implementation of the 2018 National Examination. This raises problems that could have been viral on social media. The Indonesian Ministry of Education has begun to apply international standards, both for Mathematics, literacy and for Natural Sciences. These questions require Higher Order Thinking Skills (HOTS) from students. To be able to answer questions like this, students must be taught the HOTS learning process. HOTS learning can be applied without relying on technology [4]. Questions and HOTS learning are studied by Indonesian researchers [5].

Starting in 2013, Indonesia implemented the 2013 Curriculum to improve the quality of Indonesian Education. The Government of Indonesia makes regulations on Process Standards using 3 (three) learning models that are expected to shape scientific, social behavior and develop a sense of curiosity with Permendikbud No. 22 of 2016. The three models are (1) the Discovery/ Inquiry Learning model, (2) the Problem-based Learning (PBL) model, (3) the Project-based Learning (PjBL) model. The three models are expected to become priority models that are applied in the learning process in schools. But if the teacher wants to use another model, the teacher is expected to be able to use another cooperative learning model.

Until now, the regulations issued by the government have not been used by teachers entirely at school or on campus. The teacher or lecturer still likes the drill learning model for mathematics. Even though the drill learning model is not a cooperative learning model. The drill learning model has many advantages, including: being able to complete the subject matter in a short time, students easily repeat in doing activities or questions, and this model may be done without learning media. So the drill learning model is perfect for teaching the subject matter that is very much required by the curriculum.

Similar to other study programs, lecturers in mathematics study programs like the drill learning model in the learning process, especially for subjects related to pure mathematics, for example: Basic Statistics Subject. The question exercises that the students do repeatedly will make them proficient in working on similar problems. Most of the questions tested on the midterm and end of the semester exams do not require too much creative thinking. So if students often practice working on questions then the grade of the course will also be good.

The problem that will be answered in this research is What HOTS learning model is suitable for Basic Statistics Subject. Are the results of lectures with the HOTS learning model better than the learning model without HOTS?

2. LITERATURE REVIEW

2.1. Learning Model

Teaching, and assessing higher-order thinking skills has been a challenge for teacher pedagogy for years, and also for the design of an assessment system that can track progress systematically for each student [6]. The Government of the Republic of Indonesia recommends three HOTS learning models for teachers to use in the learning process to improve Indonesian education. These three learning models are expected to shape scientific, social behavior and develop a sense of curiosity. The three models are (1) Discovery / Inquiry Learning model, (2) Problem-Based Learning (PBL) model, (3) Project-based Learning (PjBL) model. If the three models are still not enough, teachers are also still permitted to use other cooperative learning models, such as: Jigsaw, Numbered Head Together (NHT), Make a Match, Think-Pair-Share (TPS), Example not Example, Picture and not Picture, and others.

2.1.1. Discovery/ Inquiry Learning Model

The discovery/ inquiry learning model is used to understand concepts and relationships through intuitive processes to finally arrive at a conclusion. Discovery / inquiry learning is done through observation, classification, measurement, prediction, determination and inference. Discovery itself is a mental process to assimilate concepts and principles in the mind, while the process that occurs is a cognitive process [7]. The syntax of the discovery / inquiry learning model is as follows: (1) Stimulation, (2) Problem Statement, (3) Data Collection, (4) Data Processing, (5) Verification, and (6) Making conclusions (Generalization).

For the stimulation step, the teacher starts the learning activity by asking questions, encouraging reading books, and other learning activities that lead to the preparation of problem solving. While students are faced with something that causes confusion (do not proceed to provide generalizations), so that the desire to investigate itself arises. The stimulus in this phase aims to provide conditions for learning interactions that can develop and assist students in exploring material.

In the Problem Statement step, the teacher gives students time intervals to identify as many problems that are relevant to the subject matter, then the problems are generalized and formulated in the form of hypotheses (temporary answers to problem questions). Students must formulate it in the form of statements, or hypotheses. The hypothesis is a temporary answer to the question posed.

The next activity is Data Collection. When exploration takes place, the teacher also gives students time intervals to gather as much relevant information as possible to prove the hypothesis is true or not. This stage aims to answer the question or prove the hypothesis whether it is true or not. Thus students are given time to gather various relevant information, read literature, observe objects, interview with speakers, conduct their own trials, and so on.

Data Processing aims to process data collected in the previous step. The teacher provides guidance when students do data processing. Data processing is an activity to process data and information through interviews, observations, and so on. Then the data is interpreted. All information from reading, interviewing, observing, and so on, all of them are processed, randomized, classified, tabulated. If necessary, the data is calculated and analyzed in a certain way, and interpreted at a certain level of trust.

Verification is very closely related to the hypothesis. Verification aims to make the learning process work well and creatively. The teacher provides the opportunity for students to find a concept, theory, rules, or understanding through examples in their daily lives. Learners examine carefully to prove the hypothesis (which was made before) is true or not. This decision was decided by the results of data processing.

The final step is making conclusions (generalization). Generalization is the process of drawing a conclusion that can be used as a general principle. With regard to the results of verification, conclusions must apply to all events or problems that are the same. Based on the results of the verification, the principles underlying the generalization were formulated.

The main reason for using the discovery/ inquiry learning model is the belief that students will understand and remember knowledge longer. Because they have found reasonable reasons for getting this knowledge [8]. The discovery/ inquiry learning model is designed to bring students into the research process through investigation and explanation in a short time setting [9].

Teacher responses to discovery/ inquiry learning model are generally positive. discovery/ inquiry learning model is useful to increase student motivation and improve science teaching. Teachers reflect on their experiences in implementing discovery/ inquiry learning model. They talk about surprises from the extraordinary student effort after the teacher approaches motivating, encouraging student involvement in doing relevant and authentic assignments. But teachers feel frustrated with their experience, because they lack the time and resources to prepare inquiry-based learning. Teachers also have difficulty managing group work and completing material according to curriculum requests [10].

2.1.2. Problem-Based Learning Model

Problem-based learning model is learning that uses various thinking skills of students, individually or in groups, in the real environment to solve problems so that learning becomes meaningful, relevant, and contextual [11]. The problem-based learning model according to Arends [12] has the steps: (1) the orientation of students to the problem, (2) organizing students to learn, (3) guiding individual and group investigations, (4) developing and presenting the work, (5) analyze and evaluate the problem solving process.

In the step of the orientation of students to the problem, the teacher tells the problem to be solved as a group. Issues raised must be contextual. Problems can be observed by students on reading material or activity sheets. The student group is expected to be able to observe and understand the problems presented by the teacher or the problems contained in the recommended reading material.

The step of organizing students to learn is a consolidation activity. The teacher makes sure each group understands their assignments. Groups of students discuss and share the tasks of each member to find data, materials, or tools needed to solve problems.

Guiding individual and group investigations steps spend a lot of time in the problem-based learning model. The teacher monitors the involvement of students in collecting data or materials during the investigation process. Learners conduct an investigation (looking for data, references, sources) for group discussion material.

The next step is developing and presenting the work. The teacher monitors the discussion and guides the preparation of the report, so that the work of each group is ready to be presented. Groups conduct discussions to produce solutions to problem solving and the results are presented or presented in the form of work.

Finally, analyze and evaluate the problem solving process is done. The teacher guides the presentation and encourages the group to give attention and input to other groups. The teacher and students conclude the material. When one group makes a presentation, another group gives an appreciation. The next activity is to summarize or make conclusions in accordance with the input obtained from other groups.

There are three main trends in developing problem-based learning models, namely: creating problem-based interactive learning technology, designing problematic situations that can form competencies as expected, developing integrated learning media that are suitable for problem-based learning [13]. Development of integrated learning media is the situation of the problem, the activity of the problem, the module of the problem, the design of the problem, and others.

2.1.3. Project-Based Learning Model

Project-based learning is a teaching approach that teaches curriculum concepts through projects [14]. Project-based learning model is a learning model that involves the activeness of students in solving problems, carried out in groups or independently through scientific stages with certain time intervals that produce a product, and then presented to others. The steps of the project-based Learning model are (1) creating fundamental questions, (2) designing product planning, (3) scheduling the stages of product creation, (4) monitoring the activeness of members and project development, (5) testing results, and (6) evaluation of learning experiences.

The steps to creating fundamental questions are done at the beginning of the learning period. The teacher presents the topic and asks questions how to solve the problem. The teacher asks fundamental questions about what students should do about the topic or problem solving.

The next step is designing product planning. The teacher ensures that each student in the group is able to choose and know the procedure of making a project or product that will be produced. Learners discuss to draw up plans for making a problem solving project which includes the division of tasks, preparation of all the tools, materials, media, resources needed.

Scheduling the stages of product creation must be done in the right timeframe. Teachers and students make an agreement about the project making schedule (stages and collection). Learners prepare a project completion schedule by taking into account the deadline that has been determined together.

Monitoring the activeness of members and project development must be carried out during the manufacturing process. The teacher monitors the activeness of the students while implementing the project, monitors the realization of developments, and guides if they experience difficulties. Learners make

projects according to schedule, take notes on each stage, and discuss problems that arise during project completion with the teacher.

Testing results are carried out on the product produced. The teacher discusses project prototypes, monitors student involvement, measures achievement of standards. The group discusses the feasibility of the project that has been made and makes a product or work report to be presented to others.

The final step is evaluation of learning experiences. The teacher guides the project exposure process, responds to the results. Furthermore, teachers and students reflect and conclude. Each student presents the report, the other students give their responses, and together with the teacher concludes the results of the project.

2.1.4. Drill Learning Model

Drill learning model is widely used in lectures in the Mathematics Education Study Program. The exercise allows students to show that they are able to perform quickly with little or no error [15]. The drill learning model will be efficient if it focuses on the competency of the skills to be mastered. The things that will be trained consist of various activities or questions with levels of difficulty that begin with an easy level. The teacher must provide a variety of interesting activities that can be specifically selected by students and allow students to work independently.

Drill Method is a teaching method by training students about the material that has been taught and given so they have the skills to solve problems. The drill method is a way of teaching where students are asked to carry out repetitive training activities on a learning material until a specified indicator is reached. The application of the Drill method helps students be better prepared to use their skills because they are already accustomed to repeated practice. Although the Drill method has advantages, but this method also has disadvantages, among others, potentially making students tend to learn mechanistically. Mechanistic learning means learning that begins with theory, examples, and practice questions [16].

The steps of the drill learning model are (1) teaching the material, (2) working on the sample questions or activities in stages, (3) assigning students to work on the problems or activities in stages, (4) reflection and conclusions. During the teaching the material step, the teacher teaches the subject matter and answers students' questions. The teacher takes the next step, namely working on the sample questions or activities in stages, and is proceeded with the step of assigning students to work on the problems or activities in stages. The stages of reflections and conclusions are used to convey a summary of the level of achievement of each student, and the follow-up to learners will be based on the level of questions or activities that can be done.

2.2. Basic Statistics Subject

Syllabus for Basic Statistics Subject are arranged so that students are able to teach statistics and can apply them in research. The material discussed includes: understanding and providing applied examples of basic statistical concepts and theories that include basic understanding of statistics, distribution and diagrams, averages and variances, basic theory of probability, sample distribution, estimating, hypothesis testing, analysis of variance, regression analysis and correlation. So students have: the ability to teach in secondary schools, as a prerequisite to advanced statistical material, to continue their education to a higher level, and to be able to apply it in simple research. The core of introductory statistics courses include t-test, ANOVA, chi-square test, simple linear regression, and multiple linear regression [17].

3. METHOD

This type of research is a type of descriptive research and continued with quantitative research. The selected HOTS learning model is determined based on the suitability of the model with the syllabus of the Basic Statistics Subject, the learning objectives, and the tasks expected of students. While determining the best HOTS learning model for Basic Statistics Subject is decided based on quantitative research results. The data obtained is quantitative data about student learning outcomes. The data is used to analyze data to test hypotheses about the similarity of the two averages. The analysis is used to find out whether the learning outcomes of students who study with the HOTS learning model selected are better than the drill learning model commonly used in Basic Statistics Subject.

The data analyzed in this study are learning outcomes. To analyze learning outcomes data, instruments are needed first. In this case the researcher used the test sheet as an instrument. This test sheet is used to determine student learning outcomes, which are used at the end of the meeting. The data collected is the value from the student answer sheet. To analyze differences in student learning outcomes, the authors use the similarity test of two averages, but first a normality test and a homogeneity test must be used.

4. RESULTS AND DISCUSSION

4.1. Selection of Learning Models

The learning model proposed in this study is the HOTS learning model. HOTS learning models that will be considered in this study there are four models. According to Permendikbud No. 22 of 2016 concerning

Process Standards, there are 3 (three) learning models that are expected to shape scientific and social behavior, and develop a sense of curiosity. The three models are (1) discovery/ inquiry learning model, (2) problem-based learning model, (3) project-based learning model.

After reading some literature, there are studies [16] that have been conducted that compare discovery learning model / Inquiry learning and drill learning models. The study said that the value of learning outcomes taught by the two models is the same. So the learning outcomes obtained by using the discovery / inquiry learning model are the same as the learning outcomes obtained by using the drill learning model that is often used in mathematics education study programs. So then we will consider the problem-based learning model and the project-based learning model.

The Project-based Learning Model is very suitable for subjects with assignments to make projects. Basic Statistics Subject discuss basic statistical concepts and theories that include basic understanding of statistics, distribution and diagrams, averages and variances, basic theory of probability, sample distribution, estimation, hypothesis testing, analysis of variance, regression analysis, and correlation. By paying attention to the syllabus of this course, the task of making a project is not suitable to be the student's assignment in this course. So this research will only consider the problem-based learning model.

In this study, experiments will be conducted using two models, namely comparing the problem-based learning model and the drill learning model. The study will pay attention to differences in student learning outcomes taught by the problem-based learning model and with the Drill model. By getting these results, we can determine which model is best between the problem-based learning model and the discovery / inquiry learning model.

4.2. Result of Using Learning Models

Teaching with the learning model in this study was conducted at the University of HKBP Nommensen. The population is all students of Mathematics Education Study Program. The selected sample were students who took the Basic Statistics Subject in 2019/2020 Academic Year Odd Semester. Group A students are taught with the problem-based learning model and Group B students are taught with the drill learning model. The selection of study groups for learning models is based on the size of the room. The problem-based learning model requires more space than the drill learning model. Because group A's room is larger than group B's room, the problem-based learning model is used in group A students. This can be done because the determination of study groups from students in the Mathematics Education Study Program is random.

Learning for both models is carried out in the same number of hours, which are both 3 times 3 hours of lecture. At the fourth meeting, for 100 minutes they were given the same post test questions to find out their level of mastery for the material they had learned during the three meetings. The results of their answers are taken as learning outcomes data which will be compared between group A and group B students.

4.2.1. Application of Drill Learning Model

By paying attention to the explanation of the drill learning model, then in Basic Statistics lectures the drill learning model is prepared. First, the lecturer explains about a subject matter to students. Example questions are solved together as a guide to solving other problems. Furthermore, students are given questions that start from easy problems to difficult problems. Finally the lecturer gives conclusions and reflections from the newly learned material. The application of drill learning model can make all students seriously participate in learning.

Post test results were collected from 34 students who attended lectures using the drill learning model. The average learning outcomes obtained were 27.71 and the standard deviation was 10.59. Frequency table of group B student learning outcomes can be seen in Table 1, where X_1 is student learning outcomes taught with drill learning models, and f_i is the frequency of data x_i.

Table 1. The Learning Outcomes with Drill Learning Model

No	The Learning Outcomes	Frequency
1	20	15
2	27	11
3	33	4
4	47	1
5	53	2
6	60	1
Total		**34**

4.2.2. Application of Problem Based Learning Model

The steps of the problem-based learning model carried out in this study are based on the syntax proposed by Arends (2012). The first step is done by explaining the learning objectives and is continued with the orientation of students to the problem. In this orientation step, students are given a problem that must be resolved. The next step, organizing students to learn activities are carried out to ensure each member understands their assignments. During group activities, the lecturer conducts for guiding individual and group investigations. After finishing the discussion and group assignments, they were asked to developing and presenting the work. The work is written on cardboard

and affixed to the space provided. Two people from each group member will be assigned to guard the exhibit from the group and the other members will visit other group's exhibition sites. In this exhibition, visitors will ask the exhibition keepers about what is not yet known. So that exhibition activities become information exchange activities. Finally, each group discussion again to make conclusions. The group with the best work will be asked to present their work. Finally the teacher provides analyze and evaluate the problem solving process.

Table 2. The Learning Outcomes with Problem-Based Learning Model

No	The Learning Outcomes	Frequency
1	27	2
2	33	8
3	47	1
4	53	7
5	60	4
6	67	3
7	73	5
8	80	2
9	87	2
10	100	7
Total		41

In the learning process, students look very enthusiastic to do their assignments. Teachers always walk around to ensure that all participants work according to expectations. This class is very active and tries to give the best, from preparation, exhibition, and presentation.

Post test results were conducted for 41 students who took lectures with a problem-based learning model. The average learning outcomes obtained were 62.83 and the standard deviation was 34.44. Frequency table of group A student learning outcomes can be seen in Table 2, where X_2 is student learning outcomes taught with drill learning models, and f_i is the frequency of data x_i.

4.3. Discussion

This study uses an error rate of α = 5%. Data normality test is done first. Data from learning outcomes taught with drill learning models obtained L_0 = 0.2913, and for n = 34, α = 5% obtained L_t = 0.1523. By comparing these two values, it is concluded that learning outcomes data taught with the drill learning model is not normally distributed. Likewise, for learning outcomes data taught with problem-based learning models obtained L_0 = 0.1389, and for n = 34, α = 5% obtained L_t = 0.1387. By comparing these two values, it is concluded that learning outcomes data taught with the problem-based learning model is not normally distributed.

Because the two data are not normally distributed, the Mann-Witney test is used to test the learning model that results in better post-test scores. The Mann-Whitney formula used is a formula for data more than 20. From the calculation, the z value is 6.43 and the z table value for α = 5% is 1.96. Because the z value of the calculation is greater than the z table, the value of the learning outcomes taught with the problem-based learning model is better or higher than the value of learning outcomes taught with the drill learning model.

From the results of the leterature study, the discovery/ inquiry learning model and the drill learning model gave no different results. While the project-based learning model is not suitable because the tasks given to the Basic Statistics Subject are not in the form of projects. The results of quantitative research conducted are the learning outcomes of students taught with the problem-based learning model better than the drill model. So from the three HOTS models proposed, it can be concluded that the most suitable learning model for Basic Statistics Subject is the problem-based learning model.

5. CONCLUSION

This research produces several conclusions, namely:

1. The drill learning model is often used in pure mathematics courses at HKBP Nommensen University.
2. The learning outcomes obtained are the same if the learning process uses the drill learning model or by using the discovery learning model.
3. Learning outcomes obtained by using problem-based learning models are better than learning outcomes with drill learning models.
4. The HOTS based learning model that is most suitable for teaching Basic Statistics Subject is a problem-based learning model.

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