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The Effectiveness of Using the Minnesota Model in Completing University Physics Selection Exam

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Abstract

This study raises the issue of whether the Minnesota model in solving university selection physics questions gets the right results in terms of answers and time. This research aims to determine the effectiveness of using the Minnesota problem-solving model for the accuracy of answers and time in solving physics problems. The type of research is quantitative research with experimental methods. The population of this study was students of class XI from senior high school in Banda Aceh. The sample in this study was two classes. There was the experimental class and control class. Determination of the sample is done by purposive sampling. The approach used is a quantitative approach with the type of experimental research. The data was collected using a written test technique and data processing using an analysis of the effectiveness of the accuracy of the answers using an assessment rubric that has been validated and using t-test statistics, as well as the effectiveness of the use of time analysis based on the average time use of the two classes. The results of the data analysis showed that the average value of the experimental class using the Minnesota problem-solving model was higher than the control class, and the experimental class's time usage was faster than the control class. It was stated that the Minnesota problem-solving model was effectively used in solving physics problems.

Keywords: effectiveness, minnesota model, physics problem

INTRODUCTION

Physics is a fundamental science in terms of reasoning and application, which is arranged based on facts, concepts, principles, laws, hypotheses, theories, and models that has an essential role in science and technology. The mastery and application of physics concepts in solving problems is needed in physics learning, but there are obstacles found in physics learning. There are the student's difficulties in solving problems (physics questions) and understanding physics material (Colleta & Chiappetta 1994; Aji 2016; Musdalifah 2017).

The students difficulties in solving physics problems are they are not able to convert physics problems into a systematic form, are unable to write down physics problems information, are unable to apply physics concepts to solve those problems, and are incapable of changing the language of the questions into physics equations and could not solve problems with mathematical equations (Andriani et al. 2016).

Every problem requires a solution, as well as the difficulty of students in solving physics problems is also needed solutions. Problem-solving is a skill that needs to be mastered by teachers and students in the 21st century, and Student achievement can be improved by using a problem-based learning model, even though the motivation to learn glasses is not high (Liana et al. 2020; Guntara & Utami

2021). Problem-solving is using cognitive abilities and understanding to overcome obstacles to get the desired goal through an essential and complex thought process in finding solutions that humans need in learning science (Krulik & Rudnick 1993; Jennifer & Heller 1994; Merisa et al. 2020). The purpose of problem-solving is to clarify concepts and improve competence and intellectual skills that are proven by the ability to understand, analyze, interpret, and assign questions given (Selvaratnan 2008; Toth & Sebestyen 2009).

Solving physics problems is related to physics concepts. Factors that influence solving physical problems are the knowledge possessed by people who solve problems and character problems. People who can solve physics problems can manage, apply knowledge, and relate one concept to another when solving physics problems. Physics problem-solving is done by identifying relevant concepts, planning, implementing and evaluating (Young & Freedman 2012; Sujarwanto 2019).

Problem-solving models are widely used in solving physics problems, one of which is the Minnesota Model pioneered by two physics education researchers, Patricia Heller, and Kenneth Heller, from the University of Minnesota, USA. The Minnesota model has five stages, namely focusing on the problem, describing the focus situation, planning solutions, implementing the plan, and evaluating answers (Syukri 2012; Darvina 2012; Merisa et al. 2020).

The first of the Minnesota model stages focus on the problem, which has two sub-stages, they are 1) Making a sketch of the problem by writing down the information about the problem and determining the question, 2) Choosing a physics concept related to the problem. The Second of the Minnesota model stages describes a physical situation with two sub-stages. They are 1) Drawing a physics diagram by identifying the physical quantities on the diagram and 2) Determining the mathematical relationship based on the principles of physics on the physics diagram. The Third of the Minnesota model stages is Planning a Solution which has two sub-stages, they are 1) Choosing a specific physics formulation to answer the problem and looking for a physics formulation to get an equation for an unknown quantity, 2) Substituting the results of the equations of unknown quantities into the initial equations and obtaining a new equation and examining the new equation units. The Fourth of the Minnesota model stages is Implementing the Solution, which has one sub-stage, which is Entering the known numbers in the problem along with the correct units into the new equation and converting the units if needed. The last stage is Evaluating answers which have one sub-stage, it is Checking that the answers have been stated correctly and checking that the answers are reasonable, and stating the final result.

The effectiveness of a problem-solving model is seen from the measure of the success of a problem-solving model in achieving goals and the level of satisfaction and intensity achieved (Miarso 2004; Mahmudi 2010; Danim 2020). The characteristics of successfully solving ill-structured problems are similar to those commonly seen by people with high levels of problem-solving skills (Cho & Kim 2020). Researchers are interested in conducting research to see whether the Minnesota problem-solving model is effectively used in solving physics problems.

The era of globalization requires students to have high-order thinking skills or HOTS, which requires the ability to understand, conclude, connect concepts and facts, manipulate, and apply (Thomas & Thorne 2009). Problem-solving really requires high-level thinking skills, especially in physics problems (Nurhayati & Agraeni 2017). Completing higher-order thinking questions requires visualization of the questions so the students can determine the physics formulation. This visualization makes problem-solving informative and communicative (Pertiwi, Muliati & Serevina 2016)

High-level thinking skills are needed to solve HOTS questions. One of the HOTS questions is found in Joint Selection to Enter State Universities, which requires students to solve problems by analyzing, evaluating, and creating (Amalia & Wahyuni 2020). This study uses High Order Thinking Skills (HOTS) questions taken from university selection physics tests questions and solved using the Minnesota model. Physics questions with a certain level of difficulty and limited completion time require students not only to be able to answer questions within the allotted time but also, they are required to get the right answers. Thus, we need a physics problem-solving model that is effective in terms of processing time and the accuracy of the answers.

METHODS

Research Method and Design

The method used in this research is the experimental method. This method is carried out by giving the Minnesota model treatment to the experimental class and looking for the level of effectiveness of using the model in terms of time and answer results. The research design used in this research is Quasi-Experimental Design. The form of quasi-experimental design used in this study is the Nonequivalent Control Group Design.

Research Population and Sample

The population of this study was all students of class XI. The sampling technique used in this study was a purposive sampling technique considering that both classes have the same cognitive abilities and have studied mechanics subject. The sample in this study was class XI-1 with ten students as the experimental class, and XI-2 with ten students as the control class.

Data collection

The test used in this study was a written test by providing five essay questions. Each of these questions will be assessed in stages according to each sub-stage of the problem-solving model. Essay questions are used to make it easier for researchers to find out how students solve problems and the students' mistakes in solving questions for each sub-stage.

The experimental class in this study used the Minnesota model, and the control class used the Conventional model, which includes writing down what was known, asked, and the solution that was based on each student's method. Observing the implementation of this written test includes the state of the class and students in solving questions and the use of time required by each student for each question. The difference in the average results of the accuracy of the answers between the experimental class and the control class in solving physics problems.

Data analysis

The analysis used in this written test includes an analysis of the effectiveness of the accuracy of answers and an analysis of the effectiveness of the use of time. Researchers create research instruments that will be used to assess the results of students' answers. The research instrument used is an assessment rubric that experts have validated. There are two assessment rubrics, namely the Minnesota model assessment rubric and the conventional model. The experimental class using the Minnesota problem-solving model will be assessed based on the Minnesota problem-solving assessment rubric, as well as the control class using the Conventional Model will be assessed based on the Conventional Model completion assessment rubric. The Minnesota model has five stages consisting of eight sub-stages, and the conventional model has three stages consisting of 5 sub-stages. Assessment is carried out by giving a score to each sub-stage. The highest score is 4, and the lowest score is 0, with the scoring criteria validated by experts. The score results for each sub-stage will be processed using the following formulation:

$$\text{Score} = \frac{\text{The average score of sub−stage}}{\text{Maximum Total Score}} \text{ x } 100 \quad (1)$$

Time effectiveness is assessed from the average time needed by the experimental class to answer all the questions compared to the average time needed by the control class to answer all the questions. The experimental and control classes will be given at the same time to answer each question. The researcher will calculate the processing time needed by each student for each problem.

RESULTS AND DISCUSSION

Results And Discussion of Answer Accuracy

The experimental class in this study is class XI-1 which uses the Minnesota problem-solving model. The experimental class was first taught how to answer questions using the Minnesota problem-solving model before carrying out the written test. The results of the answers were analyzed by checking students' answers based on the reference to the rubric for assessing the accuracy of the answers. Experts have validated the results of student answers using the Minnesota model according to each sub-stage of the Minnesota model. The written test results for the accuracy of the answers to each question can be seen in TABLE 2.

TABLE 2. Results of the Minnesota Model Experimental Class

No	Name	Values Per Sub-Stage of Minnesota Model								The average of sub-stage	Score
		a	b	c	d	e	f	g	h		
1	Student 1	4.0	3.8	4.0	3.8	3,6	3.2	2.8	1.8	3.38	84.38
2	Student 2	3.8	3.2	3.6	3.2	3.0	2.8	2.4	1.4	2.93	73.13
3	Student 3	4.0	3.4	3.0	3.8	3.6	3.0	2.8	1.2	3.10	77.50
4	Student 4	3.8	2.0	3.4	3.0	4.0	3.4	2.6	1.8	3.00	75.00
5	Student 5	4.0	4.0	3.8	3.8	4.0	4.0	3.0	3.8	3.80	95.00
6	Student 6	4.0	2.8	3.8	2.8	4.0	4.0	3.0	3.2	3.45	86.25
7	Student 7	3.6	2.2	2.8	2.2	3.4	2.6	2.4	0.2	2.43	60.63
8	Student 8	2.8	1.2	3.4	0.8	3.6	2.6	3.2	3.8	2.68	66.88
9	Student 9	3.8	3.6	3.8	3.6	3.8	3.8	3.2	3.6	3.65	91.25
10	Student 10	3.6	1.8	3.2	1.8	2.6	2.4	2.2	1.6	2.40	60.00
Average		3.74	2.80	3.48	2.88	3.56	3.18	2.76	2.24	3.08	77.00

The Minnesota model has five stages. There are focusing on the problem, describing the physical situation, planning solutions, implementing solutions, and evaluating answers. Each stage has sub-stages mentioned in TABLE 1. A detailed assessment of the accuracy of the answers is carried out and analyzed in each sub-stage of the Minnesota model, in TABLE 2 is presented the average value data per sub-stage of the Minnesota problem-solving model.

Letters a, b, c, d, e, f, g, h in order are sub-stages of the Minnesota model, which are presented in TABLE 1 (see TABLE 1), such as (a) are sub-stages of problem focus, namely visualizing questions and writing questions, (b) is the sub-stage of the problem focus, namely writing down physics concepts, (c) is the sub-stage of describing the physical situation, namely describing the physics diagram by identifying the physical quantities on the diagram and so on.

TABLE 2 presents the score of each student for each sub-stage of the Minnesota model, based on the assessment rubric that has validated that the Minnesota model has eight sub-stages. Each sub-stage is assessed from the range 0-4. Zero is the lowest value, and 4 is the highest value for each sub-stage. The value per sub-stage of the Minnesota model is the total value of the sub-stages divided by the number of questions, which is five, and the average value of each sub-stage is the value of each sub-stage divided by the number of sub-stages, which is 8. The score is the average value of the sub-stages divided by 4 as the maximum score and multiplied by 100. This score is the final score obtained by students in solving problems using the Minnesota model.

The Minnesota problem-solving model has five stages, at the stage of problem focus directed students to be able to visualize, write, and write down concept questions. On average, all students can complete this stage correctly. This stage requires students' understanding of the concept of physics so that they can connect the concept to the problem. This stage helps students answer the question correctly in the next stage describing the situation and planning a solution. This is following the statement that the step of understanding the problem emphasizes the success of obtaining a solution to the problem. This step involves deepening the problem situation, sorting out the facts, determining the relationship between the facts and formulating problem questions and the knowledge one strongly influences understanding has, if the information about the questions is consistent with the knowledge possessed then the questions can be solved easily (Prince & Felder 2006; Wardhani 2010).

In stages of describing the situation of physics, students are directed to be able to describe physics diagrams along with known and unknown quantities and are asked and write down the principles of physics. This stage helps students in solving problems, it can be seen that students draw diagrams of quantities that help students find physics principles, such as student answers that describe objects moving on an inclined plane and experiencing frictional forces so that the concepts and principles of physics that are chosen are correct, namely particle dynamics and friction. This is in line with the opinion that visual representation formats in pictures, graphics, and models can reduce some misconceptions in students because students are able to understand concepts optimally and create good thinking and communication patterns so that a structured perspective is formed (Schnotz 2002; Arum 2014).

The third stage of the Minnesota problem-solving model is planning a solution by writing a physics formulation, connecting the known quantities with the unknowns to get new equations to answer the questions. In this third stage, students must think of a physics formulation that follows the specified physics principles. At this stage, students can choose a physics formulation, but some students are less able to substitute some equations to get a new one. This happens because of a lack of understanding and students' mathematical abilities, in line with the opinion that high mathematical understanding and ability will easily understand physics concepts and solve physics calculation problems and connect a new idea with previous ideas (Walle 2008; Haryadi 2015)

The fourth stage is implementing the solution by entering values and units of magnitude into the equations obtained. At this stage, the average student can enter numbers and units into the equation. Units of magnitude are very important to include in the equation because it is to know the true and false of an equation obtained. Understanding physics concepts is influenced by the way students perceive equations and physics formulas to be able to work on problems correctly and precisely (Tumanggor et al. 2019).

The fifth stage is the evaluation of answers which is done by checking the answers, stating the results of the answers and the logical answers. Students re-examine the answers from beginning to end, state the final results such as writing sentences and get results..... and check reasonable answers such as questions about determining the coefficient of friction, students write that the answers make sense because the answers to the coefficient of friction are greater than zero and smaller than one. Evaluation requires reflective and logical thinking to ensure that all stages are carried out correctly (Snyder 2008; Peter 2012; Ruggiero 2012).

The control class in this study is class XI-2 which uses a Conventional problem-solving model. The process of answering questions based on the way of each student. The results of the answers were analyzed by checking students' answers based on the reference to the rubric for assessing the accuracy of the results of conventional models. The written test results for each question can be seen in TABLE 3.

TABLE 3. Results of the Conventional Model Control Class Written Test

No	Name	Values Per Sub-Stage of Conventional Model					The average of sub-stage	Score
		a	b	c	d	e		
1	Student 1	3.4	1.8	2.4	1.6	1.6	2.16	54.00
2	Student 2	1.6	2.6	1.4	2.0	1.8	1.88	47.00
3	Student 3	3.2	2.2	3.2	2.0	2.2	2.56	64.00
4	Student 4	3.2	1.4	3.4	3.0	2.8	2.76	69.00
5	Student 5	3.2	0.8	3.6	3.0	2.8	2.68	67.00
6	Student 6	2.0	0.8	3.4	3.0	2.6	2.36	59.00
7	Student 7	3.2	1.6	3.2	3.2	2.8	2.80	70.00
8	Student 8	3.8	3.0	3.2	3.0	3.0	3.20	80.00
9	Student 9	3.2	0.6	3.4	3.0	2.8	2.60	65.00
10	Student 10	3.6	2.2	3.4	3.2	2.8	3.04	76.00
Average		3.74	2.80	3.48	2.88	3.56	2.60	65.10

A detailed assessment of the accuracy of the answers was carried out and analyzed at each sub-stage of the conventional problem-solving model. Stage 1 writes down what is known with sub-steps (a) writes down the known quantity complete with units, stage 2 is to write down what is asked with sub-steps (b) writes down the quantity asked complete with units, and stage 3 is to solve the problem with sub-steps (c) write the formulation of the answer, (d) write the new equation and (e) enter the numbers. The following TABLE 5 presents the average value data per sub stage of the Conventional problem-solving model.

TABLE 2 presents the value of each student for each sub-stage of the Conventional model, based on the assessment rubric that has been validated that the Conventional Model with 5 sub-stages, each sub-stage is assessed from the range 0-4. Zero is the lowest value and 4 is the highest value for each sub-step. The value per sub-stage of the Conventional model is the total value of the sub-stages divided by the number of questions, namely five, and the average value of each sub-stage is the value of each sub-stage divided by the number of sub-stages, which is 5. The score is the average value of the sub-stages divided by the value maximum is 4 and multiplied by 100. This score is the final value obtained by students in solving problems using Conventional Models.

The control class uses a Conventional problem-solving model by writing down what is known, being asked and answering questions. In the stages of writing that are known, the average students can write what they know about, but some questions have implied quantities so that they need to be visualized. Students do not write down known quantities and make uncertain examples, so it is very important to describe the state of the problem by drawing physics diagrams. Students need understanding in order to be able to modify the problem into a physics diagram to see the magnitude implied in the problem. Comprehension occurs if we are able to modify the reading (question) for our own purposes (Torres & Constain 2009)

The next stage of the Conventional model is to write down what is being asked. At this stage, students must be able to identify questions, sometimes the questions give long sentences for questions and students must be able to conclude questions with one magnitude, such as questions with the sentence "...The two planes have different heights. …m", the meaning of this question, when written in physical terms, is h1-h2 or delta h, but there are some students who skip this stage.

The last stage of the Conventional model is writing answers. At this stage, students write answers based on each student's thoughts. The average student is not right in completing this stage due to being wrong in determining the appropriate physics formulation for the problem. Students write physics formulations, but there is an error. They could be found in determining the direction of the vector quantity so that the force vector which is expressed with a plus-minus value on the problem, causes an error to occur in entering the value. Therefore, to overcome this error, it is necessary to visualize the problem and draw a physics diagram to find out the directions of a vector quantity.

One of the student's abilities to solve physics problems can be seen from the aspect of the accuracy of student answers obtained from the average value in each class. The average value of the experimental class using the Minnesota problem-solving model was higher than the control class using the conventional problem-solving model. Physics problems require solutions that use visualization/illustration. Therefore, in answering physics questions, it is very necessary to focus on the problems, make physics diagrams, plan solutions, implement solutions and evaluate answers. At the end, the Minnesota problem-solving model is effectively used in solving physics problems compared to the conventional model.

Results and Discussion Timeliness

The effectiveness of time in this study was measured by the amount of time that the students needed to complete the questions against a predetermined limit time. The researcher gave a processing time for one question which was 15 minutes. This study used five questions thus the total processing time for the whole question was 15 minutes x 5, which was 75 minutes. The time needed by the experimental class to solve the questions given using the Minnesota problem solving model can be seen in TABLE 4 and the stages of working on the questions every fifteen minutes can be seen in TABLE 5.

TABLE 4. Time to Solve Problems for Each Stage of the Minnesota Model in minutes

No	Name	Time Per Question					Total Time
		1	2	3	4	5	
1	Student 1	295	515	870	757	714	3151
2	Student 2	217	489	939	686	695	3020
3	Student 3	450	482	868	768	572	3140
4	Student 4	300	551	855	755	674	3135
5	Student 5	198	295	945	695	610	2883
6	Student 6	475	554	670	752	648	3040
7	Student 7	307	675	878	825	753	3438
8	Student 8	310	333	615	640	600	2508
9	Student 9	330	450	735	654	690	2859
10	Student 10	514	670	856	900	819	3696
Average		340	510	817	743	677	3087

TABLE 5. Time of Completion of Problems for Each Stage of the Minnesota Model in minutes

No	Nama	Minnesota Stages Every 15 minutes			Problem Solving Time	Average Time of Each Question
		15 minutes	30 minutes	45 minutes		
1	Student 1	2b	3a	5a	53	11
2	Student 2	3b	4c	5c	50	10
3	Student 3	3b	4b	5b	52	10
4	Student 4	2c	4c	5c	52	10
5	Student 5	3b	4a	4d	48	10
6	Student 6	2b	3d	4e	51	10
7	Student 7	2e	4a	4d	57	11
8	Student 8	3a	4e	-	42	8
9	Student 9	3b	4c	5b	48	10
10	Student 10	2b	3a	4a	62	12

TABLE 5 presents data on the stages of student answers every fifteen minutes, numbers indicate the number of questions and letters indicate the stages of the Minnesota model (a) focus on the problem, (b) describe the physics situation (c) plan solutions, (d) implement solutions and (e) evaluate answer. For example, student 1 in 15 minutes completes up to 2b (question number 2, stage b, which describes a physics situation). Problem solving time is the time needed by the students to complete the whole problem (5 questions) and the average time for each question is the time to solve the problem divided by the number of questions.

The experimental class uses the Minnesota problem solving model with the initial stages of focusing on the problem that is describing the core of the problem, this helps students understand the problem, thus it speeds up problem solving at the next stage. This is in line with the statement that the step to understand the core of the problem emphasizes the success of obtaining a problem solution.This step involves deepening the problem situation, sorting the facts, determining the relationship between facts and formulating problem questions (Prince & Felder 2006; Wardhani 2010).

The stages of describing the physics situation by making physics diagrams accelerate students in solving problems because students are able to change the language of the questions into diagrams, concepts and physics principles that help students understand problems and speed up problem solving so that this is what makes the experimental class more quickly in solving problems. It can be seen in Fig. TABLE 7 that every fifteen minutes, experimental class students are not on the same question, here it can be seen the progress of students in solving problems. Learning achievement in this case fast and precise problem solving is influenced by the ability to change the form (the question language to the description of the problem) and the ability to use the laws and principles of physics to solve problems (Druxes 1993)

Students need multiple presentations of questions, such as in the stages of implementing the plan, students enter numbers along with units of magnitude. This makes it easier and faster for students to get the final result of a complete answer with the correct unit. The final unit obtained in this process determines that the previous stage process is correct and in the last stage, which is evaluating the answer, it can be seen from the units obtained so as to speed up solving problems accurately. Multirepresentation, that is writing descriptions of problems, representations of diagrams, using mathematical formulas needed to determine answers and checking can involve solutions that determine the accuracy of answers (Leigh 2004; Wardhani 2010).

The time required for the control class to solve the questions given using the Minnesota problem solving model can be seen in table 6 and the stages of working on questions every fifteen minutes can be seen in TABLE 7.

TABLE 6. Conventional Model Control Class Written Test Time in seconds

No	Name	Time Per Question					Total Time
		1	2	3	4	5	
1	Student 1	690	629	1066	1215	900	4500
2	Student 2	900	931	1080	1290	900	5101
3	Student 3	443	613	899	1587	949	4491
4	Student 4	1020	623	657	780	820	3900
5	Student 5	690	778	1275	857	1095	4695
6	Student 6	690	841	1470	601	973	4575
7	Student 7	900	1110	1065	1020	947	5042
8	Student 8	900	1140	933	990	825	4788
9	Student 9	630	1580	1090	965	779	5044
10	Student 10	276	759	1213	1189	1213	4646
Average		340	714	900	1075	1049	4078

TABLE 7. Time of Completion of Problems for Each Stage of the Conventional Model in minutes

No	Name	Conventional Stages Every 15 minutes					Problem Solving Time	Average Time of Each Question
		15 minutes	30 minutes	45 minutes	60 minutes	75 minutes		
1	Student 1	2a	3a	4a	4c	5c	75	15
2	Student 2	1c	2c	3c	4a	5a	85	17
3	Student 3	2a	3c	4a	4c	5c	75	15
4	Student 4	1c	3c	4c	5c	-	65	13
5	Student 5	2a	3a	3c	4c	5c	78	16
6	Student 6	2a	2c	3c	4c	5c	76	15
7	Student 7	1c	2c	3a	4a	5a	84	17
8	Student 8	1c	2c	3c	4c	5a	80	16
9	Student 9	2a	2c	3c	4a	5a	84	17
10	Student 10	2c	3c	4b	4c	5c	77	15

TABLE 7 presents data on the stages of student answers every fifteen minutes, numbers indicate the number of questions and letters indicate the stages of the conventional model (a) write down what is known, (b) write down what is asked (c) solve the problem. For example, NL in 15 minutes finishes up to 2a (question number 2, stage a, which is to write down what is known). Problem solving time is the time needed by the students to complete the whole problem (5 questions) and the average time for each question is the time to solve the problem divided by the number of questions.

The control class students on average answered questions beyond the allotted time. It happens because in the stage of completing the answers there is no process of visualizing images, making physics diagrams and determining physics concepts and principles. As a result, students take too long to answer questions in these stages because students have to complete the answer based only on what is known and what is being asked.

Some students are not able to solve problems on time so that students cannot find the correct final result. It is due to the respondent's lack of knowledge in carrying out mathematical operations, so respondents have not gone to the right solution to get the final result. The students have the weaknesses in connecting symbols, a tendency to see equations in physics only as mathematical equations, as well as a lack of mathematical manipulation skills so that the results obtained are less precise. By having good mathematical abilities, students can easily solve problems, especially in solving physics problems that require mathematical ability in order to be able to answer correctly the problems given in the allotted time (Zeitz, P 2007).

Students need a systematic process to solve a problem because many students in the control class answered unsystematic questions, leading to them not getting the correct final result and wasting time. Students who cannot solve the problem in the allotted time are due to the respondent's lack of knowledge of the material of the problem to be solved. With very little knowledge, any problem-solving stage is carried out will not be able to find the right solution, this is in line with the opinion (Dwiyogo 1999) that problem-solving is a process, that is a thought or mental process and the application of the acquired knowledge.

The ability of students to solve problems can be seen from the time of problem-solving towards the time given. Both classes were given the same problem-solving time, it was found that the experimental class using the Minnesota problem-solving model could work on the questions faster than the control class using the Conventional problem-solving model.The stages of solving problem with Minnesota can make students easier and more focused with the problem-solving steps from the initial stage to the final result search stage, thus with this stage, the more effective results can be obtained in solving physics problems with the allotted time.

CONCLUSION

Based on research that aims to determine the effectiveness of the Minnesota model in solving university selection physics test questions in terms of the accuracy of answers and timeliness with the experimental method, the results are that 1) the Minnesota model is effectively used to solve glasses questions in terms of answer accuracy and time. 2) The results of the accuracy of the answers and the acquisition time for the Minnesota model class are higher, and the time for completing questions is shorter than the conventional model. 3) The average value of the Minnesota model class is 77.00, while the convention model class is 65.00, and the average working time for the Minnesota model class is 3087 seconds, while the convention model class is 4078 seconds.

The results showed that the use of the Minnesota problem-solving model was effectively used in solving university physics selection test questions or similar questions that required high-level thinking. The Minnesota problem-solving model can develop students' thinking skills at the level of analyzing problems, planning solutions, and evaluating. In addition, so that the Minnesota problem-solving model can be used in learning, the researcher suggests that the developer integrate the stages of the Minnesota problem-solving model in problem-solving and optimize the involvement of students in analyzing, planning, and evaluating questions.

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