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Effectiveness Concept Attainment Tutorial Based Multi Representation of Mastery Concepts and Scientific Consistency College Student

Sri Tresnaningsih¹, Supardiono², Munasir³, Dwikoranto⁴
 Pramonoadi⁵, Titik Setyowati⁶, Dwi Sambada⁷, Rahyu Setiani⁸

^{2,3,4}Department of Physics, Faculty of Science and Mathematics, State University of Surabaya, Indonesia

^{1,5,6,7}Open University UPBJJ-UT Surabaya, Indonesia

⁸STKIP PGRI Tulungagung, Tulungagung, Indonesia

E-mail: sritresnaningsih@ecampus.ut.ac.id

Abstract. This study aims to describe the effectiveness of multi-representation based concept attainment tutorials to improve the mastery of students' concepts and scientific consistency. The trial was limited to 34 prospective teacher students using the matching pretest-posttest control group. The research data was collected using test and questionnaire methods with concept mastery test instruments, scientific consistency and response questionnaires. The data obtained were analyzed using quantitative and qualitative descriptive analysis, N-gain and t-test. The results showed that multi-representation based concept attainment tutorials included in the effective criteria in terms of the increase in mastery of concepts with a mean N-gain of 0.77, scientific consistency of students with N-gain of 0.75 and a positive response. The implementation of the Concept Attainment tutorial needs to be expanded to provide greater support with high yield criteria. Based on the things above, it can be concluded that the multi-representation based concept attainment model was developed effectively to improve the mastery of students' concepts and scientific consistency.

Keywords: concept attainment, multi representatif, mastery of concepts, scientific consistency

1. Introduction

The Basic Concepts of Science in Primary Schools are given to S1 students Open University Primary School Teacher Education (PGSD UT S1) consists of biological and physical material. The Basic Concept Material of Science consists of concepts and theories that require various analyzes and there are phenomena that require organized thinking. Students must be accustomed to understanding information and relating it to everyday life. Tutorial Basic Concepts of Science must be sought to optimize the ability of students to think and involve students in problem solving. This course is about living things and the universe; the characteristics and diversity of living things, living things and their environment, human organs, the development of living things, the structure of the human body, food, health, disease and prevention, kinematics and dynamics, matter and nature, waves and sounds, optics, electricity and magnetism, earth and universe [1]. The concepts in the course are very important, so PGSD S1 students as prospective teachers must have a good concept in mastering science. Understanding of concepts that will improve the ability to think and solve various problems must be owned by prospective teacher students [1,2,3].

Students still have difficulties in mastering essential concepts in this course. Difficulties in understanding essential science concepts are partly due to the concept of being abstract [4,5]. The results of the concept mastery tutorial in Pokjar in UPBJJ-UT Surabaya area showed that concept mastery was still 60.4 on a 100 scale [6], where the lowest value of the study was expected to be 70. The low understanding of the initial concepts caused difficulties in understanding the following concepts [20]. A preliminary study with students programming the Basic Concepts of Science in Elementary Schools by this subject tutor, students are more oriented to the mathematical problem-based problem solving exercises, and are still lacking in finding questions in the form of graphical representations or tables [6].



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Current PGSD UT student input from public and private high schools and Madrasahs. The results of the assessment conducted by TIMSS (The Trends in the International Mathematics and Science Study) [7] which is an international assessment and a benchmark for the quality of education, with the aim of knowing an increase in understanding of mathematics and science in school curricula held every four years [8]. Based on the TIMSS results in 2011 Indonesia is still ranked 40th out of 42 countries in terms of science mastery. How could this happen. This is because learning is weak in the ability to integrate information, draw conclusions, and generalize the knowledge that has to other things [9]. On the other hand, eighteen out of twenty three TIMSS science questions in 2011 were presented in the form of representations of images, graphs and diagrams so that students were not familiar with the model. In line with the opinion [10] students can only solve IPA problems in a systematic way and are less skilled in solving problems in the form of diagrams, tables, graphs, etc. The lack of even distribution of representations raises the concept information that is not optimal.

This certainly influences and is carried on until the student becomes a PGSD student and will be carried away as well as becoming an Elementary School teacher if not given enlightenment and giving or training the ability to understand concepts in a new way that links with representation. which is more powerful, sturdy, and comprehensive towards the concepts learned. It can be predicted that students are still weak in working on the questions presented in the form of multi-representation. Representation as a configuration that can describe, represent or symbolize something in a way [11,12]. While multi-representation is a way to present various representations to instill a concept in the minds of students or students need to be trained to prospective teacher PGSD students.

Based on the results of the multi-representation based concept mastery test that was tested on 42 students who programmed the Basic Science Concepts in Elementary Schools the results had not yet reached the value of 70 [12]. The questions tested consist of three themes, and one theme consists of three representations namely verbal representation, mathematical representation, and representation of images or graphics. After being analyzed the results were weak in working on the questions in verbal representation, from three verbal representation questions 6.67% were able to answer correctly, while in mathematical representations 50% were able to answer correctly, and in the graphical representation there were 20% who answered correctly.

Here it can be seen that lack of mastery of concepts and weaknesses in questions are in the form of multi representation. The results of the consistency test in answering questions, students still have not consistently answered the questions. This can identify that they do not understand the concepts being taught so that when the same concepts are presented in the form of different representations they cannot answer correctly. Therefore, in the tutorial process, a tutor is advised to have adequate mastery of concepts so that when the concepts are presented in different representations they are able to answer correctly so that they can be said to be scientifically consistent.

Tutorials with multiple representations can improve mastery of concepts [14]. Based on this, it is expected that applying a multi-representation based approach can train representation capabilities. Multi representation has three main functions, namely, to complement representation, to limit and guide other representations and the third to build a deeper understanding of concepts [15]. One of the main functions of multi representation is to build a deeper understanding of concepts, with this function it is expected that a multi-representation approach can improve mastery of concepts.

Concept Attainment is a model of concept achievement tutorial designed to develop the ability of students to think inductively. Inductive thinking is a thought process that takes place from a specific thing to a general thing. The use of the tutorial concept attainment model with a multi-representation approach is expected to be able to make students understand the concepts of science so that they can represent the concept in various forms that will make mastery of the science concept increase.

Research conducted [6], showed that after treatment of problem-based learning with a multi-representation approach, scientific consistency increased by 0.38 to be in the medium category and there was an increase in learning outcomes with a gain of 0.44 in the medium category. Based on the research conducted by [16], it shows that the concept achievement tutorial model is able to improve learning outcomes with a moderate value gain. Besides that research [4] shows that tutorials using

multi representation have good impact on mastery of concepts, and provide meaningful learning to students. Based on the various facts described above, the researcher used the Concept Attainment tutorial model with a multi-representation approach to improve mastery of concepts and scientific consistency.

Based on the background stated above, the problem can be formulated as follows: How is the effectiveness of the multi-representation based concept attainment tutorial model developed to improve the mastery of the concepts and scientific consistency of PGSD students in terms of improving concept understanding, scientific consistency and student response? The purpose of this study is to describe the effectiveness of multi-representation based concept attainment tutorial models to improve the mastery of the concepts and scientific consistency of PGSD students.

2. Research Methods

This study aims to examine the effectiveness of the multi-representation based Concept Attainment tutorial model to improve the mastery of students' concepts and scientific consistency. The research was carried out during the registration of 2018 in UT UPBJJ Surabaya in Pokjar Jombang and Pokjar Bojonegoro. The research subjects were students who programed the elementary science elementary school subjects at registration 2018.1 and 2018.2. Conducted using quasi-experiment with One-group pretest-posttest design [17] conducted by means of one group of students subject to treatment and the dependent variable measured to assess the effect of treatment [18]. The treatment in question is learning by applying the tutorial concept attainment and dependent models that are the results of understanding the basic concepts of elementary science and scientific consistency. The diagram of the One-group pretest-posttest design [19, 18] used during the limited trial is shown in Figure 1 below.

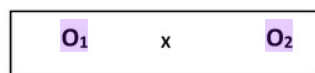


Figure 1. One group scheme pretest-posttest design

Information:

O1 = pretest is carried out before the implementation of the model concept attainment

O2 = posttest is done after the implementation of the model concept attainment

X = treatment using a concept attainment model

Data was collected by a concept understanding test and scientific consistency and student response questionnaire. Then analyzed by percentage and N-gain to find out how much improved understanding of the concept and scientific consistency and response.

3. Results and Discussion

The effectiveness of the Concept Attainment Model in multi-representation-based tutorials is viewed from the components of increasing student understanding of concepts, increasing scientific consistency of students, and student responses to the Concept Attainment Model applied in the tutorial. Understanding the concept of measuring the concept achievements received by students after the tutorial process is carried out. The results of the analysis of the value of understanding the concepts before and after students take part in the lecture process are presented in Table 1 below.

Table 1. Results of the Understanding of Basic Science Concept Test Value Analysis

Topic	Understanding Criteria	Pretest			Posttest		
		Σ Mhs	%	$\bar{x}$	Σ Mhs	%	$\bar{x}$
Living things	Height	0	0.00	17.53	31	91.18	78.88
	Medium	2	5.88		3	8.82	
	Low	32	94.12		0	0.00	
Earth and Nature	Height	0	0.00	15.65	31	91.18	76.59

	Medium	0	0.00		3	8.82	
	Low	34	100.00		0	0.00	
Dynamics and Kinematics	Height	0	0.00	16.41	32	94.12	80.53
	Medium	1	2.94		2	5.88	
	Low	33	97.06		0	0.00	
Optic	Height	0	0.00	17.65	33	97.06	79.76
	Medium	2	5.88		1	2.94	
	Low	32	94.12		0	0.00	
Wave and Sound	Height	0	0.00	17.94	33	97.06	80.18
	Medium	2	5.88		1	2.94	
	Low	32	94.12		0	0.00	
Electricity and magnetism	Height	0	0.00	19.59	33	97.06	81.06
	Medium	4	11.76		1	2.94	
	Low	30	88.24		0	0.00	

Description: $\bar{x}$ = Average value, Σ Mhs = Number of students

The application of the Concept Attainment model can increase the average test scores for understanding the basic concepts of science on all topics. The application of the concept attainment model can increase the number of students to a higher level of understanding on each topic. A total of more than 30 students before joining the learning process with the concept attainment model are still in the low category of understanding on each topic. There are 4 students who are in the category of moderate understanding, and no students enter the category of high understanding. The application of the Concept Attainment model can increase the number of students in the high category. Almost all students after participating in learning have an understanding of the basic concepts of science in a high category.

Improved understanding of the basic concepts of science respects and the sensitivity of the items about understanding concepts to PGSD undergraduate students can be seen in Table 2 below.

Table 2. Value of N-Gain and Sensitivity Item Understanding concepts

No	Topic	N-Gain		Sensitivity	
		Coefficient	Information	Coefficient	Information
1	Living Things	0.93	Height	0.46	Sensitive
2	Eart and Nature	0.82	Height	0.60	Sensitive
3	Dynamics and Kinematics	0.74	Height	0.62	Sensitive
4	Optic	0.63	Medium	0.34	Sensitive
5	Wave and Sound	0.64	Medium	0.12	Not sensitive
6	Electricity and magnetism	0.85	Height	0.56	Sensitive

Improved concept understanding is seen from the average N-gain for four topics; living things, earth and universe, kinematics and dynamics, electricity and magne in high categories. While increasing for two topics; wave and sound, optics in the medium category.

Scientific consistency is the consistency of students in answering questions correctly scientifically. With various forms of student ability questions measured. Results Analysis of the N-gain value is scientific consistency before and after students follow the tutorial in Table 3.3 below.

Table 3. N-gain value and sensitivity of scientific consistency

Topic	N-Gain		Sensitivity	
	Coefficient	Criteria	Coefficient	Information
Living Things	0.74	Height	0.67	Sensitive
Eart and Nature	0.72	Height	0.67	Sensitive

Dynamics and Kinematics	0.77	Height	0.64	Sensitive
Wave and Sound	0.75	Height	0.62	Sensitive
Optic	0.76	Height	0.60	Sensitive
Electricity and magnetism	0.76	Height	0.58	Sensitive

Table 3 shows that consistency in answering questions correctly by students before and after the tutorial process with the concept attainment model is included in the high criteria on each topic. The items used in the scientific consistency test are good and sensitive to the tutorial process on all discussion topics.

The results of student responses when implementing the Concept Attainment model showed that most students felt new to the tutorial process that had been done, felt clear about the information conveyed by the lecturers, felt easy in learning and working on questions, and were interested if the Concept Attainment model was applied to other materials. This shows that according to the theory if learning is done correctly, then the student response will also be good and the results are as expected.

7 4. Conclusion

Based on the results and discussion it can be concluded that the multi-representation based concept attainment tutorial model is effective for improving mastery of concepts and scientific consistency of prospective teacher students.

Suggestions for further research are as follows: (1) Improving the multi-representation technique in the model to increase the N-gain value on a relatively moderate topic, so as to improve student scientific consistency. (2) Paying attention to class management design, especially in group work, equal distribution of members, supporting equipment, and allocation of learning time.

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