Enhancing students’ mathematical synthesis ability by superitem learning model

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Abstract. This study aims to determine the improvement of student’s mathematical synthesis ability and student attitudes toward learning mathematics with superitem learning model. This research was quasi experiment in nature, with pretest-posttest control group design. The experimental class is given in the form of learning with superitem learning model and control classes are given learning with conventional learning model. The populations of this study are students of 8th grade public junior high school at North Bandung, with the research sample is selected two classes. Two classes are selected to be used as experimental class and control class. The instrument used consisted of mathematical synthesis ability test and attitude scale. The results of this study conclude that students’ mathematical synthesis ability that’s learning with superitem learning model better than students who received learning with conventional model. Students give positive responses and attitudes toward learning with superitem learning model.

1. Introduction

Whether we realize it or not, we usually use synthesis thinking ability in everyday life, in different level. With our synthesis capabilities it will be easy to solve a problem. The ability to synthesis related with aspects in the cognitive domain that exist in Bloom's taxonomy.

Based cognitive taxonomy by Benjamin S. Bloom [1] synthesis cognitive thinking is the ability to work with the parts, pieces, elements, and compile them into a new determination as pattern and structure. Students who have had a synthesis aspect in mathematics if they have the ability to organize (conceptualize) concepts and postulates so that something new can be obtained.

However, the reality on the level of students 'synthesis ability in Indonesia is still poor, according to Tjalla [2] from 49 countries participating in TIMSS 2007, Indonesian students' achievement in mathematics was ranked 36th, with an average score of 405 (average score international = 500). In the achievement of Mathematics learning, the five best world sequences were occupied by Taiwan followed by South Korea, Singapore, Hong Kong, and Japan. Indonesia's position is still far better than that of Syria, Egypt, Algeria, Columbia, Oman, Palestine, Botswana, Kuwait, Spain, Saudi Arabia, Ghana, Qatar and Morocco. In general, the results of TIMSS 2007 show that our students have basic mathematical knowledge but not enough to solve routine problems (form manipulation, choosing strategies, etc.) especially non-routine ones (intuitive and inductive reasoning based on patterns and regularity).
Based on research we can conclude that the students' ability in solving problems with wide material and high level of difficulty is still very poor, in this case the poor ability of students to synthesize. Because if the ability of students to synthesize is high in solving math problems, of course our rank in the eyes of the world will rise too.

Poor student achievement in this case the quality of mathematics learning outcomes due to the lack of suitable learning model given to students. Some interpretations of quality are seen from products obtained by a graduate in the form of mathematical intellectual abilities and some interpret it as a chain error that not only looks at the results, but also includes the process.

One criterion that can be used as an indicator or guide to the quality of education is student learning outcomes. Student learning outcomes indicate whether the instructional objectives that have been prepared are achieved or not. Therefore good learning outcomes can show the instructional objectives that have been prepared and achieved. Otherwise, if the learning outcomes are far from expected, it is necessary to review the instructional objectives that have been prepared, as well as review whether the teaching and learning process that has been done is appropriate or not with the lesson plans contained in the unit of study.

To achieve student learning outcomes that are in line with what is expected is not only determined by student factors, but also factors outside students which are basically the role of the teacher and the condition of the community in which the student is located. In connection with this, Rohani [3] stated that the five factors underlying the occurrence of educational interaction in this case affect the success of students in learning, namely: 1) goal factors, 2) object / material / content factors, 3) teacher and students’ factors, 4) method factors, and 5) simulation factors.

In order to be able to foster learning motivation in students it is not easy, but it is expected that with increasing student learning motivation, learning outcomes can reflect that the instructional objectives made have been achieved. Therefore the teacher must be able to carry out teaching and learning activities that can motivate students towards mastering the material. As Walker [4] has stated, changes that are learned usually produce good results when people / individuals have the motivation to do so; and practice sometimes results in changes in motivation which result in changes in achievement.

Some ways to foster motivation are through various ways of teaching, conducting repetition of information, and providing new stimulation. In general, students will be stimulated to learn (actively involved in learning) if he sees that the teaching situation tends to satisfy him according to his needs.

Another issue that also appeared prominent was the material capacity delivered, namely until now there are not many teachers (individually) or a school delivering routine or non-routine materials / questions that train students to answer how and why. Or not stimulate students to think creatively, innovatively and alternatively.

In order for students to be actively involved in the learning process, one that needs to be considered is student readiness to learn. Student readiness to learn can be accelerated by using a spiral approach from Bruner. Acceleration of student readiness to learn occurs by presenting different material or concepts adjusted to the ability of students, so that students more easily understand it. The spiral approach is the path taken to develop concepts, from intuitive ways to analysis, from exploration to mastery by providing enough space between the lowest and highest stages. The spiral approach is relevant to the characteristics of mathematics learning, namely learning from concrete things to abstract, from simple to complex and concepts or principles level.

Students will understand a lesson if they have sufficient prerequisite knowledge and the material is presented in accordance with the readiness of students, according to the application of a spiral approach from Bruner. Meanwhile Biggs and Collis [5] conduct studies on the structure of learning outcomes with tests arranged in superitem form. Biggs and Collis suggest that each stage or cognitive level has the same response structure and is increasing from simple to abstract. The structure is called the SOLO Taxonomy (Structure of the Observed Learning Outcome). Based on the quality of the child response model, the SOLO stage of children is qualified in five stages: structural, unstructured, multi structural, relational, and abstract.
The study of the SOLO stage was also carried out by [6]. The findings in this study reinforce the belief that in mathematics learning, the concept description to students should not be directly in a complex concept or process but must start from a simple concept and process.

Recognizing the importance of a learning model that focuses on improving the ability of synthesis in mathematics learning, because with the ability of synthesis in mathematics learning students are able to solve mathematical problems in everyday life, and are able to apply mathematics to other disciplines well, and able to minimize symptoms in students who cannot solve the problem of synthesis ability in mathematics learning. For this reason, we need a learning model that emphasizes active student learning. This can be realized through a form of learning designed so that students are active.

One alternative model of mathematics learning that links SOLO Taxonomy and enhances student learning outcomes (in synthesis ability) is to use a superitem learning model. Superitem [7] is "a general situation or branch of information followed by five questions, one question for each level in the SOLO taxonomy." In addition, the superitem learning model is learning that starts from the simple ones that increase in the more complex.

This was also confirmed by the results of Firmasari's [8] study which reported that the average mathematical reasoning ability using SOLO taxonomy-based teaching materials with superitem techniques was better than the average class using ordinary teaching materials. In addition, Firmasari's research [7] shows that there is complete mastery of students' understanding and mathematical reasoning abilities using superitem techniques.

2. Methods

This study uses the pretest-posttest control group design research. In the experimental group is given learning with superitem learning models to examine students' mathematical synthesis abilities. The subjects of this study were 84 grade 8 students from one state junior high school which was determined purposively. This study instrument is: synthesis ability test in mathematics learning, observation sheets and student worksheets.

3. Result and Discussions

The following are the results of research on students' synthesis ability in learning mathematics as presented in Table 1.

| Grade   | Normalized Gain | Experiment | Control |
|---------|-----------------|------------|---------|
| High    | 0.8980          | 0.4623     |         |
| Medium  | 0.6749          | 0.6139     |         |
| Low     | 0.7307          | 0.5997     |         |

Based on the data in table 1 above, the ability of students to analyze mathematics in high groups by using superitem learning models is better than students who learn with ordinary learning. This can be seen from the difference in the average normalized gain value of the control class with the experimental class in the high group of 0.4623 and 0.8980. From this value, it can be seen that the difference in the increase in synthesis ability in mathematics learning in the experimental group is included in the high category because \( g \geq 0.7 \), while for the control group the average normalized gain is in the medium category because it is in the range between \( 0.3 < g < 0.7 \).

The ability to synthesize students in learning mathematics in the medium group by using superitem learning models is better than students who learn with ordinary learning. This can be seen from the difference in the average normalized gain value of the control class with the experimental class in the medium group which is 0.6139 and 0.6749. From this value it can be seen the difference in the increase
in synthesis ability in mathematics learning in the experimental group and the control group, the average normalized gain is in the medium category because it is in the range between 0.3 < g < 0.7.

The ability to synthesize students in mathematics learning in low groups by using superitem learning models is better than students who learn with ordinary learning. This can be seen from the difference in the average normalized gain value of the control class with the experimental class in the low group of 0.6369 and 0.7307. From this value, it can be seen that the difference in the increase in synthesis ability in mathematics learning in the experimental group is included in the high category because g ≥ 0.7, while for the control group the average normalized gain is in the medium category because it is in the range between 0.3 < g < 0.7.

Mathematics teacher was given an observation sheet to evaluate the researcher and measure student activity during the learning process. Observation sheets are given three times during the teaching and learning process. At the first meeting the learning activities conducted by researchers only reached 50% and the learning activities carried out by students only reached 25%. At the second meeting the learning activities conducted by researchers only reached 75% and the learning activities carried out by students only reached 62.5%. At the third meeting the learning activities carried out by the researchers had reached 100% and the learning activities carried out by the students reached 100%. This means that the teacher and also the students have carried out teaching and learning activities effectively and in accordance with the learning scenario.

4. Conclusion
Based on the results, following conclusions were obtained: 1) the ability of students to synthesize mathematics in high and low groups by using superitem learning models better than students learning with ordinary learning, 2) synthesis ability students in learning mathematics in the medium group using superitem learning models are no better than students who learn with ordinary learning. Students' attitudes are known from the high interest, motivation, activity during learning, and understanding of the importance of mastering mathematics.

5. References
[1] Ruseffendi H E T 2006 Pengantar kepada Membantu Guru Mengembangkan Kompetensinya dalam Pengajaran Matematika untuk Meningkatkan CBSA (Bandung: PT Tarsito)
[2] Tjalla A 2010 Potret mutu pendidikan indonesia ditinjau dari hasil-hasil studi internasional http://repository.ut.ac.id/2609/1/fkip201047.pdf
[3] Rohani Ahmad H M 2004 Pengelolaan Pengajaran (Jakarta: PT Rineka Cipta)
[4] Walker 1984 Conditioning dan Proses Belajar Instrumental (Jakarta: UI Press)
[5] Biggs J B and Collis K F 1982 Evaluating the Quality of Learning: the SOLO Taxonomy (New York: Academic Press)
[6] Sumarmo U 1994 Suatu Alternatif Pengajaran untuk Meningkatkan Kemampuan Pemecahan Masalah Matematika pada Guru dan Siswa SMP. Laporan Hasil Penelitian FPMIPA IKIP. (Bandung: Tidak Diterbitkan)
[7] Firmasari S and Aminah N 2016 Analisis Pemahaman dan Penalaran Matematis pada Perkuliahan Teori Bilangan menggunakan Teknik Superitem Repository FKIP Unswagati http://www.fkip-unswagati.ac.id/ejournal/index.php/repository/article/viewFile/343/306
[8] Firmasari S 2015 Implementasi Metode Tutor Sebaya dalam Pengembangan Bahan Ajar Menggunakan Taksonomi SOLO Superitem Euclid Jurnal Pendidikan Matematika ISSN 1 12355-1712