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Implementing the Contextual Teaching and Learning to Improve Students' Mathematical Connection and Representation Skills

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Abstract. This study aims to improve students' mathematical connection and representation skills as well as students' learning activities. This study implemented the Contextual Teaching and Learning (CTL) for students in studying the topic of linear programming. The subjects were 36 students of eleventh grade at MAN Binjai consisting of 13 male and 19 female students. The purpose of the observations was to measure students' learning activities and using the tests to measure students' mathematical connection and representation skills, and also questionnaires to measure students' positive responses in learning mathematics. The results showed that there was an increase in students' mathematical connection skills with the mean percentage of 65.63% for Cycle 1 and 87.50% for Cycle 2. There was an increase in students' mathematical representation skills with the mean percentage of 75% for Cycle 1 and 93.75% for Cycle 2, and there was an increase in students' learning activities with the mean percentage of 80.72% for Cycle 1 and 87.86% for Cycle 2. Students who were taught with the aid of CTL approach could increase their learning activities in the good category.

Keywords: Contextual Teaching and Learning, Mathematical Connection Skills, Mathematical Representation Skills

INTRODUCTION

Mathematics is one of the subjects that strongly supports the development of science and technology. This is because mathematical concepts and principles are widely used and needed in everyday life, both as a tool in the application of other fields of science and in the development of mathematics itself. Mathematics is not only a science that is needed for oneself, but a science that is useful for most people for other sciences (Hudoyo, 2003). The rapid progress of science and technology today cannot be separated from the role of mathematics. It can be said that the main foundation of science and technology is mathematics. Mastery of mathematics is a must, especially in the era of global competition like today. In addition to mathematics as an entry point in mastering science and technology which is growing so rapidly, by learning mathematics people can develop the ability to think systematically, logically, critically and creatively which is very much needed in life (Sriyanto, 2007). The objectives of learning mathematics in the curriculum in Indonesia are to improve problem solving skills, argumentation skills, communication skills, connection skills, and representation skills.

Based on observations that the results of learning mathematics at MAN Binjai for the last 2 years have not been maximized as expected. This is because there are unfinished grades, especially in the topic of linear programming. The low score of mathematics must be viewed from five aspects of general mathematics learning, which outlines that students in learning mathematics must understand and actively build their previous knowledge: learning to communicate, learning to reason, learning to solve problems, learning to connect and form attitudes and positive attitude towards mathematics (NCTM, 2000).

This happens because the mathematics taught tends to be monotonous and generally uses less varied approaches and only adheres to dictation or textbooks. There are still teachers who teach the lecture method without actively involving students so that students become bored, sleepy, passive, and only take notes (Slameto, 2010). This resulted in the process of learning mathematics is still often encountered teacher dominance which resulted in students tend to be more passive. So this causes the mastery of the material that has been conveyed by the teacher is not mastered by the students. Thus, student learning outcomes are very low (Budiningsih, 2008).

The students' mathematics learning outcomes still did not show good results. It showed that students' learning outcomes were still in the low category. This was because students did not understand the basics of linear programming so that the results obtained by students at the end of learning were still less than optimal. The low learning outcomes of students' mathematics can not be separated from the role of teachers in managing learning. Teachers tend to transfer their knowledge to students' minds, emphasize results rather than process, teach sequentially page by page without discussing the relationship between concepts or problems (Marpaung, 2004). In learning mathematics the teacher always emphasizes on students to imitate the teacher in solving problems so that they are more rote in nature, not giving students the freedom to solve the problems according to their style (Ismail, 2006).

Responding to problems that arise in the process of learning mathematics in schools, it is necessary to find solutions to learning approaches that can improve students' mathematical connection and representation skills. So the approach that will be implemented in this recent study is the Contextual Teaching and Learning (CTL). To improve students' mathematical connection skills in learning mathematics is one of the important things. Authentic learning is also very much needed to improve students' mathematical connection skills, one of which is a contextual approach. It should be noted that the principle of the contextual teaching and learning is the principle that learning will be more meaningful if students experience it themselves (Hamalik, 2010). Representation is the result of translating a diagram or physical model into symbols or words. To develop the ability to represent, it is necessary to understand mathematics: understanding the concepts, principles, and strategies for solving. The low ability of students' mathematical connections and representations is also seen from the lack of skill of students in generating ideas, asking questions, and responding to questions or opinions of others.

Contextual Teaching and Learning is a learning model that links the material being taught with the real situation of students (Nurhadi, 2003). This model also encourages students to be more active in learning activities. The concept of CTL has a constructivist foundation and holds the view that learning will be meaningful if children discover what they are learning for themselves, not knowing it from others. Thus, learning outcomes are expected to be more meaningful for students, because the learning process takes place naturally in the form of student activities, namely working and experiencing, not transferring knowledge from teacher to student. In this CTL-based learning model that the learning process takes precedence over results, so it is hoped that students can understand the concepts taught according to their own learning styles, so that students can realize that the learning is meaningful for themselves (Johnson, 2009).

METHOD

This study was conducted at MAN Binjai from August to October 2018. The subjects were 36 students of eleventh grade at MAN Binjai totaling 13 male and 19 female students. This study was conducted in two learning cycles. If Cycle 1 is still felt to be less successful or does not meet the success indicators, it will be continued for Cycle 2 by first making improvements to the lesson plans that have been made (Arikunto, 2006). The improvement of the lesson plan is the implication of the

reflection that has been done in cycle I. For each cycle, two meetings are held. At the end of each cycle, one formative test is conducted outside of learning hours. With two learning cycles, it is expected that students' mathematical connection and representation skills will increase, and even students' activities in learning will run well.

The data analysis employed the qualitative and quantitative approach. They were carried out every time after giving a learning action in each cycle. The data analysis is the result of observations made to test the results of program planning implementation, research monitoring and research reflection on each implementation of classroom action research. It study was carried out using the flow method which includes the data reduction, data presentation, and drawing conclusions.

The success indicator is based on the minimum completeness criteria applied at MAN Binjai, where this study is aimed at improving the students' mathematical connection and representation skills, indicated by the following indicators: (1) the results of students' mathematical connection and representation skills are at least 70, (2) the percentage of classical completeness is at least 85% of all research samples, (3) at least 80% of students' learning activities are in the good category, and (4) at least 80% of teacher's activities are in the good category.

RESULTS AND DISCUSSION

Results for Cycle 1

Based on an agreement with the teacher, the study was carried out every Wednesday and Friday during the mathematics learning hours for eleventh grade for the topic of linear programming. Based on the teacher's observations, in studying the perimeter and area of geometric shapes, students generally did not understand the concept of the formula. So far, students have memorized the formula for the perimeter and area of the flat figure. This has shown that students needed to pay attention towards the aspects of mathematical connections and representations so that they did not need to memorize and simply connect the concepts that they have already known.

The activities carried out for Cycle 1 include planning, acting, observing, and reflecting. In carrying out the learning action, the researcher acts as a teacher. The learning activities for Cycle 1 have implemented the CTL.

1. Planning

There are several plans that must be carried out by researchers before carrying out research actions: (a) preparing a learning implementation plan for the topic of linear programming in accordance with the stages of the CTL that is used as a reference in carrying out actions, (b) planning the group division heterogeneously based on the students' social background and intellectual abilities. In determining the group division assisted by peers, (c) making observation sheets for teacher activities with the aid of CTL in teaching linear programming, (d) making observation sheets for student activities to observe student activities during the application of the action, (e) preparing contextual teaching materials which is used in groups, (f) arranging the evaluation tests to measure students' mathematical connection and representation skills, (g) preparing questionnaires to measure students' responses to mathematics learning through CTL, and (h) coordinating any actions with peers as observers in the learning process.

2. Acting

It carried out all the plans that have been prepared through CTL in the learning process of mathematics. The implementation of the actions for Cycle 1 was carried out for two meetings in the learning process and one more meeting to measure students' mathematical connection and representation skills.

3. Observing

During the implementation of the Cycle 1, which consisted of two meetings, all observers observed the activities of teachers and students in learning mathematics through CTL. In general, observations of teacher and student activities for Cycle 1 were presented below.

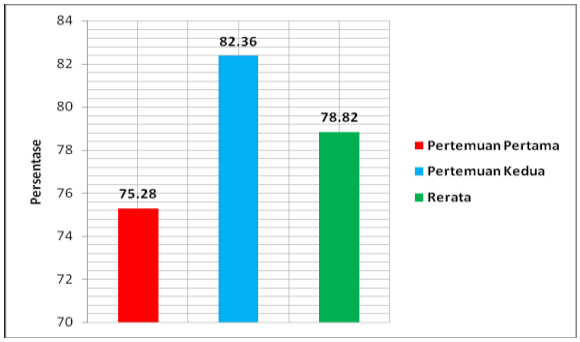

Figure 1. Teacher's Activity Observation

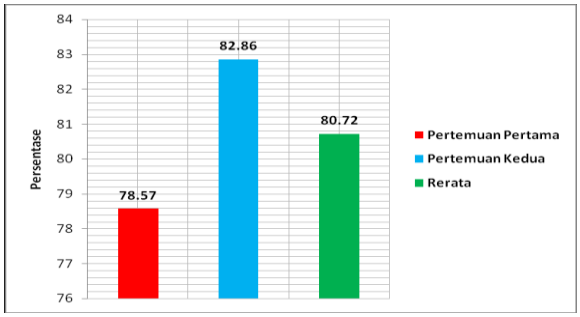

Figure 2. Students' Activity Observation

In general, the results of students' mathematical connection and representation skills for Cycle 1 were presented as follows:

Table 1. Students' Connection Skills

No.	Aspects	Number of Students	Percentage
1.	Complete learning	21	65.63%
2.	Incomplete learning	11	34.37%
3.	Average	69.01%	
4.	Classical learning completeness	$\frac{21}{32} \times 100\% = 65.63\%$	

Table 2. Students' Representation Skills

No.	Aspects	Number of Students	Percentage
1.	Complete learning	24	75%
2.	Incomplete learning	8	25%
3.	Average	77.08%	
4.	Classical learning completeness	$\frac{24}{32} \times 100\% = 75\%$	

4. Reflecting

Before the researcher did a reflection with colleagues on all the results of the evaluation and observations during the mathematics learning process through CTL. It was discovered that the results of teacher activities and students' mathematical connection and representation skills did not meet the indicators of success, so the action would be continued for Cycle 2.

Before proceeding with further actions, there are several aspects that must be carried out by researchers on students who have not succeeded, including: (1) conducting interviews with students who are still having difficulties, (2) identifying difficulties faced by students, (3) providing additional contextual teaching materials that have not been understood by students, and (4) giving assignments individually. The results of this reflection will be used to revise the plan for Cycle 2. These deficiencies for Cycle 1 are considered as plans for Cycle 2.

Results for Cycle 2

The action in this study was a follow-up to the results of the reflecting phase of the Cycle 1. The action of the Cycle 2 was carried out as an effort to improve and solve problems that arise Cycle 1. The emphasis for Cycle 2 was the activities to find answers to the problems given in contextual teaching materials.

1. Planning

In general, the activities carried out at each stage for Cycle 2 were the same as the activities Cycle 1. The fundamental change was the pattern of the types of actions given as previously stated. The action plan for Cycle 2 was prepared based on the results of reflecting phase and data analysis for Cycle 1. In the Cycle 2, the action plan taken was to change group members by grouping students heterogeneously based on the test results of students' mathematical connection and representation skills for Cycle 1, and the teacher paid more attention to student learning activities in the learning process through CTL.

2. Acting

It carried out all the plans that have been prepared through CTL in the learning process. The implementation of the actions for Cycle 2 was carried out for two meetings in the learning process and one meeting to measure students' mathematical connection and representation skills.

3. Observing

During the implementation of the Cycle 2, which consisted of two meetings, all observers observed the activities of teachers and students in studying mathematics through CTL. In general, observations of teacher and students' activities for Cycle 2 could be clearly seen below.

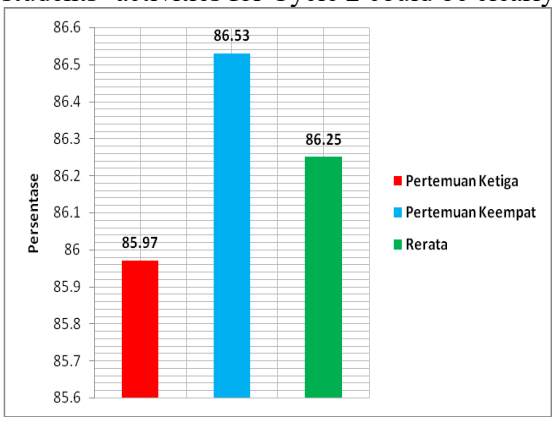

Figure 3. Teacher's Activity Observation

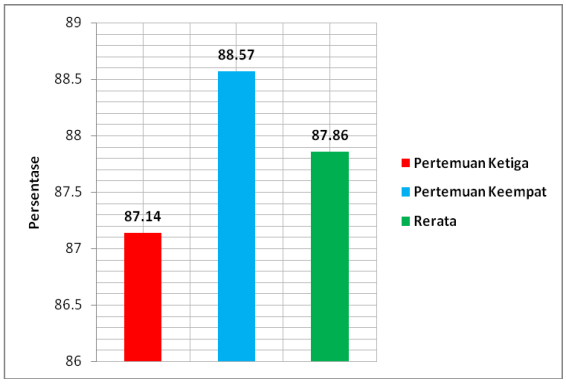

Figure 4. Students' Activity Observation

In general, the results of students' mathematical connection and representation skills for Cycle 2 could be seen as follows.

Table 3. Students' Connection Skills

No.	Aspects	Number of Students	Percentage
1.	Complete learning	28	87.50%
2.	Incomplete learning	4	12.50%
3.	Average	78.65%	
4.	Classical learning completeness	$\frac{28}{32} \text{x} 100\% = 87.50\%$	

Table 4. Students' Representation Skills

No.	Aspects	Number of Students	Percentage
1.	Complete learning	30	93.75%
2.	Incomplete learning	2	6.25%
3.	Average	84.11%	
4.	Classical learning completeness	$\frac{30}{32} \text{x} 100\% = 93.75\%$	

4. Reflecting

The researcher previously conducted a reflection with colleagues on all the results of the evaluation and observations during the mathematics learning process through CTL. Thus, the effectiveness of the learning process in terms of the completeness of learning outcomes based on the results of students' mathematical connection and representation tests for Cycle 2. Based on the test results of students' mathematical connection and representation skills, the classical mastery of students' mathematical connection skills was 87.50% or 28 students who had met the minimum completeness criteria, while the classical mastery of students' mathematical representation skills was 93.75% or 30 students who had met the minimum completeness criteria. Based on these results, it was concluded that the results of students' mathematical connection and representation skills for Cycle 2 had met the criteria for success indicators; at least 85% students had mastered their learning activities, so that learning did not need to be continued anymore for the next cycle.

After processing the data that has been obtained for the actions of Cycle 2, the researchers and their colleagues reflect based on the results that have been achieved. The reflections were presented as follows:

1. Learning management by dividing study groups consisting of 5-6 students with contextual teaching materials as a teaching medium provided a more meaningful learning experience for students. The reason for reducing the number of students in groups was so that students were more controlled so that students were more active and more optimal in learning. In the learning implementation of the Cycle 2, students began to get used to the CTL, so that the obstacles they have faced began to be overcome. Students began to dare to ask questions, provide responses, and provide ideas, opinions or arguments and able to draw conclusions on problems that have been resolved.
2. Based on the observations on teacher's activity and the percentage obtained at the third meeting was 85.97% in the good category, and at the fourth meeting the percentage was 86.53% in the good category. Generally, the teacher's activities had reached good criteria with the mean percentage of 86.25%.

   Based on the results aforementioned, it showed a significant increase so that it could be concluded that the learning process carried out by the teacher in managing the learning process through CTL for Cycle 2 had met the criteria for the success of the learning process with good assessment as well.
3. Observations made on student activities during learning processes have shown a better level of activity. This is based on the results of the percentage of each meeting; the percentage at the third meeting was 87.14% in the good category, the percentage at the fourth meeting was 88.57% in the good category, and in general the student activities in the mathematics learning process through CTL was good with the mean percentage of 87.86%. Thus, it was concluded that student activities

during learning processes through CTL have shown a better level of activity. This could be seen from almost all indicators of student activities have been achieved. This was because students were already familiar with the learning approach used by researchers.

4. The results of students' mathematical connection and representation levels for Cycle 2 have achieved classical learning mastery and met the minimum success indicator of 85%. Thus, the learning implementation of the Cycle 2 has been completed and did not need to be continued for the next cycle.

Discussion

1. Improving Students' Mathematical Connection Skills through CTL

Based on the results of students' mathematical connection tests for Cycle 1 and Cycle 2, it was found out the mean percentage was from 69.01% to 78.65%, the lowest percentage was from 41.67% to 58.33% and classical learning completeness was from 65.63% to 87.50%. From the test results, it could be seen that there was an increase in students' mathematical connection skills. The increase in students' mathematical connection skills in this study occurred as a result of the teacher's ability to carry out learning through CTL and the use of contextual teaching materials. Through the steps of the CTL approach, material information presented in the form of challenging contextual problems in each contextual teaching material has attracted students' interest in finding answers through process sharing activities between students when they have discussions in the classroom (Agustina, 2011).

The existence of the discussion has created verbal communication between students where students share ideas in conveying their opinions with words that match their understanding and compare them with the opinions of their friends without being afraid to make mistakes in solving problems. Through group discussion activities there will be good cognitive elaboration, which can increase the power of reasoning, student involvement in learning, giving them the opportunity to express their ideas and opinions on the given problem. When the discussion occurs, the teacher guides and sees the weak points experienced by students in finding solutions to the problems given. From the various weaknesses of these students, the teacher provides scaffolding in the form of encouragement, instructions, examples and questions that direct students to be able to write down known components, asked components and mathematical modeling. The scaffolding provided by the teacher connects students' knowledge with what they learn (Sanjaya, 2008). Thus, it was concluded that there was an increase in students' mathematical connection skills in studying the topic of linear programming through CTL.

2. Improving Students' Mathematical Representation Skills through CTL

Based on the test results of the students' mathematical representation skills for Cycle 1 and Cycle 2, it was known that the mean percentage was from 77.08% to 84.11%, the lowest percentage was from 58.33% to 66.67% and classical learning completeness was from 75% to 93.75%. From the test results, it could be clearly seen that there was an increase in students' mathematical representation skills. The increase in students' mathematical representation skills in this study occurred as a result of the teacher's ability to apply the CTL approach properly and correctly. In addition, students were more flexible and had sufficient space to optimize their ability to study individually or in groups with friends, where this learning emphasizes more on the students themselves. Learning is no longer focused on the teacher alone, but rather involves student activities in the learning process (Mudzakkir, 2006). Thus, it was concluded that there was an increase in students' mathematical representation skills in studying the topic of linear programming through CTL.

3. Increasing Student Activities through CTL

The success of students in learning mathematics is not only seen from the success of students in completing the material, but the most important thing is how the completion of the material is carried out. This means that student activities in the mathematics learning process are also very important to note. In this concept, students are required to be active in constructing their knowledge through: (a) student activities in formulating learning objectives, (b) student activities in carrying out initiatives, (c) student activities both physically, mentally, emotionally and intellectually in the learning process, (d) student activities to self-evaluate the learning outcomes that have been carried out, and (e) student

activities independently to carry out activities such as tests and tasks that must be done (Sitohang, 2010).

Based on the results of observations of student activities during learning through CTL, there was a very significant increase in student activities. This was based on the results of observations made by colleagues obtained the mean percentage of 80.72% for Cycle 1 to 87.86% for Cycle 2. In line with the increase in student activities through CTL, the ability of mathematical representation and mastery of student learning increases as well.

Likewise, the involvement of students in finding and utilizing each learning resource is still in the moderate category. So we need an effort to provide learning resources that can mediate the knowledge that students already have with the knowledge they will learn. The mediation process referred to in this case is a student activity sheet containing contextual problems. Trianto (2009) views the knowledge that is built in children's minds as a result of active interaction with their environment through the process of assimilation and accommodation. As for the factors that influence the creation of a better learning process, among others: (1) the creation of a good reciprocal relationship between teachers and students, indicated by the teacher's activities guiding students who are already good, the increase in student activity is marked by daring appearances. students in front of the class in presenting the results of their group discussions, (2) the cohesiveness of students in discussing and completing the tasks given by the teacher so as to foster a conducive learning atmosphere, and (3) new learning models or approaches so that students do not feel bored with the teaching that is being taught in the classroom (Syaban, 2009). Thus, it was concluded that there was an increase in student activities through CTL.

CONCLUSIONS

Based on the results that has been described, it was concluded that: (1) learning through CTL could improve students' mathematical connection skills with the mean percentage of classical learning completeness was 65.63% for Cycle 1 to 87.50% for Cycle 2, (2) learning through CTL could improve students' mathematical representation skills with the mean percentage of classical learning completeness was 75% for Cycle 1 to 93.75% for Cycle 2, and (3) learning through CTL could increase student activities in the classroom and it was in the good category.

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REFERENCES

Agustina, L. (2011). *Increasing mathematics activities and connections for the 8th grade students at SMPN 8 Medan through a contextual learning approach*. Thesis. Unimed: Unpublished.

Arikunto, S. (2006). *Prosedur penelitian suatu pendekatan praktik.* Jakarta: PT. Rineka Cipta.

Budiningsih, A. (2008). *Learning and instruction*. Jakarta: PT. Rineka Cipta.

Hamalik, O. (2010). *Proses belajar mengajar.* Jakarta: Bumi Aksara.

Hudoyo, H. (2003). *Curriculum development and learning*. Bandung: Alphabeta.

Ismail. (2006). *Capita selecta mathematics learning*. Jakarta: Open University.

Johnson, E.B. (2009). *Contextual teaching and learning makes teaching and learning activities fun and meaningful*. Bandung: MLC.

Marpaung, Y. (2004). Reformasi pendidikan matematika di sekolah dasar. *Jurnal Basis*, *53(7)*: 21-28.

Mudzakkir, H.S. (2006). *Learning strategy "think-talk-write" to improve the ability of*

mathematical representation of various junior high school students (experiments on 8th grade students of garut regency junior high school. Thesis. UPI Bandung: Unpublished.

National Council of Teachers Mathematics. (2000). *Principles and standards for school mathematics*. NCTM: Reston VA.

Nurhadi. (2003). *Contextual learning approach*. Jakarta: King Grafindo Persada.

Sanjaya, W. (2008). *Educational process-oriented learning strategy*. Jakarta: Kencana Prenada Media Group.

Sitohang, R. (*2010). Application of contextual learning to improve student learning outcomes*. Thesis. Unimed: Unpublished.

Slameto. (2010). *Belajar dan faktor-faktor yang memengaruhinya*. Jakarta: PT. Rineka Cipta.

Sriyanto, H.J. (2007). *Successful strategies for mastering mathematics*. Yogyakarta: Galang Press.

Syaban, M. (2009). Developing students' mathematical power.http://educare.e-fkipunla.net/ index2.

Trianto. (2009). *Designing a progressive innovative learning model.* Surabaya: PT. Golden.