THE ENHANCEMENT OF JUNIOR HIGH SCHOOL STUDENTS' ABILITIES IN MATHEMATICAL PROBLEM SOLVING USING SOFT SKILL-BASED METACOGNITIVE LEARNING

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Abstract

The aim of this study is to know the differences of enhancement in mathematical problem solving ability (MPSA) between the students who received soft skill- based metacognitive learning (SSML) with the students who got conventional learning (CL). This research is a quasi experimental design with pretest-postest control group. The population in this study is the students of Junior High School in Pekanbaru city. The sample consist of 135 students, 68 of them are from the high-level school, and 67 students are from the middle-level school. The instruments are mathematical prior knowledge (MPK) test, MPSA test, instruction observation sheet, students journal about the lesson, and the guideline for interview. The data was analyzed using t-test and two-way ANOVA. The result of data analysis indicates: (1) overall, the enhancement of students' MPSA with SSML approach significantly is higher than those with conventional learning (CL); (2) there is no interaction between the learning approach (SSML and CL) with the school level (high and middle) toward the enhancement of MPSA; (3) there is no interaction between the learning approach (SSML and CL) with MPK (upper, middle, and low) toward the enhancement of MPSA.

Keywords: Mathematical Problem Solving Ability, Soft Skills-Based, Metacognitive Learning

Abstrak

Penelitian ini bertujuan mengetahui perbedaan peningkatan kemampuan pemecahan masalah matematis (KPMM) antara siswa yang mendapat pembelajaran metakognitif berbasis soft skills (PMSS) dan siswa yang mendapat pembelajaran konvensional (PK). Penelitian ini berbentuk kuasi eksperimen dengan disain kelompok kontrol pretes-postes. Populasi adalah siswa SMP Negeri Kota Pekanbaru dengan sampel 135 siswa, yaitu 68 siswa sekolah level tinggi dan 67 siswa sekolah level sedang. Instrumen penelitian adalah tes kemampuan awal matematis (KAM), tes KPMM, lembar observasi pembelajaran, jurnal siswa, dan pedoman wawancara. Analisis data menggunakan uji t dan ANAVA dua jalur. Hasil yang diperoleh dalam penelitian ini adalah: (1) secara keseluruhan, KPMM siswa yang mendapat pendekatan PMSS memperoleh peningkatan yang secara signifikan lebih tinggi daripada siswa yang mendapat pendekatan PK; (2) tidak terdapat interaksi antara pendekatan pembelajaran (PMSS dan PK) dengan level sekolah (tinggi dan sedang) terhadap peningkatan KPMM; (3) tidak terdapat interaksi antara pendekatan pembelajaran dengan KAM (atas, tengah, dan bawah) terhadap peningkatan KPMM.

Kata Kunci: Kemampuan Pemecahan Masalah Matematis, Pembelajaran Metakognitif Berbasis Soft Skills

The low of Indonesian students' mathematical abilities are a classic problem that cannot be overcome in a short period of time. The study of TIMSS 2007, TIMSS 2011 and PISA 2009 suggest that Indonesian students have low proficiency in answering the questions of international standard, especially in mathematical problem solving ability. This weakness appears due to the students are

unusual to solve non-routine problems in mathematical learning that challenge students to think. According to Sabandar (2010), it is necessary about situations and problems in the classroom that challenging and exciting until can get the curiosity and also improve the students' wishes to think. Description about the result studies of TIMSS and PISA equivalent results with Elvina & Tjalla (2008) and Kadir (2008 and 2009). The major drawback found in the study are included in the determination of the appropriate mathematical model when solving problems so not completed impact on solving the problem. Preliminary study (Murni, 2010) also found that the mathematical problem solving abilities of students grade VII in several schools in Pekanbaru city is still low. The weakness that was seen in the work result of the students are in terms of: determining the mathematical model, selecting the right and systematic strategy, using a concept or principle, and computational errors.

Charles et al. (Laurens, 2010) states that the purpose trained mathematical problem-solving abilities are to: (1) develop thinking skills, (2) develop the ability to select and use problem-solving strategies, (3) develop attitude and confidence in solving problems, and (4) develop the ability to monitor and evaluate their own ideas for solving problems. When associated with metacognition which has an important role in designing, monitoring, and evaluating cognitive processes students in learning and thinking so that this goal has a correlation with metacognition. Schoenfeld (Yimer & Ellerton, 2006) stated that metacognition is known as a key factor in problem solving, including: (1) determine the knowledge, (2) formulate a plan solving, (3) choose the solving strategies, and (4) monitor and evaluate the activity that is used during problem solving. Thus, metacognitive strategies can help students to solve problems start from exploring its knowledge to solve problems, plan solutions, monitoring the process of thinking in problem solving, and evaluating the process and results of problem solving. This means, it can be said that metacognitive strategies are very important towards students in mathematical problem solving.

The research about mathematical problem solving by observating metacognitive behavior contribution that have more do start from elementary school until college. Those research are by Eizenberg & Zaslavsky (2003); Yimer & Ellerton (2006); and Ibraheem, A et al. (2009). Eizenberg & Zaslavsky (2003) show that the findings have a association among collaboration, control and successful problem solving. Problem solving by collaborative more beneficial than problem solving individuality. Rate of successful is higher than in getting the right solution that is got from them who works by couple because can control each other about problem solving ability. Yimer & Ellerton (2006) explain the research result that give five phases problem solving description (understanding, formula-transformation, implementation, evaluation, and internalization) are accociated with metacognitive behavior. The metacognitive behavior is very required in each phase of those mathematical problem solving.

In reality learning mathematical, efforts to balance between the cognitive, affective and psychomotor have always done, but in the reality is the cognitive as dominant. As a result, students are rich capabilities that are hard skills but still weak in soft skills are contained in the affective and

psychomotor aspects. The weakness soft skills of students as a result of the less cultivated and less developed soft skills in mathematics learning. As stated by Prastiwi (2011) that develop soft skills of students in learning is very important so that they can adjust to the environment, good morals, and to solve problems in their lives independently.

Taking into account the above conditions so it is necessary for teachers or schools to development in the process of learning mathematics. One strategy that can be applied in learning mathematics is to enhance students' awareness of the process of thinking and learning activities. Learning begins serving contextual problems by involving soft skills in order to develop students' mathematical problem-solving skills.

Learning is applied in this study named soft skills-based metacognitive learning. Learning is instill awareness to the student a process of how to design, monitor, and evaluate the thought processes and activities carried out in solving problem. To solve the problem, students need to connect the past and present knowledge, use appropriate problem-solving strategies, and reflect on the process and the solution. In every activities of the students in the learning process of development values of soft skills such as: religious, self-confident, independent, curiosity, hard work, courtesy, respect, honesty, and cooperation. When opening the lesson, was empowered values of soft skills such as: religious, confident, polite, and honest. When students work independently, was empowered values of soft skills such as: self-confidence, curiosity, responsibility, independent, and hard work. When the discussion group, was empowered values of soft skills such as: self-confidence, teamwork, independent, caring, respectful, logical, polite, and honest. When the results of the group discussions were presented to the class aimed in sharing ideas between groups, the values that was empowered soft skills such as: self, respect, confidence, responsibility, and polite.

Besides learning factors, there are other factors suspected to contribute to the development of mathematical problem solving ability of the school level factors and factors of mathematical prior knowledge (MPK) of students. This research was focused on metacognitive learning basis for soft skills (SSML) to get the development of mathematical problem-solving abilities (MPSA) of grade VII in terms of the whole student, school level (high and middle) and mathematical prior knowledge (MPK) of students (upper, middle, and low).

Empowerment of soft skills so that students do not feel anxious in learning mathematics. Through the teacher's behavior is polite, ask questions and engage students with a friendly, is inviting students mutual respect and cooperation in the discussions, empowering curiosity, honesty, and self-confidence are expected to gain the values of soft skills in students. The values of soft skills are empowered to bring a comfortable condition to the students in learning mathematics so that the student of dilligent of participation to get a successful mathematical problem solving in this study. Thus, this study in addition to develop metacognitive behaviors also empowers students soft skills that is necessary in the character building of students so that the dissertation is entitled: "The Enhancement

of Junior High School Students' Abilities in Mathematical Problem Solving Using Soft Skill-based Metacognitive Learning".

METHOD

This research is a quasi experimental design with pretest-postest control group (Ruseffendi, 2005) described as follows.

A: O X O

A: O O

Information:

A: The selection of a random sample of classes at each school level.

X: The application of Soft Skill- based Metacognitive Learning (SSML)

O: MPSA test (pretest-postest)

The research sample is determined by the purposive sampling technique in grade VII students from two junior high school level from both junior high school level (high and middle) in Pekanbaru city. From each selected Junior High School, the researcher took three classes of VII grade about a schedule does not intersect. Then the researcher determined that the class randomly gets SSML approach (experimental class), and the class that got CL approach (class control). The sample consist of 135 students, 68 of them are from the high-level school and 67 students are from the middle-level school.

The instruments used in this research are: (1) mathematical prior knowledge (MPK) test, (2) test of mathematical problem solving ability (MPSA), (3) the observation sheet of teachers and students, (4) interview students and teachers, and (5) student journals.

RESULT AND DISCUSSION

Mathematical Prior Knowledge (MPK)

MPK test is given to determine the quality of mathematical prior kmowledge students have prior to this research, that is, before students take Social Arithmetic learning in VII class and to see an equivalent sample. It is also used as a basis for determining a group of students in the experimental class group Soft Skill-based Metacognitive Learning (SSML). MPK test consists of 26 multiple choice questions that contain material prerequisites to follow the material in this study are integers, fractions, algebraic form of operation, and linear equations in one variable. The result analysis showed that there was no difference of MPK between students who received SSML and CL approach at each school level. It is well qualified to provide different treatment for each group.

MPK data analysis also shows that the MPK average high school level students is higher than the MPK middle school level students. It supports the reason for choosing these two schools are representing high and moderate level.

Mathematical Problem Solving Ability (MPSA)

Mathematical problem solving ability is students ability in understanding problem, devising a plan and carrying out the plan and looking back the problem solving result. Mathematical problem solving ability of students is showed by themselves ability in performing three aspects above and getting during learning.

The difference of the enhancement MPSA between SSML and CL

The result of MPSA data analysis is in overall students, both school level, and three MPK categories for both learning (SSML and CL) are presented in Table 1.

Table 1. The Differences of MPSA Students Enhancement in Two Learning Group

Group data	Group learning	Average			Information
		Pretes	Postes	N-Gain	
Overall students	PMSS	17.03	55.75	0.442	Significantly SSML different from CL
	PK	11.90	41.01	0.313	
High level school	PMSS	19.46	58.23	0.457	Significantly SSML different from CL
	PK	12.32	43.26	0.333	
Middle level school	PMSS	14.45	53.12	0.426	Significantly SSML different from CL
	PK	11.45	38.70	0.292	
Upper MPK	PMSS	23.06	68.53	0.569	There is no significant difference
	PK	13.64	44.36	0.332	
Middle MPK	PMSS	14.34	53.84	0.431	Significantly SSML different from CL
	PK	11.79	42.69	0.331	
Low MPK	PMSS	17.00	44.62	0.310	There is no significant difference
	PK	10.86	33.36	0.243	

In Table 1, it can be seen that in overall students data before learning, the average MPSA of two students groups is relatively low. But after learning the two groups of students gain a significant enhancement MPSA, in terms of overall student data, the data in each school level, an each MPK data categories. From Table 1 it can be seen that the enhancement in three groups MPSA students is various. Students who received SSML approach, enhancemet MPSA students in the meddle category ($0.3 < g \leq 0.7$). The enhancement MPSA students who reseived CL approach in the middle category, except at the moderate school level and low MPK in the low category.

This research result show that the enhancement MPSA give the description that soft skill-based metacognitive learning (SSML) is better than conventional learning (CL) to enhance mathematical problem solving ability. This research result parallel with the past research are Nanang (2009), Pativissan & Neiss (2007), Yimer & Ellerton (2006), Biryukov (2003). Concluded that metacognitive behavior contribution can enhance the students problem solving ability.

The Interaction between the Learning Approach with Level School to the Enhancement of MPSA Students

The test results the presence or absence of interaction between learning school level to enhancement MPSA students are presented in Table 2.

Table 2. Test Interactions between Learning Approach with School Level to the Enhancement of MPSA

Source	Number of Squares	df	Average Squares	F	*Sig.*	H_0
School level	0.043	1	0.043	1.122	0.291	Accepted
Learning approach	0.566	1	0.566	14.694	0.000	Rejected
Interaction	0.001	1	0.001	0.021	0.886	Accepted
Error	5.046	131	0.039			
Total	24.940	135				

In Table 2 can be seen that there is no interaction between the school level learning approach to enhancement MPSA students. The difference is caused by an enhancement MPSA students learning different approaches used (SSML and CL). Figure 1 below clarifies the absence of such interactions.

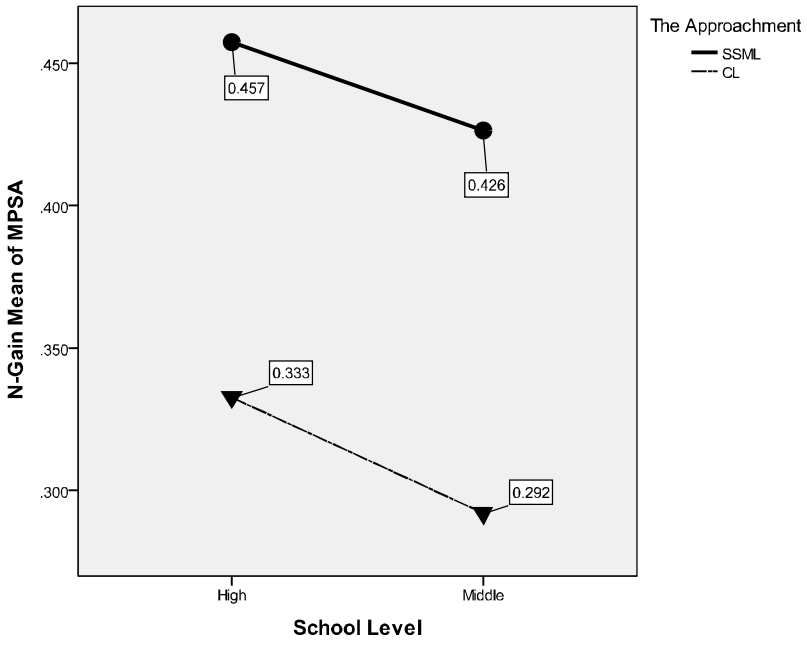

Figure 1. The Interaction between Learning Approach with Level Schools to Enhancement of MPSA

Figure 1 shows that the average enhancement in MPSA students approach is who received SSML approach are getting higher than who received CL approach. It means that SSML approach can be applied to enhance MPSA student at both school level.

From this research results show that learning factor give significant impact towards the differences of the enhancement students mathematical problem solving ability. This is sufficient a reasonable because when students face the obstacle in solving problem so the teachers give the metacognitive questions and support the students to ask themself until the students can associate the problems that are faced with the problems that are ever received. The teachers in metacognitive learning should often ask the questions that provoke the students thinking activity and support the students to ask the questions for themselves so the students can know their thinking process. By this

strategy, students tell their thinking process and go on problem solving process. Those activities are received gradually during process to find the solution from a problem solving. Careful teachers in observating each students condition and creativity also teachers skills in asking metacognitive questions for students are very required when students are finishing about questions of problem solving.

In soft skill-based metacognive learning, students follow a leraning by five steps are: early discussion; independence; group discussion; group presentation; and reflection and conclusion. Every activities that students do in learning and empowerment soft skills values are: religious, confidence, honest, independent, polite, respect other, hardwork, curiosity and cooperation. Soft skills that are associated with some one character are still to arrange her or his self and get interaction with some one else need to empower in learning process (Schulz, 2008). This is paralel with demand of Education Unit Level Curriculum (EULC) that should do about integrating character in learning process (Directorat of Secondary School, 2010). Metacognitive learning based on soft skills develop metacognitive behavior and empowering soft skills so that the studentshave a consciousness in planning, monitoring, and evaluating thinking process and activity in solving problem and also feel comportable in following a learning. This condition is hoped that can appear students wisher to participate a successful studying.

The Interaction between Learning Approach with MPK to Enhancement MPSA Student

The test results shows that the presence or absence of interaction between learning approaches with MPK to enhancement MPSA students are presented in Table 3.

Table 3. Test of Interaction between Learning Approach with MPK to Enhancement MPSA Students

Source	Sum of squares	df	Average Squares	F	*Sig.*	H_0
MPK	0.419	2	0.210	6.014	0.003	Rejected
Learning approach	0.469	1	0.469	13.460	0.000	Rejected
Interaction	0.119	2	0.059	1.701	0.186	Accepted
Error	4.496	129	0.035			
Total	24.940	135				

In Table 3 shows that there is no an interaction between learning approach with MPK to enhancement MPSA students. Differences of enhancement MPSA students are also caused by differences in learning approaches that is used (SSML and CL), and the different MPK categories (upper, middle and low). Figure 2 below clarifies the absence of such interaction.

Figure 2 shows that the difference between the enhancement MPSA students who received SSML and CL approaches, differ significantly between the three students categories MPK. It also means that the learning approach interaction with MPK produce differences in students. In Figure 2 is also seen differences of an enhancemet MPSA students who received SSML approach and which gets

CL approach in upper MPK is larger than middle and low MPK. It means that MLSS approach is meaningfull felt by upper MPK students.

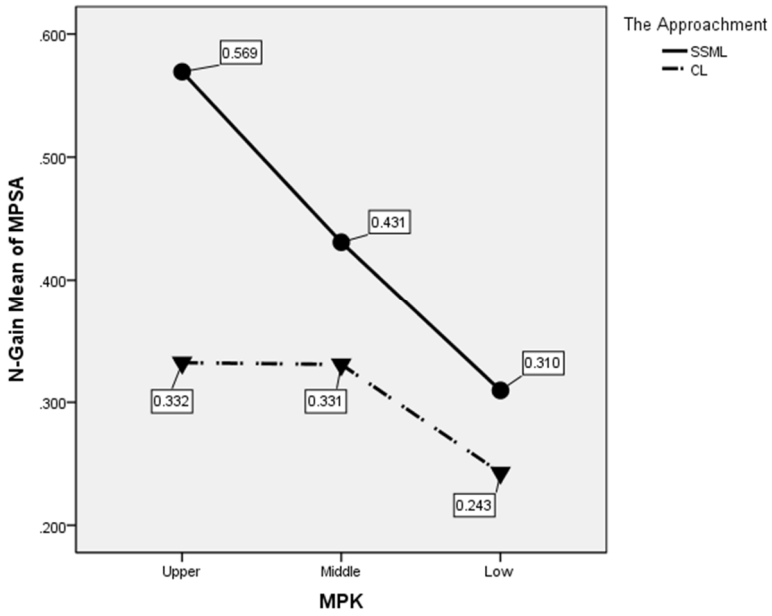

Figure 2. The interaction between Learning Approach with MPK to Enhancement MPSA Student

SUMMARY AND SUGGESTION

Summary

Based on the analysis, findings, and the discussion that has been mentioned in the previous chapter some conclusions are obtained below.

1. There are significant differences of MPSA between students who received SSML approach with students who got CL approach. Significantly, the enhancemet MPSA students who received SSML approach is higher than those who got CL approach.
2. In school of high-level, there are differences about enhancement MPSA significantly between students who received SSML approach to students who got CL approaches. The enhancement MPSA students who received SSML approach significantly is higher than those who got CL approaches.
3. In school of middle-level, significantly there are differences about enhancement MPSA between students who received SSML approach to student who got CL approach. Significantly, the enhancement MPSA students who received SSML approach is higher than those who got CL approach.
4. In the high and low MPK, there are no differences about the enhancement MPSA students significantly between both learning approaches.

5. In the middle MPK, there are difference about enhancement MPSA significantly between students who received SSML approach to students who got CL approach. Significantly, the enhancement MPSA students who received SSML approach is higher than those who got CL approach.

Suggestion

1. The lowest achievement of students in problem solving is in looking back aspects about the results problem solving. This is caused by the lowest students ability in devising and carrying out a plan. Therefore, student should always be trained to determine every aspect of solving the problem appropriately.
2. Mathematical reasoning ability, mathematical communication ability, mathematical connection ability and the others affective values can develop basis for soft skill learning.

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