The Development of Materials Based on Metacognitive Approach to Improve Mathematical Reasoning Ability and Emotional Intelligence Students of SMP Sabilina Tembung

Nur Rahmi Rizqi[1*]   Asmin[2]   Kms.. M. Amin Fauzi[2]
1.State University of Medan (UNIMED), Jl. Willem Iskandar Psr. V, Medan 20221, Indonesia
2.State University of Medan (UNIMED), Jl. Willem Iskandar Psr. V, Medan 20221, Indonesia

Abstract
There were three objectives of this research, namely; (1) to describe the validity, praticallity and effectiveness of metacognitive approach-based materials to improve students' math reasoning skill and emotional intelligence, (2) to improve students' math reasoning skill through developing materials, (3) to improve students' emotional intelligence through developing materials. In order to achieve the objectives of the research, this developing research used the modification of 4-D development model. There were four stages perfomed, namely; define, design, develop, amd disseminate. The experiment was conducted in grade VIII-7 and VIII-8 containing 37 students of Private Junior High School SMP Sibilina Tembung. After experiment I and II, this research found that (1) the validity of material was valid based on the experts, the praticallity of materials met the standards in which the validator stated that the materials can be used by doing some revision, the result of the observation also showed that the material was high category level, the material had proper worksheet, and the effectiveness of materilas could be showed from three sides; the number of students' completeness, the active participation of students, and the positive feedback of students, (2) there was the significant improvement of students' math reasoning skill in which experiment II with 73,03 was higher than experiment I with 69,03, and (3) there was the significant improvement of students' emotional intelligence in which experiment II with 2,89 was higher than experiment I with 2,82.
Keywords: materials, 4-D model, metacognitive approach, math reasoning , emotional intelligence

1. INTRODUCTION

The purpose of the math education in school is to create students' reasoning skill so the students are able to solve the problems found in math subjects. Through mathematic, there are some objectives, namely; practicing the way of thinking and reasoning in drawing a conclusion, improving problem solving skill, and developing the ability of presenting the idea through spoken, written, picture, graph, map, diagram, and so on (Depdiknas 2006:6).

There are two theories which discussed about mathematical reasoning skill. Firstly, Shivakumar dan Suvarna (2014:1) stated that *Reasoning skills develop gradually though a person's lifetime and at different rates for different individuals .... Reasoning skills are recognized as the key abilities for human being to create, learn, and exploit knowledge. These skills are also an important factor in the process of human civilization. Therefore, the importance of reasoning skills has been of great concern in educational settings and the world of work.* Then, accoding to Wahyudin (Rohana, 2015) *reasoning ability is very important to understand mathematics and mathematically reasoning is thinking habit. This result of reasoning then poured into systematical concepts in mathematics. Those concepts continually developed to become concepts which more complex and advance even can be used to solve various problems in life.*

Yet, the observation conducted in junior high school SMP SIBILINA Tembung through circle material showed that students' mathematical reasoning skill is still low even lower. It is supoorted by the research of Simanullang (2014:74) conducted in Grade VII State Junior High School SMP 17 Medan found that there were only 6 students with fair mathematical reasoning skill, while others were very low with the average achieved 2,06 (lowest category). It means that mathematical reasoning skill can be achieved if the students understand the material and concept very well, and the students are able to think rationally or it is also called Intelligence Quotient (IQ).

Although IQ is viewed as the standard measurement of someone's success, most students with high intelligence still have low achievement, while the students with lowintelligence can achieve the high result. It is showed that intelligence is not the main factor determining students' success, since there are other factors affecting the success. Accorsing to Goleman (Uno, 2005:70), Intelligence Quotient (IQ) only contributes 20% determining the success of someone, and 80% comes from other factors including: Emotional Quotient (EQ). Based on the first observation undertaken by the researhcers through questionnaire relating to Emotional Quotient (EQ) with 5 questions provided, namely; completely agree, agree, disagree, and extremely disagree, it was found that there were 30 students of grade VII Private Junior High School SMP Sabilina Tembung with a very low emotional intelligence. As Hidayat (2014:55) said that there are two kindsof students, they are; the

students with high intelligence yet they have low achievement, and the students with low intelligence yet they have higher achievement. This happens because mathematic learnning process is focused on teachers so the students are not being able undeersstand the concept with their awareness of thingking and they are not familiar with the problems involving mathematical reasoning skill and emotional intelligence. Absolutely, this kind of situation has an impact to students' mathematic achievement, then the teachers are expected to teach creatively in order to let the students involve the teaching learning process actively so the students are able to understand any concept with awareness of thinking. in addition, teachers are demanded to elaborate mathematic learning process through teaching materials. Teaching material is the essential component which determines the success of teaching learning process in the classroom prepared by the teachers before teaching learning process. hamdani (2010:218) stated that teaching material is any material used to help teachers or instructors in performing teaching learning process in the classroom.

According to Nieveen (2007:26) there are three standards of material, they are; validity, praticallity and effectiveness. Yet, the observation held in Private Junior High School SMP Sabilina Tembung showed that the materials used by the teachers do not increase students' math reasoning skill and emotional intelligence yet. The books used still focused on worsheet with monotonous pattern and exercise. Thus, it can be inferred that the book used do not meet the standars of materials; valid, pratical and effective. The book used is not valid because it is never validated by teacher and headmaster of Private Junior High School SMP Sabilina Tembung which based on one of teacher who said that "the book used was from publisher and it was never desigeng by teacher". Relating to fact above, this research will focus on material development used by teachers and students in Private Junior High School SMP Sabilina Tembung in order to increase students' mathematical reasonig skill and emotional intelligence so the students are abel to understand the concept with their awareness of thingking through metacognitive appraoch. According to Borich (Yamin, 2013:230) metacognitive is the srategy to carry out, and to monitor model of thingking involving reasoning skill.

2. Literature
2.1 Teaching Materials
Teaching material is any material used by teachers in performing teaching learning process in the classroom. Teaching material can be both written or non-written. Hamdani (2010:219) stated that teaching material involves information, tool, text needed by teachers for planning and reviewing the implementation of learning. In other words, teaching material must be designed systematically in ordet to create the conducive situation for students in learning process. Moreover, Majid (2012:174) classifed teaching materials based on technology used into four classifications, namely; 1. printed materials such as; handout, book, module, worksheet, brochure, leaflet, wallchart, photo/picture, model. 2. Audio materials such as; cassette, radio, LPs, compact disc audio. 3. Audio visual materials such as; video, compact dics, film. 3. Multimedia mateials (interative teaching materials, such as; CAI (Computer Assisted Instruction), compact disc (CD), web-based learning materials. All these materials depend on teachers' need that they want to use in theit teaching learning process. while, this research will develope both teachers' and students' book.

2.2 Mathematical Reasoning Skill
The term of reasoning come from the word "reason" which means one's way of thinking. In mathematic, reasoning takes place the highest level which covers the way of thinking logically and systematically. In addition, reasoning is the way of thinking to relate between two things or more based on known rules and truths by using the stages to draw the final conlusion (Hasratuddin, 2015:91). Thus, reasoning is the mental process in generalization with the valid reasons. While, Copi (Shadiq, 2014:25) stated that Reasoning is a special kind of thinking in which inference takes place, in which conclusions are drawn from premises." It can be inferred that reasoning focuses on drawing final conclusion based on true statement accepted.

Based on the above it can be concluded that reasoning mathemtical skill is the process of thinking to draw the final conclusions based on some statements that the truth has been proven before. Then the reasoning mathemtical skill in this research is the effort of someone to seek the truth in using the rules measured and evaluated based on the ability of thinking. Then it is expected to have the ability to be able to make argument and arrange the proof, to check the validity of an argument, and to draw conclusions from the statement.

Based on Dirjen Dikdasmen Regulation No. 506 / C / PP / 2004 (Sadiq, 2009), there are seven indicators to be achieved by the students, namely: (1) Ability to present oral, written, drawing and diagram statements, (2) Ability to file allegations, (4) Ability to construct the evidence, give reasons / evidence to the truth of the solution, (5) Ability to draw conclusions from the statement, (6) Examine the validity of an argument, (7) Find the pattern or the nature of the mathematical phenomenon to compose generalizations. Yet, the reasoning mathemtical skill in this research includes students' ability to make predictions, to construct evidence and provide a justification for the truth of the solution, to examine the validity of an argument, and to draw conclusions from a statement.

2.3 Emotional Intelligence

Emotional intelligence is the ability to recognize our own feelings and also others' feeling, to motivate ourselves, manage emotions well for ourselves, to manage emotions well on oneself and in relation to others. According to Goleman (Hidayat, 2014: 55), Emotional Intelligence is the ability of a person to manage our emotional life with intelligence; the appropriateness of emotion and its expression through self-awareness, self-control, self-motivation, empathy and social skills. The emotional intelligence indicator used in this study refers to aspects of emotional intelligence based on Saloveny (Uno, 2005: 73-75) namely; (1) recognizing the emotions of self, (2) managing emotions, (3) self-motivating, (4) recognizing the emotions of others, and (5) building the relationships.

2.4 Metacognitive Approach

John Flavell, (in Usman, 2014) who was the first one pointed Metacognitive stated that "literally metacognitive means thinking about thingking". According to Fauzi (2011: 21), the concept of metacognition is the consciousness of thinking what one knows (metacognitive knowledge), what one can do (metacognitive skills), and what one knows about his own cognitive (metacognitive experience). The method of learning mathematics with metacognitive approach developed is the method obtained by modifying the method that has been developed by Meyer (Fauzi, 2011: 30) that is learning method that presents the lesson in three stages with details as follows: first stage is initial discussion, second stage is working independently to complete the exercises, and the third stage is reflection and summary. Based on the explanation above, the metacognitive approach is an approach that refers to stages, namely: (1) preliminary discussion; (2) working independently to solve problems; and (3) reflection and summary.

3.   RESEARCH METHOD

The method of the research is Reseach and Development (R & D) with 4-D model developed by Thiagarajan consists of four stages: define, design, develop and disseminate. This research develops teaching materials based on metacognitive approach to improve mathematical reasoning skill and emotional intelligence of students of private junior high school SMP Sabilina Tembung. The developing products involve teacher's and student's books. The subject of the reserch are grade VIII-7 and VIII-8 students of SMP Sablina Tembung repectively 37 students. Then, the instruments and tools for collecting data in this research are validation sheet, questionnaire and observation sheet.

The detail is shown in Table 1

Evaluating Aspects	Instruments	Data Observation	Respondents
Validity	Validation sheet	Teachers' book valdity (BG) and students' book validity (BS)	expert
Practicality	Validation sheet	Teachers' book praticality (BG) and students' book praticality (BS)	Expert
	Observation sheet	Teaching materials implementation	Observer
Effectiveness	Test	Classical completeness	SUbjects
	Observation sheet	Stduents' activity	Observer
	Questionnaire	Students' feedback	Subject

The criterion states that metacognitve approach-based material has high degree of validity, if the validity of the minimum level achieved is valid with level ($4 \leq Va < 5$). Then, the criterion states that metacognitve approach-based material has good practical level, consisting of 2 indicators namely (1) all validators / experts stated that metacognitve approach-based material can be used with "minor revision" or "no revision". Meanwhile, to see the ability of metacognitive approach-based material implementation is high reliability with coefficient 0.75 or 75%. Furthermore, the criterion of instructional metacognitve approach-based material developed effectively with 85% students who follow the test of mathematical reasoning skill and emotional intelligence with some standards; the lowest average score is 56 or in category C. then, considering students' acitivity, four of six criteria of tolerance criteria should be achieved through all categories 1, 2, 3, 4, 5 and 6 are met. Note that the tolerance criteria of 3 and 4 must be met, and a minimum of 80% of the subjects studied provide a positive response to the component of the developed learning material.

4.   FINDINGS AND DICUSSION

After conducting the research, there are some findings found, namely; the validity, the practicality, and the effectiveness of teaching materials, improving students 'mathematical reasoning skill, and improving students' emotional intelligence.

4.1 Material Validity of Teaching Materials

The validity of instructional materials is measured by the experts. Based on the results of expert materials

analysis, metacognitive approach-based material for both teachers' and students' books obtained the average value of total validity as shown in table 2.

Table 2. The Validation of Teacher's and Student's Books

Aspects	Aspect Average(A_i)		Total (V_0)		Validity Degree
	Teacher's Book	Student's Book	Teacher's Book	Student's Book	
Template	4,47	4,48	4,43	4,43	Valid
Language	4,30	4,37			
Illustration	4,40	4,32			
Content	4,55	4,54			

Based on table 2 above, the average value of the total validity of metacognitive approach-based material is at intervals: $4 \leq Va < 5$. It means that the development of metacognitive approach-based material is valid.

4.2 Practicality of instructional materials

The practicality of teaching materials based on development of metacognitive approach-based material is seen in 2 (two) aspects, namely: (1) expert / practical assessment of the developed teaching materials can be used with minor revision; (2) the results of observation of the implementation of teaching materials in the classroom is quite high category (teaching material is applicable). Based on the result of observation data analysis of metacognitive approach-based material, the average value of observation of teaching materials implementation for each meeting in experiment I shown in table 3.

Table 3. The Average of Observation of the Implementation of Material in Experiment I

The Average of All Experts	Meetings $\overline{P_2}$			Total $\overline{P_3}$	Note
	1	2	3		
EXPERIMENT 1	3.68	3.93	4.04	3.88	High (Practical)

Based on table 3, the average of observers of teaching material is in the high category ($3 \leq P \leq 4$) with the interval: $4 \leq Va < 5$. Based on the criteria of implementation, it means that the development of metacognitive approach-based materials developed is categorized as pratical.

4.3 The effectiveness of instructional materials

The criteria for determining the effectiveness of metacognitive approach-based materials in Experiment I and II consisted of three indicators as discusses as follows:

4.3.1 Completeness

Based on the findingof research in experiment I and II, the results obtained the completion as in table 4:

Table 4.The Grade of Classical Completion of Mathematical Reasoning Skill in Experiment I and II

Categories	Mathematical Reasoning Skill			
	The total of students		Persentage	
	Experiment I	Experiment II	Experiment I	Experiment II
Complete	31	33	83.78%	89.19%
Incomplete	6	4	16.22%	10.81%
Total	37	37	100%	100%

Based on table 4, it is showed that posttest result of mathematical reasoning askill in Experiment I test did not met the criteria of classical completeness achievement. In accordance with the students' learning completeness criteria in classical is at least 85% of students who follow the learning achieving ≥ 71. Thus, the posttest result of mathematical reasoning skill in experiment II completely met the criteria of classical achievement. This is supported by Anggo's research (2015: 140) who concludes "Student's math learning outcomes through the test in the application of learning with metacognitive strategies is increasing". It implies that students' mathematics learning outcomes through tests in the application of learning with metacognitive strategies are increasing. Furthermore, Yulianti's research (2013) which also concludes students' classical mastery of mathematical reasoning ability with Model-Eliciting Activities learning is better than expository learning.

4.3.2 Students' activity

Student activity's in learning is effective, if four of the six criteria for tolerance of achievement of the ideal time used in categories 1, 2, 3, 4, 5 and 6 are met. The tolerance criteria for 3 and 4 must be met. Based on the results of research in experiment I and experiment II, the results obtained from student activities are as follows:

Table 5. The Percentage of Analysis Results of Student Activity in Experiment I and II

Percentage	The Pecentage of Students' Activity (%)					
	1	2	3	4	5	6
Experiment I	25.63	13.54	19.79	27.50	9.38	4.17
Experiment II	25.83	13.75	20.21	27.71	9.58	2.92

Based on the data in table 5, it can be showed that the result of the percentage of student's activity in the experiment I did not meet the standard. While, percentage of student activity for each indicator in experiment II successfully met the standard of students' activity

4.3.3 Students' Feedback

Students' feedback criteria can be effective, if there are 80% research subjects showed positive feedback againts component of developing teaching material. Based on the results of research on experiment I and II, students give positive feedback to the content of teaching materials developed. This is reinforced by Mawaddah's research (2015: 10) found that students show positive feedback for learning mathematics model with discovery learning and metacognitive approach.

4.4 Improvement of Mathematical Reasoning Skill

To know the improvement of mathematical reasoning skill, the data obtained from experiment I and trial II were analyzed by comparing the mean score of students. the description of improving students' mathematical reasoning skill using metacognitive approach-based material developed in experiment I and II shown visually in table 6.

Table 6. Description of the Results of Mathematical Reasoning Skill

Description	Experiment I	Experiment II
Highest Score	85	92
Lowest Score	54	52
Average	69,03	73,03

Furthermore, a description of the enhancement of students' mathematical reasoning skill by using developing metacognitive approach based material experiment I and II for each student's mathematical reasoning indicator can be shown in table 7.

Table 7. The Average of Student Mathematical Reasoning Skill for each indicator

Indicators	Average		
	Experiment I	Experiment II	Improvement
Presenting prediction	2.88	3.09	0.21
Composing proof, giving the reason of the solution	3.06	3.14	0.08
Checking the validity of argument	2.75	2.92	0.17
Drawing conclusion	2.35	2.53	0.18

Picture 1 below visually shows the average of mathematical reasoning skill
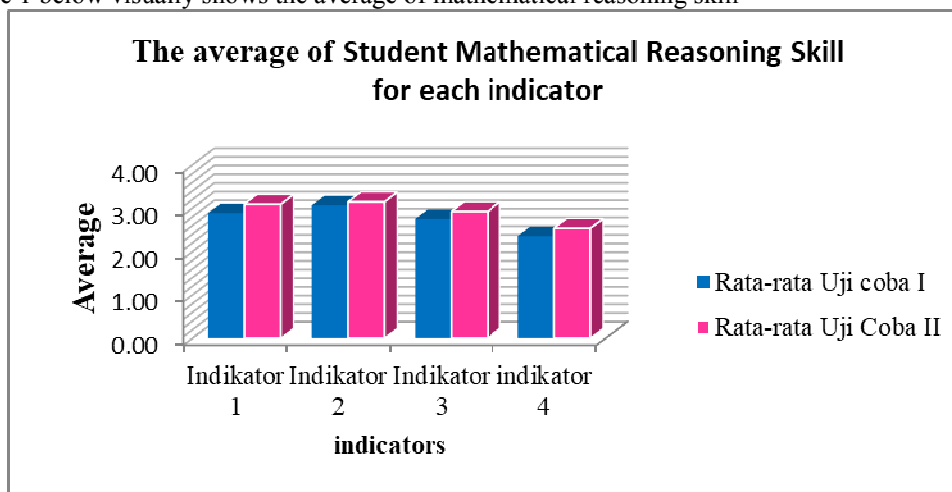
Picture 1 Student Mathematical Reasoning Skill for each indicator

Based on Table 7 and Figure 1 above, it can be concluded that students' mathematical reasoning skill from experiment I and II by using developing metacognitive approach teaching materials increase significantly. Then, Mevarech's (2006: 85) found that the improve students significantly outperformed their counterparts on both mathematical knowledge and mathematical reasoning. Moreover, a study by Siregar (2017) concluded that there

were differences in students' mathematical reasoning skills that were taught by the method of taught by prompting technical approach. Furthermroe, a research by Dewi (2016) concluded that the increasing of students' mathematic reasoning ability by using geometrical learning material based on the constructivism at the grade VIII of SMP Negeri 3 Padangsidimpuan was on the medium category.

Here is an example of student answers from question number 1:

Problem:

1. There are two parks; A and B are circular. There are tree planted around the park every 2 meters. The numbers of trees in each garden are as many as 88 trees and 77 trees.

    A.   Which garden diameter is shorter? Explain your opinion?

    B.   Prove the shorter garden diameter?

    C.   The park is shorter than the number of trees planted as many as 88 trees. Is it true?

    D.   What can you conclude from the number of trees?
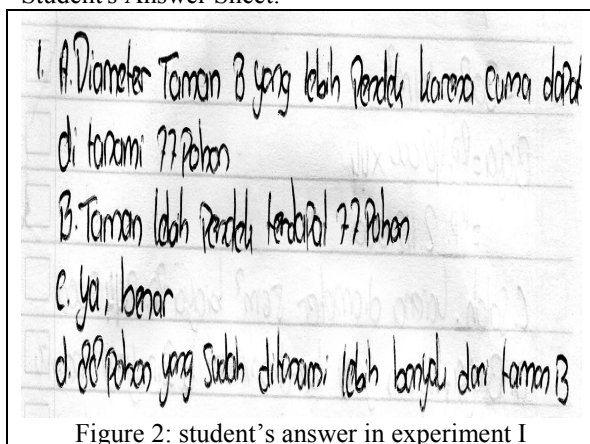
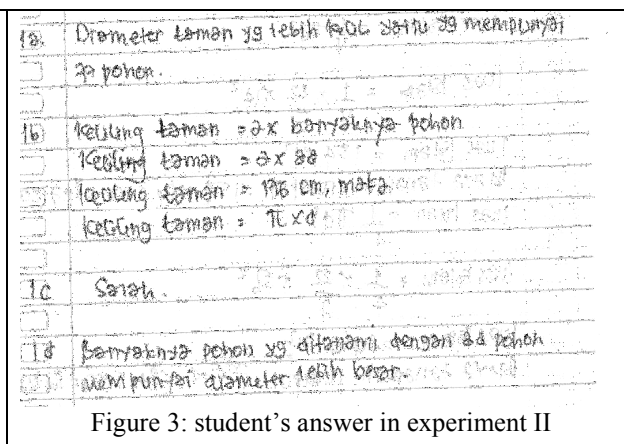Student's Answer Sheet:

Figure 2: student's answer in experiment I

Figure 3: student's answer in experiment II

From Figure 2 and Figure 3, there is an improvement in student's feedbcak between experiment 1 and II which shown from each indicator. In experiment 1, students' answers to the 2nd indicator were not able to prove which diameter was shorter and the 3rd indicator was wrong. But in the 2nd trial, the student's answer to the 2nd indicator of the student could prove the answer according to the formula but not completed. It is suggested o the students to be able to know the appropriate formula. In the indicator 3, students correctly answer although the students can not compose reason correctly, it is suggested to the students to review the previous questions so they will be able make the reasons correctly.
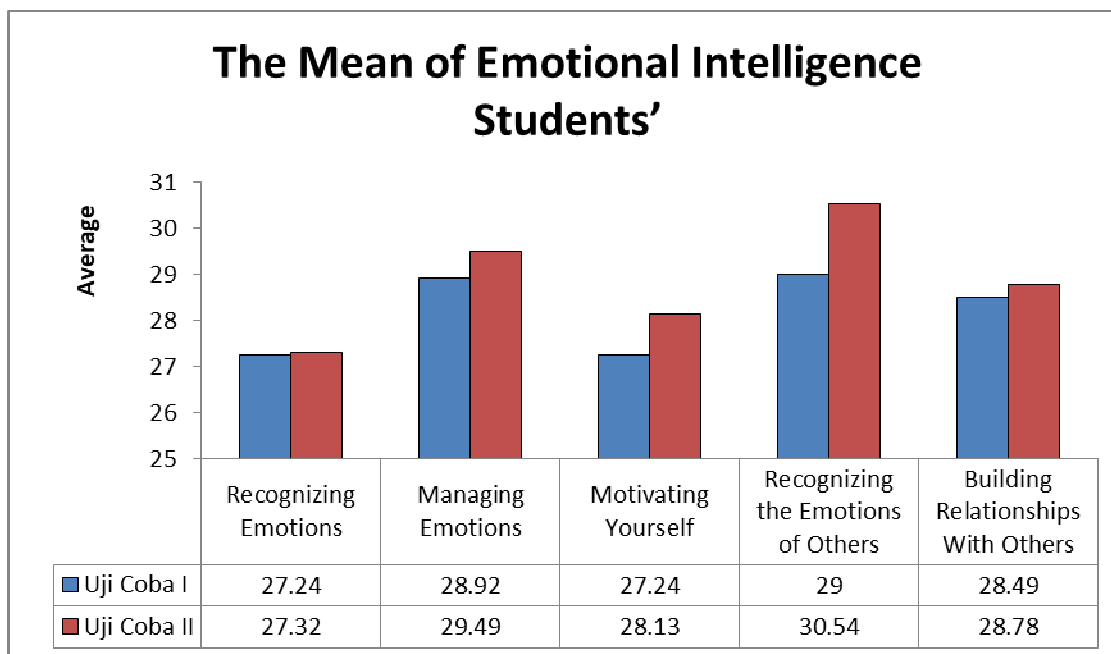
4.5 Improvement students' emotional intelligence

Based on the results of experiment I and II, it is obtained the result of questionnaire of students' emotional intelligence. This questionnaire is given at the end of each meeting which aims to see students' emotional intelligence. Then obtained data from the results of questionnaire emotional intelligence experiment I and II were analyzed to determine the improvement of students' emotional intelligence by comparing the average score of students obtained from the questionnaire attitudes emotional intelligence experiment I and II. The descriptions of improvement of students' emotional intelligence after the application of developing metacognitive approach-based material are shown in table 8.

Table 8. The Mean of Emotional Intelligence Students'

No	Indicators	Mean for each indicator		Mean
		Experiment I	Experiment II	
1	Recognizing the emotion	27.24	27.32	0.08
2	Managing the emotion	28.92	29.49	0.57
3	Self-motivating	27.24	28.13	0.89
4	Recognizing others' emotions	29.00	30.54	1.54
5	Buidling the relationship	28.49	28.78	0.29
The mean of each indicator		2.82	2.89	
The mean of emotional intelligence improvement from experiment I and II				0.07

Detailly, it is visually shown in picture 2

The Mean of Emotional Intelligence Students'

	Recognizing Emotions	Managing Emotions	Motivating Yourself	Recognizing the Emotions of Others	Building Relationships With Others
Uji Coba I	27.24	28.92	27.24	29	28.49
Uji Coba II	27.32	29.49	28.13	30.54	28.78

Based on Table 8 and Figure 4 above, it can be concluded that the average result of questionnaire of students' emotional intelligence significantly increased experiment I to experiment II. It is supported by Hasratuddin (2012: 65) shows that there is a difference in the increase of emotional intelligence between students who are given mathematics learning through realistic mathematical approach with students who are given regular learning. It is clearly seen in Figure 4, the indicator of recognizing other's emotions is higher than the other indicators because the feelings among students play a role in learning so that psychological insight and understanding of students in reasoning are able to capture hidden social signals indicating what is needed or desired by others. So it can be concluded that metacogniitve approach-based material improved students' emotional intelligence.

5. CONCLUSION

Based on discussion of the research, the conclusions are drawn as follows:
1. The validity of developing instructional materials belongs to valid category. It means that metacognitive approach-based material meets the practical criteria reviewed from: (1) expert / practitioner who state that metacognitive approach-based material can be used with minor revision; And (2) the implementation of teaching materials has reached high category, that is in experiment I with 3.88 and experiment II the implementation of teaching materials has reached higher category with 4.05, and the observation sheet of the reliability of implementation of metacognitive approach-based material was veru goo in which in the experiment I was 94.80% and experiment II was 97.58%. in other words, metacognitive approach-based material has met the effective criteria. Effective criteria reviewed from: (1) students' learning mastery has been achieved 89.19% classically in xperiment II; (2) student activity during learning activities meets the criteria of ideal time tolerance set; And (3) positive students' feedback to the components of learning materials and learning activities developed.
2. Students' mathematical reasoning skill sifgnificantly increased from experiment I to experiment II using metacognitive approach-based material
3. Students' emotional intelligence siginificantly increase from experiment I to experiment II using metacognitive approach-based material

6. SUGGESTIONS

Based on the conclusion above, some suggestions are offered:
1. metacognitive approach-based material successfully met the aspects of validity, practicality and effectiveness, so the teachers are suggested to use this component of teaching materials in order to develop students' mathematical reasoning skills, especially grade VIII Juniro High School SMP / MTs. Students.
2. For other researchers who want to do research to measure mathematical reasoning skill in order to pay more attention to the ability of students on indicators to compile evidence and check the validity of an argument.
3. For other researchers who want to conduct research to measure the emotional intelligence of students in order to find other emotional intelligence indicators in order to enrich the science of the researchers about emotional intelligence.

4. Developing teaching materials produced until dissemination stage, but it is only disseminated in the research place which is only SMP Sabilina Tembung. To find out the effectiveness of metacognitive approach-based material in a variety of mathematical subject matter and other appropriate lessons, it is expected for teachers and researchers to implement metacognitive approach-based material in other schools.

5. Metacognitive approach-based material can be used as reference to create a component of teaching materials with other materials in order to develop mathematical reasoning skill both at the same or different level of education unit.

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