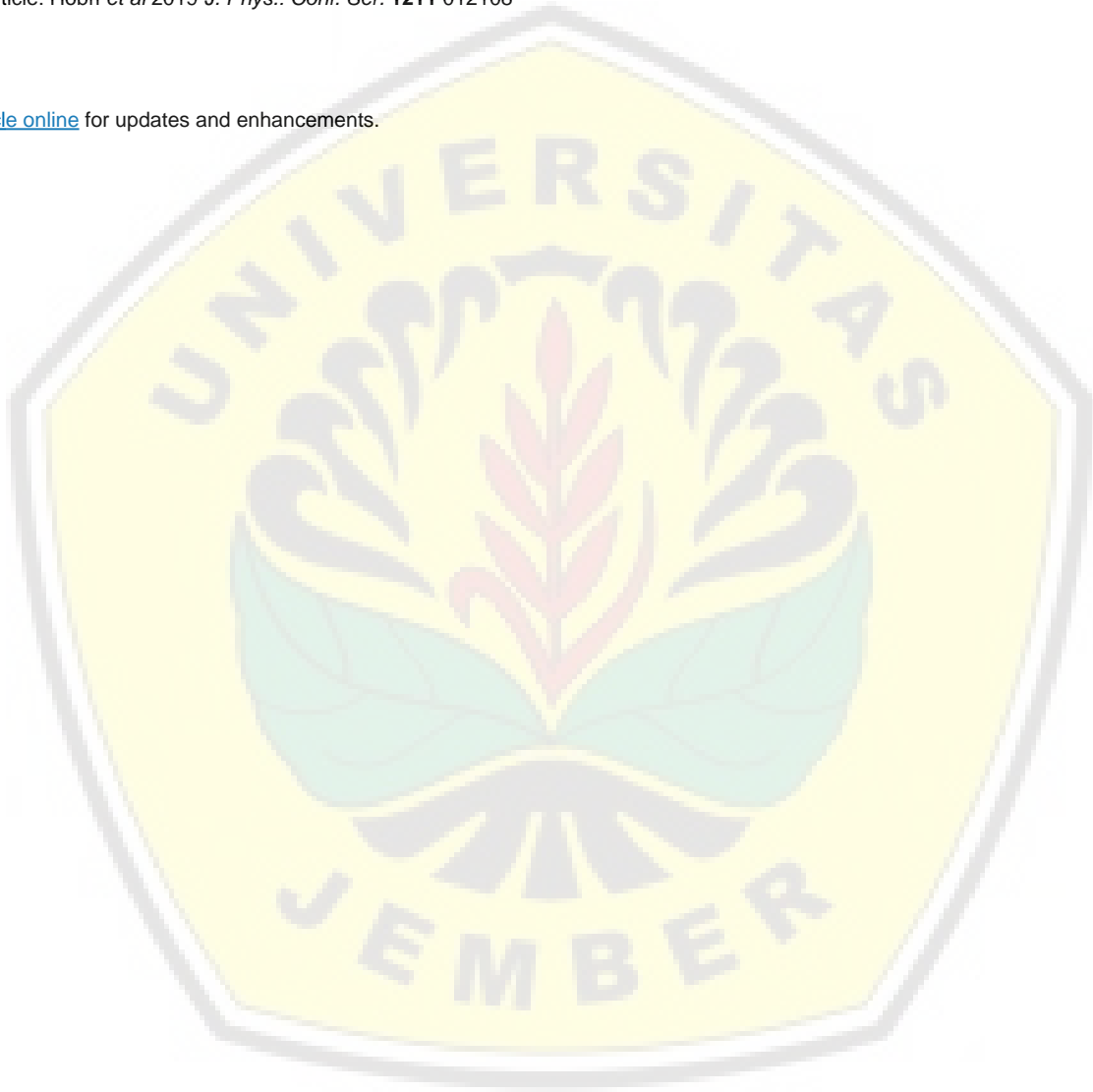


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Collaborative learning and caring community in mathematics learning by using student's worksheet based on scientific approach

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Abstract. Mathematics teaching and learning process will be efficient and effective if it is supported by high quality of materials learning, especially Student's Worksheet (SW). Student's worksheet of Mathematics in Curriculum 2013 must possess 5 phases, in which they are observing, questioning, exploring, associating, and communicating. This research was intended to describe caring community on numbers material through student's worksheet that based on scientific approach at SMPN 1 Situbondo. In this research, the data were analyzed by qualitative research. The data were collected through observation and interview. The results of this research can be summed up into, (1) the quality of interaction between students in a group was good, the high-level student gave some scaffoldings to junior high school students, and they gave some scaffoldings to lower-level students, but the interaction between high-level student and lower-level student was not so good, (2) the activity in the solving the questions on worksheet was considered well. In observation phase, all students observed problem and task one by one and discuss edit together about how to determine $\frac{a^m}{a^n}$, and its application. In questioning phase, some students within several groups asked and discussed the process and the result of $\frac{a^m}{a^n}$, but there were several students who just observed and copied the problems.

During associating phase, some students communicated their idea of how to simplify $\frac{a^m}{a^n}$ to a^{m-n} through oral discussion and doing the SW, the other one showed another way, and the others wrote on their SW. In associating phase, all students solved problems and tasks, but they found several wrong, thus, some students said that their answers were wrong, asked the students in their group and discussed the others' explanations about the meaning of $\frac{a^m}{a^n}$, if $m = n$, $m < n$ and $m > n$. The last, in communicating phase, one of students in group explained the conclusion of $\frac{a^m}{a^n}$ and its application, and if the teacher asked him about his explanation, the other students in his group would answer it. It can be concluded that the quality of interaction and caring community on mathematics teaching and learning process was good.

1. Introduction

The curriculum development is necessary to do since there are various challenges would be faced, either internal or external challenges [1]. Internal challenges concern on the education condition of education demands referring the eight National Education Standards which covered the standards of



management, cost, infrastructure, educator and education personnel, content, process, assessment and competence graduates. Other internal challenges are in accordance with the factors of Indonesian development on the growth of productive population. Meanwhile, external challenges faced by education related to challenges that will be occurred in the future, the competence is necessary in the future, public perception, the development of knowledge and pedagogy, as well as various negative phenomena which arise [2].

An important aspect of curriculum 2013 is the application of scientific approach as a learning approach. This is due to a belief that learning can be paired with scientific process [3]. Scientific approach is considered a golden bridge and a development of students' attitudes, skills, and knowledge. Referring approach or working process which fulfils the criteria of scientific, the scientists bring up the inductive reasoning rather than deductive one. Deductive reasoning takes common phenomenon and draws specific conclusion. Moreover, inductive reasoning focuses on the phenomenon or specific situation then draws overall conclusions. Inductive reasoning puts specific evidences in relation to broader ideas. The scientific method generally puts a unique phenomenon with specific studies and details then formulates general conclusions. In addition, innovative learning tool is able to improve students' cognitive and psychomotor abilities [4], [5]. Innovative method can also improve students' critical thinking skill [6], [7], [8].

In mathematics learning, scientific approach plays an important role. It happens since the mathematical characteristics is in accordance with scientific method [9]. Scientific method refers to the investigative techniques on one or several phenomena or symptoms, the acquirement of new knowledge, or correcting and integrating previous knowledge. As it is called as scientific, the research method (inquiry) should be based on evidences of the observable object, empirical and measurable principles of specific reasoning [10]. Therefore, scientific method generally covers a series of activities of collecting data through observation or experiment, processes information or data, analyzes and formulates as well as tests the hypotheses.

To help the students (scaffolding), especially at junior high school, namely SMP/MTs in relation to mathematics learning with scientific approach is the use of SW (lesson plans, student books and teacher books) [6]. Therefore, the development of math worksheets in SMP/MTs is required. In the first year, math worksheets for Junior Class VII, VIII, and IX with a scientific approach were made and a valid product based on an expert assessment was also generated. In this research, the tests were used to find out whether or not the results of the product were practical and effective.

2. Method

Based on the formulation of the problem and research objectives that have been set, this research was a developmental research. Developmental research was oriented towards the development of products described as accurately as possible in the process development and the final products were evaluated [11]. This research was developed in the form of mathematics worksheets of SMP/MTs. The development process was related to the activities on each stage of the development. The final products were evaluated based on the quality aspects of the product. In the first year, Math Worksheet for SMP/MTs Grade VII, VIII, and IX was generated and valid, which had been validated by expertise.

The next step was tryout. Tryout was carried out to see the extent of the practicality and effectiveness of SW in the classroom. Based on the results of field tryout and data analysis, the result of test is needed to revise. Tryout and revision could be done repeatedly until the prototype (SW) reached the aspects of practicality and effectiveness [12]. The tryout in this research was conducted at SMPN 1 Situbondo. Practicality of the model was measured based on the rating given by analysts to declare whether or not the worksheets could be used in the classroom. The instrument used was the observation sheet.

Documentation and observation methods were used as special judgements on how caring community created with good quality. The activity was analyzed by using LSLC (lesson study for learning community). The assessments were done by looking at the aspects, collaborative learning,

learning community, caring community, and jumping task. This research pointed out the detail on the aspect of caring community [13].

3. Results and Discussion

Here is how the excerpt of learning given in the implementation of the tests. The first step was, the teacher guided and directed the students to discuss their home work. The second one referred to the teacher who did the apperception by conveying learning objectives, organizing the students in each group, distributing Student's Worksheet (SW) to each student.

The third step done as the teacher motivate the students by informing them that mastering the concept of exponential number would be able to help them master advanced mathematics related to numbers and its power. The teacher asked/told the students in groups to work on scientific SW, it was in the fourth step. If there were students or groups who faced difficulty in doing the task, the teacher provided limited assistance. Fifth step was the teacher facilitated and guided the group works in order to obtain the results that fulfilled the learning goals. Sixth step was the teacher facilitated and guided the students to understand the exponential number and its properties. If there were some students who had difficulty in completing the tasks, the teacher provided limited assistance.

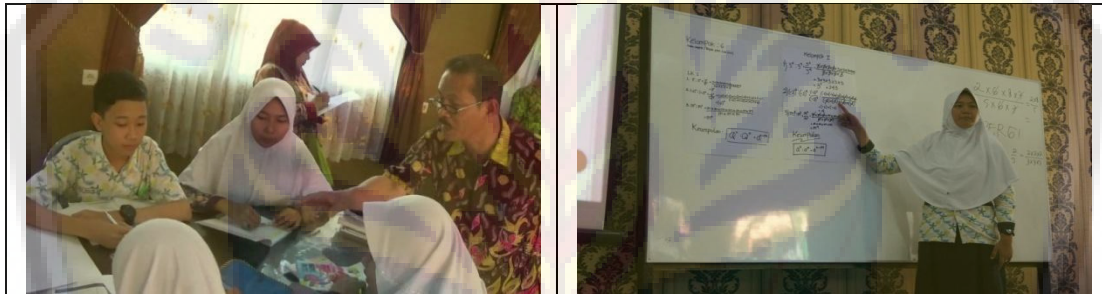


Figure 1. The teacher provided assistance and monitored the students' discussion activity

Seventh step was the teacher asked some students as the representatives of their groups to write down the results of the process on the board. Eighth step was the teacher facilitated and guided the students in understanding the problems, the solving steps, applying the solutions, and checking again. Ninth step was the teacher guided the students to make a summary of the whole material. Last step was the teacher gave homework to the students.

Table 1 is presented the results of mathematic learning observations assisted by SW scientific approach with a very high aspect.

Table 1. Results of mathematic learning observations

SYNTAX

1. The level of adherence to all stages of learning
2. The coverage of important aspects in learning mathematics
3. The implementation of learning activities that reflects the learning sequences through Scientific Approach.

SOCIAL SYSTEM

1. The level of adherence to the situation (atmosphere) that you want (forming groups, discussing, questioning, debating, proposing, mutual respect at work)
2. The level of adherence to the learning interaction (student-student and student-teacher)
3. The implementation of the teacher's behaviour that embodies 5M or scientific approach to learning
4. The level of adherence to the social system of learning

PRINCIPLES OF REACTION AND MANAGEMENT

1. The implementation accommodates the teacher and give the students opportunity to ask, express opinions and give feedback
 2. The level of implementation of the teacher's behaviour gives scaffolding, help, guidance, guiding the students' works
 3. The level of adherence to the teacher's behaviour motivated through the creative association of mathematics with daily life
-

4. The rate of adherence to the teacher's behaviour engages the students to be active in the learning process
5. The level of adherence to the teacher facilitates the students' learning

The effectiveness of learning Mathematics through SW-Oriented Scientific approach

The effectiveness of the 5M approach was that the worksheets are provided in terms of four aspects of measurement, as follows: (1) The results of students' learning, (2) The percentage achievement of ideal time activities done by the students and teacher, (3) The teacher's ability to manage the learning, and (4) the students' response to the components and learning activities.

Traditionally, the average level of the students' mastery of the material was high reached 78.5 mastery levels. The percentage of the students who had a minimum mastery level "medium" was 86.11% of 36 students who took the tests. If the percentage is referred to the completeness criteria of the learning program that has been set, it can be classically concluded that the learning subject in the 9th grade students of SMPN 1 Situbondo was "complete".

On the substance of the material, several examples of the following analysis were given, in which the students still had many errors, they did not use parentheses in writing operation and a sign of negative numbers and in writing division mark was not aligned with the equal sign.

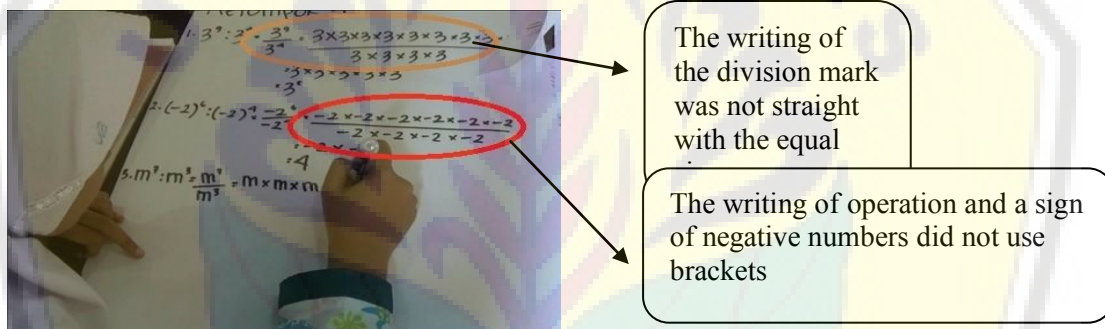


Figure 2. The students' errors

Another example was the concept of group 1. Group 1 explained that dividing could be done by crossing to the same number, when it should be the word "strike" that was right to simplify or divide to the same number.

Student's Response

The results of the data analysis component and the students' responses to the learning activities are presented in the table 2.

Table 2. Results of the data analysis component and the students' responses

- The teacher organizes the classroom for study
- The leader forms/organizes groups
- The leader provides group worksheet for each group, and student worksheet for each student
- The teacher gives information about what the students should do
- The teacher allows the students to work in groups and recap the results of their works in groups too
- The teacher provides an opportunity for each group to present their works, while the other groups are listening and discussing
- The teacher monitors the activity of the students that work in groups and assists the groups to ask questions
- The teacher provides reinforcements for the groups that can answer the questions correctly, and provides guidance for the groups that cannot answer the questions correctly
- The teacher gives a chance for each student to understand the mathematical concept with the help of SW
- Randomly, the teacher gives a chance for each student to present their works
- The teacher gives opportunities for the other students to respond their friend's presentation, and then doing discussion
- The teacher provides reinforcements for students who can answer the questions correctly, and provides guidance for students who cannot answer the questions correctly
- The teacher provides applicative questions

The teacher gives a chance for each student to present the results of their works in front of the class
 The teacher provides the opportunity for the other students to respond their friend's work
 The teacher allows the students to do discussion
 The teacher facilitates the class discussion
 The teacher guides the students to work and understand the questions correctly
 The teacher gives homework for the students
 Time management

Based on data, the answers were obtained that students were generally happy with the components and activities of learning. In addition to the new fun comments on the components and activities of learning, 91.67% (36) of the students expressed interest to participate in the learning of mathematics. The reason of why students expressed interest was because the students understand the concept better, interested in solving a mathematical problem posed and the use of teaching aids by the vocational teacher who taught in very interesting ways (giving the opportunity to ask, discuss, providing fun learning environment and happy to respond to any questions of the students). The students suggested learning not only in the classroom, sometimes close to the object of the problems posed. If the results of this analysis were referred to the specified criteria, it can be concluded that the students' response to the component and activities of learning with a model that had been implemented was positive.

Based on the table above, the students said that they were happy about the component and activities of learning. This shows that students were interested and enthusiastic in learning mathematics with the applied learning strategies. The reason why the students said they were happy about the component and activities of learning were very diverse. The recapitulation of the students' comments is presented below.

Table 3. Students' comments towards the learning activities

No.	Students' Comments	Number of students
1.	I am so happy to learn mathematics and we become active with the SW	3
2.	For me, in learning mathematics it is important to be active to observe, to question, to give reason, to try and to communicate	5
3.	The teacher's teaching method is impressive, and all questions are answered well	4
4.	I am happy with the atmosphere of learning, discussion and guiding us through the SW	3
5.	Never learning math in this way	7
6.	The way the teacher teaches is good and interesting so the material is easy to understand	4
7.	I more easily understand the material because it is given clear instructions	3
8.	The teacher interacts with students and trains students to solve problems well	2
9.	Pleased because there are no student books and SW	5

Furthermore, most of the students stated that the components and the activities of learning were new. This indicated that the students had not experienced learning by using SW 5M or scientific approach. The reason why the students stated that the components and the activities of learning were new was still very diverse. The recapitulations of the students' comments are presented below.

Table 4. Students' reasons to comment on education

No.	Students' reason	Number of students
1.	The completion of the tasks assigned to the group is clear, and can be done well	6
2.	Never studied in a unique way like this	10
3.	With student worksheets and books, it really helps me to learn mathematics, although there are some that were confusing	11
4.	as with new lessons, I learned mathematics more difficult	9

In addition to the new fun comments about components and activities of learning, all students expressed interest to participate in the learning of mathematics in other materials and other subjects with this model. The reason why the students expressed interest was that the students understand the mathematical concepts better, interested in solving mathematical problems posed because of using the

5M stages. The students were given the opportunity to discuss, to question, and to criticize the works of their friends, fun learning environment and teachers were happy to respond the students' questions. The students were interested in the appearance of the student books, SW, illustrations and layout drawings, and clear in terms of legibility, language usage, and punctuation. If the results of the data analysis of student response referred to the specified criteria, it can be concluded that the students' response to the component and activities of learning with the model was positive.

The overall conclusions of the trial are as follows: (1) the level of the mathematics learning model from the 5M implementation assisted by SW was at a high level; (2) showing students' learning outcomes, in the classical style of learning had been completed; (3) the value of the teachers' ability to manage learning was sufficient; and (4) the students and teacher responses to the components and activities of learning were positive. If the conclusion of the results obtained from this trial were referred to the criteria of practicality and effectiveness of the model that had been set, it can be concluded that the results of applying the model to the learning device provided met the criteria of practicality and effectiveness of the specified models.

Collaborative Learning and Caring Community

Collaborative learning and caring concept refers to the substantial aspects of lesson study for community learning. This concept can be optimized in the learning of mathematics to improve the quality of student's activity, especially in terms of cooperation, collaboration and caring for others. Here is presented the results of a collaborative among students.

In group one, the process of doing SW, the more dominant members of the group were women, despite their occasional discussions. The steps of the Scientific Approach in this group were visible. This is evidenced by several things including: students did observe the process by reading for several times. The process of asking in this group occurred when a student asked formulas used to work on the problems to the other students in the group. The students began to make sense of the right answer to do with SW, and copied it on A3 size paper. After getting the answer returned, they discussed it (correcting) and found an answer that was less true and crossed out the results of these discussions as well as rewriting the answer they thought was right.

In contrast to the previous group, group 2 teamwork was more visible. Each member could ask and answered the questions within the group. They were enthusiastic and eager in doing SW. Scientific Approach also passed well. At the stage of observing, each member of the group understood the questions on the worksheet and started looking for the alternative answers by the helped of the materials on textbooks. However, there was one student who did not understand the problems existed on the worksheet and the students were likely to be busy writing the member's name on A3 paper. Each student worked together to solve mutual problems and helped each other to understand the material they were studying. In this group, it was very visible that the SW could improve students' enthusiasm in learning.

In group 3, there was one student who looked less active in discussions with his friends so that the modelled teacher invited all students to understand the problems that had not been covered by the other members in order to make the students focused in solving the problem with other group members. Similar to the previous group, Scientific Approach was already performed well.

Group 4 showed shortcomings in the discussion because there was a student who simply listened to the friend explanation in handling the problem. The student argued that he did not like the subject and still did not get attention of the modelled teacher. The student should be given more attention, for example explaining the materials to each individual.

Group 5 did not experience problems at all about the learning process with Scientific Approach since all the students in the group could cooperate actively. If there was a friend who lack of understanding the problems in SW and lack of understanding matter, the other group members could help him to learn. Therefore, it was highly visible that group 5 was very solid and cooperative.

In group 6 there was a student who was less active in discussing the problem that needed to be resolved such as in group 4. However, the measures of Scientific Approach continued to run well. This

was slightly different from group 7. There was one student who was less active to be cooperative because the student was lack of confidence, but the modelled teacher had provided motivation to encourage the student. Whereas, in the last group that was group 8, there was one student who was actually active, but at the time of the discussion, the student lack of cooperation with other friends and his learning response was also less attractive.

Overall, learning with Scientific Approach was very interesting. All students could play an active role in their own group. There were just one or two students who had not played an active role in the group. Most of the students who were less active had received the motivation by the modelled teacher but some were still not getting the attention of the modelled teacher. Measures Scientific Approach was already performed well. SW was very helpful in implementing learning with Scientific Approach. In addition, learning by SW Scientific had greatly assisted students in learning the material division exponential number, the students could work in groups to find a solution to the given problem (peer tutoring), fostered self-confidence to express opinions and be able to see the characteristics of students through the answers given when doing SW.

Collaborative Learning and Caring Community Patterns

In the tryout at SMPN 1 Situbondo, MTsN5 Jember, and MTsN 1 Lumajang, learning by using SW-oriented scientific approach showed collaborative learning and caring community with the pattern as follows.

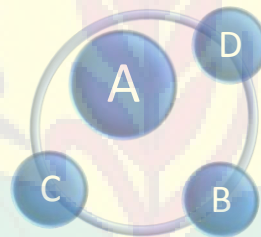


Figure 3.First type of students' collaboration

The first type could be described that there was 1 student at the centre of discussion answering question. The three other students formed a circle 3-way communication in discussions and asked questions. In this type, one student was seen to have advantages both in terms of mastery of the material as well as how to communicate (to explain).

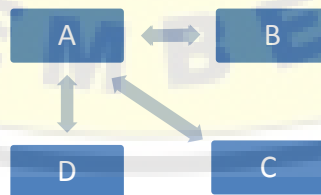


Figure 4. Second type of students' collaboration

The second type was one student as the only center of discussion and he was asked by three other students in the group. In this type, three members of the group did not discuss with each other, but they immediately asked or talked to one person who was deemed as "more" qualified.

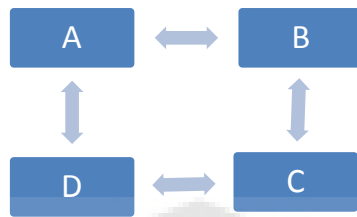


Figure 5. Third type of students' collaboration

The third type was the two students who sat next to each other were asking question to each other and talking to each other. In this study, each student had equal ability and could co-exist. Thus, if there were problems or issues associated with learning difficulties, they would finish with a friend sitting nearby (left and right).

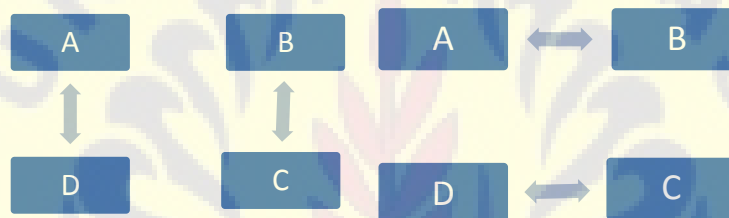


Figure 6. Fourth type of students' collaboration

The fourth type was students discuss with one person only (left or right). This pattern occurred because the ability of 4 students was almost evenly. Thus, students would choose a discussion of emotional closeness 2-2 choice.

The fifth type was there are no discussion and no questions asked out. This pattern occurred because the task was too easy or too difficult for them. Moreover, it was also because they were waiting for the teacher order to have discussion.

Based on those five types of patterns, the interaction and discussion as well as students questioning, in accordance to the level of closeness, ability, and communication skills developed by the students, were good.

4. Conclusion

Based on the results and analysis of this study, it could be concluded that obtaining grade math worksheets VII, VIII, and IX / SMP / MTs with a scientific approach, carried out by observing stages, questioning, reasoning, trying and communicating, was practical and effective. The effectiveness was in terms of enhancing students' understanding and students' responses as excellent as they can. In details, the results of tryout I and II in this study indicated that: (1) The level of implementation of the model-assisted learning of mathematics 5M SW was at high level, (2) Student learning outcomes in classical learning was completed, (3) The value of the teacher's ability to manage learning had been quite good, (4) The response of students and teachers to the components and the learning activities was positive.

The following suggestions were given based on the results of this study, (1) for the teacher, the teacher should be able to create and implement the Student Worksheet assisted learning the *scientific approach* (5M), (2) for students, by the help of worksheets, students should be able to understand the material properly through the stages of observing, questioning, reasoning, trying and communicating,

(3) for the government, the government should emphasize the 5M and the socialization of scientific methods massively and systematically, (4) for future researchers, the future researchers are expected to examine the broader relation related to *higher order thinking* (HOT).

Acknowledgements

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