International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Realistic Math-Based Learning Model Based on Mandailing Culture

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Abstract

This study described the activities of teachers and pupils in Realistic Mathematics Based Learning based on Mandailing Culture (PMR-BBM) of North Sumatra. This type of research was a descriptive research. Subjects in this study were teachers who apply learning mathematics that apply PMR-BBM and Junior High School pupils of class VII-2 SMP Negeri 2 Kotanopan as 26 people. The object of this research was the activity in the learning activity. Data collection was done through observation of teachers and pupils activities. Data aanalysis of teachers and pupils' activityies carried out in the 4 learning meetings; it found that teachers activity score was 4.41 where; it was a good category. The overall activity of pupils' activities in the 10 observed sessions reached the limits of tolerance. Thus the activities of teachers and pupils in realistic cultural-based mathematics learning were fall into the effective model.

Keywords: Learning Activity; Culture; Mandailing; Realistic Math.

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1. Introduction

Mathematics is an obligatory subject from primary, secondary and tertiary levels. Cornelius in Abdurrahman [1] suggests 5 reasons for the need to study mathematics: (1) clear and logical means of thinking, (2) the means to solve problems in everyday life, (3) the means of recognizing relationships and generalizations experience, (4) means to develop creativity, and (5) means to raise awareness of cultural development. Thus required a good learning activities and learning in accordance with the conditions of implementing learning.

Learning is an activity implemented by teachers and pupils to achieve a certain goal. Reference [2] reveals that learning is the basis for future progress and development is created through the ability to learn and the capacity to create new discoveries that are continued from generation to generation. In learning, pupils are the subjects or learners while the teacher plays a role as a motivator and facilitator. In order for pupils to play an active role in learning activities, then the teacher should design a learning model that stimulates the activity of pupils in teaching and learning activities.

Based on information from the implementation of preliminary observation, (Date 10 April 2017) in Junior High School (SMP) Negeri 2 Kotanopan of North Sumatra, the researchers concluded that the implementation of learning is still conventional and requires a new paradigm that is more appropriate with the natural way of pupils in learning mathematics. It is believed to increase pupil activity in learning activities. In addition, new innovations are required in the implementation of learning by linking local culture in the implementation of learning that can make pupils feel close to the subject matter, learning is more meaningful and the self-embedded pupils that learning and mathematics is a culture of its own positive impact on the love of pupils teaching and learning activities and mathematics.

Furthermore, Reference [3] revealed that realistic mathematics education made pupils active in learning mathematics and the approach of mathematics education realistic improved the quality of teaching and learning process. Ekowati and his colleagues [4] in his research, with the type of classroom action research, showed that through the application of realistic mathematics education improved the activities of pupils in learning. It was seen from their participation in answering the tests given by teachers to for each group. Research conducted by [5] indicated that the active activities of pupils who were given lessons with realistic Indonesian math lessons better than those of given conventional approaches. The Realistic Mathematics Education (RME) approach has been applied in Aceh partially, but not completely. A higher percentage of activities as reported by the Aceh education office with the application of Realistic Mathematics Based Learning (PMRIs) in all primary schools were reached. It found the Mathematics lessons have been more effective in Realistic one.

Additioanlly, Reference [6] suggested that mathematics should be viewed as a human activity. It means, In learning mathematics, pupils should not be viewed as passive human, but must be positioned as human active, creative and have the potential to develop. Mathematics learning activities conducted by pupils with the aim of finding new things in the form of knowledge that has not been understood previous pupils. In order for mathematics can be learned by pupils through activities until pupils are able to solve problems. De Lange in Reference [7] revealed the process of rediscovery of mathematical concepts through the exploration of real-

world problems. Thus the learning of mathematics needs to start from a situation close to the pupil's daily life.

This research were based on the 2013 Indonesian Curriculum. The topic for the learning Math for pupils of second Grade of Junior High School in the odd semester included: 1) sequence on integers and fractions; 2) count operation on integers; 3) counting operations on fractions; 4) integer and fractional numbers.

2. Conceptual Framework

2.1. Realistic Mathematics Learning (PMR)

Realistic Mathematics Learning (PMR) is a model of learning activities of teaching and learning mathematics. Reference [6] states that realistic mathematics learning is a human activity, developed with basic principles, namely (1) *Guided Reinvention and Progressive Mathematization*, (2) Didactical Phenomenology (Phenomenon in Learning, and (3) Self-developed Models In accordance with the principle of realistic mathematics learning above, in learning with PMR approach it is necessary to consider the characteristics of PMR according to Reference [8], namely: (1) The use of context in learning, (2) Usage model for developing progressive mathematization, (3) Improvement of pupil construction result, (4) Occurs inter-activity of teacher and pupil, (5) Linkage of mathematics materials.

With regard to the principles and characteristics of Realistic Mathematical Learning (PMR), the PMR uses a context (real-world problem) starting point to build a lesson concept. Context is given to pupils with the aim of pupils rediscovering ideas and mathematical concepts with teacher guidance. With the giving of context, pupils will translate real-world problems into the form of mathematical models (*mathematization*). Reference [8] states that *mathematization* in PMR involves generalizing and formalizing. Both of these aspects are also known as horizontal *mathematization* and vertical *mathematization* which at the end of the process is obtained by the formal model of mathematics. The process of developing concepts and ideas of mathematics beginning with the real world by the following is illustrated by De Lange Conceptual Mathematization [9]:

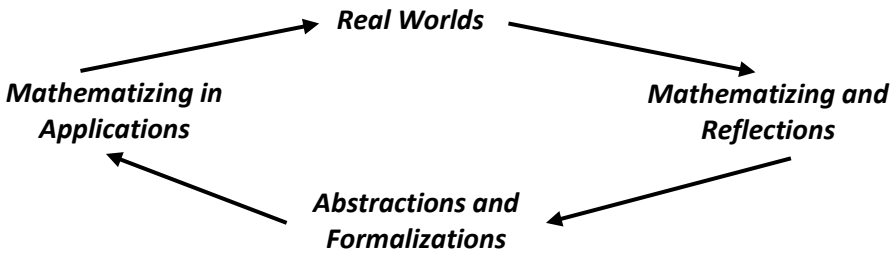

Figure 1: Conceptual Mathematization

Implementation of PMR interactivity occurs between teachers and pupils. Intercommunity that occurs includes the interaction between pupils to pupils and pupils to teachers. With the interaction between pupils in learning teachers provide direction to pupils in relating subject matter materials. The attribution of the material is given freedom by the conclusion of the conclusion. Johnson [10] stated that each linked lesson provides a rich learning

context, although the goals, assessments and final values are separate.

In realistic mathematics learning real world problem (real word) is the starting point in learning. Blum and Niss in [7] eloborated that the real world is everything beyond Mathematics, like other lessons, daily life situations and the environment around us. The appeared problems need to consider the socio-cultural situation contained in learners. The removal of socio-cultural problems cannot be separated from the habits found in the life of society. Thus it is necessary to get linked in the learning system in accordance with local culture.

If the culture of Mandailing was viewed from the community in running, the traditional government led by the king. The king with his assistant in this case provided a guidance or protection to his community with the *Dalihan Natolu* as Philosopical Ideal. Further Nasution [11] argued the Mandailing customs in everyday life as well as certain ceremonial ceremonies are still practiced based on the *Dalihan Natolu*. This social principle has an ideal basis (philosophy) *Holong Dohot Domu (Love seeks Peace)*, and the structural foundation *Patik, uhum, Ugari, Hapantunon* and operational *pokat basis* (discussion).

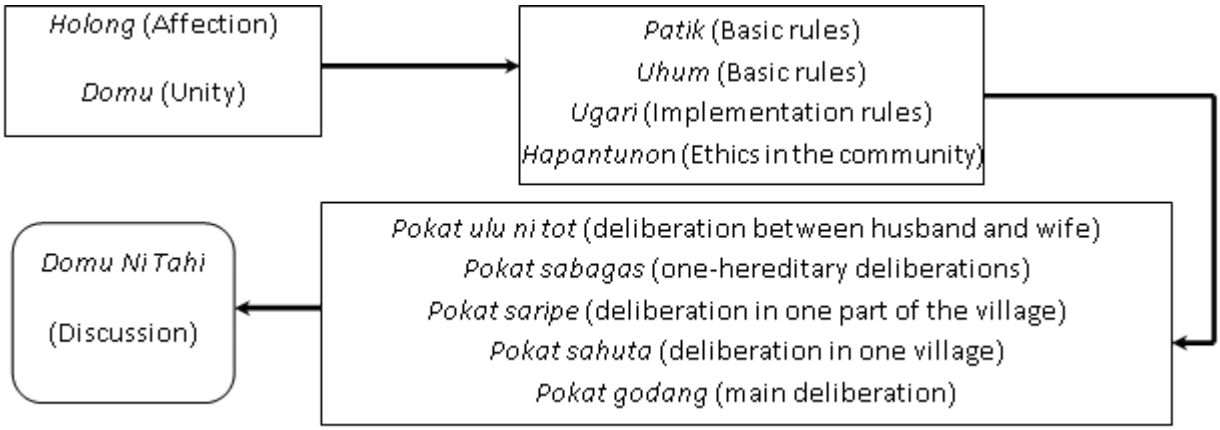

Figure 2: Systematic chart of indigenous cultures of Mandailing [11]

The society of Mandailing on the *Dalihan na tolu* basis holds three parties (clans). Lubis [12] reveals there are three ethics in the life of society that is respectful to *mora*, persuasive to *anakboru* to *kahanggi (suhut)*.With the application of the principle of *dalihan natolu* then the pesky system based on *olong* (affection) will cause the society *marsiolongan* (mutual mercy) that will cause *atigoran* (honesty) as well as *domu* will cause *adomuan* (unity) that will realize *adamean* (peace) .With the systematics of custom law of Mandailing based on *dalihan na tolu* can be obtained *mardomu tahi* (discussion/deliberation) which will become light weight that difficult to be easy in every problem.

Following the social system of Ethnic Mandailing, the Realistic Mathematics Learning Model on the Culture of Mandailing (PMR-BBM) was designed. The result of modification or collaboration of Realistic Mathematics Learning Model (PMR) with Mandailing culture was made; it means that all principle contained in PMR are applied in PMR-B3M model by involving Mandailing cultural aspect in each component model and in the implementation of learning PMR-BBM is a model of mathematical learning based on constructivist views that pay attention to the characteristics of mathematics and cultural values of Mandailing.

The application of PMR-BBM class was implemented through the syntax of learning derived from the integration of PMR application with the Mandailing Culture; where the PMR was implemented with the principle of Mandailing culture that is *Dalihan Na Tolu*. Membership in groups is seen as a component of the *Dalihan Na Tolu* that playing the role of *suhut, anak boru* and *Mora*. Furthermore, when we viewed from the *mora* would have a *mora*, if we viewed from the angle of *suhut*, then the position is *mora ni mora*, as well as *anak boru* exactly have *anakboru* also that if viewed from the *Pisang Raut* position and this is the expansion of *dalihan natolu* (Nasution, 2005: 86). The existence of the expansion of *Dalihan na Tolu* gives an impression on the operational component of *Dalihan na Tolu* where components are not rigid on 3 components. But can be formed 5 or 6 components. The application of group learning in this case is carried out by exploring the expansion of *Dalihan na Tolu* by involving *anakboru* from *anakboru* (*Pisang Raut*), *mora ni mora* and ranks of *kahanggi* from *suhut* side. Intrusion expansion pattern of *Dalihan na Tolu* can be observed in the following figure:

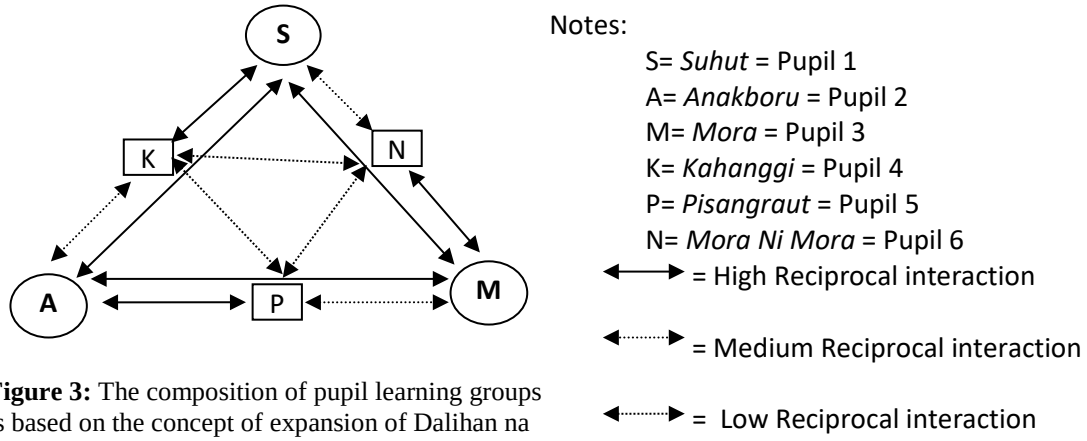

Figure 3: The composition of pupil learning groups is based on the concept of expansion of Dalihan na Tolu

There are six syntaxis of PMR-BBM implementation which is the core activity of learning. The six syntaxs are among others:

(1) Apperception of Mandailing Culture

Mandailing cultural perception in this case is an activity to reintroduce the existing culture and link it in mathematical problems. Mandailing culture is to convey the cultural system which must be practiced in Mandailing. In the case of customary law of Mandailing, there is an ideal base of Mandailing custom, structural foundation (*patik, uhum, ugari, hapantunan*) and operational base of Mandailing culture. The delivery of this cultural system is aimed at forming pupil learning motivation and instilling the importance of learning activities undertaken. Furthermore, problems contained in Mandailing culture will be disclosed and linked into the form of mathematical problems with the emergence of problems that are sourced from the daily life of pupils who cannot be separated from the social and cultural needs of pupils need the solution of problems related to the way of social culture solving as well.

(2) Group Formation and Provide Contextual Problems to Pupils

At this stage, a formation for the composition of the group of pupils with the pattern of expansion of *Dalihan na Tolu* with 5-6 pupils was made. The groups were organized by considering each group of pupils to interact well. The groups were arranged homogeneously with each group consisting of heterogeneous pupils. Where the structure of behavior and activities in the group were adjusted to the principle of *Dalihan na Tolu*. Provinding material in the Pupil Activity Sheet (LAS) is a sheet containing contextual issues; Math problems relate to the facts contained in the Mandailing culture. The pupil activity sheet was provided by the teachers; based on the grouping party, who acts as a *suhut*. Then the existing problems were shared by the group with equal division of tasks for the three components of *Dalihan na Tolu*.

(3) Explaining Contextual Problems

The contextual problem in this case is a mathematical problem derived from the Mandailing cultural facts, it was found in the LAS. The problems contained in the Mandailing culture were clarified by the teachers while conveying the principles related to the culture and purpose in learning the problem. Explanations were made to sharpen pupils' understanding of the issues presented and to clarify the execution of activities required when using props.

(4) Mutual Cooperation of Guided Discovery

Problem solving of contextual pupils discussed in groups. The group consisted of 5-6 pupils. In the group pupils will discussed the problem with the pattern of interaction of *dalihan natolu*. In terms of implementation, there is the principle of respectful *marmora, elek maranakboru, rosu-rosu markahanggi*. In the implementation the *mora and mora nimora* pupils got 1/3 part of the task to be completed, as well as *anakboru* along with banana sharp and *suhut* with *kahanggi*. Each of these components addressed one-third of the overall problem. The problem-solving process was done in collaboration, but the task of the *Dalihan na Tolu* component was specifically 1/3 part. Implementation in group work was carried out in full co-operation with solidarity. After each component of *dalihan natolu* completed the whole answer then proceeded with *pokat* (deliberation) where in the group happened to explain each other the results of the discovery in each group.

(5) Identifying and developing the work

The presentation of the work was specifically administered to the members of the *Dalihan na Tolu* group who played as a children. In terms of delegating, the *anakboru* from group members had to read out the results of the discussion (problem solving) that existed in the LAS or describes and got to write down a math calculation on the blackboard, thus must explain the drawings and calculations written on the blackboard. In the case of developing the work of the pupils invited other pupils to give comments or questions in the form of question and answer to the explanation given. Giving responses or answers from other groups were accepted and answered by *anakboru* who were presenting in front of the class. If *anakboru* was in front of the class then the group representative provided assistance through group members or pupils who became the *pisang raut*. Questioning process was done between pupil renderer (*anakboru*) who was assisted by representatives of renderer group (*Pisang raut*) and other group that responded or made questions to solving the problem.

(6) Make inferences according to the mathematical material and the context of the problem summing up the subject matter was done by each group of pupils. the assignment of the task of conveying the conclusions has been specifically given to the members of the group plotting as *mora* in each group. The conclusions obtained from problem solving were read by each *mora* in as group representatives in turn from the entire group. After the completion of the conclusion of each group then the teachers made the conclusion in general. Submission of conclusions by teachers was a directive or reinforcement of the conclusions given by previous pupil group representatives.

Learning of the application of real-world problems that comes from the culture of pupils or community itself was done; not excluding the cultural interaction of the community. This model was expected to provide good activity for pupils in learning. Thus the researchers had to assess the activity of teachers and pupils in PMR-BBM with the problem and the level of activity of teachers and pupils in learning PMR-BBM.

2.2. Realistic Mathematics Learning with Dalihan Na Tolu

Realistic mathematics learning with Mandailing's *Dalihan Na Tolu* involves the use of learning aids in the form of Pupils' Activity Sheets (LAS). LAS was distributed to the pupils with component of *Dalihan Na Tolu* which acts as *Suhut*. The mathematical problems given were related to Mandailing cultural facts. The problems of Mathematics in the LAS were submitted specifically to each component, as practiced in *Dalihan Na Tolu* equally system or each component of the *Dalihan Na Tolu* should obtain the equal parts (each component = 1/3 part). Problems were discussed by each component of *Dalihan Na Tolu;* by working together in which the solution requires the deliberation in *pokat ulu ni tot* (meeting within a small group). In classroom, the results of the discussion were written on the existing LAS working report. One of the Mathematics problems in question was: *"In the marriage procession of the Bayo Lubis and the Boru Nasution, it is required additional party costs IDR. 4.500.000, -. If the Math question was solved in the additional financing, the party was done in accordance with customarily practice of Ethnic Mandailing, e.g; Mora,* Suhut and Anakboru *with the same part. If the anakboru consists of 5 families will finance the same portion. How much should each family pay from the line anakboru ? "*. The problems were solved by the pupils by redefining the given problem, sketching the form of problem solving, making mathematical modeling. Carry out the calculation process and, the conclusions of solving the problem.

Every problem that given to the small group was following by the *Dalihan Na Tolu system;* it was solved jointly by each component. Furthermore, after the problem solving, each component was followed by deliberation in one group of pupils. In that case, the whole solutions of the Mathematical problems in the LAS that already discussed led to the resuls. Thus the whole groups found the Mathematical problems were to derive the general conclusions.

3. Method

This research applied a descriptive method by analyzing the activities of teachers and pupils in the implementation of PMR-BBM. Data collection was conducted through observation of teachers and pupils

during the learning process. Implementation of learning model was conducted in 4 meetings, involving 2 observers and 1 cameraman. Observers aimed to obtain the pupils' activity data in learning. Furthermore, cameramen aimed to get video learning and photo activities that served as authentic materials to analyze learning activities undertaken.

The observations were made on a randomly selected group of pupils. Class PMR-BBM (class VII-2 SMP Negeri 2 kotanopan); there were 26 pupils who have been active in the implementation of learning. The classes of VII-2 pupils were divided into 5 homogeneous groups. Thus, randomly selecting selected one group subject to be made in the observations. The selected gong group was consisting of 5 members. Observation of pupil activity was done by noting the relevant things done by the pupils. Recording of pupil activities were carried out within five minutes where the first minute to the fourth minute conducted observations of the dominant pupil activity and the fifth minute were done to write down the results of observations obtained. Implementation of learning carried out during two hours of lesson (2x40 minutes) so that the results obtained observations of each pupil as much as 16 times.

The activities of pupils in the category of observations in PMR-BBM activities had 10 actions. These ten actions had been analyzed for their effectiveness by comparing them with the percentage of acquisition of each action with effectiveness tolerance limits. The ten measures referred to and the effectiveness tolerance limits in question are: a) Reading / understanding of books or LAS (5% - 15%); b). Taking into account the teacher's explanation (5% - 15%); c) Resolving the problem (10% - 20%); d) Ask questions (5% - 15%); e) Discussion between fellow pupils (15% - 25%); f) Discussion between pupils and teachers (5% - 15%); g) Demonstrate results / convey ideas / ideas (5% - 15%); h) Record items relevant to learning activities (0% P 10%); i) Make a conclusion (0% P 10%); j) Portfolio or completion of work (0% P 10%).

Furthermore, to analyze the activities of teachers in learning activities conducted by an observer to observe and record the ability of teachers in managing PMR-BBM activities.

The observed aspect included the overall action of teachers in the implementation of learning which includes: a) preliminary activities; b) core activities (Mandailing Cultural Apperception, Group Formation and Providing Contextual Problems to Pupils, Understanding Contextual Problems, Mutual Cooperation of Guided Discovery, Concentrating and Developing Works, Making Conclusions In accordance with Mathematics and Context Problems) and; c) final activity. Assessment is done through the provision of check mark in column of observation sheet using likert scale 1-5. '1' means 'less good', '2' means 'less good', '3' means 'enough', '4' means 'good', '5' means 'excellent'.

4. Results and Discussion

The results of the research indicated that Realistics Mathematic on the Etnic Mandailing culture was relevant to the implementation of the learning in Junior High School. In accordance with the observations of the learning process conducted by the observer in 4 meetings, it could be reported as follows.

Based on the above table, it can be observed in terms of each meeting then Aspects observed in teaching and

learning activities meet the limits of tolerance given. On the "a" aspect of the first meeting was 7.5%, the second meeting was 8.75%, the third meeting was 7.5% and the fourth meeting was 8.75% where the tolerance limit for aspect "a" was 5% - 15%. Thus the "a" aspect of the first meeting until the fourth meeting meets the tolerance limit. Furthermore, in terms of the average value then the aspect "a" obtained value of 8.13%. It also shows that the value obtained meets the limit of effectiveness tolerance. Likewise with the next aspects the observed aspects are meeting the tolerable limits. Thus the pupil activity in learning is effective. The diagram of the observations from the I-IV encounter can be observed in the following figure.

Table 1: Pupils activity observation results

Aspects observed	Learning Activity (%)				Average
	I	**II**	**III**	**IV**	
a) Read / understand books or LAS	7,50	8,75	7,50	8,75	8,13
b) Pay attention to teacher explanations	8,75	7,50	8,75	7,50	8,13
c) Solve the problem	13,75	15,00	15,00	16,25	15,00
d) Asking question	11,25	10,00	8,75	8,75	9,69
e) Discussion between fellow pupils	22,50	23,75	22,50	20,00	22,19
f) Discussion between pupils and teachers	10,00	11,25	11,25	11,25	10,94
g) Demonstrate results / express opinions / ideas	10,00	11,25	11,25	12,50	11,25
h) Noting things that are relevant to the learning activities	6,25	5,00	5,00	6,25	5,63
i) Make a conclusion	6,25	5,00	5,00	5,00	5,31
j) Portfolio or completing homework and works	3,75	2,50	5,00	3,75	3,75
Total	100	100	100	100	100

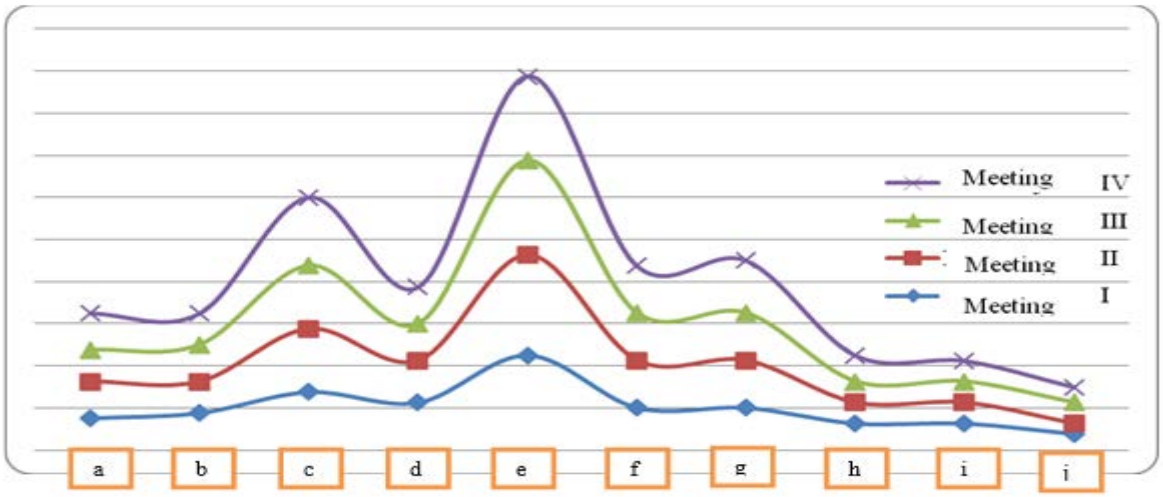

Figure 4: The observations from the 1st-4th meetings

From the figure above, it can be observed that the activity of the pupils from 1st-4th meetings was the most widely appear in the first position of the discussion between pupils ("e"), this due to the learning activities of pupils have interaction levels in groups; they interacted directly or can be through an intermediary. With the rules set then the interaction to be done pupils direction more clearly. Furthermore, in the second position to solve the problem ("c") where in this case the pupils had been very enthusiastic in solving the problem because the problems that already displayed related to the culture of pupils who needed to be studied and applied in the environment both the educational environment and the social environment. Activity of pupils who were in the third position to demonstrate the results / convey opinions / ideas ("g") ; this because pupils in one group already knew each part. Where the officer demonstrated the results performed by one position assigned. The position that demonstrated the results was the routine task of the pupil who played as *anakboru*. Given the clear division of tasks, each member had a separate responsibility. The next in the lowest position made the Portfolio or completing the homework and works ("J"); this was due to the tasks assigned to the pupils (homework assignment) have been completed in each home, and when the teacher asks to collect the pupils' homework ready to collect it further for writing the number of questions on homework assignment has been provided on the pupil's books in accordance with the material being studied. Teacher activity in the implementation of learning can be viewed from the ability of teachers in managing learning. The implementation of learning cannot be separated from the applied learning model that includes the initial activities, core activities and end activities. The core activities carried out follow the PMR-BBM model. Where in the application of the model cannot be separated from the syntax of the learning. Further it is analyzed management of classroom time and class situation. Below is presented the results of observations on teacher management of learning activities:

Table 2: Results of teacher management observation of learning

Aspects observed	Average score of I-IV meetings
Initial activity	4,56
Core activities	
a. Apperception of Mandailing culture	4,19
b. Group formation and provide contextual problems to pupils	4,50
c. Understanding contextual issues	4,25
d. Invention is guided by mutual cooperation	4,40
e. Presenting and developing the work	4,05
f. Make inferences according to the mathematical material and context of the problem	4,00
End activities	4,31
Time Management	4,00
Observation of Class Situation	4,38
Average Score	**4,26**

From the above description, it can be observed that the initial activity reached the score of 4.56, thus the initial activities of 4 (four) meetings are categorized well. Furthermore, the core activities obtained an average value of

4.23 in this case all indicators in core activities PMR-BBM categorized well. Subsequent to the final activity obtained an average value of 4.31; this value included in either category, time management obtained an average value of 4.00 based on the criteria categorization of these scores into the category of good, then the classroom atmosphere was viewed from the enthusiasm of teachers and pupils to follow learning achieved the score of 4.28. Then this value belongs to either category. Furthermore, taking into account the overall average value then obtained an average value of 4.26. Thus the teacher management in the learning was included in the good category.

5. Conclusion

Based on the results and discussion of the study, it concluded that the activity during four meetings in the learning of Realistic Mathematics Based on Mandailing Culture (PMR-BBM) met the criteria of liveliness; the initial activity reached the score of 4.56, the final activity obtained an average value of 4.31. The teachers in managing learning through observation during the four meetings pupils were more passionate and happy in the learning process, an increase in pupil activities such as pupils asking questions about the material taught, discussing in groups, doing the LAS with passion, presenting the results of the discussion in the future class, the pupils increasingly appreciate the results of problem solving found friends, and better understand the math materials learned tended to increase.

It is advisable for teachers to use the Realistic Mathematics Based Learning on Mandailing Culture (PMR-BBM) on mathematical material. In addition, teachers are expected to make this PMR-BBM learning as an alternative to improve pupil learning activities.

Acknowledgement

The authors would like to thank the Incentive Program for National Innovation Research of Ministry of Research, Technology and Higher Education of Indonesia; it has provided funding in Individual Research Incentive in the research of revitalization and reactualization identity of the nation in the face of globalization year of 2017 implementation.

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