Mathematics literacy abilities and responsibility with realistic mathematics education learning based ethnomathematics

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Abstract. The results of observations at SMP Negeri 40 Semarang found that the sense of responsibility and mathematics literacy skills of grade VIII students was not optimal. The purpose of this study was to determine the mathematics literacy skills of students in the classroom using the ethnomathematics based RME to achieve classical completeness and the average mathematics literacy skills of students were better than the average mathematics literacy skills of students in classes using the expository learning model, to determine whether there was an effect of responsibility towards students' mathematics literacy. This research method is an experimental quantitative method. The population of this study were students of class VIII SMPN 40 Semarang in the academic year 2019/2020. The sample was taken by using cluster random sampling technique, it was obtained class VIII A as the experimental class and class VIII B as the control class. The results of this study indicate that (1) students' mathematics literacy in the experimental class achieve classical completeness, (2) the average mathematics literacy skills of the experimental class students are better than the control class students' mathematics literacy abilities, (3) there is significant influence of student responsibility on mathematics literacy abilities.

1. Introduction
The Organization for Economic Cooperation and Development (OECD) organizes a study on an international student research program called the International Program of Student Assessment (PISA). The limiting things in other PISA studies are mathematics literacy, reading literacy and scientific literacy, which aims to assess the extent to which students between the ages of 15 are able to master knowledge and skills so that they can apply the knowledge gained from school in their daily life. [1]. PISA is held every three years, from 2000, 2003, 2006, to 2018. The results of the PISA-based Mathematics Literacy (ML) in 2009 and 2012, the mathematics literacy score of Indonesian students was still very low because it was ranked 64 out of 65 countries, in 2015 the ranking of 63 out of 70 countries only got a score of 386 from the average OECD score of 500, and in 2018 the score was only 379 and was ranked 72nd out of 78 participating countries, [2-4].

According to [5] mathematics literacy are the ability for students to be able to understand and apply some mathematical applications such as facts, principles, operations, and problem solving in everyday life in the past as well as the present. Stating that mathematics literacy can help a person to understand the role or usefulness of mathematics in everyday life and as a basis for consideration in making the right decision as a society that builds, cares, and Bines.

Math learning contains not only materials, but there are values contained therein. One of the values of the character to be implanted is responsibility. Responsibility is the attitude and attitudes of one to
carry out his duties and obligations, which he should do, towards oneself, society, the Environment (nature, social and culture), the State and God Almighty. The character of responsibility is important in the learning and learning Group.

Mathematical literacy and student responsibility must be supported by innovative and realistic learning. The innovation that can be done is by choosing the right learning model. One of the appropriate learning models and approaches is the Realistic Mathematics Education (RME) based Ethnomathematics model (RME-E). Applying the RME-E model, students can solve math problems related to the real world. RME has three principles, (1) Guided discovery and mathematical processes, this is in line with the opinion [6] namely, in Freudenthal's view, students should be given the opportunity to rediscover mathematics by organizing or sculpting either real-world situations or mathematical relationships and processes has substance for students, (2) the phenomenon of decay, (3) the formation of the model by the students themselves. Vygotsky encourages conceptual development in interpersonal relations through semiotic mediation and the use of cultural tools such as mathematical symbols which is one of two in Vygotsky's Theory [7].

Ethnomathematics can be a bridge between mathematics and culture as well as a manifestation of Indonesia's cultural preservation through education. Ethnomathematics are defined as a specific way used by a particular cultural group or community in mathematics activity. Mathematics activity is an activity that occurs in the process of abstracting from real experience in everyday life into mathematics. The implications of Ethnomathematics should observe the following things; (1) Human interaction, Ethnomatematics associate mathematical activities in the community; (2) Social values, involving mathematics with values, beliefs that are in the community; (3) language, mathematical and cultural interactions, due to language as the main bearer of mathematical ideas; (4) The History of mathematics, developing mathematical ideas in the cultural diversity of society; (5) Cultural roots. There are seven elements of the universal culture are: arts, technology and equipment system, community organization system, language, live-search eye system and economic system, knowledge system, and religious system. The culture that will be applied in learning is a variety of traditional snacks that exist in the market. Central Java has a variety of traditional snacks such as, Lumpia Semarang, Ice Dawet Ayu, Arem-Arem, Wingko tripe, Wedang tofu etc. The traditional food is included in the seven cultural elements, a live-search eye system and an economic system.

Look at the difficulties of students in understanding the story related to the life of the day as described by one of the teachers of mathematics in SMPN 40 Semarang above. Then the researcher provides an ethnomatematic-inspired RME learning model to the students, in this case researchers expect students to be easier to understand the questions pertaining to the daily life that will be given, this is because the Ethnomatematika itself is a study of mathematics based on culture, where the culture itself is closely related to the environment surrounding the students and through the culture will also be able to form characters in students especially the responsibility of students. Based on the background of the problems described above, the problem formulations to be examined in this study are (1) whether students' mathematical literacy skills with the application of RME learning with Ethnomatic nuances can achieve classical completeness, (2) Is the average student's mathematical literacy ability with the application of RME learning with Ethno-mathematical nuances higher than the average mathematical literacy ability of students with expository learning (3) Is there an effect of the character of student responsibility on students' mathematical literacy abilities.

The RME-E learning syntax is in line with the suggestion provided by [8] i.e., to improve mathematics literacy in the mathematics learning process also need to build meaning with symbols, contexts, graphs, diagrams, and other models. So math learning will be meaningful to students. If the teacher plans and implements learning systematically, students can understand the concepts being learned. One of the efforts to overcome the problem of the meaning of learning is to use innovative learning models and approaches and to train students' abilities to solve problems of everyday life. This opinion is supported by [9, 10, 11], RME-E gives students the opportunity to experience a process similar to mathematical creation, namely building their own mathematical tools or ideas, and finding their own answers.
2. Methods

This research is a quantitative experimental research on a population by taking a random sample. Data collection using instruments and the data analyzed quantitatively with statistics to test the hypothesis that has been determined [12]. On this research, researchers used the RME-E learning model in the experimental class and the Expository learning model in the control class.

The population in this study was grade VIII student of JHS 40 Semarang academic year 2019/2020. The sampling on this study was conducted with the cluster random sampling with class VIII A as the experimental class and class VIII B as the control class. The statistical test used to determine the classical submission of mathematical literacy skills tests using the right-party proportion test (Z-Test) and the ratio of mathematical literacy skills to the two-party difference test and the regression equation test and the correlation coefficient test to determine whether there is an influence between students' responsibilities to the students' mathematical literacy skills.

The study was conducted four times in the experimental class using an ethnomathematics-inspired RME model and a control class using an expository model. The material used is a two variable Linear equation system with completion using substitution method, elimination method and combined/mixed method. The variables used in this study were the ability of mathematical literacy and the responsibility of students.

The method of collecting data in this research are the method of documentation and test method. The documentation method is a method of collecting data to obtain preliminary data about the literacy skills that will be the research object. A test is a tool or procedure used to know or measure something in the atmosphere, in the manner and rules specified. The instrument used in this study is a written test instrument. Before the test was used in test questions mathematics literacy skills will be tested first, then will be carried out the validity test, the level of difficulty of the reliability test, and the differentiator power. Then will be taken into question that meets the criteria.

Data analysis about the classical completeness hypothesis test of mathematical literacy class RME-E used the proportion test using the z statistic. Analysis of hypothesis test data for the average mathematical literacy of the RME-E class was better than the average for the Expository class. The average difference test used the t-statistic. Analysis of the data on the significant effect of responsibility on mathematical literacy used linear regression with statistic F.

3. Result and Discussion

3.1. Research Results

3.1.1. The results of the classical mastery of mathematics literacy hypothesis test in the RME-E class

\[ H_0 : \pi < 0.75 \]

The percentage of students in the RME-E class whose mathematical literacy attains individual completeness achieves classical completeness of less than 75%.

\[ H_1 : \pi \geq 0.75 \]

The percentage of students in the RME-E class whose mathematical literacy achieves individual completeness achieves classical completeness of more than or equal to 75%.

Since \( z_{\text{count}} = 1.32 > z_{\text{table}} = -1.64 \), \( H_1 : \pi \geq 0.75 \) The percentage of students in the RME-E class whose mathematical literacy achieves individual \( H_1 \) is accepted. So, the percentage of students in the RME-E class whose mathematics literacy achieved individual completeness achieved classical completeness was more than or equal to 75%.

3.1.2. The results of the hypothesis test on the mean difference in mathematics literacy in the RME-E and Expository classes

\[ H_0 : \mu_{\text{experiment}} \leq \mu_{\text{control}} \]

The average mathematics literacy in the experimental class is less than or equal to the mathematics literacy average for the control class.
The average mathematics literacy in the experimental class is more than or equal to the mathematics literacy average for the control class. So through the above hypothesis based on SPSS 20.0, acquired value $\text{sig} = 0.01 < 0.05$, Then $H_1$ accepted. So the average mathematics literacy in the experimental class is more than or equal to the mathematics literacy average for the control class.

This is in line with the results of research conducted by [13] that learning using the RME approach is effective with the ability of students' mathematical literacy as demonstrated by the achievement of individual and classical learning.

The result of this research is in line with Vygotsky theory that there is a social interaction where the students study by forming small groups in order to participate students to be active in searching for information and discussions. It is supported by the fact in class that is at The use of context stage in RME, students are required to form a small group, then teachers give assignments to the students to go to the market observing the prices of traditional snacks sold on the market, and then students are asked to buy two different types of food, the food will be brought by students as a material discussion in class.

3.1.3. The results of hypothesis testing the effect of responsibility on mathematics literacy

$H_0$: There is no significant effect between responsibility on mathematical literacy

$H_1$: There is significant effect between responsibility on mathematical literacy

Because the sig in the ANOVA regression table is $0.00 < 0.05$, $H_1$ is accepted. So there is a significant influence between responsibility on mathematical literacy. From the test results of the regression equation formed is $\hat{Y} = 61.151 + 0.393X$. $\hat{Y}$ Estimated mathematics literacy and $X$ is students' responsibility. The contribution of responsibility influencing mathematical literacy is shown by the coefficient of determination 0.88.

3.2. Discussion

Based on the results of the classical completeness hypothesis test and the average difference test, it was found that by applying the RME-E learning model of mathematics literacy students can achieve classical completeness and the average mathematics literacy of students is better than the average class mathematics literacy using expository learning. By applying the RME-E learning model, students are more active in discussions. This is because students are involved in finding problems around real life. Students actively solve problems together in groups. The results of this study are in accordance with the research results [14], Umbara, U., & Nuraeni, Z., it is possible that the increase in students' mathematical literacy skills is triggered by the Adobe Flash Professional CS6-based RME learning which in the implementation of learning always focuses on self-regulated learning. Farida N., Bagus, A.S., Maya, R. R. [15] researching that profile of student's problem solving ability with high mathematical ability was very good. Problem solving is a component of mathematical literacy. Ulandari L., Amry Z. & Saragih S. [16] also researching about learning materials based on realistic mathematics education approach met the effective criteria and can improved mathematical problem solving ability. Mathematical problem solving is component of mathematics literacy which matches the results of this study.

Furthermore, the problems that have been presented in the form of mathematics will be exchanged with other groups to be solved according to the indicators of mathematics literacy. The use of realistic questions on the two-variable linear equation system material is more acceptable and understood by students because it is relevant and logical to the problems that occur in the students' environment. Through the given realistic issues, it can train students to be able to relate the experiences gained in everyday life. This is supported by [9, 10, 11] which states that RME has advantages, including: (1) Students build their own knowledge, students do not easily forget what they find, (2) The atmosphere in the learning process is fun to use the reality of life, so that students not bored in learning mathematics, (3) Students feel valued and more open because each student's answers are valuable, (4) Foster a sense, (5) Take responsibility for group assignments, (6) Train students' courage to speak to explain their answers, (7) Train students to get used to thinking and brainstorming, and (8) Cultivating respect.
The result of the effect test using linear regression shows that there is a positive influence between responsibility and mathematics literacy. This is because the RME-E learning process will not run well without a sense of responsibility that students have. The results of this study are supported by research results, that that the learning process requires responsibility which is indicated by significant changes in student learning attitudes to obtain better learning outcomes optimal. So that the higher the student's responsibility, the optimal learning outcomes will be obtained, especially the students' mathematics literacy abilities [17]. This is in line with research [18] mathematics literacy is likewise a powerful asset for responsible citizenship in a world that is planning for peace. The results of the research on the existence of responsibility for mathematics literacy are also in accordance with the results of the research [19] that benefits of being responsible for their own learning. The results also strengthen the effect of responsibility on students' mathematics literacy, that only responsibility feeling variable that could affect the environmental behavior [20]. One more research result that supports the results of the study that responsibility affects mathematics literacy that the distribution of achievement gains is more socially equitable in schools with high levels of collective responsibility for learning [21].

4. Conclusion
Based on the explanation above, it can be concluded that the students' mathematical literacy skills with Realistic Mathematics Education learning style with an ethnomathematics achieve a classical genius and minimal submission criteria, and the RME-E also gains an average of the ability of mathematical literacy skills better than the class using other learning models. In addition, the students' responsibilities have an effect on the ability of students' mathematical literacy with a Realistic Mathematics Education learning style. The suggestions that can be given. (1) Teachers can use nuanced RME learning Ethnomathematics As an effective and interactive learning alternative to improve students' mathematics literacy; (2) Teachers can also use exploratory activities in RME learning these ethnomathematics to hone the character responsibilities in the students so as to improve student literacy skills. However, when choosing this exploration activity is used in classes with hours of study that are long enough or not paused due to rest or other obstacles so that the results obtained can be optimal according to what is expected.; (3) The learning Model of realistic mathematics Education in Ethnomathematics can also be applied to some other mathematical learning materials, such as; Geometric sub-chapter material on building both flat and curved side spaces, and statistical sub-chapter material and on the level of Elementary, Junior and Senior secondary education. The learning Model in this research can also be applied to several sub-chapters of material in other fields of science such as Science lessons in sub chapters of physics, Chemistry and Biology, IPS lessons on sub chapters of sociology and geography; (4) This research can be used as a reference material for conducting further research, e.g. when students are asked to make a question of the results of its exploration activities, the teacher gives a card that is shaped cartoon character or the like to each group to be used as a writing media of the problem that will be made and exchanged to the other group. So that students can be more passionate about following learning.

References
[1] OECD. 2014. PISA 2012 Results in Focus: What 15-year-olds know and 2 what the can do with what they know. (Paris: OECD Publishing)
[2] Stacey K 2010 J. Math. Educ. 2 1
[3] Stacey K 2011 J. Math. Educ. 2 2
[4] Stacey K 2012 J. Sci. Math. Educ. Southeast. 33 1
[5] Ojose B 2011 J. Math. Educ. 4(1) 89
[6] Freudenthal H 1973 Mathematics as an educational task (Dordrecht: Reidel)
[7] Davydov V V 1995 Educ. Res 24 3
[8] Thompson D R and Rubenstein R N 2014 J. Adolesc. Adult Lit 58(2) 105
[9] Wardono and Mariani S 2014 Int. J. Educ.Res. 2(7) 361
[10] Wardono and Mariani S 2019 J. Phys.: Conf. Ser. 1321 032094
[11] Wardono et al 2015 *Int. J. Educ. Res.* 3 1
[12] Sugiyono 2012 *Metode Penelitian Pendidikan Pendekatan Kuantitatif, Kualitatif, dan R&D* (Bandung: Alfabeta)
[13] Ningrum D A S, S. Mariani and Wardono 2018 *Unnes J. Math. Educ.* 6(2) 2252
[14] Umbara U and Nuraeni Z 2019 *Infin. J.* 8(2) 167
[15] Farida N, Bagus A S and Maya R R 2018 *J. Res. Adv. Math. Educ.* 3(1) 13
[16] Ulandari L, Amry Z and Saragih S 2019 *Int. Electron. J. Math. Educ* 14(2) 375
[17] Aisyah A, Nusantoro E and Kurniawan K 2014 *Indones J. J. Guid. Couns.: Theory Appl.* 3(3) 44
[18] Fawcett H P 1947 *Math. Teach.* 40(5) 199
[19] Nader A and Tanju D 2019 *Int. J. Teach. Learn. High. Educ.* 31(2) 224
[20] Ratieh W, Rediana S, Kardiyem and Wisudani R 2019 *J. Environ. Manag. Tour* 10(1) 5
[21] Valeriee L and Julia B S 1996 *Am. J. Educ.* 104(2) 103