International Journal of Science and Research (IJSR)
ISSN: 2319-7064
Index Copernicus Value (2016): 79.57 | Impact Factor (2017): 7.296

The Students' Mathematical Communication Ability in Learning Ethomathematics-Oriented Realistic Mathematics

Wahyu Widada[1], Dewi Herawaty[2], Dwi Yanti[3], Dena Izzawati[4]

[1, 2, 3, 4]The Graduate Program of Mathematics Education, Universitas Bengkulu, Jl. WR SupratmanKandangLimun Bengkulu, Indonesia 38371

Abstract: ***The purpose of this study was to determine the contribution of realistic mathematics learning and ethnomathematics to mathematical communication skills.This research is a quasi experimental study using a 2x2 factorial design. The sample is 60 students, who are chosen with the whole group technique. The experimental class was given an ethnomathematics-based realistic mathematics learning approach, and a control class with a traditional approach. Data collection is done by using a mathematical communication ability test. Data were analyzed by ANCOVA. The result, if the two groups of students were given the ethnomathematics material, the students' mathematical communication skills were taught with a higher realistic learning approach used by traditional learning approaches.***

Keywords: ethnomathematics, mathematical communication, realistic mathematics learning

1. Introduction

The learning mathematics requires students to communicate actively, both verbal and written communication.Widada (2016) suggested the implementation of a meaningful learning model in students' information processing systems. It has been able to improve the mathematical communication process of students in every level of thinking.They have been able to achieve mathematical communication activities ranging from actions, processes, objects and schemes (Widada, 2015, 2016a).

Students have been able to communicate mathematics meaningfully until they reach the extended-trans level(Widada & Herawaty, 2018b). Oleh karena itu, pembelajaran matematika harus dimulai dengan masalah nyata dalam kehidupan sehari- hari atau dekat dengan pikiranya (Widada, 2017). Pembelajaran ethnomathematics menjadipilihan yang tepat(d'Ambrosio, 1989).

Ethnomathematics merupakan was the concept relies on a model of individual behavior based on the cycle: reality - individual - action – reality (d'Ambrosio, 1985). According to Marsigit (2016),one aspect that can be developed for learning innovation is local local culture. Local wisdom is a learning that is close to the mind of students and their life activities. This is a realistic learning with the starting point are contextual problems(Herawaty & Widada, 2018).

The ethnomathematics-based realistic mathematics learning approach enhances the concept understanding ability (Widada & Herawaty, 2017). According toWidada & Herawaty (2018a), that mathematical communication of students taught using realistic mathematics learning was higher than those who taught using the traditional method (the learning materials in both groups was non-ethnomathematics oriented). Second, mathematical communication of students learned the ethnomathematics oriented material was higher than those learned non-ethnomathematics oriented materials (realistic mathematics learning applied in both groups). Third, mathematical communication of students who learned the ethnomathematics oriented materials was lower compared to the students learned the non-ethnomathematics materials (the traditional learning method applied in both groups).

The description shows that learning with an ethnomathematics-based realistic mathematical approach has been able to improve mathematical abilities, including mathematics communication. According to Pourdavood & Wachira (2015) through mathematical communication, teachers can foster student engagement and participation while focusing on the deep conceptual understanding.

The mathematical communication was carried out by students through interaction in realistic mathematics learning(Fauzan, Slettenhaar, & Plomp, 2002). Students can be use the surrounding environment as a beginning of learning. Local culture makes it easier for students to do the horizontal mathematizing (Van den Heuvel-Panhuizen & Drijvers, 2018). Also, it facilitates students in the process of abstraction, idealization and generalization. Students can achieve mathematical concepts formally. Students get it through a good mathematical communication processes.

Students learn with an ethnomathematics-based realistic mathematical approach to improve verbal and written communication. The results of (Fauzan, Ahmad; Slettenhaar, Dick; Plomp, 2002), the first pilot with realistic mathematics education had many positive impacts on the teaching-learning process in the classrooms. The difference in the learning behavior of the pupils found from day to day showed that the realistic mathematics education is a potential approach for teaching and learning mathematics.

The similar results were obtained by(Widada & Herawaty, 2017), the realistic mathematics learning model based on ethnomathematics can help students in the process of

abstraction, idealization and generalization by utilizing the model off and model for.By implementationof the realistic mathematics learning based on Bengkulu ethnomathematics can improve students' cognitive level. The highest level of cognitive level of students is from Level 0 to Level 1 by 32%.According to (Van den Heuvel-Panhuizen & Drijvers, 2018) ,the realistic mathematics education is undeniable a product of its time and cannot be isolated from the worldwide reform movement in mathematics education that occurred in the last decades.

The description provides recommendations for implementing the realistic mathematics education with starting point ethnomathematics to improve the mathematical communication abilities.

2. Method

The research is a quasi-experimental study using a factorial 2x2 design. The population of this study were all students of SMA Negeri 2 Bengkulu City. The sample was 60 students, selected by intact group technique. The experimental class was given the Bengkulu-based mathematics mathematics realistic learning approach, and the control class with traditional approaches, and the combine. Data collection is done by using mathematical communication ability instruments. Data were analyzed with ANCOVA statistics.

3. Result and Discussions

Treatment penelitian adalah pendekatan matematika realistik berorientasi ethnomathematics. Ini dilakukan sebanyak enam kali pertemuan.Pertama,siswa diberi pretest, dan empat pertemuan adalah treatment, dan diakhiri dengan posttest. Skor pretest adalah kovariat.

The data of mathematical communication abilities in realistic mathematics learning with ethnomathematics learning at SMA Negeri 2 Bengkulu is carried out inferential statistical analysis. Covariance analysis was carried out by controlling the initial ability of students of mathematical communication. The results were presented in Table 1.

Table 1: Levene's Test of Equality of Error Variances

F	df1	df2	Sig.
1.683	3	56	.181

Based on Table 1, Tests the null hypothesis that the error variance of the dependent variable is equal across groups. It can be seen that F = 1.683 with df (3, 56) concluded p-value = 0.181> 0.05. This indicates that Ho was accepted, which means that the variance of the four groups is the same or homogeneous. Furthermore, there were tested the regression parallels of the four sample groups. See Table 2 below.

Table 2: Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected M.	8672.025	7	1238.861	7.102	.000
Intercept	8000.040	1	8000.040	45.864	.000
A * B	1690.654	3	563.551	3.231	.030
X	2976.832	1	2976.832	17.066	.000
A * B * X	303.320	3	101.107	.580	.631
Error	9070.308	52	174.429		
Total	124424.000	60			
Corrected Total	17742.333	59			

Based on data analysis in Table 2, it can be concluded that the regression alignment of the four treatment groups is as follows.
Hypothesis Pair, Ho: (AB) ij X = 0, &Ha: besides Ho.

See column A * B * X, shows that F = 0.580 with df (3, 52) and p-value = 0.631> 0.05, which means that Ho was accepted. Thus it can be concluded: the regression coefficients of the four groups are homogeneous, or the four regression equations are parallel.

Based on the prerequisite test above, that the data variance of the understanding ability of trigonometry is homogeneous, and the four groups form parallel regression equations, then ANCOVA can be continued as follows.

Table 3. Tests of Between-Subjects Effects

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	8368.706[a]	4	2092.176	12.276	.000
Intercept	8279.225	1	8279.225	48.579	.000
A	1992.088	1	1992.088	11.689	.001
B	940.202	1	940.202	5.517	.022
A * B	596.418	1	596.418	3.499	.047
X	4751.306	1	4751.306	27.878	.000
Error	9373.628	55	170.430		
Total	124424.000	60			
Corrected Total	17742.333	59			

Table 3 shows that Fo (A) = 11.689, df = (1, 55) and p-value = 0.01 <0.05. That Ho was rejected. This means that there are significant differences in mathematical communication skills between students taught by realistic and traditional mathematics learning approaches.

The column B shows Fo (B) = 5.517, df (1, 55) and p-value = 0.022 <0.05. That Ho was rejected. This means that there are significant differences in mathematical communication skills between students who are given ethnomathematics-oriented non-ethnomathematics learning materials.

Also, column AB produces Fo (AB) = 3.499, df (1, 55) and p-value = 0.047> 0.05. Ho was rejected. This is to show that there are interaction effects of the learning approach and the orientation of mathematical material on the ability of mathematical communication skills.

See column X, that Fo (X) = 27,788, df (1, 55) and p-value = 0,00 <0,05.Ho was rejected means that there is an effect of the linear ability of the initial covariate on students' mathematical representation and the ability to understand mathematics.

Finally from Table 3, see the corrected model column, Fo = 12.276, with df (4, 55) and p-value = 0.00 <0.05 Ho rejected. Thus, the initial ability of students in mathematical communication, learning approaches and orientation of mathematical material together affect the ability of mathematical communication.

Table 4. Parameter Estimates (1)

Parameter	B	Std. Error	t	Sig.
Intercept	20.040	4.962	4.039	.000
[A=1.00]	18.322	4.852	3.776	.000

Table 4 shows that t = 3.776 and p-value = 0.000 <0.05. This means that Ho is rejected. Also, the average of the mathematical communication abilities of students taught with realistic mathematics learning approaches were higher than students who were taught using traditional learning approaches.

Table 5: Parameter Estimates (2)

Parameter	B	Std. Error	t	Sig.
Intercept	30.268	4.241	7.136	.000
[B=1.00]	7.906	3.754	2.106	.040

Value of t = 2.106, and p-value = 0,04<0.05 in Table 5. Ho rejected. The means that the average ability of the students' mathematics communication learned using the ethnomathematics-oriented material was higher than those given non-ethnomathematics.

Table 6. Parameter Estimates (3)

Parameter	B	Std. Error	t	Sig.
Intercept	20.040	4.962	4.039	.000
X	1.105	.209	5.280	.000
[A=1.00] * [B=1.00]	14.651	4.940	2.966	.004

See Table 6, obtained that t = 2.966 and p-value = 0.004 <0.05. This states that Ho is rejected. The shows that there was an interaction effect between the learning approach factors and the mathematical material orientation on mathematical communication abilities.

Table 7. Estimates Parameters (4)

Parameter	B	Std. Error	t	Sig.
Intercept	20.04	4.962	4.039	.000
X	1.105	0.209	5.28	.000
[A=1.00] * [B=1.00]	14.855	5.034	2.951	.009
[A=1.00] * [B=2.00]	-18.322	4.852	-3.776	.000

See column [A=1.00] * [B=1.00] on Table 7, the results of t-test showing t = 2.951, and p-value = 0,009<0,05. It was indicating that Ho rejected. Thus, if both groups of students were given ethnomathematics-oriented materials, then mathematical communication ability of students who were taught with a realistic mathematics learning approach was higher than those taught by the traditional learning approach. Furthermore, the t-test result on column [A=1.00] * [B=2.00] shows that t = -3.776 and p-value = 0.000<0.05. The meaning was Ho rejected. Therefore, if both groups of students were given mathematics materials of non-ethnomathematics, then mathematical communication ability of students learned using realistic mathematics learning approach was lower compared to the students learned by the traditional learning approach.

The results of this study provide a real contribution that ethnomathematics-based realistic mathematics learning has a positive effect on mathematical communication skills. Therefore, it supports the results of previous research.As, (Widada, Nugroho, Sari, & Pambudi, 2018), that for the students studied using the realistic mathematics learningapproach, the mathematics representation ability of students given the ethnomathematics- oriented materials was higher than the students learning with the non-ethnomathematics materials. The realistic mathematics learning has a positive effect on mathematics learning outcomes compared to traditional learning (Fauzan et al., 2002)(Fauzan, Ahmad; Slettenhaar, Dick; Plomp, 2002).Also, the ethnomathematics was playing an important role in learning mathematics rather than traditional learning (d'Ambrosio, 1989).Kualitasrespon matematika siswa meningkatselama pembelajaran ethnomathematics (Widada, Sunardi, Herawaty, Boby, & Syefriani, 2018).

Thus, we recommend to teachers and researchers to develop ethnomathematics-based realistic mathematics. In this case, local culture is a favorite to be developed. This can also improve and strengthen character education for students.

4. Conclusion

The results were convincing that the students' mathematical communication abilities taught with realistic mathematics learning approaches are higher than those taught by traditional learning approaches. Also, the average ability of the students' mathematics communication learned using the ethnomathematics-oriented material was higher than those given non-ethnomathematics.

References

[1] d'Ambrosio, U. (1985). Ethnomathematics and its place in the history of mathematics. *For the Learning of Mathematics*, *5*(1), 44–48. https://doi.org/10.2307/40247876
[2] d'Ambrosio, U. (1989). *Ethnomathematics (Link between Traditions and Modernity)*. *Philosophia Mathematica* (Vol. s2-4). Rotterdam: Sense Publishers. https://doi.org/10.1093/philmat/s2-4.1.3
[3] Fauzan, Ahmad; Slettenhaar, Dick; Plomp, T. (2002). Teaching mathematics in indonesian primary schools using realistic mathematics education (rme)-approach. *Science And Technology*.
[4] Fauzan, A., Slettenhaar, D., & Plomp, T. (2002). Traditional Mathematics Education vs . Realistic Mathematics Education : Hoping for Changes. In *Proceedings of the 3rd International Mathematics Education and Society Conference. Copenhagen: Centre for Research in Learning Mathematics, pp. 1-4* (pp. 1–4).
[5] Herawaty, D., & Widada, W. (2018). The Influence of Contextual Learning Models and the Cognitive Conflict to Understand Mathematical Concepts and Problems Solving Abilities. In *Advances in Social Science, Education and Humanities Research* (Vol. 218, pp. 96–102). Paris, France: Atlantis Press.
[6] Marsigit. (2016). Pengembangan Pembelajaran Matematika Berbasis Etnomatematika. In *Makalah dipresentasikan pada Seminar Nasional Matematika dan Pendidikan Matematika 2016 STKIP PGRI Sumatera Barat dengan Tema Etnomatematika, Matematika dalam Perspektif Sosial dan Budaya. 16 April 2016. Padang. Indonesia.*
[7] Pourdavood, R. G., & Wachira, P. (2015). Importance

of Mathematical Communication and Discourse in Secondary Classrooms. *Global Journal of Science Frontier Research*, *15*(10). Retrieved from https://globaljournals.org/GJSFR_Volume15/2-Importance-of-Mathematical.pdf

[8] Van den Heuvel-Panhuizen, M., & Drijvers, P. (2018). Realistic Mathematics Education. *Encyclopedia of Mathematics Education*, 521–525. https://doi.org/10.1007/978-94-007-4978-8_170

[9] Widada, W. (2015). The Existence of Students in Trans Extended Cognitive Development on Learning of Graph Theory. *Jurnal Math Educator Nusantara*, *1*(1), 1–20.

[10] Widada, W. (2016a). Profile of Cognitive Stucture of Students in Understanding the Concept of Real Analysis. *Journal of Mathematics Education*, *5*(2), 83–98. https://doi.org/10.22460/infinity.v5i2.215

[11] Widada, W. (2016b). The Syntax of The Mathematics Learning Model Based on Students' Cognitive Development. *Jurnal Pendidikan Matematika Raflesia*, *1*(2), 163–172.

[12] Widada, W., & Herawaty, D. (2017). Realistic Mathematics Learning Based on Bengkulu Ethnomatematics to Increase Cognitive Level. In *Conference Proceeding BICSE – 2017* (pp. 214–225). Bengkulu: FKIP UNIB Press.

[13] Widada, W., & Herawaty, D. (2018a). Realistic mathematics learning based on the ethnomathematics in Bengkulu to improve students ' cognitive level. *SOUTH EAST ASIA DESIGN RESEARCH INTERNATIONAL CONFERENCE, 27-18 June 2018*, 1–6.

[14] Widada, W., & Herawaty, D. (2018b). The Effects of the Extended Triad Model and Cognitive Style on the Abilities of Mathematical Representation and Proving of Theorem. *Advances in Social Science, Education and Humanities Research, Volume 218*, *218*(ICoMSE 2017), 89–95.

[15] Widada, W., Nugroho, K. U. Z., Sari, W. P., & Pambudi, G. (2018). The Ability of Mathematical Representation through Realistic Mathematics Learning Based on Ethnomathematics. *Seminar on Advances in Mathematics, Science, and Engineering for Elementary Schools. 16 August 2018. Website: Http://Samses2018.Upiconf.Org*.

[16] Widada, W., Sunardi, H., Herawaty, D., Boby, E., & Syefriani, D. (2018). Abstract Level Characteristics in SOLO Taxonomy during Ethnomathematics Learning. *International Journal of Science and Research (IJSR)*, *7*(8), 352–355. https://doi.org/10.21275/ART2019438