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Model-Eliciting Activities (MEAs) with Integrated Local Wisdom as a Mathematics Learning Model

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Abstract:
***Background**: It is important for a prospective mathematics teacher to have problem solving skills as well as other skills such as reasoning and proofing, communication, connections, and representation as stated in NCTM. Problem solving skills are also needed by students. In order to improve their problem-solving skills and their learning achievement, innovation and a new mindset to achieve the purpose of education are necessary. The models, methods, and strategies of learning mathematics should be varied to optimize students' potential. Lecturers' efforts to organize and use various learning variables are important factors determining students' success in achieving learning goals. Choosing the most suitable method, strategy, and approach in designing a learning model with active students' participation and meaningful activities has become a demand lecturers have to meet. Thus, model-eliciting activities (MEAs) with integrated local wisdom in learning mathematics is needed to be developed in order to improving students' problem-solving skills.*
***Materials and Methods**: This study used research and development method to develop MEAs with integrated local wisdom in learning mathematics to increase students' problem-solving skills. After that, an experimental research was applied to know the effectiveness of the model with pre-experimental one group pretest-posttest design. In this study, students' problem-solving scores and their learning achievement were analyzed.*
***Results**: The inferential analysis of students' problem-solving score resulted in t-count 8.984 with significance of 0.000 < alpha score 0.05, meaning statistically it is significant to approve H1 and reject H0 in which there is a significant difference between students' problem-solving average score on pretest and that on posttest. Judging from the students' average score in the pretest with 68.16 and that in the posttest with 80.82, the students' problem-solving skills increased. The inferential analysis of students' problem-solving score resulted in t-count 6.807 with significance of 0.000 < alpha score 0.05, meaning statistically it is significant to approve H1 and reject H0 in which there is a significant difference between students' problem-solving average score on pretest and that on posttest. Judging from the students' average score in the pretest with 70.40 and that in the posttest with 81.26, the students' problem-solving skill increased.*
***Conclusion:** It is concluded that the use of MEAs with integrated local wisdom in learning mathematics was effective in improving students' problem-solving skills and learning achievement.*
***Keywords**: MEAs, local wisdom, problem solving skill, learning model*

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I. Introduction

Quality of education is still the main problem in improving the quality of national education. A lot of efforts have gone into improving the quality of education, taking all of the educational components into account including curriculum, teachers' and lecturers' quality, textbooks and education facilities, learning system, assessment system, as well as education organization and management. Other issues in the implementation of national education program are concerning education policies, children development, teacher/lecturer, and relevance, quality, accessibility, management, and cost of education.

The shift of higher education is developed based on four pillars of education [1]; those are: (i) learning to know, (ii) learning to do in which there are some competences to be mastered based on ISCE (International Standard Classification of Education and ISCO (International Standard Classification of Occupation), de-materialization of works and skills to response the increase of service sector business, and working in informal economic sector, (iii) learning to live together (with others), and (iv) learning to be, as well as lifelong learning. As a matter of fact, those four pillars are a unity. The categorization of pillars is just to show the main substance of the materials in the learning process. It means that in a certain material, competences of learning to do mastery cannot be separated from the competences of learning to know, learning to live together, and learning to be; they are interconnected. Thus, the categorization of learning materials into hard skills and soft skills is no longer present in a curriculum. The pre-existing elements of hard skill and soft skill are now accommodated in the dimension of cognitive, affective, and psycho-motoric processes.

Still, it is undeniable that there are some students facing difficulties in learning mathematics. There is a widely existed cynicism that those learning mathematics in higher education are still experiencing difficulties to connect the materials of the mathematics subject with their daily life and practical uses. It is correlated with a tendency of mathematics teaching and learning process which focuses itself on the aspect of product, rather than process and behavior. Mathematical principles, laws, and theories are more strongly emphasized, hugely portioned, and highly dominant in mathematics learning, so the process aspect (methods or any means necessary to obtain knowledge) and behavioral aspect (scientific behaviors consisting of various beliefs, opinions, and values that must be preserved by the people learning it) do not get enough spotlight. Consequently, mathematics learning process becomes “dry”, abstract, theoretical, confusing, and boring. Moreover, it is as if mathematics learning eventually be separated from daily life reality.

The demand to have a good score in mathematics often unwittingly tends to make students only focus on a good product or score. The biggest drive of the students in learning mathematics is only to get a good score. The problem is getting more complex when the score is regarded as the only way to measure one’s mathematical competence. Besides, without realizing it, that kind of demand forges mathematics learning in higher education merely driven to the point where the only important thing is that students can pass the exam with a high score. As a result, mathematics learning only bears students who are able to memorize formulas.

One of the students’ obstacles in learning mathematics is the approach and the way materials are organized in higher education due to the lecturer’s perspective. Generally, there are some possible mistakes in mathematics learning process, creating difficulties for students in understanding particular materials, which are: 1) focusing too much on abstract concepts without correlating them to the real daily problems, 2) failing to make students understand the purpose and benefits of learning mathematics, generating low student motivation, 3) focusing extensively on the product without paying more attention to the process, and 4) giving more dominant role to the lecturer during the teaching and learning process. Those possible mistakes should be more considered by the educators, especially when they are teaching mathematics.

From the observation, it is discovered that there is a need in giving students some strategies and improvement to increase their problem-solving skills during mathematics teaching and learning process. Despite all of those things, there are still other important aspects that students need to have, such as behavior, moral, discipline, and a soul full of good intentions. The unideal teaching and learning process in higher education is expected as an effect of continuous learning model or approach which is unvaried and unchanged throughout a certain extent of times.

Underlining the issues, it is the time to update the teaching and learning process with some innovations and changes in mindset to achieve the objective of education. The models, methods, and strategies of learning mathematics should be varied, optimizing the students’ potential. Lecturer’s efforts to organize and use various learning variables are important factors determining students’ success in achieving learning achievement. Thus, lecturers are required to be able to choose the most suitable method, strategy, and approach in designing a learning model with active students’ participation and meaningful activities.

Nowadays, there are some learning models undergoing fast development; one of which is MEAs. MEAs is a learning model which aims at enabling students to understand, explain, communicate the concepts in certain mathematical problems through mathematical model procedures [2]. In line with it, MEAs is also developed based on the real-life situations of the students, working in a small group and presenting mathematical model as a solution [3]. It is important for a prospective mathematics teacher to have problem-solving skills and other skills, such as reasoning and proofing, communication, connections, and representation as stated in NCTM [4]. A prospective mathematics teacher has to know, understand, and be able to implement a process of mathematical problem solving. It is not enough for a mathematics teacher to only be able to know mathematical problem solving for themselves since later when they become a teacher, they have a huge responsibility for teaching their students to possess mathematical problem-solving skills.

Education based on local wisdom means that the education is closely related to the real problem and circumstances faced by students. Learning model based on local wisdom becomes a model of education providing high relevance with the real-life situations improving their self-development by empowering their skills and local potentials which differ in each area. Based on the above explanation, now is the time for a change and innovation in developing learning model in higher education. Therefore, a mathematics learning model integrating local wisdom into MEAs was developed. Local wisdom integrated in the model developed in this study is a specific culture from Bugis, Makassar. Therefore, this study examined the development and use of MEAs with integrated local wisdom as a mathematics learning model. Didactical design research (DDR) was applied to develop the MEAs, expecting a mathematics learning model optimizing the improvement of students' mathematical problem-solving skills.

Eliciting means that there will be something to come, obtain, or get [5], so it can be said that MEAs is a learning model which allows students to come into, obtain, or get a solution with mathematical model through their own thinking process.

Local wisdom-based education means that education is closely related to the real problems and circumstances faced by the students. With those real-life problems and circumstances, it is expected for the students to be challenged to critically respond to it [6]. The pillars of education integrating local wisdom are (1) developing humankind with acknowledgment of human existence since they were unborn as a foundation, (2) using truth and noble as the base of education and avoiding improper thinking process, (3) developing moral and spiritual (affective aspects), not merely focus on cognitive and psycho-motoric aspects, and (4) implementing synergy of cultures, education, and tourism in an education with character [6].

II. Material and Methods

Research Design

This study applied research and development method to create mathematical MEAs with integrated local wisdom with the purpose of using it to improve students' problem-solving skill. Research and development is a systematic study to design, develop, and evaluate an educational program, process, and product with certain criteria of validity, practicality, and effectiveness. [7] Then, an experimental research was conducted to know the effectiveness of the model. Pre-experimental one group pretest and posttest design was implemented in this study. This study is also aimed to discover the students' problem solving scores and learning achievement scores.

Research Location and Subjects

This study was conducted in Mathematics Department of Faculty of Math and Science in State University of Makassar. The fifth semester students of the department were chosen as the subject of the research. There were some units of experiments in this study which were

1. problem solving test and learning achievement given to the students before the treatment of mathematical MEAs with integrated local wisdom, and
2. problem solving test and learning achievement given to the students after the treatment of mathematical MEAs with integrated local wisdom.

Data Collection Technique

Instruments used to collect the data were observations, interviews, and scales. Scales were used to measure the problem-solving skills and learning achievement before and after the treatment. Meanwhile, observations were conducted during the research to record the students' and teachers' responses to the developed learning model.

Research Procedures

The effectiveness of mathematical MEAs with integrated local wisdom measured through pre-experimental research was known from the following steps: (1) conducting pretest, (2) having learning processes in the experiment groups, (3) conducting posttest, and (4) analyzing the results of the experiments. The independent variable of this study was mathematics learning model using MEAs with integrated local wisdom, while the dependent variables were the students' problem-solving skills and learning achievement.

Statistical Analysis

Data from pretest and posttest were analyzed using descriptive and inferential statistics on the IBM SPSS statistic 23. Descriptive statistics were carried out to obtain the information about the mean, mode, median, the maximum value, and the minimum value of the data. Meanwhile, the inferential statistics of t-test paired sample test in order to see the influence of the mathematics learning model using MEAs with integrated local wisdom. However, before the t-test was administered, the normality test was conducted.

III. Result

Results of the Descriptive Statistic Analysis

1. Problem Solving Skill

The results of the descriptive statistical analysis on the pretest and posttest of problem-solving skills ae shown in Table 1 below.

Table 1 The Results of the Descriptive Statistical Analysis on the Problem Solving Skill Pretest and Posttest

No.	Statistics	Pretest	Posttest
1	Mean	68.16	80.82
2	Median	67.50	80.50
3	Mode	60.50	79
4	Standard Deviation	6.339	4.897
5	Variance	40.182	23.997
6	Skewness	0.119	-0.287
7	Kurtosis	-1.263	-0.551
8	Range	21.50	18
9	Minimum	58	70
10	Maximum	79.50	88

Source: Results of Data Analysis Using SPSS

The results of the descriptive statistical analysis on the pretest of problem-solving skills showed that: (1) the mean score was 68.16, (2) the median score was 67.50, (3) the mode score was 60.50, (4) the standard deviation score was 6.339, (5) the variance score was 40.182, (6) the skewness score was 0.119, (7) the kurtosis score was -1.263, (8) the range score was 21.50, (9) the minimum score was 58, and (10) the maximum score was 79.50.

The results of the descriptive statistical analysis on the posttest of problem-solving skills showed that: (1) the mean score was 80.82, (2) the median score was 80.50, (3) the mode score was 79, (4) the standard deviation score was 4.897, (5) the variance score was 23.997, (6) the skewness score was -0.287, (7) the kurtosis score was -0.551, (8) the range score was 18, (9) the minimum score was 70, and (10) the maximum score was 88. The categorization of problem-solving skill scores can be seen in Table 2.

Table 2 Results of the Categorization on the Pretest and Posttest of Problem-Solving Skills

No.	Interval	Category	Pretest		Posttest	
			Frequency	Percentage	Frequency	Percentage
1	0-20	Very Low	0	0%	0	0%
2	21-40	Low	0	0%	0	0%
3	41-60	Moderate	2	8%	0	0%
4	61-80	High	23	92%	12	48%
5	81-100	Very High	0	0%	13	52%
		Total	**25**	**100%**	**25**	**100%**

The categorization in the above table can also be seen in the histogram below.

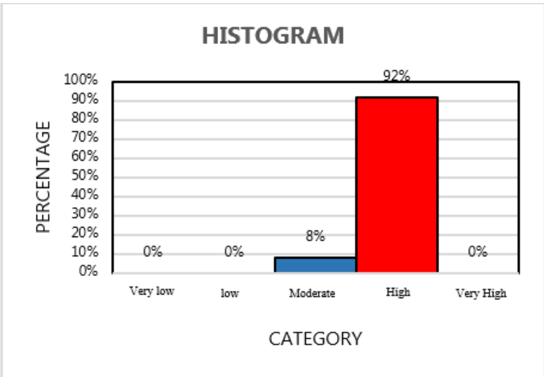

Diagram 1. Histogram of Problem-Solving Skill Pretest

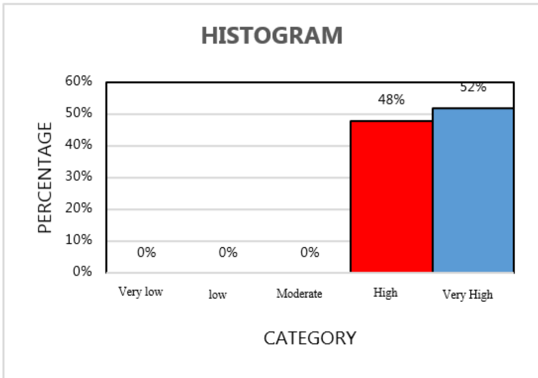

Diagram 2. Histogram of Problem-Solving Skill Posttest

2. Learning Achievement

Table 3 The Results of the Descriptive Statistical Analysis on the Learning Achievement Pretest and Posttest

No.	Statistics	Pretest	Posttest
1	Mean	70.40	81.26
2	Median	70.50	81
3	Mode	79	79
4	Standard Deviation	5.657	4.715
5	Variance	32	22.232
6	Skewness	0.019	0.053
7	Kurtosis	-0.447	-1.205
8	Range	21	15.50
9	Minimum	58	74

10	Maximum	79	89.50

Source: Results of Data Analysis Using SPSS

The results of the descriptive statistical analysis on the pretest of learning achievement showed that: (1) the mean score was 70.40, (2) the median score was 70.50, (3) the mode score was 79, (4) the standard deviation score was 5.657, (5) the variance score was 32, (6) the skewness score was 0.019, (7) the kurtosis score was -0.447, (8) the range score was 21, (9) the minimum score was 58, and (10) the maximum score was 79. The results of the descriptive statistical analysis on the posttest of learning achievement showed that: (1) the mean score was 81.26, (2) the median score was 81, (3) the mode score was 79, (4) the standard deviation score was 4.715, (5) the variance score was 22.232, (6) the skewness score was 0.053, (7) the kurtosis score was -1.205, (8) the range score was 15.50, (9) the minimum score was 74, and (10) the maximum score was 89.50. The categorization of learning achievement scores can be seen in the table below.

Table 4 The Results of the Categorization of Learning Achievement Pretest and Posttest

No.	Interval	Category	Pretest		Posttest	
			Frequency	**Percentage**	**Frequency**	**Percentage**
1	0-20	Very Low	0	0%	0	0%
2	21-40	Low	0	0%	0	0%
3	41-60	Moderate	1	4%	0	0%
4	61-80	High	24	96%	11	44%
5	81-100	Very High	0	0%	14	56%
Total			**25**	**100%**	**25**	**100%**

The categorization in the above table can also be seen in the histogram below.

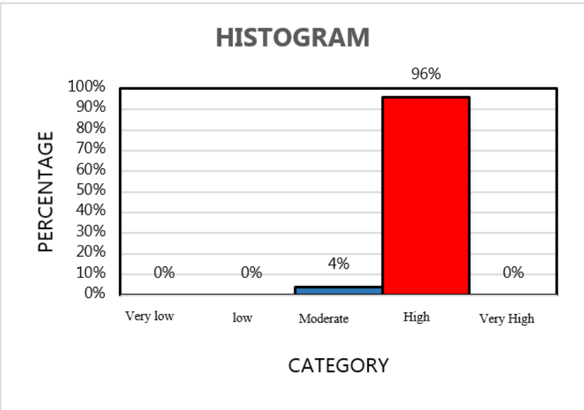

Diagram 1. Histogram of Learning Achievement Pretest

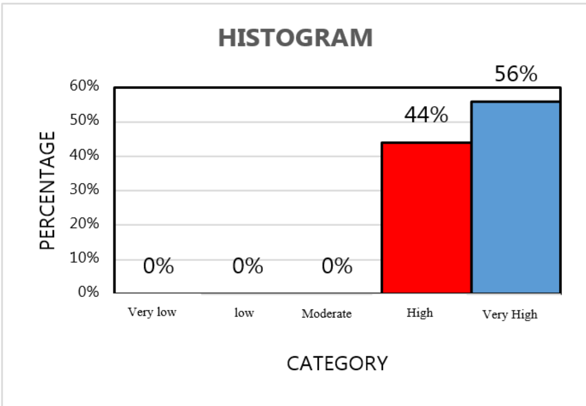

Diagram 2. Histogram of Learning Achievement Posttest

Results of the Inferential Statistic Analysis: t-Test

The effectiveness of the mathematics learning model using MEAs with integrated local wisdom can be seen from the t-test analysis of students' problem-solving skill and learning achievement.

1. Problem Solving Skill

Results of the t-test analysis of learning achievement score are as follows.

Table 5 Results of the t-Test Data Analysis of Learning Achievement Scores

	Paired Samples Test				
	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pair 1: PSA Posttest-PSA Pretest	12.660	7.04557	8.984	24	.000

Source: Result of Data Analysis Using SPSS

The analysis of students' problem-solving score resulted in t-count 8.984 with significance of 0.000 < alpha score 0.05, meaning that statistically it is significant to approve H1 and reject H0 in which there is a significant difference between students' problem-solving average score on pretest and that on posttest. Seeing from the students' average score in the pretest with 68.16 and that in the posttest with 80.82, the students' problem-solving skill was improved.

2. Learning Achievement

Results of the t-test data analysis of learning achievement score are as follow:

Table 6 The Result of the t-Test Data Analysis of Learning Achievement Score

	Paired Samples Test				
	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pair 1: LA Posttest-LA Pretest	10.860	7.97721	6.807	24	.000

Source: Result of Data Analysis Using SPSS

Based on the inferential data analysis it is known that t-count 6.807 with significance of 0.000 < alpha score 0.05, meaning statistically it is significant to approve H1 and reject H0 in which there is a significant difference between students' learning achievement average score on pretest and that on posttest. Judging from the students' average score in the pretest with 70.40 and that in the posttest with 81.26, the students' learning achievement improved. It shows that mathematics learning model using MEAs with integrated local wisdom increases students' learning achievement scores, meaning that it is effective in improving students' learning achievement. From the aforementioned explanation, it can be concluded that mathematics learning model using MEAs with integrated local wisdom is effective in refining students' learning achievement.

IV. Discussion

Results of descriptive statistical analysis on students' problem-solving skills showed that its average score increased. Problem-solving skill average score on pretest was 68.16 and that on posttest was 80.82. It indicates that the increase is an effect of the implementation of MEAs with integrated local wisdom as mathematics learning method. The median score was increased from 67.50 in pretest to 80.50 in posttest. Similar tendency also occurred with modus score from 60.50 in pretest to 79 in posttest. The standard deviation of pretest was 6.339 while that of posttest was 4.987. The variance of pretest was 40.182 and that of posttest was 23.997. They showed that data dissemination on posttest was better than that on pretest since generally posttest data tended to fall around average score. The value minimum of pretest was 58 while that of posttest was 70, and the value maximum of pretest was 79.50 while that of posttest was 88.

Data categorization showed that 8% of pretest score was in moderate category, while 92% of it was in high category. The category of posttest improved from 48% of it was in high category, while 52% of it was in very high category. Those mean that there is a change of score category, from high category on pretest to very high category on posttest. The inferential analysis of students' problem-solving score resulted in t-count 8.984 with significance of 0.000 < alpha score 0.05, meaning statistically it is significant to approve H1 and reject H0 in which there is a significance difference between students' problem-solving average score on pretest and that on posttest. Seeing from the students' average score on pretest with 68.16 and that on posttest with 80.82, the students' problem-solving skill improved. It shows that mathematics learning model using MEAs with integrated local wisdom increases students' problem-solving skill scores, meaning that it is effective in improving students' problem-solving skills. From the above explanation, it can be concluded that mathematics learning model using MEAs with integrated local wisdom is effective in improving the students' problem-solving skills.

Results of descriptive statistical analysis on students' learning achievement showed that its average score increased. The learning achievement average score on pretest was 70.40 and that on posttest was 81.26. It indicates that the increase is an effect of the implementation of MEAs with integrated local wisdom as mathematics learning method. Median score also increased from 70.50 on pretest to 81 on posttest and 79 on pretest and 79 on posttest. The standard deviation of pretest was 5.657 while that of posttest was 4.715. The variance of pretest was 32 and that of posttest was 22.232. They showed that data dissemination on posttest was better than that on pretest since generally posttest data tended to fall around average score. The value minimum of pretest was 58 while that of posttest was 74, and the value maximum of pretest was 79 while that of posttest was 89.50.

Data categorization showed that 4% of pretest score was in moderate category while 96% of it was in high category. The category of posttest was improved in which 44% of it was in high category while 56% of it was in very high category. Those mean that there is a change of score category, from high category on pretest to very high category in posttest. The inferential analysis of students' problem-solving score resulted in t-count 6.807 with significance of 0.000 < alpha score 0.05, meaning statistically it is significant to approve H1 and reject H0 in which there is a significant difference between students' problem-solving average score on pretest and that on posttest. Judging from the students' average score in the pretest with 70.40 and that in the posttest with 81.26, the students' learning achievement increased. It shows that mathematics learning model using MEAs with integrated local wisdom increases students' learning achievement scores, meaning that it is effective in improving students' learning achievement. From the above explanation, it can be concluded that mathematics learning model using MEAs with integrated local wisdom is effective in improving the students' learning achievement.

V. Conclusion

It can be concluded that the use of MEAs with integrated local wisdom in learning mathematics was effective in improving students' problem-solving skills and learning achievement. Mathematics learning model using MEAs with integrated local wisdom can transfer local values to develop students' good behaviors, characters, attitudes, and discipline.

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