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The Interaction Between Ethno-Stem Based Thematic Learning And Early Mathematics Ability In Improving Elementary Students'numerical Literacy

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Abstract. *This study aims to analyse the interaction between ethno STEM based thematic learning and conventional learning with early mathematical abilities in improving students' numerical literacy. This study used a quasi-experimental method with a non-equivalent control group design. Data collection was carried out through a numerical literacy test. Methods of data analysis using two-way variance analysis using a general linear model univariate analysis. The research subjects were fifth grade elementary school students in Tuban Regency, East Java Province. The sampling technique used a purposive sampling technique, taking into account the homogeneity of students' early mathematical abilities in both classes. Homogeneity is determined by giving pre-tests to students. The research sample consisted of 48 students, which were divided into two classes. The results showed that there was no interaction between conventional and ethno-STEM based thematic learning with the categories of students' initial abilities on students' numerical literacy. However, for each level of students' early mathematical ability, the increase in numerical literacy of students who received learning with an ethno-STEM approach was higher than students who received conventional learning.*

Keywords: *Ethno-STEM, Mathematic Ability, Numerical Literacy, Thematic Learning*

INTRODUCTION

Learning mathematics requires students to have the ability to formulate and interpret mathematics in various contexts. This ability is known as mathematical literacy. Mathematical literacy is broadly defined as an individual's ability to formulate, employ, and interpret mathematics in a variety of contexts that include reasoning mathematically and using mathematical concepts, procedures, facts and tools to describe, explain and predict phenomena (OECD, 2017). In simple terms, mathematical literacy is the knowledge possessed by an individual to understand and use basic mathematics in our daily lives (Ojose, 2015).

Within the framework of the curriculum implemented in Indonesia, the term mathematical literacy is known as numerical literacy. Numerical literacy is defined as the knowledge and skills to (a) use various numbers and symbols related to basic mathematics to solve practical problems in various contexts of daily life and (b) analyze information displayed in various forms (graphics, tables, charts, etc.) then use the interpretation of the analysis results to predict and make decisions (Kemendikbud, 2016). Numerical literacy also requires students to

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communicate and explain the phenomena they encounter with mathematical concepts (Taufikurrizal et al., 2022)

Individuals with high mathematical numerical literacy will be able to formulate, employ, and interpret mathematics in various contexts. Numerical literacy helps individuals to recognize the role that mathematics plays in the world and use it in making the right decisions in solving mathematical problems in everyday life. Numerical literacy is not limited to the ability to apply quantitative aspects of mathematics but involves knowledge of mathematics in a very broad sense (Umbara & Nuraeni, 2019) (Lange, 2003).

The main reason why students are still unable to solve problems based on numerical literacy is the teacher who has not familiarized students with literacy-based questions. The reason is that there are still many teachers who are still unable to compile numerical literacy questions, especially for teachers at the elementary school level so that students become more accustomed to solving these non-routine questions. Teachers tend to make routine questions that are closed and can be directly solved by using a formula (Warli & Fadiana, 2015) (Umbara & Nuraeni, 2019). Therefore, the focus on improving teacher quality in improving students' ability in numeracy literacy is very important.

LITERATURE REVIEW

At the elementary level in Indonesia, the curriculum 2013 requires a thematic in each lesson (Kemendikbud, 2016). The application of thematic at the elementary level, it turns out, cannot guarantee students' experience in solving numerical literacy questions because it is related to student creativity. Several studies have found that the use of thematic in increasing creativity is still limited (Arista, Marzuki, & Krenadi, 2014). Several activities that have been carried out previously have not focused on handling numerical literacy (Fadiana, Yulaikah, & Taufikurrizal, 2022). This causes the elementary school teacher, who should be the first door to introduce students to understanding numerical literacy, not optimal. In fact, as revealed by (Umbara & Nuraeni, 2019), that students' experience in solving problems is limited to routine questions, most of which only have one correct answer. This limits the creativity of students who basically develop rapidly at the elementary level.

Even though the education curriculum in Indonesia has changed several times, learning is expected to contain ethnopedagogical content where learning activities are required to emphasize students' local wisdom. Local wisdom is certain principles and ways adopted, understood, and applied by local communities in interacting and interrelating with their environment and transformed into a system of values and customary norms.

In elementary schools in Indonesia, local wisdom-oriented learning has not been implemented optimally even though thematic learning has been implemented. Findings in the field, the cause of less optimal local wisdom-oriented learning is the limited knowledge and skills of teachers in designing learning models that integrate local wisdom in the local area. In fact, each region has unique local wisdom and can be used as a source of student learning.

One learning approach that can be applied by teachers in introducing local wisdom values is the STEM (Science, Technology, Engineering and Mathematics) approach based on ethnopedagogy or what is known as ethno-STEM. Learning using the STEM approach integrates learning science, technology, engineering, and mathematics in helping the success of 21st century skills (Sumartati, 2020). (Stohlmann, Moore, & Roehrig, 2012) explain STEM is a learning approach that is formed as a combination of several disciplines, namely science, technology, engineering, and mathematics. The STEM approach helps students collect and analyze and solve a problem that occurs and is able to understand the interrelationships of one problem with another. It accommodates students to be naturally involved in learning so as to provide meaningful learning experiences for students including in terms of conceptual understanding abilities. STEM is in accordance with the objectives of the curriculum 2013 which emphasizes the process of critical, creative and innovative thinking skills on aspects of essential abilities in building the country in the future (Sari & Wijaya, 2017).

In general, teachers understand the position of learning as one of the components that influence the success of learning activities. However, learning is not the only factor that influences student learning success. Several other factors may influence student success in learning. One of these factors is the initial ability of students. Students' initial abilities are a set of relevant knowledge and skills that students already have before participating in experiential learning (Mu Fadiana, 2009) (Hevriansyah & Megawanti, 2017).

Based on this, the initial ability becomes very important in determining the success of student learning because it is very dependent on the knowledge and skills possessed by students at the previous stage. Initial ability can describe the readiness of students to accept lessons that will be delivered by the teacher. By knowing the initial abilities of students, teachers can design learning better, because if students are given material that is already known, they will feel bored (Razak, 2017). Therefore, students' initial mathematical abilities which are known from the beginning of the learning process have relevance to the determination, formulation, and achievement of learning instructional objectives to be carried out.

The initial mathematical abilities of each student differ from one another depending on the knowledge they have, especially regarding the mathematical concepts to be studied. These

differences affect how their ability to interpret and manage the information obtained (Ahmar, 2016). Initial ability is a lower level competency that is owned by someone who should have mastered it before students start the learning process to work on even higher competencies (Ekawati, Kohar, Imah, Amin, & Fiangga, 2019). Thus, initial abilities become an important and inseparable part of subsequent cognitive abilities as a result of the learning process. Therefore, students' initial mathematical abilities are thought to influence students' numerical literacy. Based on this, the purpose of this study was to analyze the interaction between conventional and ethno-STEM-based thematic learning with students' initial mathematical abilities in increasing students' numerical literacy.

METHODS

The research method used is quasi-experimental research. The design used in this study was a non-equivalent control group design. The design was used in accordance with the aim of this study which was to analyze the interaction between conventional and ethno-STEM-based thematic learning with students' initial mathematical abilities in increasing students' numeracy literacy, so the study had to use two samples. The sample in the first class is an experimental class that uses ethno-STEM-based thematic learning. Meanwhile, the second class is the control class which receives conventional learning.

The population in this study were all fifth-grade elementary school students in Tuban Regency, East Java Province. The sampling technique was carried out using a purposive sampling technique by considering the homogeneity of students' initial abilities in both classes. Students' initial ability is determined based on the results of the initial test given to students. Classification of students' early mathematical abilities was carried out by calculating the average $\bar{x}$ and standard deviation (sd) of each student's test results (n). Meanwhile, the criteria for determining the group of students' initial mathematical ability used Table 1.

Table 1. Criteria Grouping Ability Beginning Mathematics Student

Value Intervals	Interpretation Ability Beginning Mathematics
$n > sd + \bar{x}$	High
$sd - \bar{x} > n < sd + \bar{x}$	Medium
$N < sd - \bar{x}$	Low

Meanwhile, the sample in this study was 48 students, who were divided into two classes. The instrument used in this study was a numerical literacy test which was compiled by researchers based on the minimum competency assessment at the elementary level. The cognitive level

developed in this study is knowledge, reasoning and application with a total of 10 questions in the form of essays. All questions developed contain socio-cultural content in Tuban, East Java. One example of the questions developed is as follows:

Guidelines scoring results answer student refers to scoring about the minimum competency assessment. The statistical test used to determine the interaction between the learning model factors given with factor category enhancement numerical literacy student can A two- way ANOVA test was carried out using General Linear Model Univariate Analysis.

Legen drink

Legen is a typical drink from Tuban. However, if left for a few hours, Legen will turn into Tuwak. To maintain the quality of Legen, it can be stored at cold temperatures and given a natural preservative, longan seed extract. Following are the data on the effect of storage time and storage temperature on the alcohol content of Legen after adding longan seed extract.

Treatment		Alcohol
Storage Time	Storage Temperature	
1 day	4^0C	0, 992%
2 days	4^0C	0, 169 %
3 days	4^0C	0, 281 %
4 days	4^0C	0, 191 %
1 day	25^0C	1,473 %
2 days	25^0C	4, 172 %
3 days	25^0C	4, 751 %
4 days	25^0C	4, 591 %

Based on this information, which statements are true? Put a cross. Answer more than one
a. The lowest legen alcohol content was 2 days of storage and 4^0C temperature
b. Legen storage at 25^0C is better than legen storage at 4^0C
c. Legen alcohol content at 25^0C was higher than storage at 4^0C
d. The highest legen alcohol content was 3 days of storage and 25^0C temperature

RESULTS

This research was conducted to examine the interaction between conventional and ethno-STEM-based thematic learning factors and student ability category factors related to increasing students' numerical literacy. Ethno-STEM-based thematic learning was used in the experimental class while the conventional approach was used in the control class. Through this research, a number of data were obtained which included: pre-test scores and post-test scores for the numerical literacy of students in the experimental class and the control class. Students' abilities before being given treatment can be seen from the results of the pre-test, and students' abilities after being given treatment can be seen from the results of the post-test. The initial stage of analysis carried out in this study was to calculate the pre-test score data and post-test scores to produce N-gain data, using normalized gain. The average normalized gain is a description of the increase in numerical literacy in the experimental class and the control class. After processing the N-gain data from the results of the numerical literacy test in the experimental class and control class, descriptive statistics are obtained as shown in Table 2.

Table 2. Average And Standard Deviation Literacy N-Gain Value Numeration

Class	Average	Gains Qualification	Std. Deviation
Experiment	0.49	Currently	0.15
Control	0.27	Low	0.23

Based on Table 2, it can be seen that students in the experimental class with ethno-STEM-based thematic learning have a greater average gain than control class students whose learning uses conventional learning. This shows that the increase in the numeracy literacy of the experimental class students is higher than the numerical literacy of the control class students. Furthermore, to determine the interaction between conventional and ethno-STEM-based thematic learning applied to students' ability categories, an analysis was carried out using a two-way ANOVA. The results of the analysis test calculations with SPSS 25.0 using the General Linear Model (GLM) - Univariate which was carried out at a significance level of 5% ($\alpha = 0.05$). The results of the analysis are shown in Table 3.

Table 3. Analysis Of Variance Of Numeracy Literacy Gains Based On Ethno-Stem-Based Thematic Learning And Conventional With The Category Of Students' Early Math Abilities

Dependent Variable : N-gain capability literacy numeration					
Source	Type III sum of squares	Df	Mean square	F	sig
Corrected Model	1.577a	5	0.317	10,877	0.000
Intercepts	3,696	1	3,698	127,38	0.000
Ability beginning mathematics	0.693	2	0.355	11,889	0.000
Model	0.476	1	0.481	16,519	0.000
Ability mathematic * Model	0.02	2	0.009	0.308	0.733
Error	1,712	59	0.030		
Total	11,589	65			
Corrected Total	3,288	64			
aR Squared = .480 (Adjusted R squared = .436)					

Based on Table 3, the value of Fcount = 0.308 with a significance level (Sig.) of 0.733 is greater than $\alpha = 0.05$, so the null hypothesis is accepted. This means that there is no interaction between conventional and ethno-STEM-based thematic learning with early mathematical abilities in increasing students' numerical literacy.

DISCUSSION

The results showed that there was no interaction ethno-STEM-based thematic learning between each pair of initial mathematical abilities (high, medium, and low) in increasing students' numerical literacy. The absence of this interaction occurs because only students with high and moderate abilities get the most benefit from ethno-STEM-based thematic learning. However, for each level of students' initial mathematical ability, the increase in numerical literacy of students who received learning with ethno-STEM-based thematic learning was higher than students who received conventional learning. This happened because the learning process carried out in the two classes had different characteristics.

Ethno-STEM-based thematic learning consists of 7 phases, namely; orienting students to problems, organizing students for learning, hypothesizing problem solutions using STEM components, compiling project plans (design projects), assisting independent and group investigations, assessing the outcome, and evaluating experiences (evaluation of experience). All phases must be carried out as a whole and sequentially so that the learning objectives that have been designed can be fulfilled. However, if there are still parts that need to be fixed at one stage students can return to that stage and continue with the next stage until the design of the solution is perfectly designed (Winahyu, Ma'rufi, & Ilyas, 2020).

STEM is a learning approach based on the principle of integration between the fields of science, technology, engineering and mathematics so that they are taught coherently. The STEM approach is student-centered for learning that integrates science and mathematics and is an interdisciplinary curriculum where these disciplines are taught in an interdisciplinary manner and are not bound by specific disciplines with an emphasis on innovation and problem-solving processes using modern technological tools (Rifan & Hamdu, 2020; Winahyu et al., 2020). The STEM approach creates integrated knowledge that allows students to understand mathematics more easily, helps solve mathematical problems, and designs innovative products in the classroom where numbers are included in mathematics, calculation and mathematics are related to the approach. Thus, mathematics is a starting point for students to learn and broaden their knowledge in the four disciplines. STEM has special characteristics that distinguish between the four aspects in it. These four characteristics are described as follows:

a. Science represents knowledge about the laws and concepts that apply in nature.
b. Technology is a skill that is used to manage society, organization, knowledge or design and use an artificial tool that can facilitate work.
c. Engineering or engineering is the knowledge to operate or design a procedure to solve a problem.

d. Mathematics is a science that relates quantities, numbers and space that requires logical arguments.

Integration of all aspects of the learning process can make knowledge more meaningful. On the other hand, these activities did not occur in conventional mathematics learning in the control class. Activities in the control class are conventional learning that is commonly used by most teachers, such as the teacher explaining concepts and sample questions followed by students working on practice questions or filling out worksheets. In conventional learning activities, the teacher sometimes explains through questions and answers and sometimes students are grouped to complete practice questions. Learning with conventional learning has not been able to stimulate students' numerical literacy, both based on the process and content of the material taught by the teacher. Student activities during this lesson tend to be passive and do not train students in thinking and understanding mathematical concepts compared to learning mathematics with ethno-STEM-based thematic learning.

(Baran, Baran, Karakoyun, & Maskan, 2021) stated that the application of Project based Learning-STEM can significantly improve students' 21st century skills, including skills in collaboration and the level of sensitivity to the environment. Students also feel a positive impact in improving their skills such as communication, collaboration, problem solving, creativity, critical thinking, responsibility, environmental awareness and information technology literacy.

Other studies have concluded that a student's initial ability can be seen clearly in his attitude of receiving information conveyed in learning and his ability to process this information to solve mathematical problems (Kurniah, Basir, & Ikram, 2018). The interaction between variables in a study is a causal relationship that occurs between each variable. Interaction occurs because there are categories in each sample. In this study, the effect of the independent variables on one of the sample categories in the dependent variable in this study was not visible, so there was no interaction.

The results of this study are in line with research which concludes that there is no interaction between learning and the level of students' initial knowledge of mathematics on improving students' mathematical critical thinking skills (Syahbana, 2012). In this case, the teacher's role as a facilitator in carrying out learning must continue to innovate in implementing the learning process both through the use of learning and learning models, methods and learning strategies that are more varied.

On the other hand, numerical literacy which is less explored in learning is a factor that is quite significant in influencing the results of this study, students' ability to think logically to solve

problems given in learning. Two factors that are suggested as forms in developing numerical literacy are mathematical reasoning and problem solving (Putri et al., 2022). Students are still accustomed to answering questions through ordinary procedures that are concrete, so that other learning methods are needed to familiarize students in dealing with problems related to processes, content and mathematical contexts.

CONCLUSION

This study found that there was no mutual effect between ethno-STEM-based thematic learning and conventional learning with students' initial mathematical ability categories on students' numeracy literacy. However, for each level of students' initial mathematical ability, the increase in numeracy literacy of students who received ethno-STEM-based thematic learning was higher than students who received conventional learning. This research only reveals the interaction between ethno-STEM-based thematic learning and conventional learning with the category of students' initial mathematical abilities towards students' numeracy literacy. Thus, the interaction between learning factors and other factors needs to be done. The practical implications of the results of this study include the following: (1) it is necessary to conduct research that focuses on interactions between other factors and learning factors, with different mathematical abilities; (2) Ethno-STEM-based thematic learning also enriches efforts to improve the quality of mathematics learning because it makes it easier for teachers to involve students in achieving learning goals.

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