

Student Creative Thinking Analysis in Ethnomathematics Based Inquiry Learning on Transformation Materials

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Abstract.

Creative thinking is a very important aspect of learning, with creative thinking students can develop their abilities in every material taught. This study aims to describe students' creative thinking skills in learning using an ethnomathematics-based inquiry model. This research is descriptive qualitative research. The subject of this study was a grade XI student MIA MA Al Mukhtar Adipala Cilacap who numbered 10 people. The results of this study showed that at the first meeting for the average creative thinking level of students in all three groups was 85% (high), at the second and third meeting the average level of creative thinking of students was 83%(high). At the fourth meeting, the average level of creative thinking of students reached 85% (high).

Keywords: *Creative Thinking, Inquiry, Ethnomathematics, Transformation*

INTRODUCTION

The development flow of science and technology runs so fast that it has a big influence on the quality of human resources(Purwasih & Sariningsih, 2017). In the world of Education, one of the consequences of students are required to continue to develop the skills and potential of various learning activities they get in the classroom (Mawaddah & Maryanti, 2016). The progress of these developments is closely related to the way and ability to think. So it takes a skills and obtain, choose and process information. These abilities require critical, systematic, logical and creative thinking (S. K. Putri et al., 2019).

The current reform trend is to address the needs of students through accommodation of pedagogical approaches that improve math learning. Today's challenges make mathematics relevant to today's students because students love direct, visual, and contextual learning rather than abstract-theoretical learning (Grace-Bridges, 2019). Teachers should be aware of these preferences and use techniques that stimulate learning. One of the challenges of teaching teachers is how to expose students to the ever-present relationship between real-world practice and mathematical ideas, between visual-intuitive and rational.

Efforts to make mathematics more collaborative, practical, and connected to the real world align with the mathematical education reforms that began at least three decades ago as NCTM standards (Verner et al., 2019). 21st century proficiency is achieved when students have good communication, co-ordination, creativity and critical thinking skills. Kemendikbud formulates about 21st century learning focusing on the ability of learners in finding out from various sources, formulating problems, critical thinking and collaborating and collaborating in solving problems (Salim Nahdi, 2019). The process to develop creativity includes cognitive abilities, features and products produced (HAYLOCK, 1987). An approach based on daily life and a culture close to students becomes a solution to achieve on the goal of learning mathematics.

In the last decade, literature has developed related to culture and mathematics as well as describing mathematical examples in a cultural context otherwise known as ethnomathematics (Barton, 1996). D'Ambrosio (2001) defines ethnomathematics as mathematical activities practiced by identifiable cultural groups, meaning they relate to mathematical conceptions and techniques developed in different cultures to solve real-life problems. Mathematical concepts obtained from cultural environments and embedded through generations become one of the first steps in learning mathematics so that mathematics can be learned more easily by society. Ethnomathematics is formed from ways or habits that integrated with the traditions of the local community. Habits or ways that are done hereditary and have benefits for people's lives so that it is still maintained to this day (L. I. Putri, 2017).

Mathematics has a special purpose as a subject that is favored by many students. So it takes the role of teachers with new breakthroughs in transferring knowledge. One of the breakthroughs is with creativity in the learning process that teachers pour in the form of Group Worksheets (LKK) Ethnomathematics-based Unquenching.

Group Worksheet (LKK) Ethnomathematics-based Inquiry is a worksheet of research innovation to help the learning process of students in learning the transformation of geometry. The steps of inquiry learning with ethnomathematics approach are packaged in a Group Worksheet (LKK) that aims to help students think creatively in understanding the concept of geometry transformation. Creative thinking is an ability resulting from cognitive activities to get an idea in solving problems by collaborating concepts that have been authorized by smoothness, flexibility, novelty and elaboration (Jagom, 2015).

Inquiry-based learning is a learning process that helps students to find a hypothesis or temporary conjecture about a new knowledge. The knowledge is then used by students to conduct an experiment until they find conclusions about the learning materials (Ministry of Learning, 2004). The enculture learning model allows for the cultivation of students' scientific prowess and creative thinking

(Panjaitan et al., 2015). The process of discovery becomes very important in the process of inquiry learning. In line with Bruner's opinion, Bruner said that a learning process will go well and foster a creative attitude if the teacher gives students the opportunity to explore and discover concepts, theories, rules, or understanding concepts through the examples faced (Hasibuan & Amry, 2017).

Rizky (2018) in his research said the development of ethnomathematics-based Mathematics E-Module began from the stage of definition where data was found that most of the teaching materials circulating in the community use content that is foreign to students, so that more effort is needed so that students are able to customize with the scheme of knowledge that has been owned so that it is compiled draft 1 ethnomathematics-based teaching materials that use cultural content around learners (Utami et al., 2018). Noor Aishikin Adam (2010) a Malaysian researcher in his research showed that the interaction between weavers and mathematicians succeeded in uncovering some perspectives that concern both sides. This is evidenced by innovative ideas developed by one of the weavers since participating in dialogues with mathematicians, as shown from his work double peak serving hood and triple peak (Adam, 2010). Diyarko (2016) in his research entitled Analysis of Literacy Skills that Mathematics Reviewed from Metacognition in Learning Inquisition Assisted Independent Worksheet *Mailing Merge* stated able to facilitate students to solve math problems and impact on complete mathematical literacy skills (Diyarko, 2016). This suggests that ethnomathematics is a relatively new field of study and is supported by many researchers in the field of mathematics education (Cimen, 2014).

Indonesia is one of the countries in Asia with a multi-cultural population (Haryanto et al., 2017). Culture is a typical way for humans to adjust to the environment, whereas mathematics manifests itself because of human activity. This corresponds to Freudenthal's phrase, "mathematics as human activity" (Supiyati et al., 2019). Thus, ethnomathematics is a bridge that integrates mathematics with ideas and community culture practice (Barton, 1996).

Cilacap is a district in central Java that is directly adjacent to the province of west Java so that it has a culture, a characteristic that is different from other regions. One of them is in the pattern and art of batik clothes produced as well as cilacap batik motifs. UNESCO has designated Batik as *masterpieces of the Oral and Intangible Heritage of Humanity* on October 2, 2009. Indonesia determined that on October 2nd became the National Batik Day as a form of Indonesian nationality towards batik that has gained world recognition as a world heritage that should be developed. The motifs in Cilacap Batik appear to show a variety of mathematical concepts, especially in the concept of transformation. Wijaya Kusuma flower is one of the icons of Cilacap city which then Wijaya Kusuma batik motif is most in demand. Srandil is presented on the basis of buildings that become cultural heritage in Adipala sub-district. Ngasem is taken from a kerse *m*tree. These three icons were

taken by researchers as a medium of learning in this study. In addition, many motifs of various marine animals that in fact Cilacap is located on the south coast, so many batikpun motifs that use marine biota. The process of making batik with batik writing and printing techniques. This indicates that mathematical concepts, especially transformation concepts, have indirectly taken root in society.

METHODS

The method used in this study is descriptive qualitative. Subject this research is class XI MIA MA Al Mukhtar numbered 10 people with a record of complying with the Covid-19 Health Protocol. Instruments or data retrieval tools in this study is 1) Lembar Kerja Kelompok (LKK) (2) questionnaires in response to learning using LKK with ethnomathematics-based inquiry models. Both instruments have been validated by one maths lecturer and two math teachers. Directed LKK can mendukung creative thinking students, especially on material geometry transformation. The preparation of LKK is adjusted to the steps- in ethnomathematics-based inquiry, namely: (1) observation of problems, (2) formulating problems, (3) making conjectures, (4) designing experiments, (5) trials, (6) drawing conclusions.

The percentage of students' creative thinking at each meeting is categorized in table 1 (Arifani et al., 2015).

Table 1. Score Conversion Category

percentage	category
$90,00 \leq P \leq 100$	Very high
$80,00 \leq P \leq 90,00$	tall
$65,00 \leq P \leq 80,00$	keep
$55,00 \leq P \leq 65,00$	low
$P \leq 55,00$	Very low

Indicators of student creativity in ethnomathematics-based inquiry LKK developed by researchers can be seen in table 2.

Table 2

Indicators of Student Creativity in Ethnomathematics-Based Inquiry LKK

No	Ethnomathematics-based Inquiry Steps	Components of Creativity	Creativity Indicators
1.	Presenting information	<i>Fluency</i>	Understand about the teacher's explanation of the problems / problems in LKK

2.	Orientation to the problem		Observing the problems /questions presented in the LKK
3.	Formulating problems		Students discuss with their group
4.	Collecting data	<i>Flexibility</i>	inding solutions to ideas from a given problem
5.	Testing hypotheses	<i>Novelty</i>	plans a new strategy that students don't usually use to answer problems
6.	conclude		Presenting ideas and solutions and problem solving

The data obtained from this study is the result of the answers of each heterogeneously formed group at each step of ethnomathematics-based inquiry learning. The data is then analyzed based on predetermined creativity indicators and converted into percent value.

RESULTS AND DISCUSSION

In this research, during the teaching and learning activities using the Ethnomathematics-based Inquiry learning model was formed a group of 3 groups. Each group worked on the Worksheet of the group (LKK) as many as 4 LKK consisting of 4 sub-subjects namely translation at meeting 1, reflection on meeting 2, rotation at meeting 3, and dilatation at meeting 4.

Directed LKK can support creative thinking skills of students, especially in the material of geometry transformation. The preparation of LKK is adjusted to the steps in ethnomathematics-based Inquiry, namely: (1) observation of problems, (2) formulating problems, (3) making conjectures, (4) designing experiments, (5) trials, (6) drawing conclusions. The details of LKK developed are as follows. First *of all*, there is the first page (cover) there is a title LKK and column name of group members to be filled by the group in question. *Second*, the second page contains the identity of LKK containing the title, education level, subjects, classes/ semesters, subjects, sub-subjects and time allocation), core competencies, basic competencies, indicators and learning objectives. *Third*, there is a third page there is a material title, instructions for use LKK are menu "know you" which aims to provide knowledge about ethnomathematics to lead to ethnomathematics-based inquiry activities. *Fourth*, there is a section "problem observation" students are asked to

observe the problem in the LKK in groups. This section is the first step of ethnomathematics-based inquiry learning. *Fifth*, "formulating the problem" students are asked to write what is gained from the activity and make inquiries about the material being studied. *Sixth*, in the "making guesses" section students are asked to hypothesize the problem. *Seventh*, there a section "building experiment" students are asked to do the design or design of the experiment to be made. *Eighth*, In the "yukss trial" section students apply what has been designed or made the design to be applied or tested in the available fields. *Ninth*, In the last part is "drawing conclusions" students are asked to make conclusions about the material studied. *Tenth*, the last page of LKK there are questions that must be solved by the group. The exercise its aims to understand the extent of students' understanding of the concept studied. The developed LKK is designed for a sub-subject at faithful meetings. So in this development of research produced 4 LKK Inquiry based ethnomimetic for 4 meetings.

This process involves students in learning, formulating questions, investigating widely and then building the creativity of students who are adapted from the culture in the surrounding environment to express the relationship between mathematics and culture in the surrounding environment. The culture referred to in this study uses Cilacap Batik. Researchers used three batik motifs at each meeting by being distributed to groups formed with heterogeneous. The motifs used in this study are Wijayakusuma batik motif, Ngasem Batik Motif and Srandil Batik Motif. The three motifs are typical motif designs of Cilacap district.

Figure 1. Kinds of Batik Motifs Cilacap

Motif Batik
Wijayakusuma

Motif Ngasem

Motif Srandil



Siswono (2008) stated that there are several categories of thinking ability if. *First*, it is very creative that students are able to show fluency, flexibility, novelty and flexibility in solving problems. *Second*, creative students can show fluency and novelty or fluency and flexibility in solving problems. *Third*, creative students are able to show novelty or flexibility in solving problems. *Fourth*, i.e. less creative; students are able to show fluency in solving problems. *Fifth* is not creative; students

are unable to demonstrate all three aspects of creative thinking indicators (Lisliana et al., 2016).

The success of students' creativity is seen from the answers of groups that have been formed heterogeneously in solving problems given to LKK Inkuiri based on Metamathematical Batik Cilacap. The performance indicators in this study were at least 70% of students achieved on the student creativity indicator about transformation assuming the level of creativity of the students is equal to the level of creativity in the group.

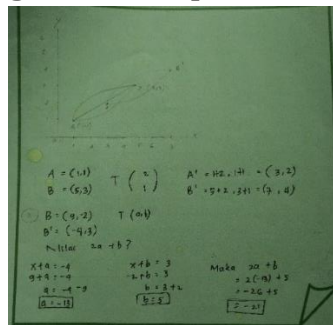
LKK results at the first meeting, the level of creativity of students is seen in the group's answer in completing the steps of LKK Inquiry based on ethnomathematics Batik Cilacap on translation materials as shown in the following table:

Table 3. First Meeting Student Creativity Indicators

No.	Student Creativity Indicators	Group Score Level		
		I	II	III
1.	Understand about the teacher's explanation of the problems / problems in LKK	2	2	2
2.	Observing the problems /questions presented in the LKK	2	2	2
3.	discuss with his group	2	1	2
4.	Finding solutions to ideas from a given problem	2	1	1
5.	Solve problems by designing new strategies that students are not used to solve problems	1	1	1
6.	Presenting the results of ideas and solutions and problem solving	2	2	2

From the table above, it can be concluded that the percentage of creativity of students in group one and group three reached 91% and group two reached 75%. Students together with their group are very enthusiastic about learning when given a real problem. This makes students have their own positive values to be able to complete the land. Here is the answer of one of the groups at meeting 1, namely in the translation sub-chapter in Figure 2.

Figure 2. Group 1 Answers



From the picture above, it can be seen that at first the students saw the concept of translation in Batik Wijaya Kusuma in real time then students can express the material received clearly. LKK results at the second meeting, the level of creativity of students is seen in the group's answer in completing the Steps LKK Inquiry based on ethnomathematics Batik Cilacap on reflection materials as in the following table:

Table 4. Second Meeting Student Creativity Indicators

No.	Student Creativity Indicators	Group Score Level		
		I	II	III
1.	Understand about the teacher's explanation of the problems / problems in LKK	2	2	2
2.	Observing the problems / questions presented in the LKK	2	2	2
3.	Students discuss with their group	2	2	2
4.	Finding solutions to ideas from a given problem	2	1	2
5.	Solve problems by designing new strategies that students are not used to solve problems	1	1	1
6.	Presenting the results of ideas and solutions and problem solving	2	1	

At this second meeting the percentage of group one reached 91%, group two reached 75% and group three reached 83%. this indicates that groups one, two and three meet the prerequisites to state that students' creativity can be seen through ethnomathematics-based inquiry learning.

LKK results at the third meeting, the level of creativity of students is seen in the group's answer in completing the steps of LKK Inquiry based on Ethnomathematics Batik Cilacap on rotational materials as in the following table:

Table 5. Third Meeting Student Creativity Indicators

No.	Student Creativity Indicators	Group Score Level		
		I	II	III
1.	Understand about the teacher's explanation of the problems / problems in LKK	2	2	2
2.	Observing the problems /questions presented in the LKK	1	2	2
3.	Students discuss with their group	1	1	2
4.	Finding solutions to ideas from a given problem	2	1	2
5.	Solve problems by designing new strategies that students are not used to solve problems	2	1	1
6.	Presenting ideas and solutions and problem solving	2	2	2

At this third meeting the percentage of group one reached 83%, group two reached 75% and group three reached 91%. At this meeting students can answer and apply the concept of rotation on Cilacap batik.

LKK results at the fourth meeting, the level of creativity of students is seen in the group's answer in completing the Steps of LKK Inkuiri based on ethnomathematics Batik Cilacap on dilation material, with the descriptor table as follows:

Table 6. Fourth Meeting Creativity Indicator

No.	Student Creativity Indicators	Group Score Level		
		I	II	III
1.	Receive teacher explanation about problems / problems in LKK	2	2	2
2.	Observing the problems /problems presented i in LKK	2	2	2
3.	Students discuss with their group	1	2	2
4.	Finding solutions to ideas from a given problem	2	2	2
5.	Solve problems by designing new strategies that students are not used to solve problems	2	1	1

6.	Presenting the results of ideas and solutions and problem solving	1	1	2
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At the fourth meeting the percentage of groups one and two reached 83%, while the third group reached 91%. In the learning process conducted by each group can find the concept of dilation in Batik Cilacap. This is an introduction for students in learning the concept of dilation itself to understand dilation in a field.

In this study, researchers were able to show that students' creativity is high in understanding, answering, and applying the concept of geometry transformation seen by using the learning process through ethnomathematics-based Inquiry LKK.

Creative thinking is rapidly becoming a common goal around the world and fostering better creative thinking skills in students has become an important trend in the educational revolution (Sharma, 2014). Therefore, matematika is studied systematically and regularly and must be presented in a clear order and must be adapted to the intellectual development of students and the prerequisite abilities that have been possessed.

Ethnomathematics-based inquiry learning becomes an alternative learning to answer the problem of lack of creativity in learning a material. Just like the research conducted by Diyarko and Budi (2016) *Lemba Kerja Mandiri Mailing Merge* provides problems can improve students' literacy skills. Inquiry learning is a learning designed with teaching methods by identifying problems and then applying appropriate ways to achieve results and assessing the extent to which students have achieved them (Novak & Krajcik, 2007). In line with the research conducted by Agus Mardani & I putu Artayasa (2020) that students who apply the incubate model have higher creative thinking skills than students who apply conventional learning (Artayasa, 2020). Group Worksheet (LKK) ethnomathematics-based inquiry that provides the problem of geometry transformation is not only able to apply the concept and application of geometry transformation in order to calculate with formulas but given problems in order to interpret part of geometry transformation with real objects nuanced local wisdom. An important change in mathematical instruction needs to be made to accommodate the ongoing changes in student demographics in Indonesia (Rosa & Orey, 2011). The emerging creative thought process can help students in reducing the difficulties faced.

CONCLUSIONS AND SUGGESTIONS

From the results of the research that has been described it can be concluded that at the first meeting the level of creative thinking of students in the three groups is 85% with the category High, at the second and third meeting the average level of creative thinking of students is 83% with the category High. At the fourth meeting the average level of creative thinking of students was also 85% (High).

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