Improving external mathematical connections and students’ activity using ethnomathematics

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Abstract. Most students repute that mathematics is a difficult subject and has no connections in real life. It makes students’ external mathematical connections to be low, students less active in learning process, and it affected on the low achievement of students in mathematics. Ethnomathematics is one of the attempts to overcome it. Indonesia is a multiculture country and the people usually do anything in daily life influenced by their culture. Ethnomathematics is an instruction approach that makes a connection between mathematics concepts dan culture. The purpose of this study is to conduct experiment by applying ethnomathematics to the eighth grade students of junior secondary school in Tegalluar Village. The method that implemented in this study is experiment. The result of this study shows that students’ achievement using ethnomathematics is better than their average achievement using direct instruction. Conclusion of this study is ethnomathematics can improve students’ external mathematical connections and students’ activity in mathematics learning.

1. Introduction
Mathematics is one of important subjects and people need mathematics in their life because mathematics is an abstraction of the real world and it has to be understood that we apply it everyday. Unfortunately, most students thought that mathematics is a difficult subject and no related to daily life. It drove the students less interest to learn mathematics and impact on the low achievement of students in mathematics.

Based on preliminary study conducted by researchers, it was found that the achievement of junior secondary school students in mathematics in agricultural areas of Kabupaten Bandung, West Java, Indonesia is still low and it’s because of the students feel have no engagement with mathematics and think that mathematics is not important for their life, less motivated to learn mathematics deeper, and not active during the learning process of mathematics. This situation should not be ignored and the solution must be found immediately. It should be shown to the students that mathematics is involved in their culture and daily life. It means, students’ external mathematical connections have to be improved.
Indonesia is a country which has various cultures and the people still hold on their culture to do anything in their daily life, such as: using traditional measure units *bata, depa, ramo*, and many more. Tegalluar Village is one of agricultural areas in Kabupaten Bandung, West Java, Indonesia, and the people there are still holding on their culture in daily life. This study will discuss about the effect of implementation of Ethnomathematics to improve students’ external mathematical connections and their activities in SMPN 1 Bojongsoang, Tegalluar Village, West Java, Indonesia.

1.1. External mathematical connections
Mathematical connections are part of a structured network that resembles a spider web, containing dots that are considered as parts of information, and the threads connecting the dots describe its "connection"[1]. Kutz [2] explained that the term of mathematical connections refer more to an understanding that requires students to show internal and external mathematical relationships or connections. Internal mathematical connections mean the relationship between mathematical topics, while external mathematical connections include the relationship between mathematics with other fields of science and with the real life. Mathematical connections are classified into three types as follows: (a) connection between topics and mathematics process; (b) connection between mathematical concepts and other fields of science; and (c) connection between mathematical concepts and real life. The National Council of Teacher of Mathematics [3] defined that mathematical connections is ability to make students able to: a) see mathematics as an integrated whole; b) use mathematical idea to further their understanding of other mathematical ideas; c) using mathematics to solve problems in daily life which contain the local culture; and d) explore mathematical problems and describe the results using graphical, numerical, physical, algebraic, and verbal mathematical models of representations.

Based on previous explanation, it can be said that external mathematical connection is ability for making the students can appreciate the role of mathematics in culture and society by using mathematics to solve problems in daily life which contain the local culture. Because by appreciating the role of mathematics, students will have engagement with mathematics and think that mathematics is important in their life. It will affect on students’ achievement in mathematics.

1.2. Ethnomathematics
Ethnomathematics is a knowledge that built from the culture which gave rise to mathematics [4]. Agree with it, Achor et al [5] stated that ethnomathematics contains of how the people from different cultures apply mathematics in daily life. Based on those opinions, it could be said that ethnomathematics is an approach or study which relate mathematics and culture. The relation between mathematics and culture can be shown to many aspect as follows: 1) ways of particular culture applies mathematics in daily life; 2) mathematical concepts that contained in the culture; 3) ways of teaching mathematics adapted to the local culture and unique characters of students; 4) the depth of mathematics blended to the local culture; and 5) mathematical activities that have done by locals.

It is possible to adopt ethnomathematics into mathematics learning [6]. It supported by Owens [7] that ethnomathematics can be implemented as an alternative to mathematics learning. The application of ethnomathematics in mathematics learning has several benefits such as the students can explore mathematical concepts contained in local culture and making connection between mathematical concepts with the culture. It makes the students feel that mathematics is related to daily life, so that ethnomathematics is important to be applied in mathematics learning.

1.3. Ethnomathematics in Tegalluar Village
Kabupaten Bandung has many agricultural areas, one of which is Tegalluar Village. Most of the inhabitants are farmers and they still adhere to their culture in everyday life. They usually do ritual ceremony such as *hajat lembur* as a form of gratitude to the God. They also use some particular term as unit of measurement system such as: *tangtung, gantang, kulak, kompet*, and many more.
There is only one junior secondary school in Tegalluar Village, that is SMPN 1 Bojongsoang. SMPN 1 Bojongsoang is surrounded by paddy fields and it located at the river bank. Most students of SMPN 1 Bojongsoang came from Tegalluar Village. They also still hold on their culture in daily life and speak in Sundanese language.

2. Method
This study used experimental design. The main goal of this study is to find positive effect from the application of ethnomathematics in mathematics learning. Subjects of this study were 35 students of the 8th grade of SMPN 1 Bojongsoang, Tegalluar Village, Kabupaten Bandung. Procedures of this study are as follows: a) preliminary study, by doing interview to the inhabitants of Tegalluar Village and formulating the problems; b) literature review; framing of research instrument, by creating mathematical connection problems for the 8th students of SMPN 1 Bojongsoang; c) collecting data, from test results which have done by the students and from observation sheet; d) analysing data; and e) make a conclusion.

Instruments used in this study are mathematical connections test which contains seven problems and observation sheet. Each problem of mathematical connections test contains ethnomathematics of Tegalluar Village. The test is used for measuring students’ mathematical connections and observation sheets are used for observing students’ activity in the classroom. The students have to solve the problems for 90 minutes.

3. Result and discussion

3.1. Analysis of external mathematical connections
The maximum score for each problem are as follows: (a) 15 for problems number one, two, three, and seven; (b) 20 for problem number four; and (c) 10 for problem number five and six. After marking students’ mathematical connections test, researchers obtained the data shown in table 1. Table 1 shows that the students who achieved score 60 or more are 22 students and 13 students got less than 60. It means, 62.86% students achieved good score. Based on the data of table 1, mean score is 63.51 with the highest score is 84 and the lowest is 37.

| Score | Frequency |
|-------|-----------|
| 30–39 | 1         |
| 40–49 | 4         |
| 50–59 | 8         |
| 60–69 | 10        |
| 70–79 | 9         |
| 80–89 | 3         |

Analysis of achievement needs to be done to determine the extent to which students mastering indicators of mathematical connections. Recapitulation of the calculation results is presented in table 2. Table 2 shows that problems number 1, 2, 4, 5, and 7 measure the students’ internal mathematical connections. Number 3 and 6 measure the students’ external mathematical connections. Table 2 also describes that students achieved the highest percentage on indicator seeing mathematics as an integrated whole. The lowest percentage achieved by students on indicator exploring mathematical problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models of representations.

Based on data in table 2, it’s shown that the students achieved 80.67% on indicator using mathematics to solve problems in daily life which contain the local culture. Preliminary study result shows that students’ external mathematical connections is still low (indicated by the average of
students’ daily scores). It means, students’ external mathematical connections after implementing ethnomathematics is better than before implementing ethnomathematics.

Students’ external mathematical connections are influenced by students’ motivation to learn mathematics. If they have no engagement with mathematics and feel that mathematics is not related to their daily life, then they will think that mathematics is meaningless and not important in their life. It will have an impact on students’ motivation to learn mathematics and lead to low students’ academic ability. Eduardo [8] stated that knowledge of mathematics can be taught effectively and more meaningfully when associated with the culture. It is supported by Rubio [9], who found that mathematical learning associated with the culture makes students able to construct their experiences in the classroom and improve their academic ability. Therefore, it can be said that ethnomathematics could improve students’ external mathematical connections.

Table 2. The results of achievement analysis of indicators of mathematical connections.

| Number of problem | Indicators | Average percentage of achievement |
|-------------------|------------|----------------------------------|
| 1                 | See mathematics as an integrated whole | 87.81 |
| 2 and 5           | Use mathematical idea to further their understanding of other mathematical ideas | 72.24 |
| 3 and 6           | Using mathematics to solve problems in daily life which contain the local culture | 80.67 |
| 4 and 7           | Explore mathematical problems and describe results using graphical, numerical, physical, algebraic, and verbal mathematical models of representations | 36.81 |

3.2. Analysis of students’ activity

Observation sheet is used to observe and record students’ activities during the lesson using ethnomathematics. It contains sixteen aspects of students’ activities observed. Students’ activities are observed in every 5 minutes and record the dominant activity aspect done by the students. Detailed observational analysis is presented in table 3. Table 3 shows that there are eight aspects of students’ activities which earn 66.67 % (i.e. aspects number 1, 7, 9, 10, 13, 14, and 15), five aspects earn 83.33 %, one aspect earns 100 %, and two aspects of students’ activities get 50 %.

Whipple [10] stated that students’ activity in learning can be seen from: (a) students’ participation in problem solving; (b) number of questions asked to the teacher or to other students; (c) students’ efforts to look for information to solve the problems; and (d) students’s participation in group discussion. Hamalik [11] added that students’ activity consists of several types as follows: 1) visual activities; 2) oral activities; 3) listening activities; 4) writing activities; 5) drawing activities; 6) emotional activities; 7) motoric activities; and 8) mental activities. He also stated that students’ activity is influenced by factors as follows: a) internal factors; b) external factors; and c) learning approach factors. Internal factors are derived from within students, such as physiology and psychology aspects. External factors mean environmental conditions around the students. Learning approach factors mean strategies applied to support the success of learning process.

Based on data in table 3, it’s shown that the average percentage of students’ activities is 71.86 % and it’s included in active criteria. Table 3 shows that the first dominant of students’ activity is asking questions. It means, ethnomathematics can bring a sense of students’ curiosity about the subject that
has been delivered by the teacher. Table 3 also shows that the second dominant of students’ activities are interest in paying attention to the teacher, earnestness to get the lesson, responding to what the teacher is saying, actively discussing with other students, and doing the tasks given by the teacher eagerly. The third dominant of students’ activities are seriousness in listening to what the teacher is saying, bringing up any ideas, actively finding information through books and internet, giving ideas to other students, preference in finding solutions, honesty in doing the tasks assigned by the teacher, compete with other students in finding solutions, and punctuality in completing the tasks assigned by the teacher. The rest of students’ activities are giving another opinion which is different from the teacher and refuting the other students’ opinion. It shows that ethnomathematics also drives the students became more actively involved in learning process. Adenegan [12] found that ethnomathematics leads students became more active during learning process and can improve students’ imagination. Therefore, data in table 3 has affirmed Adenegans’ statement.

| Number | Aspects observed                                      | Amount | Percentage |
|--------|-------------------------------------------------------|--------|------------|
| 1      | Seriousness in listening to what the teacher is saying| 4      | 66.67      |
| 2      | Interest in paying attention to the teacher           | 5      | 83.33      |
| 3      | Earnestness to get the lesson                         | 5      | 83.33      |
| 4      | Asking questions                                      | 6      | 100.00     |
| 5      | Giving another opinion which is different from the teacher | 3  | 50.00      |
| 6      | Responding to what the teacher is saying              | 5      | 83.33      |
| 7      | Bringing up any ideas                                | 4      | 66.67      |
| 8      | Refuting other students’ opinions                     | 3      | 50.00      |
| 9      | Actively finding information through books and internet| 4  | 66.67      |
| 10     | Giving ideas to other students                        | 4      | 66.67      |
| 11     | Actively discussing with other students               | 5      | 83.33      |
| 12     | Doing the tasks given by the teacher eagerly          | 5      | 83.33      |
| 13     | Perseverance in finding solutions                     | 4      | 66.67      |
| 14     | Honesty in doing the tasks assigned by the teacher    | 4      | 66.67      |
| 15     |Compete with other students in finding solutions       | 4      | 66.67      |
| 16     | Punctuality in completing the tasks assigned by the teacher | 4  | 66.67      |

4. Conclusion
Junior secondary school students’ achievement in mathematics in agricultural areas of Kabupaten Bandung is still low. It is caused by the students think that mathematics has no important role in daily life and their culture. It leads the students less motivation to learn mathematics and not involved actively during learning process. Ethnomathematics makes the students realise that mathematics is closely related to daily life and their culture through increasing students’ external mathematical connections.

The result of this study shows that application of ethnomathematics to the 8th grade students of SMPN 1 Bojongsoang, Tegalluar Village in Kabupaten Bandung can improve students’ external mathematical connections. The application of ethnomathematics also triggering the students become
more active during learning process. It is caused by the students feel that they can use mathematics to solve any problems in their daily life and feel that their culture contains mathematical concepts. It means, ethnomathematics can improve students’ activity in mathematics learning.

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