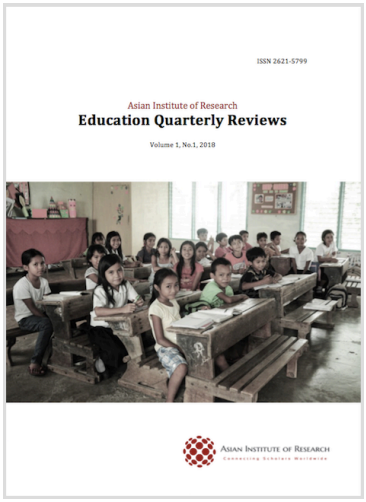

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Enhancement of Mathematical Communication Competency Upon Students of Junior High School Through Contextual Learning Based on Coastal Culture

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Abstract
Various studies have pointed out that communication in mathematics is one of the necessary competencies in learning mathematics. Students are expected to possess such competency in order to communicate learning materials in an efficient and effective manner which is supposed to create easiness for students to learn. A particular learning approach which is allegedly to enhance mathematical communication competency is the contextual learning based on coastal culture. This research was conducted by undertaking mixed method with sequential explanatory strategy. Design of study is pretest-posttest control group design. The population is students of Junior High School in East Flores District, Province of East Nusa Tenggara with 119 students as sample. The sampling technique is purposive sampling. Four separate classes of class 8 of Junior High School in Larantuka were randomly selected to be distinguished as an experimental class and a control class. The instrument of this study is a test of mathematical communication competence. Results show that there is an enhancement in mathematical communication competency upon students of the group which were learning through contextual learning based on coastal culture (CLBCC) and conventional learning approach (CLA). Learning outcomes and enhancement in mathematical communication competency of the CLBCC group were found to be higher than those of the CLA group. For both groups, the lowest average enhancement was upon the indicator of expressing a certain situation or mathematical relationship into mathematical models (graph, figures, and mathematical expressions). The highest average enhancement was found upon the indicator of outlining significance upon given situation or problem, which occurred within both groups.

Keywords: Mathematical Communication, Contextual Learning, Coastal Culture

1. INTRODUCTION

Communication is significantly important in the learning process as it determines the success of transferring information of knowledge and experiences between teachers and students, students and students, and between students and learning materials. Furthermore, communication allows individuals to express the ideas and thoughts. Mathematics ideas, which have been derived and expressed through mathematical languages in figures, graphs, texts, and mathematical models, have been designed to be comprehensible to the audience. This utterance is parallel to those of Jamison (Kabael, 2012) who argues that mathematical language is composed by logical structure and rhetoric which is comprehensible towards all parties and is presented based on definition formats, proof, and theory. Conveying mathematical ideas clearly and accurately presents irrefutable significance.

Since an early age, children are encouraged to comprehend and express mathematical facts, thoughts, and ideas that they possess. This allows children to be accustomed to express mathematical ideas in accurate and correct manners in such a way to be comprehensible to the audience. Children should be trained to express mathematical ideas in mathematical sentences in order to simplify problems and solutions. This confirms to NCTM (2000) which underlines that communication in mathematics is an utmost significance and therefore, should be exposed to children at an early age.

Besides, the importance to be comprehensible to the audience communication is beneficial to evaluate the correctness of thinking. Through communication, the correctness of mathematical ideas by students can be evaluated by their peers as well as their teachers. Through this medium, students will be encouraged to realize their mistakes in mathematical thinking and therefore, will be encouraged to undertake correction. This statement confirms to that of NCTM (2000) which utters that communication enables mathematical thinking to be observable and encourages students to reflect upon self-mathematical thinking as well as mathematical thinking of others.

The importance of communication is underlined by the National Council of Teachers of Mathematics (NCTM, 2000, 29), which suggests that in learning mathematics, there are four competencies ought to be attained by the student. They are problem-solving, reasoning, communication and representation.

In accordance to NCTM, within the Decree of Indonesian Minister of Education Number 22 Year 2006 regarding standard contents of mathematics, The 2013 Curriculum set out in Decree of Indonesian Minister of Education Number 64 Year 2013 regarding standard contents of the 2013 curriculum, and Decree of Indonesian Minister of Education Number 65 regarding the 2013 curriculum process standards, it is stated that aims of mathematics learning are upon the following: (1) solving problems which comprise ability to comprehend to problems, design mathematical model, solve upon the model, and interpret the solution; (2) communicating ideas with symbols, tables, diagrams, and other mediums to clarify certain situations or problems; and (3) possessing attitudes in respecting practicality of mathematics in daily life, which comprises of possessing curiosity, concerns and interests towards learning mathematics, alongside being tenacious and confident in solving mathematical problems.

Recalling the significance of mathematical communication competency, it is therefore required particular mathematical learning strategy which has the potential to increase mathematical communication competency. One of the strategies which have the potential to increase mathematical communication competency is contextual learning based on coastal culture (CLBCC).

Mathematical learning is an effort to develop mathematical competencies requires a strategy that emphasizes the role of students in maximizing their activity. Learning should involve students in the search for meaning through the use of an environmental context. Unnecessary concepts will not be stored well in the student's memory. Therefore, learning must be based

on the idea that meaning arises from relationships between content and context. Context gives meaning to content. The more skilled the students associate the lesson with the context, the more meaning they gain from the lesson.

The above exposure indicates that the importance of context in every learning implementation. Contextual learning is referred to as contextual teaching and learning (CTL). In this learning, all student activities are related to the subject matter and real-life context they find. This means that students seek meaning in finding interesting mathematical problems, seeking information and drawing conclusions, actively selecting appropriate strategies, composing, planning, investigating, questioning, and making conclusions about solving a mathematical problem, and linking mathematical concepts learned to the context in life situations.

The illustration above shows that mathematical communication competency is an utmost significance ought to be possessed by students in learning mathematics. Therefore, it is required a study which analyzes mathematical communication competency of students, especially those being prepared to be teachers of mathematics. These students righteously possess mathematical communication competency to convey information in an effective and efficient manner which eases students into learning.

Derived from the above introductory, the problem of this study is formulated as: (1) Are there differences upon outcomes of mathematical communication competency between a group of students of contextual learning based on coastal culture approach and group of students of the conventional learning approach? (2) Are there differences upon enhancement of mathematical communication competency between a group of students of contextual learning based on coastal culture approach and group of students of conventional learning approach? (3) Which indicator of mathematical communication competency of students resulted to be the highest? (4) Which indicator of mathematical communication competency of students resulted to be the lowest?

Aim of this research is to identify: (1) differences upon outcomes of mathematical communication competency between group of students of contextual learning based on coastal culture approach and group of students of conventional learning approach; (2) differences upon enhancement of mathematical communication competency between group of students of contextual learning based on coastal culture approach and group of students of the conventional learning approach; (3) The highest and the lowest indicator of student mathematical communication competency.

2. LITERATURE REVIEW

2.1 Mathematical Communication Competency

Communicating upon and through mathematics is part of learning to become a problem solver of mathematics and learning to think mathematically. Communication can be developed to encourage students to use their own words in expressing their own ideas, and to record their thoughts in various mediums such as through words, symbols, diagrams, and models.

Mathematical communication competency is identified as the ability to comprehend and express mathematical facts, thoughts, and ideas (Dan, 2013). Previously, Sumarmo (Koswara, Sumarmo, Kusumah, 2012) analyzed upon various experts' suggestions thus concluding that characteristics of mathematical communication competency comprise of: (a) constructing real objects, figures and diagrams into mathematical ideas; (b) explaining mathematical ideas, situations, and relationships by oral and written expressions, or by means of real objects, pictures, figures, and algebra; (c) explaining daily events in mathematical symbol languages; (d) listening, discussing, and writing upon mathematics, comprehensive reading on mathematical presentations; (e) explaining and drafting questions upon learnt mathematical materials.

The explanations on mathematical communication competency above comprise two main points which are representing mathematical ideas correctly in the form of figures, graphs, and algebra and expressing mathematical ideas by oral or written expression which would be easy to comprehend by its audience. Representation is a means of structuring certain situations thus creating a more meaningful expression. The audience is bound to comprehend to a particular concept if it were top be communicated incomprehensible and appealing fashion.

NCTM (2000) suggests that indicators of mathematical communication competency in mathematics learning comprise of: (1) Ability to express mathematical ideas through oral and written expressions, and to visually demonstrate and depict them; (2) Ability to comprehend to, interpret, and evaluate mathematical ideas correctly in oral and in other visual terms; (3) Ability to utilize mathematical terms, notations and its structures to present ideas, picture relationships and situational models.

In detail, mathematical communication indicators in mathematics learning are identified as (1) constructing real objects, figures, and diagrams into mathematical ideas; (2) explaining mathematical ideas, situations, and relationships by oral and written expressions, or by means of real objects, pictures, figures, and algebra; (3) explaining daily events in mathematical symbol languages; (4) listening, discussing, and writing upon mathematics, (4) reading written mathematical presentation and drafting relevant questions; (5) constructing conjectures, composing arguments, crafting definitions and generalizations; (6) explaining and drafting questions regarding the learned mathematics (Sumarmo, 2003).

The indicators of mathematical communication competency described above are the indicators of mathematical communication competency which generally used for middle school learning. Recalling that this research is conducted among university students, alongside circumstances of literature shortages, therefore indicators of mathematical communication competency throughout this study is formulated as (1) expressing a particular situation or mathematical relations into a mathematical model form (graph, figure, and mathematical expression); (2) constructing particular problem or case out of a certain mathematical model (graph, figure, and mathematical expression); (3) describing meaning of a particular given situation or problem.

2.2 Contextual Learning Based on Coastal Culture

Contextual learning is learning uses a contextual approach that takes place naturally in the form of work and experience. In this learning, students are trained to experience a process of relating learning materials to the real-world context experienced by everyday students. In contextual learning, there are seven main components: (1) constructivism, (2) questioning, (3) inquiry, (4) learning community, (5) modeling, ; (6) reflection, and authentic assessment.

Constructivism means students construct new knowledge based on initial knowledge through a process of social interaction and assimilation-accommodation. The first stage of learning is the learning community. Students are divided into groups. The division of groups aims to motivate students to share information, discuss and work together in groups.

Questioning in CTL is done by teachers and students. Questions posed by teachers aim to encourage, guide and assess students' thinking abilities. While questions asked by students related to the lack of understanding of the concepts studied. Blakey and Spence (Toit & Kotze, 2009) state that learners should ask themselves what they know and what they do not know early in the learning activities. Questions for oneself in learners are an indicator of whether they understand the concepts being studied.

In mathematics learning, modeling is an important aspect. This is because in mathematics phenomena in everyday life must be expressed in mathematical models to be easily solved. However, it is realized that the ability of learners in translating daily phenomena in mathematical models is still low. Muijs & Reynolds, Killen, (Toit & Kotze, 2009) assert that modeling occurs when the teacher demonstrates the processes involved in performing difficult tasks, or when the teacher informs students about their thinking and is motivated to choose a particular strategy when solving the problem. Modeling and discussion enhance the thinking of learners and talk about their own thinking (Blakey & Spence, 1990).

The inquiry is a process that finds concepts, principles, knowledge that begins with the giving of contextual problems. The process of finding can be done in group discussions as well as after discussion. Ruseffendi (2006) points out that one of the goals of learning by inquiry is that students learn the scientific method through finding and applying it in other situations. After that, students are directed to do reflection can be done through the activities of recording what has been studied, asked, made a journal, and discussion to improve students' understanding of the various concepts learned.

Reflection aims to check how students understand the mathematical concepts learned. The ability to reflect is a prerequisite for articulation and articulation itself requires the identification of the essentials of an action. Students can reflect on what they have done based on important aspects of their thinking and actions.

Contextual learning based on coastal culture will lead to a cultural awareness because this lesson it integrates contextual issues of culture and the environment. In addition, integrating contextual problems of culture and environment in the learning of mathematics through contextual learning based on culture is expected to improve students' mathematical ability.

Learning with coastal-based contextual issues is important to note. For coastal communities, contextual learning without regard to the environment in which they live will result in their dislike in learning mathematics. This makes them further away from math. For learning that relates the context of everyday life with the concept of mathematics must provide a positive contribution to the improvement of mathematical ability and love of the environment and culture.

3. METHODS

This research undertakes a pretest-posttest control group design (Creswell, 2009). Group of the experiment is treated with contextual learning based on coastal culture approach, whilst a group of control is treated with conventional learning approach. The population of this research accounts for all students of grade 8 in East Flores District. The research sample was filtered as 119 students who were selected through a purposive sampling technique. Initial competency of both groups was homogenous. Research instrument is tested on mathematical communication competency. Quantitative data were analyzed through the descriptive and inferential approach in regards to outcomes and enhancements of mathematical communication competency. Hypothesis testing undertook parametric and non-parametric statistical analysis.

4. RESULT AND DISCUSSION

4.1 Outcome of Mathematical Communication Competency

The hypothesis of difference tests upon mathematical communication competency outcomes are as follows:

H_0 : There is no difference in outcomes of mathematical communication competency amongst groups of different learning approaches.

H_1 : There is the difference in outcomes of student mathematical communication competency amongst groups of different learning approaches.

Results of significance test employing a t-test are presented in Table 4.1.

Table 4.1
Difference Test of Mathematical Communication Competency Outcomes between 2 Test Groups

Approach	N	Avg.	Avg. Dif.	*t*	df	*Sig.*	Declaration
CLBCC	59	24.15	7.28	4.50	63	.000	H_0 rejected
CLA	60	16.88					

Based on the t-test results presented in Table 4.1, the value of probability (sig.) is lower than $\alpha = .05$, and therefore H_0 is rejected. This signifies that the group of students being taught through the contextual learning based on coastal culture approach yield higher outcomes in

terms of mathematical communication competency than those students of the conventional learning approach group.

4.2 Mathematical Communication Competency Enhancement

Different test upon mathematical communication competency enhancement between two groups undertakes the following hypothesis:

H_0 : There is no difference enhancement upon mathematical communication competency between two groups of different learning approaches.

H_1 : There is difference enhancement upon mathematical communication competency between two groups of different learning approaches.

Results of significant test employing a t-test are presented in Table 4.2.

Table 4.2
Different Test of Mathematical Communication Competency Enhancement Between 2 Test Groups

Approach	N	Avg.	Avg. Dif.	*t*	dof	*Sig.*	Declaration
CLBCC	59	0.71	0.22	4.83	63	0.000	H_0 is rejected
CLA	60	0.58					

As depicted in Table 4.2, the t-test results identify a rejection towards H_0 as the probability value (sig.) is lower than α (.05). By this, it is concluded that the group of students of the contextual learning based on coastal culture approach yield higher average enhancement of mathematical communication competency than those students of the conventional learning approach.

Enhancement in mathematical communication competency for both test groups generally lies on the average scale, however, enhancement for the contextual learning based on coastal culture group were higher than the conventional learning group. Within the metacognitive approach, students are conditioned to explore and study upon various learning sources, identify constraints, self-construct questions, answer questions and utter ideas. These particular activities trigger students to explore their insights which would ease students in delivering upon ideas in regards to working on given tasks. Through a comprehensive study of various learning materials, students are deemed to be more enhanced in comprehending to materials and therefore, will be more confident. Identifying and comprehending to the process of work completion from various sources enriches student's knowledge and in turn, boosts their confidence to communicate.

The contextual learning based on coastal culture approach encourages students to construct questions, answer questions and deliver ideas in discussions. These activities trigger students to employ their current knowledge in expressing a situation. The mere activity of delivering ideas within a discussion eases students in completing on given tasks. Browsing for solutions

upon various sources allows students to make significance on what is being learned and to express ideas comprehensible to the audience.

Interview results suggest several external factors that affect students mathematical communication competency. These factors are amongst the heavy workload of tasks given by teachers, shortages of access to learning sources, fatigue, relationships between students and between students and teachers, and academic atmosphere. Heavy workloaded tasks pinned on students by teachers leads to student fatigue. Deadline of task submission is deemed too short which heaps pressure on the students. This particular condition would indeed result in physique and mental fatigue. A tired physique would convey a lapse in concentration in learning activities within mathematical statistics subject. A decline in concentration would result in low comprehension of students towards learning concepts thus leads to the low competency of mathematical communication.

Within the contextual learning based on coastal culture, students are guided to self-identify learning concepts. This method pushes students to study from various references to learning resources. Difficulty in obtaining references is one of the constraints experienced by the students. The school library does not provide sufficient sources and literature. Access to references from the internet is unlikely to be experienced by the students due to an insufficient internet connection and frequent power outages, adding to costly internet accesses. In this case, students are bound to constraints in access to a wider source of alternative learning materials.

Learning atmosphere in the classroom is found to be one of the factors affecting student learning activities. A quiet and serene atmosphere is expected to support learning activities. Mutual interactions in assisting and respecting each other would convey positive contributions towards enhancing mathematical communication competency. A high intensity of interactions would be a significant contribution by students in creating a better learning atmosphere.

In regards to comparing pretest scores between BLBCC and CLA groups, average score upon the three indicators do not show considerable differences, whereas posttest scores comparison show relatively major differences. Upon indicators (1) and (2), enhancement of mathematical communication competency (denoted by N-gain) of the BLBCC group decently differs from those of the CLA group, whilst for indicator (3), enhancements show similarity.

Interview results point out that students experience difficulties in working on tasks related to an aspect of expressing mathematical situation or relationship into forms of mathematical models (graph, figure, and mathematical expressions). This is taken on account of proper grammar constraints in expressing ideas. Students are found inferior due to the anxiety of using improper grammar in encountering with the researcher. This leads to varying cautious using of sentences by students.

5. CONCLUSION AND SUGGESTION

5.1 Conclusion

Referring to research results and discussions in the previous section, several conclusions are drawn as follows: (a) There are differences in outcomes and enhancements of students mathematical communication competency in general; (b) The enhancements of mathematical communication competency for both groups lie on an average scale, however, enhancements found upon the BLBCC group was higher than those of the CLA group; (c) The highest enhancement occurred for the outlining significance upon given situation or problem indicator; (d) Lowest enhancement occurred for the expressing mathematical situation or relationship into forms of mathematical models (graph, figure, and mathematical expressions) indicator.

5.2 Suggestion

Derived from the conclusions, several suggestions are uttered as follows. Contextual learning based on coastal culture approach in Mathematical Statistics subject enhances student competency in mathematical communication, and therefore the metacognitive approach should be considered as an alternative learning approach for students. Interview results pointed out practices of the metacognitive approach in regards to task workload and time allocation as considerable pressure, and therefore it is suggested upon consideration regarding workload and time allocated for students upon completing the tasks, as well as improving access to alternative learning sources. Research results identify contextual learning based on coastal culture approach to enhance mathematical communication competency in general, and therefore it is suggested upon further study related to contextual learning based on coastal culture approach towards other mathematical competencies.

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