COASTAL CONTEXT IN LEARNING MATHEMATICS TO ENHANCE MATHEMATICAL PROBLEM SOLVING SKILLS OF SECONDARY SCHOOL STUDENTS

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Abstract: The use of contextual problem in the learning of mathematics has been mostly ignored. The present study employed an experiment design to investigate the effect of coastal context as teaching materials (C-Math) on students' mathematical problem solving skills. Descriptive statistic and independent-sample t test were employed in the analysis to describe students’ mathematical problem solving skills (MPSS) and to test the hypothesis. Descriptive analysis showed that students' mathematical problem-solving skills of two classes have increased. The results of testing the hypothesis concluded that the use of coastal context in learning mathematics significantly enhanced MPSS students compared to those with the conventional learning. This implies that the coastal context should be used as alternative context in teaching mathematics. In future, it is interesting to evaluate the effect of coastal context in C-Math teaching materials on the other high-order mathematical thinking skills.

Key-Words: coastal context, mathematical problem solving skills

1 Introduction
Mathematical problem solving is one of the five process standards in National Council of Teachers of Mathematics (NCTM), in addition to reasoning and proof, communication, connections, and representations [1]. In the Education Unit Level Curriculum (SBC) also mentioned as one of the problem-solving competency standards in the secondary school students. In the process of learning, problem solving is the highest learning process. According to [2], today there is a strong movement in education to incorporate problem solving as a key component of the curriculum.

Efforts to improve mathematical problem solving skills (MPSS) is now being pursued both through the learning process of teachers and curriculum. In 1989 NCTM asserted that problem solving should be the central focus of the mathematics curriculum [2]. As the focus of the curriculum, all parties need to pursue the development of mathematical problem solving skills. Mathematical problem solving question is whenever a mathematical procedure, such as arithmetic, or algebraic procedure, is needed to solve the problem [3]. The goal is to wake-quality human resources, students can use the knowledge gained in schools to solve their problems (good problem solvers), no exception for students of coastal area, small islands, or the outer islands of Indonesia. Moreover, there should be no significant difference of students skills in all of school levels. According to [4], diversity and differentiation within our classrooms, at all levels of education, is nowadays a fact. It has been one of the biggest challenges for educators to respond to the needs of all students in such a mixed-ability classroom.

Development of problem solving skills is to equip students to think mathematics logically, analytically, systematically, critically, and creatively. Unfortunately, the process of mathematics learning in formal education conducted
in the coastal areas has not sought the establishment of this capability. This resulted in a lack of mathematical problem-solving skills of students in coastal areas as seen from the low absorptive capacity of students to solve the word problems and math on national test of students in secondary school. The results of the preliminary study the writer showed that in coastal areas, the skills students in mathematical problem solving and communications is still poor, particularly in translating problems into mathematical models. This invites intervention to improve students' mathematical communication skills [5].

Low ability students' mathematical problem solving also caused by the process of learning mathematics in the classroom, i.e. less improved higher-order thinking skills and less directly related to the real daily life [6]. The challenge for teachers, therefore, is to find problem-solving activities that are authentic and important to the learner and yet manageable in the school context ([7]; [8]; [9]). Such learning is not in-line with the purpose of mathematics in secondary school students, namely that the students have the ability to problem solving. And, it is not in-line with the principle of development is also SBC, which is centered on the needs, requirements, and interests of learners and the environment as well as relevant to the life needs of life. This prompted the need for an innovative math learning that utilizes the context of a variety of coastal resources in Indonesia.

Indonesian coastal resource potential has been damaged by a very alarming rate. In fact, (1) 63% (3.1 million km) of Indonesian territorial area is covered by marine waters which is rich in natural resources, and 2) terrestrial resources are becoming less and less and difficult to develop [10]. The potential for development in the coastal areas largely consists of three groups: (1) resources can be recovered (renewable resources), (2) resources cannot be recovered (non-renewable resources), and (3) environmental services (environmental services). Coastal resources are not used optimally for the welfare of coastal communities. In fact, some community activities such as the expansion of land for reclamation, tree felling mangrove (mangrove), coral collection as materials for coastal bridges, water contamination by mud, boat mooring, waste pollution, the use of blast fishing, and oil spills have accelerated the rate of destruction of coastal resources. The conditions are interesting contextual problems in learning mathematics. In addition as needed and related to daily life, the potential damage to coastal issues also need to be introduced to the students so that they have the knowledge, awareness, a desire to solve it, and strive to preserve the coastal resources still exist.

New generating resources of coast should have good problem solving skills. This ability can be trained in mathematics learning by designing a study that utilizes the potential of the coast as a contextual problem. Through contextual learning that utilizes the potential of the coast as a starting point for learning mathematics or in the form of math story problems or presented in the student worksheet math in secondary schools, students can get to know, understand, realize, and be a good problem solver related to the coastal potency. The objective of this research is to enhance students' MPSS by using coastal context in coast-mathematics teaching materials (C-Math) and coastal-contextual teaching and learning (CCTL) in coastal area secondary schools.

2 Problem Formulation
The purpose of this study is to answer the question: "Is the use of the coastal context in mathematics learning effect is better than conventional learning on students' mathematical problem solving ability?".

This is a semi-experimental study to examine the effect of CCTL in enhancing students’ mathematical problem solving skills. The significance increase of students’ MPSS is measured after obtaining teaching materials C-Math, and also comparing to the MPSS of students who received conventional teaching materials. The study uses a pretest-posttest control group design.

Samples was determined according equality mathematics skills of students in the second grade high school SMP 5 Kendari South-East Sulawesi, Indonesia. Both classes of samples were taken randomly from the eighth grade SMPN5 Kendari which have relatively the same mathematical skills. The first class is a class VIIIB sample with the number of students 32 and the second sample class is a class VIIIC the number of students 34 people. Randomization was subsequently produce VIIIC class as an experimental class taught using the C-Math teaching materials with coastal contextual learning model (CCTL) and VIIIB class as taught by direct learning control (conventional) without the use of teaching materials C-Math (CVL). This study also involves two partners as a teacher of mathematics teachers and four panelists to assess the quality of teaching materials and devices supporting the C-Math.

Obtaining data in this research used several instruments: (1) validation sheet teaching materials,
worksheets, and tests, and (2) mathematical problem solving skills test (pretest and posttest). Before use, materials, mathematical problem solving skills tests, worksheets, and lesson plans validated by four experts prior mathematical education, and at the same time understand coastal issues. The validation results showed that the research instruments and tools good enough to be used in this study. Meanwhile, the test results showed that the mathematical problem solving skills test used in this study had moderate reliability.

Data collected were analyzed by descriptive qualitative and quantitative. Quantitative analysis used was t test. The data analyzed are the result of data validation panelists, mathematical problem-solving skills of students (before and after learning), and data enhancement mathematical problem solving skills of students who already normalized (N-Gain). N-Gain or \( g \) is introduced by Hake and is simply the absolute gain divided by the maximum possible gain (ideal), i.e.

\[
g = \frac{\text{posttest score} - \text{pretest score}}{\text{maximal ideal score} - \text{pretest score}}. \quad [11]
\]

Interpretation criteria: \( g \)-high if \( g > 0.7 \); \( g \)-moderate if \( 0.3 \leq g \leq 0.7 \), and \( g \)-low if \( g \leq 0.3 \) [12]. Hypothesis testing used the statistical program package SPSS-17 for windows at significantly level \( \alpha = 0.05 \).

3 Problem Solution

3.1. Validation results of learning tools
This study develops learning tools in the form of teaching materials, worksheets, lesson plans, and tests of mathematical problem solving skills. In addition to lesson plans, the three devices of learning are validated by experts in the fields of mathematics and mathematics education as many as four expert. The fourth of lecturer are the coastal people who understanding both math problems and coastal issues.

The results of uniformity validity test of teaching materials shows that the probability value is 0.52, greater than 0.05. This means that at significance level of \( \alpha = 0.05 \), the fourth experts give uniformly weighting about the validity of C-Math teaching materials.

The results of uniformity validity test of students’ C-Math worksheet show that the probability value is 0.06 which is greater than the probability value of 0.05. This means that at significance level of \( \alpha = 0.05 \), the four experts give uniformly weighting about the validity of students’ C-Math worksheet.

The results of the face validity of each item of mathematical problem-solving skills test showed that the probability value is 0.17 which is greater than the probability value of 0.05. This means that at significance level of \( \alpha = 0.05 \). Thus, it can be concluded that the four experts give uniformly weighting about the face validity of every item of mathematical problem solving skills pretest. Meanwhile, Cochran Q-test results on the validity of the data content of each grain of mathematical problem solving skills test showed that the value probability of 0.41 which is greater than the probability value of 0.05. This means that at significance level of \( \alpha = 0.05 \). Thus, it can be concluded that the four experts give uniformly weighting about the contents of each item mathematical problem solving skills test.

3.2. Data description of mathematical problem solving skills
Based on the descriptive analysis showed that based learning model group, both groups of students either got or who gets convention learning and CCTL relatively have the same prior mathematical problems solving skills. The average of prior skills of mathematical problem-solving of students in CCTL class at 37.53 with a standard deviation of 11.817, while the average of prior skills of mathematical problem-solving of students in conventional class 37.38 with standard deviation of 11.788.

After learning, the average mathematical problem-solving skills of students both classes have increased. The average mathematical problem solving skills of students in CCTL class increased to 63.65, higher-than-average mathematical problem solving skills of students’ conventional class which increased only to 44.06 with a standard deviation of 10.479. Thus, although the skills of solving mathematical problems both classes has increased, but the average increase in class C-Math by 40.67% higher than the average increase in the conventional class of only 10.22%. This suggests that the use of C-Math is better than the use of conventional materials to increase students' mathematical problem solving skills.

3.3. Significantly increasing of students’ mathematical problem solving skills
Hypothesis test results associated with an increase in mathematical problem solving skills C-Math graders showed that there was significantly increase
of students' mathematical problem solving skills after students learn to use teaching materials C-Math. Although a similar increase was also obtained by students who did not receive teaching materials C-Math, however, an increase in mathematical problem-solving skills of students in class C-Math significantly higher than the increase in mathematical problem-solving skills of students in conventional class.

3.4. Differences of students’ mathematical problem solving skills
Hypothesis test results related to the difference in average mathematical problem solving skills C-Math class and conventional class show that there are significant differences in average-skills students' mathematical problem solving between students who learn by using C-Math teaching materials and student learning without the use of C-Math. This shows that the mathematical problem-solving skills of students learning with C-Math higher than the mathematical problem-solving skills of students who studied with conventional materials.

3.5. Discussion
Factors that teachers use instructional materials affect the activity of the students in the class during the learning process. On teaching materials that have been used, more teachers use textbooks that are far from students’ everyday context. Teacher as a model, learning center activities, sources of knowledge, and not involve students actively in the learning activities. As a result, students become lazy, less keen attention to the material being studied, bored, not happy to learn math, and the math does not understand the material in depth so quickly forgotten. Students feel that learning is to follow the instructions of teachers, does not need to be creative, and all of that delivered controlled teacher. Learning like this is not varied, less challenging, less attractive, and less potential to develop students’ thinking. As a result, students are not able to resolve the problems that are more challenging and difficult process that requires high-level thinking. On the side of each teacher must understand the initial knowledge and prepare students to be able to keep up with a better learning process. Teachers’ knowledge of students’ number conceptions improved and that their related self-efficacy increased [13].

School mathematics is a difficult subject to learn. In some parts just need to be learned by rote but in general to study mathematics require higher-level thinking processes gradually in accordance with the hierarchical mathematics itself. Study the structure of mathematics starting from the lowest to the pattern of thinking that low anyway. The learning process has increased in accordance with changes in the broader mathematics and in requiring higher thinking skills. Mathematics learning patterns like this should continue to guide students so that all materials can be controlled to the maximum prerequisite before studying further mathematics. If students are not accustomed to learn mathematics is accompanied by a gradual increase in the ability to think, then the mathematics that students will not be fully controlled. This deficiency will result in low learning ability of students in higher math and require higher order thinking skills as well.

High-level mathematical thinking skills students can be trained to provide interesting issues and challenges that can be solved with mathematical methods [14]). Interesting problem is to make students interested in attending and actively involved in the learning process. Students will feel that the material being studied is important for life as needed. According to [15], "the best time to teach children is when they feel to need for it". To realize such learning so that the thinking of students trained, according to [15], it can be done by three methods, namely "by arranging that children learn through practical activities that are intrinsically interesting; by giving them a problem to solve, by presenting them with a challenge; and by selecting subject-matter that appeals to their natural interests ". This opinion is in line with the provision of contextual issues on C-Math teaching materials used in this study. Contextual issues attract the attention of students and challenge them to solve it by mathematical methods. The process of solving this kind of problem can train students' thinking skills.

The selection of issues to keep students interested in learning mathematics is not easy. Many mathematics textbooks in schools do not present a problem or question in the context of everyday life or the needs of students. Problems or questions like these attract fewer students. As a result, students do not always understand the problem in question. Low ability to understand the mathematical problem adversely affects the student's ability in solving mathematical problems.

Selected of interesting and challenging problems need to be done every mathematics teacher. The problem can be taken from the book outstanding mathematics itself or can be arranged to suit students' day-to-day habits (contextual issues). Problems like this are more interesting and challenging for the students so that they can
improve their mathematical thinking skills such as mathematical problem solving, mathematical communication, mathematical connections, and mathematical representations. This means that students' mathematical problem solving capabilities can be improved by familiarizing them resolve contextual issues. Those problems can be made based on the coast of the potential problems is very useful for students coast. Herein lies the importance of the development of mathematics teaching materials coastal (C-Math).

C-Math teaching material in this research includes a variety of graphics, images, data, and coast-contextual issues. Coast-contextual meant is all illustrations are part of the daily activities of coastal communities and coastal conjunction with the utilization of the potential for life. The teaching material contains seven pieces and materials Two Variables Systems of Linear Equations is taught in the first semester of eighth grade students.

If seen from the material and practice questions are given, then the materials are in compliance with the principles of the preparation of teaching materials set by the National Education Standards, which includes the principle of relevance, consistency, and adequacy [16]. The focus of the presentation materials is to train school students in order to have a mathematical problem solving skills. This is consistent with the purpose of mathematics that secondary school students have the ability to problem-solving.

C-Math teaching materials should be developed using the approach taught by CCTL which is the development of CTL learning. CCTL approach developed characteristics of learning the characteristics of CTL, namely: constructivism, questioning, inquiry, learning community, modeling, reflection, and authentic assessment. However, the approach used in the special CCTL secondary high students in the coastal areas so that they get to know, understand, have the motivation, and awareness to preserve the potential for coastal, good potential for natural resources, services, and the potential value of the local culture that characterizes the behavior of coastal communities daily life to-day.

CCTL approach that uses teaching materials C-Math is a contextual learning process begins by presenting the implementation of coastal problems to be solved independently in each group. The process of solving problems in group discussions, between students or between students and teachers, has a positive effect on students' understanding on the material being discussed. According to [17], through active discussion with their teacher and peers, students are expected to gain a greater understanding of the conceptual underpinnings of mathematics and Become a better problem-solvers. When students discuss with a friend group, students can explain in detail about the problem and how to solve it. The discussion would be effective if the subject of discussion can be understood or understood by students. Interest in the subject of discussion triggers interactions between students went on to make the process of mathematical problem solving. Important role for student coastal issues in the activities of this group discussion is needed.

CCTL on learning approach, the results of each group's discussion to solve the problem then presented in class discussions. This refers to the opinion of [18] states that after completing the task group, the results need to be presented to the entire class and a debriefing that focused on group process should be implemented. This process is carried out to reveal the students' opinions about the process of group work that has been done. Teachers can provide feedback related to problem-solving process and the results obtained to instill math concepts learned. In practice, this process is not easy to be followed by secondary school students coastal and require substantial time.

In addition to the characteristics of everyday language, mathematical characteristics of the low prior knowledge specially in solving the problems caused students' mathematical problem solving needs to be guided more often better to understand the problem, create a mathematical model, solving problems, and in doing algebra math operations. This condition requires the hard work of teachers to master the process of resolving the issues and problems that exist in students' worksheet, understanding the syntax of CCTL, master class with a good basic teaching skills, self-control in the face of students' interest in learning mathematics are low, and have a variety of teaching techniques and techniques to guide students complete in the face of situations that arise in the junior class coast. Students' interest in coastal issues presented should always be a reference to the teacher to establish positive communication with students and that students enjoy learning math. The communication can facilitate the process of solving problems and planting mathematical concepts to students. In addition, through the use of these materials, students can see that mathematics is no longer a subject that is not useful, but it is an interesting subject because it relates to student life and challenging the thinking of students. According to [19], "The experience will be even more if the problem Enriching involves
issues of public concern ...". Awareness that mathematics has many uses is the effect of the exercise of the student in solving coastal problems presented in students’ worksheet for learning mathematics through CCTL approach.

The use of coastal problems in learning mathematics not only to entice students but also to instill the importance of coastal preservation potential for the community. Familiarize students solve problems like this are useful groups to improve mathematical problem solving skills as well as interact with other people around. Difficult mathematical material will be more easily understood when students learn in groups. According to [18], the group can solve the problem more powerful allowing teachers provide questions that are more difficult than that given to students individually. Giving an interesting problem, challenge, and it takes a certain degree of difficulty to be meaningful to students. Meaningfulness of learning mathematics arises when students attempt to understand, implement, and develop mathematical knowledge on related issues. In this context, teachers need to work hard as a facilitator and a motivator to guide students become good problem solvers.

When students in a group have difficulty solving problems, teachers should always be able to determine the best way to guide students to solve their own problems through directed questions. This means that teachers must have good questioning skills so as to foster the curiosity of students to continue to explore issues, interact with other students, negotiation, mutual respect, and respect the opinions of others. Way that has been done is ask for help other students in the group to help students who struggle so that the interaction. Interaction that occurs when students help each other in the process of problem solving is very important in learning mathematics. This is in line with the opinion of [20] that this has implications for friends working in groups in mathematics classrooms, as there may be a parallel in friends opting for the more mathematically different, mathematically sophisticated, mathematically efficient or mathematically elegant solution. This opinion is also in line with the opinion [21] states that one way to do is ask for the help of fellow students to help these students. Situations like this can be done if students are grouped heterogeneously and teachers must affirm the duty of every member in the group.

Based on the above it can be said that the use of interesting materials as they relate to students' lives as well as challenging so that students do not get bored making apparently been able to improve students' mathematical problem solving skills. Even the discussion of the process and solving the problem of interest, also has been able to develop the social skills of students to always interact well with other students and with teachers. This means that there needs to be further study how coastal problems is to serve as a springboard for improving the ability of other high-level mathematical thinking and social skills or dispositions mathematics students.

The results are consistent with previous research findings that students who received mathematics with cooperative learning and acquire contextual significantly improved mathematical problem-solving skills higher than students who received conventional and contextual learning. The results [22] concludes that the four students exhibited meta-cognitive behaviors such as asking for clarification, giving a suggestion, evaluating solutions; and affective behaviors such as persisting in the task, praising and encouraging when they solved problems in a group. Similarly, the results of research [23], that mathematical problem-solving skills of students receiving a combination of contextual learning and meta-cognitive better than conventional learning; result study [24], that the ability to think critically and creatively mathematics students obtain contextual learning structured and unstructured better than conventional learning, and research results [25], that teaching is a contextual base of relevance and should be Adopted where applicable in secondary schools, particularly in the developing world. Somewhat different results found by [26], the results demonstrated that enhance neither the familiar contexts of children's problem-solving performance problems nor decrease difficulty. More than half of the children did not identify the similarity in problem-solving approaches between problem settings and real shopping. However, in general the various studies show that learning mathematics using contextual problems could develop students' mathematical problem-solving skills as well as obtained in this study.

The mean difference increased mathematical problem solving skills among students who are not learning as contextual and these results are normal according to the different characteristics of the materials used. C-Math on teaching materials, students learn actively in group discussions to solve problems that exist in the students’ worksheet coast. When students solve coastal problems, interest, attention, motivation, and held a variety of mathematical knowledge is used while exchanging
students' understanding of the mathematical material required a better mindset with the expansion of the previous mathematics so as to learn mathematics that is developing; deepening and expansion of the previous mathematics so as to learn the material requires a better mindset with the ability of the material prerequisites are good also. Mastery learning mathematics is a prerequisite in something so it is necessary in any give math lessons to students. No pass material and students' understanding of the mathematical material adversely affects the student's ability to learn further mathematics. Likewise, the mathematical problem-solving skills require higher-order thinking skills to solve it. If students are not accustomed to thinking at a higher level such as practicing solving math problems, then they cannot obtain an increase in high mathematical problem-solving skills. The results of the above studies further clarify the importance of the application of the contextual use of teaching materials to improve students' mathematical problem solving skills.

4 Conclusion

It has been shown that the use of coastal context in learning mathematics significantly enhanced students' mathematical problem solving skills compared to those with the conventional learning. This implies that the coastal context should be used as alternative context in teaching mathematics. In future, it is interesting to evaluate the effect of coastal context in C-Math teaching materials on the other high-order mathematical thinking skills.

References:


