

## Problem-Solving Skill based on Self-Directed Learning Perspective with the Implementation of Problem-based Learning Assisted by Sie Sandra

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### Abstract

This research described the problem-solving skill seen from learning style and local cultural appreciation of ethnomathematics nuanced problem-based learning assisted by Sie Sandra. The applied method was the qualitative method with 36 learners of X MIPA 1 of Public High School 2 Grabag as the research subjects in the academic year 2021/2022. The researchers collected the data with a self-directed learning questionnaire, problem-solving skill test, and interview. The researchers analyzed the data descriptively by reducing, displaying, and triangulating the data. The results showed that (1) learners with high self-directed learning and high local culture appreciation could reach high and moderate mathematics problem-solving skills; (2) learners with moderate self-directed learning and moderate local culture appreciation could reach high, moderate, and low mathematics problem-solving skill; (3) learners with low self-directed learning and problem-solving skill had moderate and low problem-solving skills.

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## INTRODUCTION

Problem-based learning is recommended learning by the ministry of education and culture of the Republic of Indonesia as stated in the 2013 curriculum. The conceptual framework of PBL implementation requires the integrated system approach of input, process, and output. The PBL process has a preparation stage. This stage determines the clarity of learning outcomes to develop skills and introduces PBL as a teaching-learning method for learners. Education allows learners to compete in various fields, such as cognition, attitude, and behavior (Hasanah et al., 2018). Education refers to the interaction between teachers and learners to promote a learning process. The objective of an educational learning system is to realize proficient, faithful, and devoted individuals in front of God, the Almighty (Indra Kartika Sari, 2021).

In the educational world, mathematics problem-solving skill is important to develop. Problem-solving skill allows learners to apply mathematics concepts in their daily lives to solve problems, connect the concept with new related concepts from other lessons, and implement them in daily life matters.

Problem-solving is an important skill of mathematics learning for the learners to apply and combine various mathematics concepts and to make decisions (Aulia & Kharisudin, 2019). Problem-solving is an effort to determine solutions for complex problems (Sutrisno & Kharisudin, 2020). Problem-solving is a vital competence in education. Thus, the skill must require adequate design to facilitate learners gaining mathematics experience as a problem-solving skill (Bahri & Sukestiyarno, 2018).

Mathematics problem-solving skills with adequate interaction could facilitate in finding mathematics problem solutions. This process allows the individual to apply appropriate learning models to improve their problem-solving skills (Medyasari et al., 2022). Problem-based learning is an excellent learning model to improve the learning outcomes (Endramawati et al., 2019).

Mathematics problem-solving is a process of interpreting mathematics situations. This process requires some cycles of interacting, uttering, examining, revising the mathematics interpretation, selecting, interpreting, modifying, and improving the mathematics concepts (Kharisudin & Cahyati, 2020). Problem-based learning applies effective instructional approaches to provide the learners with enrichment so that they could be excellent problem solvers in the current information and technology community. Thus, they could use the problem-solving skill for continuous learning (Tiantong & Teemuangsai, 2013). Hsiao et al., (2018) explain that the mathematics problem-solving training system for JHS in Taiwan applied a diagnostic assessment and instruction system to improve problem-solving skills and learning motivation. Innovative learning could improve learners' problem-solving skills, for example the implementation of problem-based learning with ethnomathematics. Innovative learning provides opportunities to improve the learners' problem-solving skills by providing ethnomathematics. PBL requires data presentation and problem discussion to habituate learners and to make them understand the problems. The learners could actively find solutions to solve problems (Bungsu et al., 2019). PBL, initiated by problem presentation and discussion, habituates learners to understand problems. The learners could also actively find solutions so they could solve problems (Kurniyawati et al., 2019).

Innovative learning provides the opportunity to improve learners' problem-solving skills by implementing problem-based learning with ethnomathematics nuance. Problem-based learning could improve the self-directed learning, responsibility, and awareness to keep up with the learning process. In this research, the researchers applied some stages for problem-based learning with ethnomathematics nuance.

Ethnomathematics is useful to connect mathematics with the learners' understanding of the learners' local culture (Yosopranata, 2018). The implementation of ethnomathematics in learning expect the learners to understand the mathematics and culture so that they could easily instill the cultural values in the learners' daily life (Purwanti & Asikin, 2021). Many ideas and mathematics activities of *hausa* culture, specifically the explicit mathematics feature (Shuaibu, 2014). Ethnomathematics is a set of

notions about mathematics history, cultures in mathematics, implicit mathematics of daily management, and mathematics education (Sunzuma & Maharaj, 2019). Cultural-based ethnomathematics becomes the supporting learning media for problem-solving skills (Brat et al., 2019). Many real problems in learners' life could be the materials for mathematics learning so that learners can formulate the solutions (Hakim et al., 2022).

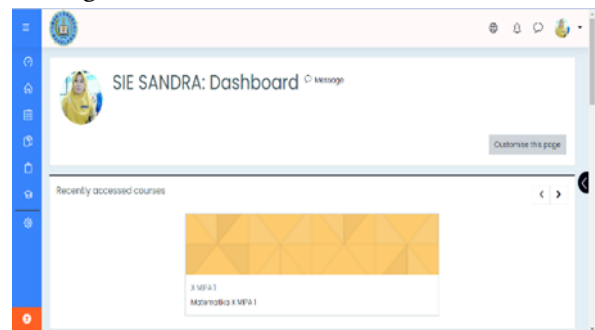
The implementation of mathematics learning in coastal areas could be the pivot point to improve the learners' mathematics competence at schools and to improve their future life quality (Zaenuri et al., 2017).

This research took the research site at Public Senior High School 2 Grabag, Magelang regency. The learning discussed and connected various objects and matters in Magelang for learning purposes. Magelang is a city in Central Java with various local customs, cultures, and casava-based culinary dishes. Thus, the implementation of problem-based learning with ethnomathematics nuances could improve the local cultural compassion character of the learners.

Self-directed learning the learners with adequate training and excellent habituation and habituation leads to learning process discipline (Hartini et al., 2018). Self-directed learning is an important character to instill in the learners. This character must be trained so that the learners could automatically learn without being instructed, without being forced by some homework, and without being forced by test requirements. Sie Sandra is an application to realize self-directed learning in learning.

Based on the preliminary observation, the MSI team of Public Senior High School 2 Grabag had implemented various free online learning platforms, such as Google Classroom, Edmodo, Quiziz, WA group, Schoology, and many more. Eventually, at the beginning of the 2021/2022 academic year, the team implemented a personal e-learning platform to develop the teachers' competencies and facilitate learning monitoring. Thus, the team created a moodle-based e-learning platform named Sie-Sandra, *Sistem Informasi Edukasi SMA Negeri 2 Grabag* (The educational information system of Public Senior High School 2 Grabag). The team developed the system to make it the teachers and learners easy while promoting online teaching-learning and face-to-face

teaching-learning. Sie-Sandra was accessible from various devices, such as smartphones, laptop computers, tablet computers, and PCs with active Internet connections. Sie Sandra allows learners to study at home. Thus, they could ask their friends or teachers via WA or other means. Learners can also ask their seniors. The following figure shows Sie Sandra application for Public Senior High School 2 Grabag.



**Figure 1.1** Sie Sandra Application

This research described the mathematics problem-solving skills seen from the self-directed learning and local culture appreciation of ethnomathematics nuanced problem-based learning assisted by Sie Sandra.

## METHOD

Make sure that work can be repeated according to the details provided. It contains technical information of the study presented clearly. Therefore, readers can conduct research based on the techniques presented. Materials and equipment specifications are necessary. Approaches or procedures of study together with data analysis methods must be presented.

The research subjects were class VIII E students who were able to take part in CORE learning with positive feedback on the Pythagorean theorem at SMP Institut Indonesia Semarang for the 2021/2022 academic year. The selection of research subjects was based on the score of the questionnaire results to obtain high, medium, and low self-esteem categories of students. By using a purposive sampling technique, 2 subjects were determined for each group as the focus of the research.

The data in this study were collected directly by the researchers so the main research instruments were the researchers themselves who were assisted by

auxiliary instruments in the form of questionnaires, tests, and interview guides. The data collection technique in this study was a test technique used to obtain data on students' mathematical communication abilities and non-test techniques to obtain data credibility.

Data analysis was carried out from the pre-field stage to the analysis stage while in the field. Prior analysis in the field was carried out by validating research tools and instruments. Analysis while in the field is the process of analyzing data on mathematical communication abilities in CORE learning with positive feedback based on students' self-esteem categories using triangulation techniques from questionnaires, and written test results with interviews. Data analysis is done by reducing data, presenting data, and verifying and drawing conclusions. Data validity uses 4 stages, namely trust, transferability, dependability, and certainty.

**RESULTS AND DISCUSSIONS**

When CORE learning is carried out students are accustomed to communicating their mathematical ideas to solve mathematical problems.

Table 1. Individual Completeness Test.

n	$\bar{X}$	s	$t_{count}$	$t_{table}$
31	82.3	8.41	8.131	1.70

The table above shows that the results of mathematical communication skills with a total of 31 students obtained a class average of 82.3 with a standard deviation of  $s = 8.41$  and obtained a count = 8.131. Determine the critical value  $t_{table} = t_{(n-1, \alpha)}$  where  $\alpha = 0.05$  chance 0.95 and  $dk = 31 - 1 = 30$  obtained  $t_{table} = t_{(31-1, 0.05)} = 1.7$ . This shows that  $t_{count} \geq t_{table}$  is  $8.131 > 1.70$ . So, the average student's mathematical communication ability is more than 70.

Table 2. Classical Completeness Test

n	$\bar{X}$	$\pi_0$	$Z_{count}$	$Z_{table}$
31	29	0.75	2.379	1.645

Based on the above it shows that out of 31 students, there are 29 students have exceeded the KKM score of 70.  $z_{count} = 2.379$ . Determination of

the critical value  $z_{table} = z_{(0.5-\alpha)}$ , where  $\alpha$  at a significance level of 5% is obtained  $z_{table} = 1.645$ . This shows that  $z_{count} > z_{table}$ , namely  $2.379 > 1.645$ . Based on the description, it can be concluded that students in CORE learning with positive feedback exceeded classical completion by 75%.

CORE learning with positive feedback triggers interpersonal dialogue or communication and pays attention to social feelings in the learning process. This is to Vygotsky's theory where students form knowledge because of their thoughts and activities through language.

The conclusion is supported by research by Utami (2015) showing that CORE learning is effective with more than 75% positive responses. These results are in line with Prasetya (2020) which shows that there is a significant increase in improving student learning outcomes and giving a positive response to the CORE learning model. Positive feedback is used in the CORE model starting from the organizing stage to the extending stage. The description questions are given in the form of identical questions done together with the group. Feedback can be seen during core activities, question, and answer, for example, the teacher asks questions.

The Connection stage according to Lestari & Yudhanegara (2017), and Humaira in Konita, et. al. (2017) provides space for students to associate old knowledge with new knowledge and associate knowledge with real life. Connecting refers to old and new information between math topics and concepts, connections between other disciplines, and with students' everyday lives. At the connecting stage, new information received by students is linked to what was previously known. So that the teacher's feedback will look meaningful for students to answer incorrectly so that it can be corrected immediately. The teacher gives positive feedback in the form of motivation. Positive sentences can increase the spirit of these students. This is because feedback in learning must be specific or praised while providing Kulhavy correction (in Lestariningsih, 2014).

The use of positive feedback is used as reinforcement so that learning becomes directed according to the learning objectives. Feedback is an important part of effective learning (Osuala, et al., 2018). The main focus of this positive feedback is to assist students individually/in groups when experiencing difficulties in understanding the

problems given to help improve student learning outcomes. In line with Ion, et al. (2019).

The test uses a paired sample t-test intending to compare student self-esteem before and after CORE learning with positive feedback.

**Table 3.** Self-Esteem Analysis Test Results

Class	<i>n</i>	$\bar{X}$	<i>t<sub>count</sub></i>	<i>t<sub>table</sub></i>
Posttest	31	80,3	3.113	1.701
Pretest	31	74.7		

Based on Table 3. shows in the posttest class that out of 31 students have an average of 80.3 and pretest as many as 31 students have an average of 74.7. Acquired value  $t_{count} = 3.113$ . Determination of the critical value  $t_{table} = t_{(30;0.05)}$ , where  $\alpha$  a significance level of 5% is obtained  $t_{table} = 1.701$ . This shows that  $t_{count} > t_{table}$  is  $3.113 > 1.701$  then  $H_0$  is rejected. Based on the conclusion that the average self-esteem of students after learning CORE with positive feedback is better than the average self-esteem of students before learning CORE with positive feedback.

Student self-esteem data was obtained from the results of the self-esteem questionnaire. Filling in the

self-esteem questionnaire was carried out in class VIII E. The self-esteem questionnaire aims to group students based on self-esteem categories divided into high self-esteem, moderate self-esteem, and low self-esteem. Based on the results of the analysis of the self-esteem questionnaire, the student grouping data is obtained which is listed in Table 4.

**Table 4.** Student Grouping in terms of the Self-Esteem Category.

Self-esteem category	Number of Students	Percentage
<i>High self-esteem</i>	5	16%
<i>Moderate self-esteem</i>	20	65%
<i>Low self-esteem</i>	6	19%
Jumlah	31	100%

Based on the results of the scores obtained by students in filling out the self-esteem questionnaire, two students with high self-esteem were selected, namely E-007 (S-1) and E-001 (2), two students with moderate self-esteem, namely E-015 (S-3) and E-006 (S-4), two students with low self-esteem, namely E-019 (S-5) and E-018 (S-6).

**Table 5.** Mathematical Communication Skills based on students' self-esteem in CORE learning with positive feedback.

Indicator	Analysis Results	Soal 1	Soal 2	Soal 3	Soal 4	Soal 5
Ability to use terms, mathematical notation and structures to present ideas	Accuracy of use notation, vocabulary, sketches or pictures	E-015	E-007	E-007	E-007	E-007
		E-006	E-001	E-001	E-015	E-001
Ability to visualize mathematical ideas		E-019	E-015	E-015	E-006	E-015
			E-006	E-006		
Ability to understand and interpret mathematical ideas in writing	Writing suitability completion step with problems	E-007	E-007	E-007	E-007	E-007
		E-001	E-001	E-001	E-001	E-001
The ability to express mathematical ideas	Writing representation problem in a sentence	E-015	E-015	E-015	E-015	
		E-006	E-006	E-006	E-006	
		E-018	E-019	E-019	E-019	
			E-018	E-018		
		E-007	E-007	E-007	E-001	E-007
		E-001	E-001	E-001	E-019	E-001

through writing	or mathematical notation	E-015 E-006 E-019 E-018	E-015 E-006 E-019 E-018	E-015 E-006 E-019 E-018		E-019
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In question number 1, there was only 1 research subject who was able to respond to the problem correctly and coherently, while other research subjects still experienced errors in responding to the problem appropriately because the research subject was not careful in doing so and forgot to include it in the calculation process, unable to understand the information on questions.

In question number 2, there was only 1 research subject who was able to respond to the problem appropriately. In general, the research subjects still did not understand how to visually illustrate mathematical ideas correctly related to everyday life, were not careful when using data, did not have the skills to read the information on questions, and did not have understanding.

In question number 3, 4 research subjects were able to respond to the problem appropriately, while other research subjects still had difficulty responding appropriately. This is because the research subjects do not have the skills to use information in writing mathematical ideas in a structured manner.

In question number 4, none of the research subjects succeeded in responding to the problem appropriately. Each subject still makes mistakes in responding appropriately. This is because the research subjects do not understand writing mathematical ideas visually, have not been able to read the information in the problem correctly, and are not able to associate the information in the problem with a set of concepts.

In question number 5, 2 research subjects responded correctly. In general, this happened because the research subjects still had difficulty reading the information on the problem, did not have numerical manipulation skills, did not understand each procedure performed, did not have simplification arithmetic operations skills, did not have the skills to link information in the problem with a set of knowledge they had to compile problem-solving plan, unable to distinguish information from problems in the problem.

The results of the research information that students with high self-esteem can draw into mathematical models perfectly. This is the opinion of

Nurma (Merlin, et al, 2015), students who can write and explain mathematical statements in the form of correct mathematical symbols means that students can present mathematical statements orally and in writing. Students with high self-esteem can illustrate ideas in the form of pictures and use concepts and formulas appropriately. On problems with students with high self-esteem, they can complete the description questions completely. The following is

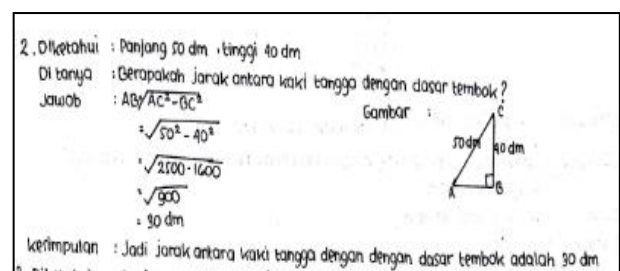


Figure 1. S-1 Subject Working on Question Number 2

This information is supported by the results of interviews with high self-esteem subjects who can provide reasons with appropriate conclusions from each problem in each indicator of mathematical communication ability. This result is in line with Adiputra (2015) which shows that self-esteem influences learning achievement. Students who have high self-esteem will generate self-confidence, self-confidence, a sense of usefulness, and always think positively about everything. In line with Yuniarti (2018) the higher the self-esteem, the higher the students' mathematical communication abilities. This means that students with high self-esteem do not experience difficulties and can solve all problems according to indicators of mathematical communication ability.

Self-esteem student research is having no difficulty in expressing mathematical modeling on 3 indicators. However, students' self-esteem is not maximal in solving problems on questions. The achievement level of students in most of the problems can be considered middle to the upper level (Ayan & Bostan, 2018).

Moderate self-esteem students need to be given the motivation to be more confident in their ability to



express their mathematical ideas. The motivation is in the form of positive support from the teacher to students for the assignments received. By raising students' awareness of the importance of working hard as a form of high enough motivation. Completion of tasks properly and with the capabilities possessed is a form of self-esteem. Students will study hard because of their self-esteem (Oktiani, 2017). Based on this explanation, motivating students to be more confident in their abilities, especially in the form of mathematical communication, will maximize their ability to solve a problem.

Students with low self-esteem show poor mathematical communication skills. The results of the study obtained information on the problems that stated pictures into the mathematical mode, low self-esteem students were able to solve problems but were still incomplete. On indicators of the ability to visualize mathematical ideas, low self-esteem students still experience problems in drawing according to problems. On indicators of ability to use terms, mathematical notations, and their structures to present ideas, low self-esteem students still lack what is known and asked and can use mathematical terms and notation correctly in both subjects. The following Figure 2 results of the work of students in the low group.

**Figure 2.** S-5 Subject Working on Problem Number 4.

This information is supported by Alfian, et al (2019) who stated that low self-esteem has not been able to fully express all indicators. Nur (2018) suggests that self-esteem has become an important concern due to some factors related to life and one of them is the success of students at school. Based on the indicators of mathematical communication ability, low self-esteem students can complete two indicators of mathematical communication ability, while other indicators mean that the answers of low self-esteem students are incomplete and maximal.

The level of self-esteem in students affects students' confidence in finding a solution to a problem that involves mathematical communication skills. So that low self-esteem students need more attention from the teacher. More guidance can be in the form of exercises or assignments in solving problems so that students will get used to solving a problem. When someone routinely works hard affects self-esteem. Tasks and exercises to solve problems in groups can be done during CORE learning with positive feedback, with heterogeneous groups of students with high abilities can help students with low abilities in solving a problem. Students who have high initial abilities greatly influence the experience in solving mathematical problems so that they can convey mathematical ideas or ideas to friends in groups (Mirna, 2018) and in these activities the right state of mind is needed so that they can be maximally productive in creative endeavors (Mann, et.al, 2016).

## CONCLUSION

CORE learning with positive feedback can improve mathematical communication skills. Mathematical communication skills with high self-esteem fulfill 4 indicators fulfilled on one subject and other subjects fulfill 3 indicators. Students in the moderate self-esteem category can fulfill 3 indicators on one subject and 2 indicators on another subject. Students in the low self-esteem category achieve 2 indicators on one subject and 1 indicator is achieved on another subject. So, the higher the level of self-esteem the higher the students' mathematical communication skills.

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