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Mathematical Communication Skills Reviewed From Mathematical Resilience in Independent Learning and Discovery Learning Assisted by E - Learning

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Abstract

This research aims to describe mathematical communication skill from mathematical resilience in independent learning assisted by module and discovery learning assisted by e-learning. This mixed – method research took population from X graders of SMA N 6 Cirebon. The sampling technique was purposive sampling. The results were X MIPA 4 as experimental group 1 (intervened by independent learning assited by module) and X MIPA 6 as experimental group II (intervened by discovery learning assited by e-learning). The subject categorization was based on mathematical resilience with high, moderate, and low categories. The instruments of this research were mathematical resilience questionnaire, mathematical communication skill test, and interview. The results showed that independent learning assited by module and discovery learning assisted by e-learning were effective. There was no difference mathematical communication skill between independent learning assisted by module and discovery learning assisted by e-learning on average. The descriptions of the students' mathematical communication skills reviewed from mathematical resilience were varied.

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INTRODUCTION

Mathematics is a study of measurement, structure, space, and change. Mathematicians seek various patterns, formulate new conjectures, and construct truth through axiomatic deduction and appropriate definition (Waluya, 2018). Mathematics is an abstract science with logical reasoning within its statement. The statement is also complemented by evidence obtained through problem solving activity (Taubah, 2018). It means mathematics is not a lesson to calculate but a logical – reasoning process.

Curriculum 2013 is identic to character education, literacy, and education to carry out 21st century. In facing the century, students are required to have hard skill and also soft skill. Hard skill is a mastery of science, technology, and technical skill related to their disciplines (Sumarmo, 2018). Softskill is defined as an individual's skill in having relationship to other people, to manage himself, and to develop his performance maximally.

In the reality, softskill and hardskill of students are still low. Their competing power to learn is till low. It is indicated by classroom – discussion process in which students have not constructed their science and always want to be assisted by more capable students or their teacher. This competing power is known as mathematical resilience. Mathematical resilience is defined as positive attitude to overcome anxiety and fear to face challenges and difficulties in learning mathematics. The resilience covers hardwork, reliable communication skill, confidence, and determination in facing difficulties (Sumarmo, 2018). Students assume that many formulas and tasks make mathematics lesson as boring lesson so their interest to learn it fading away. It leads to laziness, fear, and boredom to mathematics, causing low mathematical resilience (Cahyani, 2018).

There were several studies showing positive correlation between mathematical resilience and academic and cognitive abilities of students. Dilla (2018) stated that there was influence between mathematical resilience to students' mathematical creative thinking skills with percentage 86,6%. Based on the findings, mathematical resilience could influence cognitive skill of students.

One of cognitive skills of students is mathematical communication skill. It is an ability to deliver something recognized into both speech and writing and with or without media (Hartati, 2017). Mathematics is a lesson with its own language, such as mathematics symbols. Students need to understand the use of those symbols. Therefore, students learning mathematics should process the symbols by using communication skill. It leads to mathematical communication which becomes a certain competence to be mastered by students in learning mathematics (Habsah, 2017).

Trigonometry is a mathematics branch which studies correlation among sides and angles of triangle and its basic functions caused by those correlations. However, students had difficulties in this material. Diani (2015) stated the students' problems in learning trigonometry were selecting and implementing the correct concepts in solving real problems. One of the difficulties was solving essay questions which used sinus and cosinus rules.

The observation at SMA N 6 Cirebon showed difficulties experienced by students to express mathematics ideas through writings, to draw visually, to express daily events into speech or mathematics symbols, and to write completely and clearly the answers of a problem. It showed that their mathematical communication skills were still low.

The students also have not been able to learn independently. Their lack of awareness to master the material made them having low learning achievement. They tended asking to be guided by teacher in learning although the roles of teacher were to be facilitator and motivatior but not to be the main learning source. With various learning sourcs in this era, both from conventional books, *e-books,* and other internet learning sources, learning materials should be accessible easily by students so it would allow them to learn independently.

Independent learning in this research was done by giving module to be worked independently. The module habitualized the students in independently learning plus to improve their mathematical communication skills and resiliences. By having independent learning, students would be active because they should construct their own understandings by using various sources. However, if the students had difficulties, they could ask the teacher or their peers. Then, independent learning by using module could be done in group or individually. The module was supplemented by question exercises which were arranged for each sub-discussion. Therefore, to continue to the next sub-discussion, students had to finish the previous sub-discussion questions well.

Recently, learning approach has become student centered approach in which discovery learning is one of them (Suphi, 2016). Discovery learning is a learning model to elicit curiosity, confidence, and determination of students. Besides that, in teaching – learning activities at school would not be enough only to achieve mathematical communication skill. Therefore, there is a need of flexible media to use anytime and anywhere. Without media, learning process as communication process would be hindered and not optimum (Kusumantara, 2017). Information and communication technology is a distant medium to exchange information. E – Learning is one of web based application technologies, portals, and softwares in educational field for the sake of an educational process (Sudiana, 2016). There are three kinds of e-learning, such as edmodo, moodle, and schoology. Luaran (2012) stated that schoology is online learning session with social – media display to improve learning through better communication. One of its features is teacher could upload learning material with its tasks via online. It is not bind by time and space. This research used e-learning schoology.

Based on the problems, there is a need of further investigation about independent learning assisted by module and discovery learning assited by e-learning to find out mathematical communication skill of the student reviewed from mathematical resiliences.

METHOD

This mixed method research used sequential explanatory approach because the quantitative stage was conducted in advance. This stage also dominated this research design. The quantitative method in this research was used to know effectiveness of independent learning assisted by module and discovery learning assisted by e-learning. The qualitative method was used to describe mathematical communication skills from students' mathematical resiliences in independent learning assisted by module and discovery learning assisted by e-learning.

This research was conducted in grade X of SMA N 6 Cirebon in the academic year 2018/2019. The sampling technique was purposive sampling. The selected classes were X MIPA 4 as experimental classes I (intervened by independent learning assisted by module) and X MIPA 6 as experimental classes II (intervened by discovery learning assisted by e-learning).

The quantitative data was obtained from mathematical communication skills' test (TKKM). The qualitative data was obtained from mathematical resilience questionnaire and interview. The quantitative data was tested by using normality test, homogeneity test, proportional test, comparison test, and N-gain test. The qualitative data used Miles & Huberman's test with data collection stages: data collection, reduction, presentation, and conclusion.

RESULT AND DISCUSSION

From the normality test of TKKM, it was obtained sig score = 0,216>0,05, it meant the result of TKKM was normaly distributed. From the homogeneity test showed sig score = 0,773> 0,05, it meant the variants of the experimental classes and the control class were equal. From the achievement passing grade test of experimental

group I showed sig score = 0.000 < 0,05 with TKKM average score 78,21, it meant the average mathematical communication skill of experimental group I reached the minimum grade. From the achievement passing grade test of experimental group II showed sig score = 0.000 < 0,05 with TKKM average score 80,68, it meant the average mathematical communication skill of experimental group II reached the minimum grade. From the proportional test of experimental group I showed score $z_{count} = 1.78 \geq 1.64 = z_{table.}$, it meant the percentage of experimental group I who reaching the minimum grade was 73 higher than 75%. From the proportional test of experimental group II showed $z_{count} = 2.18 \geq 1.64 = z_{table}$, it meant the percentage of experimental group II who reaching the minimum grade was 73 higher than 75%. From the comparison test of the experimental group I and control group obtained sig = 0,000 < 0,005. Then, between experimental group II and the control group, the sig score was 0,000 < 0,005. It showed that the average of mathematical communication skills of experimental group I and experimental group II were better than control group. The comparison test between experimental group I and II showed sig = 0,220>0.05. It meant there was no difference mathematical communication skill between experimental group I and II on average. The N-gain test showed that there was resilience improvement on experimental group I and II, respectively 0,44 and 0,46. It could be concluded that independent learning assited by module and discovery learning assisted by e-learning were effective.

Independent learning assisted by module demands students to accomplish the learning by minimal guidance of the teacher. The guidance of independent learning is only just providing assistance or scaffolding based on Vygotsky learning theory. The limitation of assistance given by teacher made students to think actively in constructing the knowledge. In independent learning assisted by module, students were given freedom to accomplish their modules. In the realization, enrichment had to be given to let students reading and finishing their modules, at least based on the determined targets. This enrichment was in the form of motivation to all students and warning for those whom were lazy. This enrichment was based on Skinner's theory. Students had to be ensured that they could finish their modules independently. It was supported by Suardana (2012) showing that teacher could provide enrichment to motivate students to be more active in learning process.

Independent learning assisted by module was effective. It was due to the investigated materials were not new materials known by students. The materials were sinus and cosinus rules. The students had learnt the materials previously so they were ready to have basic concept to learn the materials. It was supported by Cukurova (2017) stated that independent learning could be done if students recognized relevant concepts to the learnt materials. Furthermore, independent learning was done by face to face guidance. Independent learning followed by guidance of the teachers proved to have significant improvement in achieving and implementing the knowledge than the independent learning without any guidance. It proved no significant changes (Cukurova, 2017).

In the module, there were question exercises with mathematical communication skill indicators so students could train their skills. Besides the exercise, there was also self-evaluation with purpose to measure achievement of their independent learning. Students would realize their mistakes so they could anticipate the same mistakes on next questions. It was supported by Sari (2018) stated that self-evaluation could improve problem solving skill. Independent learning had to be managed properly by the manager or tutor through planning process appropriately. The implementation of the learning refered to the plan, coordinated realization, and accurate result scoring process so that the learning community could achieve the expected standard competences (Putra, 2017).

Independent learning is a new thing for students so they might have difficulties and challenges to face it. Therefore, students should have well mathematical resiliences. It was proven

in the group intervened by independent learning could improve their mathematical resiliences. This improvement influenced mathematical communication skill of the students. It was supported by Kurnia (2018) stated that there was correlation between mathematical resilience and mathematical communication skill.

Effectiveness of independent learning assisted by module in this research was supported by previous findings, such as Suardana (2012) stated that independent learning model could improve student learning achievement. Kusuma (2017) stated that there was mathematical communication skill improvement in the learning assited by module. Setiawan (2018) stated that independent learning assited by module was effective to improve students' metacognitions.

In discovery learning assisted by e-learning requires students to be active in using various sources to assist them solving the given problems. E-learning schoology is a non face to face meeting outside of classroom. The students' activities in schoology consisted of submitting the tasks based on the agreed time and discussing it. In discovery learning assisted by e-learning, teachers provided guidance, warning, motivation, and problem elaboration in other forms when students had difficulties in solving the problems. The activity was limitation of providing assistance for students – called as scaffolding. It was in line with Vygotsky's learning theory. The limitation given by teacher made students to think actively in constructing their knowledge. It was proven by high average score of mathematical communication achieved by students. It showed that scaffolding influenced mathematical communication skill achievement of students. It was supported by Paruntu (2018) stated that scaffolding was effective in effort to accomplish mathematical communication.

In discovery learning assisted by e-learning, students had to have curiosity, relection, investigation, and utilization of various sources to create ideas and to seek creative solution to handle the challenges; showing intention to socialize and discuss with peers, and to show determination, confidence, hardwork, and endurance to not give up in facing problems, failures, and uncertainties. To reach learning success, then students should have positive attitude called as mathematical resilience. It was proven in the group taught by discovery learning assisted by e-learning could improve students' resiliences. It was supported by Hafiz (2017) stating that discovery learning could improve students' mathematical resilience.

Effectiveness of discovery learning assisted by e-learning in this research is supported by previous studies. Nasrullah (2017) stated that e-learning schoology influenced positively toward mathematical communication skill of students. Afriyanti (2018) stated that discovery learning assisted by schoology was effective to improve mathematical resilience and literacy.

The result showed that there was no difference of mathematical communication skill between independent learning assisted by module and discovery learning assisted by e-learning on average. It was supported by Setiawan (2018) stated that there was no difference in problem solving average between independent learning assisted by module and STAD. Maliya (2019) stated that there was no differene of problem solving skill between independent learning and CPS.

There were three aspects of mathematical communication in this research: (1) expressing ideas through writing and figures visually, seen from indicator skills to transform question into figures or other representations, (2) stating daily life problems into speech or mathematics symbols, seen from indicator skill to use appropriate terms/symbols, and (3) writing complete answers of a problem seen from indicators, such as (a) ability to use correct formula, (b) ability to share reason in solving problem, and (c) ability to correctly and systematically answer, and (d) writing the conclusion by using their own language.

Then, the qualitative analysis about mathematical communication skill seen from mathematical resiliences. The experimental group I students were given mathematical resilience questionnaire to group them into high, moderate,

and low categories. Here is the result of the questionnaire from 34 students in experimental group I, as shown in Table 1.

Table 1. Result of Mathematical Resilience Categorization of Experimental Group I

Categories	Numbers of Students
High	11
Moderate	15
Low	8

The findings showed that description of mathematical communication skill reviewed from mathematical resilience of the students were varied. It was shown from 11 high mathematical resilience students consisted of 7 high mathematical communication skilled students and 4 moderate skill students. From 15 students with moderate mathematical resilience, there were 1 high mathematical communication skill student, 13 moderate skilled students, and 1 low skilled students. From 8 low mathematical resilience students, there were 3 moderate mathematical communication skilled students and 5 low skilled students.

The impacts of independent learning assisted by module resulted to various mathematical communication skill. The high mathematical resilience students met all mathematical communication skill indicators. However, 4 of them did not reach aspect complete and clear answer writing of a problem. Students with moderate mathematical resilience had not been able to write completely and clearly from a problem. One of them could reach all of the indicators and two others could express the mathematics ideas through writing and drawing visually. Students with low mathematical resilience only could express mathematics ideas through writing and could draw them visually. Although there were 3 persons achieving 2 aspects, expressing mathematics ideas through writing and drawing it visually, when it was seen from their skill to transform the questions into figures and other representations and to state daily events into their own language or mathematics symbols, the symbols had been appropriately used.

The experimental group II students were given mathematical resilience questionnaire to group them into high, moderate, and low categories. Here is the result of the questionnaire from 34 students in experimental group I, as shown in Table 2.

Table 2. Result of Mathematical Resilience Categorization of Experimental Group II

Categories	Numbers of Students
High	10
Moderate	16
Low	8

The findings showed that description of mathematical communication skill reviewed from mathematical resilience of the students were varied. It was shown from 10 high mathematical resilience students consisted of 8 high mathematical communication skill students and 2 moderate skill students. From 16 students with moderate mathematical resilience, there were 1 high mathematical communication skilled student, 13 moderate skilled students, and 2 low skilled students. From 8 low mathematical resilience students, there were 3 moderate mathematical communication skilled students and 5 low skilleds students.

The impacts of discovery learning assisted by e-learning resulted to various mathematical communication skill. The high mathematical resilience students met all mathematical communication skill indicators. Howeer, 2 of them did not reach complete and clear answer writing indicator of a problem. Students with moderate mathematical resilience had not been able to write completely and clearly from a problem. One of them could reach all of the indicators and two others could express the mathematics ideas through writing and drawing visually. Students with low mathematical resilience only could express mathematics ideas through writing and could draw them visually. Although there were 3 persons achieving 2

aspects, expressing mathematics ideas through writing and drawing it visually, when it was seen from their skill to transform the questions into figures and other representations and to state daily events into their own language or mathematics symbols, the symbols had been appropriately used.

The result of mathematical communication skill and mathematical resilience of both experimental groups showed students with high mathematical resilience would not always have higher score of mathematical communication skill. However, there were several students with high mathematical resilience category with high and moderate mathematical communication skill. It was due to the given learning could stimulate the students to learn. It was supported by Kurnia (2018) stated that having good mathematical resilience would lead to better mathematical communication skill. Gurefe (2018) stated that students with high mathematical resilience recognized their skills. They could handle problems and could improve their problem solving skill. It is supported by Zanthy (2018) stated that low mathematical resilience could be a burden in students' lives. Thus, they treated as threat and made them frustrated. They tended to ignore and passively face the challenges in learning. Besides that, Dilla (2015) stated that students with low mathematical resilience tended to work without any modification. They even did not finish it until the last process because they were afraid to have mistakes and they were not interested in answering the questions well.

CONCLUSION

Based on the discussion, it could be concluded that independent learning and discovery learning assisted by e-learning was effective. There was no difference mathematical communication skill between independent learning assisted by module and discovery learning assisted by e-learning on average. The descriptions of the skill seen from mathematical resilience were varied. It meant independent learning assisted by module and discovery learning assisted by e-learning variously influenced mathematical communication skill.

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