Mathematical Literacy Reviewed from Student's Independence in the Treffinger Realistic Learning with Sevima Edlink Assisted Diagnostic Assessment

Laras Wahyuningrum*
Mathematics and Science Faculty
Master in Mathematics Education
Postgraduate Semarang State University
Email:laraswahyuningrums@gmail.com

Masrukan**
Mathematics and Science Faculty
Master in Mathematics Education
Postgraduate Semarang State University
Email: masrukan.mat@mail.unnes.ac.id

Wardono***
Mathematics and Science Faculty
Master in Mathematics Education
Postgraduate Semarang State University
Email: wardono@mail.unnes.ac.id

Abstract

This study aims to describing in the learning of mathematics literacy skills in the treffinger realistic learning with sevima edlink assisted diagnostic assessment reviewed from student's independence. This type of research is qualitative. The data collection technique by using tests, observation, documentation, and interviews. This research subject is class VIII SMP Negeri 36 Semarang.
Based on the results of the analysis, it was found that subjects with high learning independence were able to meet all indicators of mathematical literacy. Meanwhile, subjects with middle learning independence are unable to meet the indicators of reasoning and argument and using symbolic, formal, and technical language and operations. Furthermore, subjects with low learning independence were able to meet indicators of communication, using symbolic, formal and technical language and operations, and using mathematics tools.

Keywords: Mathematics Literacy, Student's Independence, Treffinger Realistic, Diagnostic Assessment, and Sevima Edlink

1.0 Introduction

The demands of students' abilities in mathematics do not only have the ability to count, but also the ability to think logically, critically and systematically in problem solving (Muzaki, 2019). Mathematical literacy can help individuals to recognize the role of mathematics in the real world (Novalia & Rochmad, 2017). This kind of mathematical ability is referred to as mathematical literacy ability because someone who has mathematical literacy skills does not only understand mathematics but is also able to use it in solving daily problems (Muzaki, 2019). However, the importance of mathematical literacy is apparently not in line with the achievements of Indonesian students at the international level where from the 2015 PISA results it can be seen that the ability of students in Indonesia is still relatively low (Astuti & Fahinu, 2018).

In Indonesia, there are still many students who only depend on the resources provided by the teacher (Kadir, Permana and Qalby, 2020). Learning independence is the ability of a student independently in exploring learning information from learning sources other than the teacher (Nugraha, Akbar and Bernard, 2015). One factor that needs attention in increasing learning achievement is learning independence (Ningsih, 2016). Students need to have a cognitive attitude that plays a role in efforts to develop students' thinking processes in solving mathematical problems by having reasoning abilities (Nugraha, Akbar and Bernard, 2015). Students who have learning independence will tend not to depend on others and take more initiative to solve the problems they face themselves and tend to try their best to get high learning achievements, according to their expectations (Ningsih, 2016).

Realistic treffinger learning is one of the learning models that develops mathematics learning outcomes consisting of three stages, namely, basic tools, training with processes, and working with real problem stages (Ndiung, 2020). Thus, learning with a realistic treffinger model is expected to be able to improve students' mathematical problem solving abilities (Ningsih, 2016).

Assessment is an integral part of the learning process (Popham, 2018). Sitiatava (2012: 116) states a diagnostic test, this test is carried out to determine precisely, the type of difficulty encountered in the form of certain actions or movements. Diagnostic tests can be used as a first step to find out students' mistakes and learning difficulties. Sion & Jingan (2008: 4) state that a diagnostic test is a test that provides information to teachers about students' initial abilities and misconceptions before starting learning activities.

In the future, there will definitely be changes in the world of education, one of which is face-to-face learning which is limited. This can be done by implementing Learning Management Systems in schools. LMS provides many benefits for the educational process with the main characteristic of not having physical meetings (Aldiab et al., 2019). The emergence of e-learning solutions has brought technological possibilities in bridging the gap between student and student; students and instructors through virtual communication (Bervell and Umar, 2020). LMS provides new knowledge to improve and even design new e-learning techniques and methodologies (Cantablella et al., 2019). However, the benefits of physical presence provided through face-to-face are still the preferred media, therefore it needs to be enhanced with an online component so that the world of education needs to prioritize online learning modes (Bervell and Umar, 2020).

Accordingly, the researcher conducted a study of mathematics literacy skills in the treffinger realistic learning with sevima edlink assisted diagnostic assessment reviewed from student's independence.

1.1 Research Problem

The problem in this study are that: (1) student's learning independence is still low, (2) the learning process has not been able to foster the student's learning independence, and (3) there is no assessment as a solution to overcome students' low mathematical abilities.

1.2 Objectives of the Study

This study aims to find patterns in the learning of mathematics literacy skills in the treffinger realistic learning with sevima edlink assisted diagnostic assessment reviewed from student's independence.

2. Review of Related Theories

This study includes several relevant theoretical studi that are used as the theoretical foundations, namely: (1) mathematics literacy, (2) learning independence, (3) the relation between mathematics literacy and learning independence, (4) diagnostic assessment, (5) the relation between mathematics literacy, learning independence, and diagnostic assessment.

2.1 Mathematics Literacy

In general, mathematical literacy is the knowledge to know and apply basic mathematics in daily life (Ojose, 2011). In contrast to Ojose, mathematical literacy is a social change from the process of developing awareness to changing parts of reality and pursuing a different reality (White & Joyakarta, 2017). According to Setiawan in Jumarniati, et al (2016), mathematical literacy is defined as a person's ability to formulate, apply, and translate mathematics in various contexts, including the ability to reason mathematically and use concepts, procedures, and facts to describe, explain, or economic phenomena. /incident.

2.2 Learning Independence

Kozma, et al in Sundayana, (2019) states that independent learning is a learning process in which each individual can take the initiative, with or without the help of others, in terms of diagnosing learning needs, formulating learning objectives, identifying learning resources, choosing and apply appropriate learning strategies for themselves, as well as evaluate their learning outcomes. In this case it can be interpreted that students who have independent character will always study well, solve questions well and not depend on other people and be responsible for themselves as individuals and as members of a team. Independence is very important for students to be successful in learning mathematics (Yates, 2002).

2.3 Relation between Mathematics Literacy and Independence Learning

PISA 2012 in (Pakpahan, 2017) states that identity, socio-economic and cultural conditions, ownership of computers and books are the main factors that influence the achievement of mathematical literacy. This is in line with the opinion (Mahdiansyah & Rahmawati, 2014) that the factors that influence the achievement of mathematical literacy are personal factors, instructional factors, and environmental factors. One example of the personal factors of students is their interest in learning independently. The independence of student learning is something that is very important and needs to be developed in students as students.

2.4 Diagnostic Assessment

Masrukan (2014) states that assessment is a systematic procedure with the aim of gathering information about the characteristics of people or objects. According to Geller & Yovanoff (2009), to bridge the identification of students who are at risk of failure and the implementation of additional interventions in learning that have been designed with days, a diagnosis is needed that can provide information about student misconceptions in a particular material (Mussawy, 2009). Teachers can use diagnostic assessments to gather information about student needs to plan lessons. Based on some of the opinions above, it can be said that the weaknesses and difficulties of student learning about a material being studied can be identified with a diagnosis so that the teacher can plan further learning according to the needs of each student using a diagnostic assessment.

2.5 The Relation between Mathematics Literacy, Learning Independence, and Diagnostic Assessment

Diagnostic assessment is a form of assessment that emphasizes healing learning difficulties that cannot be overcome by formative assessment (Sukardi, 2009). According to Rababah & Alghazo (2016), diagnostic assessment helps teachers to organize learning that can accommodate students with different needs and abilities. In addition, diagnostic assessments also assist teachers in using different learning tools to achieve learning goals. These benefits can be obtained because the diagnostic assessment provides information about students' knowledge and misconceptions about the concepts in relevant previous material and the material being studied (Geller & Yovanoff, 2009).

A diagnostic assessment is carried out at the end of each meeting to test students' understanding of the material being studied. The diagnostic test questions given are in the form of individual description questions. Each question contains a component of mathematical literacy to examine students' abilities and weaknesses in relation to mathematical literacy.

3. Research Method

This study is a qualitative research. The subjects in this study were VIII grade students of SMP Negeri 36 Semarang. The subjects were selected using purposive sampling technique. They were selected from three categories of learning independence, there is high learnig independence, middle learning independence, and low learning independence. The instrument in this study were

learning independence scale, mathematics literacy test, and interview. The data were collected by the documentation in the form of photos during research, questionnaire in the form of a student learning independence scale, the test in the form of students' mathematics literacy test result, and the interviews with the students.

4. Discussion

Based on the results of the learning independence scale, the subject with categories of high learning independence, middle learning independence, and low learning independence were shown in table 4.1.

Table 4.1 The Categories of the Students' Learning Independence

Category Learning Independence	Frequency	Range
Low	4	$N \leq 12$
Mid	15	$12 < N \leq 30$
High	12	$30 < N \leq 48$

Based on table 4.1, there are 4 students with low learning independence, 15 students with middle learning independence, and 12 students with high learning independence. The average score of students' learning independence is 29.20 with standard deviation of 11.22. Thus, the score range is less than 12 for the subjects with low learning independence, the range is more than 12 and less than or equal to 30 for the subjects with middle learning independence, and the range is more than 30 for subjects with high learning independence.

From the students' learning independence categories , 6 students were chosen consisting of 2 students with high learning independence, 2 students with middle learning independence, and 2 students with low learning independence. The high subjects are the ones with codes E-5 and E-30, middle subjects are ones with codes E-2 and E-11, and low subjects are ones with codes E-10 and E-12.

Based on the results of the interviews and mathematical literacy test, the results and discussion were obtained and defined in the seven stages of mathematical literacy as follows. In the communication stage, the indicator is that the students are able to understand and recognize the problems in the questions. At this stage, subjects with high, middle, and low learning independence categories did not face significant difficulties in recognizing and formulating problems in questions. In the mathematising stage, the indicator is that the students are able to change a real-world problem in the problem into its mathematical form. At this stage, subjects with high and middle learning independence categories also did not face difficulties. The subjects can change real-world problems into their mathematical form by replacing what is known in the problem with the mathematical variables. It can be seen from the subject's answer in Figure 4.1 below

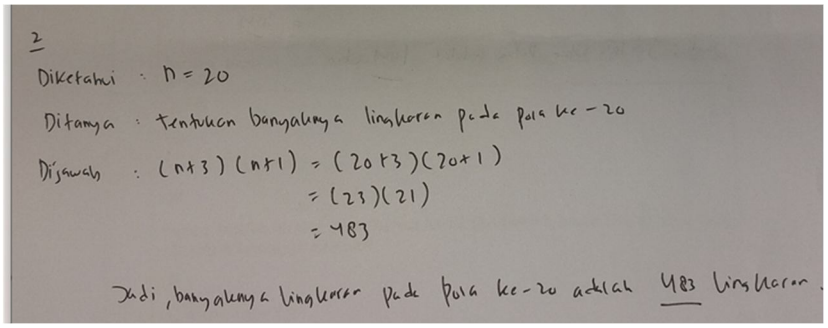

Figure 4.1 Work Result of E-5 Subject

Based on the results of E-5's work, the research subjects understood the intent of the problem so they were able to make a mathematical model of problem number 2 correctly. In addition, subject E-5 is able to change the shape of the mathematical model back into the original problem in the conclusion section. Meanwhile, subjects with low learning independence is do not understand the intent of the problem so they have not been able to make a mathematical model of problem number 2. Even though what is known in subject matter E-10 writes it down correctly.

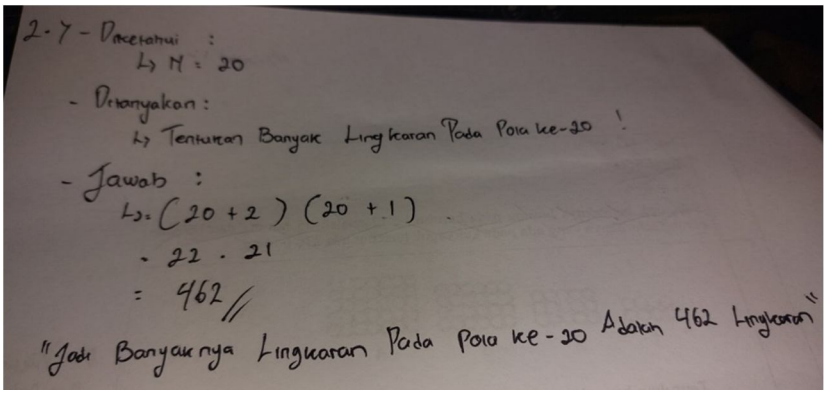

Figure 4.2 Work Result of E-10 Subject

In the reasoning and argument stage, the indicator is that the students are able to reason in solving problems and conclude and check the truth of all their findings. At this stage, only subjects with high learning independence are able to meet the reasoning and argument indicators. Subjects with middle learning independence were only able to reason in solving problems and providing conclusions but did not re-examine the truth of all their findings. Meanwhile, subjects with low learning independence are unable to reason in solving the problems. They had a tendency of not understanding the steps in working on the problems. It is proved by the results of interviews with subjects E-10 in Table 4.1 below.

Table 4.1 Interview Result with E-10

P	Why don't you answer and give a conclusion on question number 1?
E-10	I don't know the answer Ma'am, so I can't conclude the solution to problem number 1.

Based on the excerpts of the interview, subject E-10 is less able to reason and make good conclusions.

In the stage of devising strategies for solving problems, the indicator is that the students are able to explain strategies in solving problems and solving the problems with the correct procedure and can choose a good strategy in solving the problems. At this stage, the subjects with high learning independence are able to explain the strategies in solving problems in questions well. They can also explain the steps in answering the problem with the correct procedure. Meanwhile, the subjects with middle learning independence can only explain the steps in working on the problem but cannot determine and explain the strategy in obtaining the answer. Furthermore, subjects with low learning independence were not able to complete the explanation until the end of the problem solving. In the stage of using symbolic, formal, and technical language and operations, the indicator is that students can use mathematical models in solving problems. At this stage, subjects with high learning independence were able to describe the use of mathematical models in solving problems in problems very well. However, when the researcher re-confirmed, the subject realized his mistake and was able to explain the error well. Similarly, subjects with middle and low learning independence categories were also able to explain and write well the use of mathematical models in the problems in the problem although the explanation was still incomplete. In the stage of using mathematics tools, the indicator is that students use mathematical tools such as rulers. At this stage, a subject with high learning independence used a mathematical tool in the form of a ruler to make rectangle shapes. Meanwhile, the subjects with middle and low learning independence did not use any mathematical tools. Based on the description above, each subject is based on the category, has different achievement indicators. The following is the summary in Table 4.2 which represents students' mathematical literacy which is viewed as based on high learning independence, middle learning independence, and low learning independence.

Table 4.2 Summary of Students' Mathematics Literacy of Learning Independence

Mathematics Literacy Indicators	Category Learning Independence		
	High	**Mid**	**Low**
Communication	Fulfilled	Fulfilled	Fulfilled
Mathematising	Fulfilled	Fulfilled	Unfulfilled
Representation	Fulfilled	Fulfilled	Unfulfilled
Reasoning and argument	Fulfilled	Unfulfilled	Unfulfilled
Devising strategies for solving problems	Fulfilled	Fulfilled	Unfulfilled
Using symbolic, formal, and technical language and operations	Fulfilled	Unfulfilled	Fulfilled
Using mathematics tools	Fulfilled	Fulfilled	Fulfilled

A diagnostic assessment is carried out at the end of each meeting to test students' understanding of the material being studied. The diagnostic test questions given are in the form of individual essay questions. Each question contains a component of mathematical literacy to examine students' abilities and weaknesses in relation to mathematical literacy. According to Khaerunisak (2017) and Suwarto (2013b), a diagnostic assessment is given to determine students' strengths and weaknesses in learning so that learning can be improved and learning objectives can be achieved. Setiawan et al (2018) also argue that a diagnostic test can help identify parts of the material being studied which are specific student weaknesses and the causes of students' weaknesses in the material.

The results of the diagnostic assessment at each meeting were different. In general, students with low and middle independence experience difficulties in making representations and reasoning to associate problems with the mathematical concepts they have learned, while students with high independence are sometimes less thorough in carrying out certain mathematical operations. The results of the diagnostic test require the teacher to follow up to improve understanding and overcome students' difficulties in working on mathematical literacy questions.

The follow-up is to provide remedial for students who have not answered the diagnostic test questions correctly through peer tutors.

The benefits of the diagnostic assessment and its follow-up are felt through the results of student research on the final test of students' mathematical literacy abilities that meet learning completeness.

5. Conclusions

Based on the results of the analysis mathematics literacy skills in the treffinger realistic learning with sevima edlink assisted diagnostic assessment reviewed from student's independence, it can be concluded as follows: (1) students with high learning independence are abel to meet all indicators of mathematical literacy, (2) students with middle learning independence are unable to meet the indicators of reasoning and argument and using symbolic, formal, and technical language and operations, (3) students with low learning independence are able to meet indicators of communication, using symbolic, formal and technical language and operations, and using mathematics tools, (4) students with low and moderate independence on diagnostic test experience difficulties in making representations and reasoning to associate problems with the mathematical concepts they have learned, (5) students with high independence on diagnostic test are sometimes less thorough in carrying out certain mathematical operations.

6. References

Aldiab, A. *et al.* (2019). Utilization of Learning Management Systems (LMSs) in higher education system: A case review for Saudi Arabia, *Energy Procedia*, 160(2018), 731–737. https://doi: 10.1016/j.egypro.2019.02.186.

Astuti, N.K., Fahinu, Masuha, J. (2018). Analisis Kemampuan Literasi Matematika Siswa Kelas VIII SMP Swasta di Kota Kendari. 6(1), 99–112.

Bervell, B. dan Umar, I. N. (2020). Blended learning or face-to-face? Does Tutor anxiety prevent the adoption of Learning Management Systems for distance education in Ghana?, *Open Learning*, 35(2), 159–177. https://doi: 10.1080/02680513.2018.1548964.

Cantabella, M. *et al.* (2019). Analysis of student behavior in learning management systems through a Big Data framework. *Future Generation Computer Systems*, 90, 262–272. https://doi: 10.1016/j.future.2018.08.003.

Geller, Y. & (2009). Diagnostic Assessments in Mathematics to Support Instructional Decision Making, *October*, 14(16).

Jumarniati, Pasandaran, R. F. & Riady, A. (2016). Kemampuan literasi matematika dalam menyelesaikan masalah turunan fungsi trigonometri. *Jurnal Pedagogy*, 1(2), 66–75. https://www.journal.uncp.ac.id/index.php/Pedagogy/article/view/357.

Kadir, F., Permana, I. & Qalby, N. (2020). KEMANDIRIAN BELAJAR TERHADAP HASIL BELAJAR MATEMATIKA DI SMKN 1 CIHAMPELAS. *Karst : JURNAL PENDIDIKAN FISIKA DAN TERAPANNYA*, 3(1), 91–95. https://doi: 10.46918/karst.v3i1.538.

Khaerunisak, K. *et al.* (2017). The Analysis of Diagnostic Assesment Result in Pisa Mathematical Literacy Based on Students Self-Efficacy in Rme Learning. *Infinity Journal*, 6(1), 77. https://doi: 10.22460/infinity.v6i1.236.

Mahdiansyah & Ramawati. (2014). Literasi Matematika Siswa Pendidikan Menengah: Analisis Menggunakan Desain Tes Internasional dengan Konteks Indonesia. *Jurnal Pendidikan dan Kebudayaan*, 20(4), 452. https://doi: 10.24832/jpnk.v20i4.158.

Masrukan. 2014. *Assesment Otentik Pembelajaran Matematika.* Semarang: CV. Swadaya Manunggal.

Mussawy, J. A. S. (2009). Assessment Practices : Student ' s and Teachers ' Perceptions of Classroom Assessment, *Center for International Education*. 1–115. Kreatif-Inovatif. 7(1), 31-40. DOI: 10.15294/kreano.v7i1.5049

Muzaki, A. (2019). Analisis Kemampuan Literasi Matematis Siswa Mosharafa : Jurnal Pendidikan Matematika Program for International Student (Organisation for Economic Cooperation Mosharafa : Jurnal Pendidikan Matematika, *Mosharofa*, 8(September). 493–502. http://journal.institutpendidikan.ac.id/index.php/mosharafa.

Ndiung, S. (2020). The Treffinger Learning Model with RME Principles on Mathematics Learning Outcome by Considering Numerical Ability. 422(Icope 2019). 7–13. https://doi: 10.2991/assehr.k.200323.080.

Ningsih, R. (2016). PENGARUH KEMANDIRIAN BELAJAR DAN PERHATIAN ORANG TUA TERHADAP PRESTASI BELAJAR MATEMATIKA. 6(1). 73–84.

Novalia, E. & Rochmad. (2017). Analisis Kemampuan Literasi Matematika dan Karakter Kreatif pada Pembelajaran Synectics Materi Bangun Ruang Kelas Viii. *Unnes Journal of Mathematics Education Research*, 6(2). 225–232.

Nugraha, Y., Akbar, P. & Bernard, M. (2015). Pengaruh kemandirian belajar siswa smp terhadap kemampuan penalaran matematis, 01(02). 288–296.

Ojose, B. (2011). Mathematics literacy : are we able to put the mathematics we learn into everyday use?. *Journal of Mathematics Education*, 4(1). 89–100.

Pakpahan, R. (2017). Faktor-Faktor Yang Memengaruhi Capaian Literasi Matematika Siswa Indonesia Dalam Pisa 2012. *Jurnal Pendidikan dan Kebudayaan*, 1(3). 331. https://doi: 10.24832/jpnk.v1i3.496.

Popham, J. W. (2018). *Classroom Assessment : What Teachers Need to Know*. Pearson.

Rababah, A. & Alghazo, Y. (2016). Diagnostic Assessment and Mathematical Difficulties: An Experimental Study of Dyscalculia. *Open Journal of Social Sciences*, 04(06). 45–52. doi: 10.4236/jss.2016.46005.

Setyawan, A., & Sukestiyarno, S. (2018). Metacognition Development Through Stad Learning Assisted With Module by Using Diagnostic Assessment to Improve The Problem Solving Ability. *Unnes Journal of Mathematics Education Research*, *7*(1), 167-173. Retrieved from https://journal.unnes.ac.id/sju/index.php/ujmer/article/view/26020

Sion, H. H. & Janidi J., 2008. Diagnostic assessment in three (3) core subjects for primary and secondary education (mathematics, english language and science): Hands-on workshop for government primary and secondary I and II (year 7 & year 8) teachers Negara Brunei Darussalam. A Concept Paper. *Department of Human Resource Development Department of Planning, Development and Research Ministry of Education.*

Sitiatava, R. Desain Evaluasi Belajar Berbasis Kinerja. Jogjakarta: DIVA Press.

Sukardi, H.M. 2009. *Evaluasi Pendidikan: Prinsip & Operasionalnya.* Jakarta: PT. Bumi Aksara.

Sundayana, R. (2019). Perbandingan Desain Pembelajaran ASSURE dan PPSI untuk Meningkatkan Kemampuan Pemecahan Masalah Matematis dan Kemandirian Belajar. *Mosharafa: Jurnal Pendidikan Matematika*, 8(1). 143–154. doi: 10.31980/mosharafa.v8i1.420.

Suwarto. 2013. *Pengembangan Tes Diagnostik Dalam Pembelajaran.* Yogyakarta: Pustaka Pelajar.

White, A. L. and Joyakarta, S. (2017). Mathematics Literacy : An Australian Perspective And Experience. *Sothest Asian Mathematics Education Journal*, 7(1). 33–42.

Yates, S. M. (2002). The Influence of optimism and pessimism on the psycho-physical wellness of learners in grades', *Mathematics Education Research Journal*, 14(1). 4–15. https://dspace.nwu.ac.za/bitstream/handle/10394/2412/radebe_sj.pdf?sequence=1.