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Students' Mathematical Literacy Viewed from Self-Renewal Capacity and Gender in Project Based Learning Assisted by GeoGebra

Fatkhiya An-Nisa Raharani[1]✉, Iwan Junaedi, Nuriana Rachmani Dewi (Nino Adhi)

UNNES, Semarang, Indonesia

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Abstract

Factors that influence students' Mathematical Literacy (ML) can be caused by Self-Renewal Capacity (SRC) and gender. This research aims to determine the quality of the implementation of the GeoGebra-assisted Project Based Learning (PjBL) model on ML and to obtain a description of students' ML in terms of SRC and gender in the GeoGebra-assisted PjBL model. This research is mixed research with a sequential explanatory model starting with a quantitative method to test the effectiveness of the PjBL model assisted by GeoGebra and a qualitative method to describe ML in terms of SRC and gender. The techniques used are the ML test, SRC scale, interviews, documentation, and triangulation. The population of this research is all students in class IX of SMP Negeri 9 Semarang for the 2023/2024 academic year with samples of classes IX F and IX G. The results are, (1) GeoGebra-assisted PjBL is of good quality for ML (2) students' MLis viewed from the SRC in the model GeoGebra-assisted PjBL is divided into three categories. Students with high SRC generally have good mathematical literacy because they are able to master the seven indicators well. Students with moderate SRC generally tend to have fairly good mathematical literacy because they are able to master three to seven indicators well. Meanwhile, students with low SRC generally tend to have less ML because they only master two to five indicators well. (3) Male and female students get high scores on the communication indicator, while male and female students tend to score low on representation. Female students outperform male students on four indicators, namely mathematising, representation, reasoning and argument, and devising strategies for solving problems. Meanwhile, both of them have been able to meet the communication indicators; using symbolic, formal, and technical language, and operations; using mathematical tools. Based on the research results, it was found that male students had lower scores on the indicators of reasoning and argumentation and devising strategies due to less motivation, interest and participation, so further research and the development of effective teaching strategies to accommodate gender differences are needed. and other individual factors. Apart from that, low ML in students needs to be guided more intensively and given varied and challenging exercises, for example through questions such as PISA.

✉Correspondence Address:
UNNES, Semarang, Indonesia
E-mail: raharanifatkhiya@gmail.com

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INTRODUCTION

Mathematical literacy is defined as a student's capacity to recognize and understand the role of mathematics in the world, solve mathematical problems in various contexts, interpret mathematical statements, and apply mathematics rationally (OECD, 2016). From the results of the last assessment in 2022, Indonesian students' mathematics ability received a score of 366 which is in 68th position out of 81 countries (OECD, 2023). Observation results at SMP Negeri 9 Semarang stated that students' mathematical literacy was in the low category with an average of 65,2. Of the 7 indicators of mathematical literacy, students are still weak in 4 indicators, namely mathematising, representation, reasoning and argument and using mathematical tools. The low level of mathematical literacy of students must be carefully considered because this ability has an important role (Isnaniah et al., 2021; Risywandha & Khabibah, 2018; Yudiawati et al., 2021).

Mathematical literacy is related to understanding mathematical activities, the use of mathematical knowledge and abilities, reasoning, and language to solve problems. under various circumstances and needs (Abidin, 2017). In improving mathematical literacy skills, teachers can implement learning models that adhere to constructivist learning theory. One model that can be applied is Project Based Learning (PjBL). PjBL is a project-based learning model where students can collaborate to solve real problems to achieve meaningful learning. Application Project Based Learning pada mathematics learning considered effective in improving students' mathematical literacy skills (Asmara & Wardono, 2019). This is also in line with research conducted by Wicaksana et al (2017) obtained that result assisted project-based learning Schoology towards mathematical literacy skills are of good quality.

Considering the importance of students' mathematical literacy skills, learning mathematics requires supporting abilities, one of which is Self-Renewal Capacity. Students need to explore and develop the capacity to renew themselves so that they will continue to progress, always explore, and also assimilate and accommodate the cognitive structure of the information obtained (Suryana, 2016). Therefore, Self-Renewal Capacity has an effect on increasing students' abilities (Ula & Dewi, 2021).

Besides Self-Renewal Capacity, In understanding mathematical literacy, there is a difference in the understanding of abilities between men and women (Awalyah et al., 2022). These gender differences can influence students' mathematical literacy levels (Isnaniah et al., 2021; Kamila, 2018; Laksari et al., 2023; Setiawan et al., 2019). Risywandha & Khabibah (2018) explains that gender differences cause physiological and psychological differences in learning so that male and female students have differences in learning mathematics.

No less important in learning practices in the 21st century, ICT is seen as a supportive tool for improving teaching and learning. One of the applications which can be used to support learning, especially in content space and shape is GeoGebra. The use of GeoGebra in mathematics learning provides benefits for students so that it has an effect on increasing their understanding of concepts and solving problems mathematically, this of course affects mathematical literacy as well (Adelabu et al., 2022; Fauzy et al., 2023; Mukarramah et al., 2022; Riska et al., 2023).

From the description above, the aims of this research are to (1) knowing the quality of the implementation of the Project Based Learning model assisted by GeoGebra on students' mathematical literacy abilities, (2) obtained a description of students' mathematical literacy abilities in terms of Self-Renewal Capacity in the Project Based Learning model assisted by GeoGebra, (3) obtained a description of students' mathematical literacy abilities in terms of gender in the Project Based Learning model assisted by GeoGebra.

METHOD

This research is implementing a mixed method with Model sequential explanatory.

Quantitative methods are used to test the effectiveness of using learning models Project Based Learning assisted by GeoGebra. The quantitative research design used is quasi experimental design with shape nonequivalent control group design. Qualitative methods are used to describe students' mathematical literacy in terms of Self-Renewal Capacity and gender on the model Project based Learning assisted by GeoGebra.

The population of this research is all class IX students of SMP Negeri 9 Semarang for the 2023/2024 academic year. Sampling in this research used techniques cluster sampling (area sampling). This technique is carried out by taking random samples which are not individuals but groups of units. The sample of class IX F was 33 students as the control class and IXG was 34 students as the experimental class. Research subjects were taken from the experimental class. The selection of research subjects is based on technique purposive/purposeful sampling, which means selecting subjects based on certain considerations, namely 34 with 14 male and 20 female.

In this research, the data collection techniques used were tests, psychological scales, interviews and documentation. The data analysis technique begins with instrument analysis. Instrument analysis includes validity tests, reliability tests, distinguishing power, and difficulty levels. Then data analysis of mathematical literacy skills was carried out using the normality test, homogeneity test, similarity test of two means, thoroughness test, test of difference of two means. independent, proportion difference test, paired average difference test, and test N-Gain. Next, carry out the process of reducing data, presenting data, and drawing conclusions for qualitative data analysis.

RESULTS AND DISCUSSIONS

Learning quality includes three stages, namely the planning stage, implementation stage and evaluation stage. In this research, the analysis of learning planning is based on the results of validation by expert validators which include validation of the syllabus, learning implementation plan, student project worksheet, and mathematical literacy test. Results of the planning assessment Project Based Learning assisted by GeoGebra presented in Table 1 below.

Table 1. Planning Stage Assessment Results

Instrument	Validator	Mark	Average	Information
Syllabus	V1	85%		Worth using
	V2	89%	90%	
	V3	96%		
Learning Implementation Plan	V1	85%		Proper to use
	V2	92%	91,3%	
	V3	97%		
Student Worksheet	V1	75%		Proper to use
	V2	90%	87,6%	
	V3	98%		
Mathematical Literacy Test	V1	86%		Proper to use
	V2	89%	91%	
	V3	98%		

At the planning stage, it can be seen from the scores obtained in the validation of learning tools, namely the syllabus, learning implementation plan, student worksheets, and mathematical literacy test. The respective scores were 90% for the syllabus, 91.3% for the learning implementation plan, 87.6% for the student worksheet, and 91% for the mathematical literacy test. These results show that the learning tool can be declared very valid and therefore suitable for use.

The next stage is the implementation of learning which is marked by the implementation of learning and student activity at least in the good category. Details of the results of observations of learning implementation and student activities can be seen in table 2 below.

Table 2. Results of Observations

Meeting	Activity	Implementability
1st meeting	92%	90%
2nd meeting	94.6 %	85 %
3rd meeting	96 %	87.5%
4th meeting	96%	92.5%
Average	94.65%	88.75%

From these results, student activity has an average of 94.65% which is included in the very good category, as well as learning implementation which has an average of 88.75% which is also included in the very good category. Based on this, it can be concluded that learning is implemented Project Based Learning GeoGebra assistance can be said to be very good or the teacher's ability to teach can also be categorized as very good.

The next stage is evaluation. Testing the research hypothesis on the effectiveness of the model is carried out by carrying out several quantitative tests. The first is a completeness test on the average of one sample which is carried out to show the average mathematical literacy of students in the model Project Based Learning with the help of GeoGebra, it has achieved more than the Actual Completion Limit, namely 65.3. Based on value posttest, the average mathematical literacy in the experimental class was 82.84. Obviously this value has reached BTA. Based on the t test, it is obtained $t_{count} > t_{table}$, namely 11.222>1.6924. Based on the test criteria, then H_0 rejected. So, the average mathematical literacy of students is at Project Based Learning assisted by GeoGebra reach Actual Completion Limit.

The second is the one-sided right proportion test which is carried out to find out whether students' mathematical literacy is good Project Based Learning with the help of GeoGebra has achieved classical completion or not. It can be said to have achieved classical completion if the proportion of students who have completed Actual Completion Limit is at least 75% of all students. Based on the value results posttest 33 of the 34 students have exceeded the Actual Completion Limit. Based on the Z test, it is obtained $With_{count} \geq With_{table}$, that is $3{,}018 \geq 1{,}645$ So it can be concluded that the proportion of students who achieve learning completeness in class in the model Project Based Learning with the help of GeoGebra to achieve classical completion.

Third is a test for the similarity of the average of two data independent which was carried out with the aim of finding out whether the average mathematical literacy test results of students in the experimental class were higher than the average mathematical literacy test results of students in the control class. The results obtained after carrying out the final mathematical literacy test, the experimental class was 82.84 while the control class was 76.95. Based on the t test, it is obtained $t_{count} > t_{table}$, that is $2{,}695 > 1{,}669$. Thus, is the average mathematical literacy test result of students in the experimental class higher than the average mathematical literacy test result of students in the control class or the average mathematical literacy test result of students in the learning class? Project Based Learning with the help of GeoGebra is more than

the average mathematical literacy of students in learning Discovery Learning.

Fourth is the equality test of two proportions which is carried out to see whether there are differences in the proportions of the classes using the model Project Based Learning assisted by GeoGebra and classes on learning Discovery Learning. Results posttest Mathematical literacy in the experimental class showed that 33 out of 34 students had exceeded the Actual Completion Limit, while in the control class, 28 out of 33 students had reached the Actual Completion Limit. Based on the z test, it is obtained $\text{With}_{\text{count}} > \text{With}_{\text{table}}$, that is $1{,}746 > 1{,}6924$. This value shows the proportion of class learning completeness given the model Project Based Learning with the help of GeoGebra is higher than the proportion of class learning completeness given the model Discovery Learning.

Finally, there is an improvement test to find out whether students' mathematical literacy has increased Project Based Learning with the help of GeoGebra, more than students receive learning Discovery Learning. First, identify whether there is a significant average difference between the results pretest nor posttest in both classes. The test results show that there is a significant average difference in learning outcomes before and after learning. By using test N-Gain, the next step is to calculate the magnitude of the increase in mathematical literacy. From the value calculation N-Gain the average value is obtained N-Gain (%) experimental class is 48.8% with the category quite effective in increasing mathematical literacy. Meanwhile, the average value N-Gain (%) the control class is in the less effective category, namely 29.3%. Therefore, it can be concluded that students' mathematical literacy has increased Project Based Learning with the help of GeoGebra, more than students receive learning Discovery Learning.

From the description above, the quality of implementation Project Based Learning assisted by GeoGebra towards students' mathematical literacy has fulfilled all indicators at the planning, implementation and evaluation stages.

Description of students' mathematical literacy in terms of self-renewal capacity (SRC) based on the results of the mathematical literacy test (MLT), interview results, and scale filling results self-renewal capacity. Based on scale filling self-renewal capacity, Students are divided into three categories, namely 5 students fall into the category of having self-renewal capacity High SRC: 25 students fall into the medium category, and 4 students fall into the low category. Based on the test and interview results, it shows that the participants are in the category self-renewal capacity (SRC) high is grouped into one mathematical literacy pattern. Students by category self-renewal capacity (SRC) are being grouped into seven mathematical literacy patterns. Students with Self-Renewal Capacity (SRC) low is divided into two patterns.

Students with Self-Renewal Capacity High students generally have good mathematical literacy because they are able to master the seven indicators well. Students with moderate Self-Renewal Capacity generally tend to have fairly good mathematical literacy because they are able to master three to seven indicators well. Meanwhile, students with low Self-Renewal Capacity generally tend to have less mathematical literacy because they only master two to five indicators well.

Students with high self-renewal capacity are able to achieve 7 indicators of mathematical literacy (LM), namely communication, mathematising, representation, reasoning and argument, devising strategies, using symbolic, formal and technical language, and operation, using mathematical tools. They have been able to read and interpret statements, questions and objects in a problem and can write down the information that is known completely and write down what is asked in the problem and communicate the results of the solution, change the problem from real to mathematical form or vice versa, restate a problem through activities of selecting, interpreting, translating, and using information, providing reasons that involve logical thinking to explore and connect problems to make reasonable conclusions, selecting or finding or planning strategies in using

mathematics to solve problems, understanding, interpreting, manipulating, and using mathematical symbols in problem solving, as well as using mathematical tools in mathematical activities.

Students with moderate self-renewal capacity are able to fulfill 3 to 7 mathematical literacy indicators. Students tend to be less able to change problems from real to mathematical form or vice versa, as well as choosing or finding or planning strategies for using mathematics to solve problems. However, he is good at reading and interpreting statements, questions and objects in a problem and can write down the information that is known and what is asked in the problem and then communicate the results of the solution well. In addition, students are able to provide reasons that involve logical thinking to explore and connect problems to make reasonable conclusions, as well as understand, interpret, manipulate and use mathematical symbols in problem solving. In addition, students can use mathematical tools in mathematical activities.

Students with low self-renewal capacity tend to meet 2 and 5 mathematical literacy indicators. Students in this category are able to read and interpret statements, questions and objects in a problem and can write down the information that is known completely and write down what is asked in the problem and communicate the results of the solution, as well as use mathematical tools in mathematical activities.

Descriptions of students' mathematical literacy based on gender were obtained from the results of the mathematical literacy test (MLT) and the results of interviews with research subjects. In one class, there are 14 male students and 20 female students. Quantitatively, the average for female students is higher than male students, namely 83.4 for female and 81.4 for male. When viewed from mathematical literacy patterns, male and female students have different patterns. Male students are grouped into 7 patterns. Meanwhile, female students are grouped into 8 patterns.

Both male and female students scored very high on ability communication, while male and female students tend to get low scores on ability representation. Research conducted by (Kadaritna et al., 2020) produces the same conclusion that the highest achievement for female and male students is in ability communication. Even though the lowest abilities of female and male students are at representation, different results were also found, namely female students scored much higher than male students who scored the lowest in all abilities. Female students outperform male students in four abilities, namely mathematising, representation, reasoning and argument, and devising strategies for solving problems. This is in accordance with the results of research conducted by (Suprapto et al., 2023). Female students excel in the ability to use symbols, formal language, techniques and use of operations, both in modeling and planning completion steps. Meanwhile, both of them have been able to fulfill their abilities communication, using symbolic, formal, and technical language, and operations; using mathematical tools (Mahiuddin et al., 2019).

CONCLUSION

Based on the analysis of the results of research conducted at SMP Negeri 9 Semarang regarding students' mathematical literacy in terms of Self-Renewal Capacity on the model Project Based Learning with the help of GeoGebra it was concluded that (1) Model implementation Project Based Learning GeoGebra's assistance to the mathematical literacy skills of good quality students (2) Students' mathematical literacy is viewed from Self-Renewal Capacity on the model Project Based Learning assisted by GeoGebra has a different pattern. Students with Self-Renewal Capacity High students generally have good mathematical literacy because they are able to master the seven indicators well. Students with Self-Renewal Capacity while in general they tend to have quite good mathematical literacy because they are able to master three to seven indicators well. While students with Self-Renewal Capacity

low levels generally tend to have less mathematical literacy because they only master two to five indicators well (3) Students' mathematical literacy is viewed from gender in the model Project Based Learning assisted by GeoGebra has a different pattern. Both male and female students scored very high on the indicator communication, while male and female students tend to get low scores on the indicator representation. Female students outperform male students on four indicators, namely mathematising, representation, reasoning and argument, and devising strategies for solving problems. Meanwhile, both of them have been able to meet the indicators communication, using symbolic, formal, and technical language, and operations; using mathematical tools. Based on the research results, it was found that male students had lower scores on the indicators reasoning and argumentation as well as devising strategies caused by lack of motivation, interest and participation, so further research and the development of effective teaching strategies are needed to accommodate gender differences and other individual factors. Apart from that, low LM students need to be guided more intensively and given varied and challenging training, for example through questions such as PISA.

REFERENCES

Abidin, Y. (2017). Pembelajaran Literasi. Bumi Aksara.

Adelabu, F. M., Marange, I. Y., & Alex, J. (2022). GeoGebra software to Teach and Learn Circle Geometry: Academic Achievement of Grade 11 Students. MATHEMATICS TEACHING RESEARCH JOURNAL 2 GOLDEN FALL, 14(3).

Asmara, M., & Wardono, W. (2019). Mathematical literacy ability on project based learning model with RME approach assisted by schoology. Unnes Journal of Mathematics Education, 8(2), 81–88.

Awalyah, S., Nuraida2, I., & Sunaryo3, Y. (2022). Kemampuan Literasi Matematis Siswa SMP Dilihat dari Prespektif Gender. In Jurnal Keguruan dan Ilmu Pendidikan) (Vol. 3, Issue 1).

Fauzy, A., Jaenal, E., Danny, F., Hidayat, W., Hendriana, H., Putra, H. D., Sugandi, A. I., Siliwangi, I., Terusan, J., Sudirman, J., Cimahi, J., & Barat, I. (2023). Bahan Ajar Berbantuan Geogebra dan Kemampuan Pemecahan Masalah Matematis: Design Research. Teorema: Teori Dan Riset Matematika, 8(2), 257–268.

Isnaniah, I., Imamuddin, M., Charles, C., Syahrul, S., & Zulmuqim, Z. (2021). Kemampuan Literasi Matematika Siswa Berdasarkan Gender. Lattice Journal : Journal of Mathematics Education and Applied, 1(2), 131.

Kadaritna, N., Rosidin, U., & Widyastuti, W. (2020). Mathematical Literacy Abilities: Study on Elementary and Junior High School Students in Lampung Tengah Regency in Term of Gender. Jurnal Pendidikan Progresif, 10(2), 162–172.

Kamila. (2018). Deskripsi Kemampuan Literasi Matematis Siswa Ditinjau dari Gender. Pedagogy, 3(1), 126–155.

Laksari, Z. O. D., Sridana, N., Tyaningsih, R. Y., & Hikmah, N. (2023). Analisis Kemampuan Literasi Matematis dalam Prespektif Gender Siswa SMP. Pendas:Jurnal Ilmiah Pendidikan Dasar, 8(2), 2272–2281.

Mahiuddin, W. P., Masi, L., Kadir, & Anggo, M. (2019). Analisis Kemampuan Literasi Matematis Siswa SMP Di Kabupaten Konawe Dalam Perspektif Gender. Jurnal Pendidikan Matematika, 10(1), 55–65.

Mukarramah, M., Edy, S., & Suryanti, S. (2022). Pengaruh Penggunaan Software Geogebra Terhadap Kemampuan Pemahaman Konsep dan Pemecahan Masalah matematika Peserta Didik SMP. JIPM (Jurnal Ilmiah Pendidikan Matematika), 11(1), 67.

PISA 2015 Results (Volume I): Excellence and Equity in Education | en | OECD. (n.d.). Retrieved July 21, 2023, from https://www.oecd.org/education/pisa-

2015-results-volume-i-9789264266490-en.htm

PISA 2022 Results (Volume I). (2023). OECD. https://doi.org/10.1787/53f23881-en

Riska, A., Gunur, B., Tamur, M., Hendrice Ramda, A., & keguruan dan, F. (2023). Pengaruh model pembelajaran problem solving berbantuan geogebra terhadap kemampuan pemecahan masalah matematika, 14(2).

Risywandha, I., & Khabibah, S. (2018). Literasi Matematika Siswa SMA Kelas X dalam Menyelesaikan Soal Model PISA dirinjau dari Perbedaan Gender. Jurnal Ilmiah Pendidikan Matematika, 2(7).

Setiawan, A., Inganah, S., Ummah, S. K., & Malang, U. M. (2019). Analisis Kemampuan Literasi Matematis Siswa dalam Penyelesaian Soal PISA Ditinjau dari Gender. Jurnal Karya Pendidikan Matematika, 6.

Suprapto, E., Suryani, N., Siswandari, & Mardiyana. (2023). Students' mathematical literacy skill in term of gender differences: A comparative study. International Journal of Evaluation and Research in Education, 12(4), 2280–2285.

Suryana, A. (2016). MENINGKATKAN ADVANCED MATHEMATICAL THINKING DAN SELF-RENEWAL CAPACITY MAHASISWA MELALUI PEMBELAJARAN MODEL PACE. http://repository.upi.edu

Ula, N. A., & Dewi, N. R. (2021). Mathematical representation ability of class VII students on ARIAS learning model viewed from self-renewal capacity. Unnes Journal of Mathematics Education, 10(2), 107–113.

Wicaksana, Y., Ridlo, S., Padma Boulevard Selatan Blok, J. F., & Padma, G. (2017). Unnes Journal of Mathematics Education Research Analisis Kemampuan Literasi Matematika dan Karakter Rasa Ingin Tahu Siswa pada Pembelajaran Berbasis Proyek Berbantuan Schoology. UJMER, 6(2), 167–174.

Yudiawati, N., Kusmayati, Trisaputri, F., & Sari, N. M. (2021). Analisis Kemampuan Literasi Matematik dan Kemampuan Pemecahan Masalah Siswa Ditinjau Berdasarkan Gender Melalui Pembelajaran Reciprocal Teaching. Pasundan Journal of Mathematics Education, 11(1), 65–77.