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The Effectiveness of *Problem-Based Learning* At Primary Schools Toward The Mathematics Literacy Skills Reviewed From The Learning Styles And *Genders*

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Abstract

This research aims to find out how male and female learners' mathematics literacy skills with visual, auditory, and kinesthetic learning styles are. The applied research method was a mixed method. The applied strategy was a sequential explanatory. The population of this research consisted of the fifth graders of 023 Pekkabata Public Primary School in the academic year of 2019/2020. The applied sampling technique was purposive sampling. The sample was taken from one class. It was the Melati V class. The findings showed that (1) the learning applied by the problem-based learning model was effective toward the learners' mathematics literacy skills; (2) both male and female learners with visual learning styles met the seven indicators of mathematics literacy. They almost mastered all indicators. However, for male and female learners with auditory and kinesthetic learning style could not meet all mathematics literacy skill indicators but only several of the indicators.

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INTRODUCTION

Mathematic literacy is an individual skill to formulate, apply, and interpret mathematics in various contexts. It includes the reasoning skill and the utilization of concept, procedure, and fact as tools to describe, explain, and predict a certain phenomenon or event (OECD, 2010).

Mathematic literacy skills is an important topic to be reviewed in various countries. Ozgen (2013) reviewed the learners' mathematics literacy skills in Turkey and the skill correlation to the real world. The findings showed that mathematic literacy concepts were correlated and complemented the real world. Then, Sandstrom *et al* (2013) conducted a research about the learners' mathematics masteries in Sweden toward the mathematic literacy skills. The research found that learners still had difficulties to complete the mathematics tasks that had numbers and essay.

Babys (2016) found that the sample learners' mathematics literacy achievements had a low level although the questions had been adjusted with the Indonesian context. The influential factors were such as the learners' habits in solving the mathematics problems, the learners' lack of experience in promoting mathematic-deep analysis, the learners' lack of understanding toward an ongoing mathematics material. It is in line with what Diyarko & Wahyudi (2016) and Wardono & Mariani (2017) found. Several influential factors of the learners' difficulties in solving mathematics literacy questions were the habituation promoted by the teachers so the learners were less trained to solve problems with substantial context, that required reasoning, argumentation, and creativity.

To get the initial portrait of the learners' mathematics literacy skills, the researchers distributed the initial skill test questions for 36-fifth graders of 028 Public Primary School, Pekkabata. The obtained results from the learners showed a percentage of their initial literacy skills was 67%. Most of the learners had not been able to complete the mathematics literacy skill questions perfectly. The mathematical literacy skill aspects were *communication, devising a strategy to solve problems, mathematizing, reasoning, and arguing.*

Siregar *et al* (2018) state that learning styles are combinations of individuals' ways to internalize, regulate, and manage the obtained information. Meanwhile, according to Akinyode & Khan (2016), learning styles are the applied cognitive modality preferences in a learning process. According to Amin & Suardiman (2016), learning style is an individual's easiest way to internalize, regulate, and manage the obtained information.

Indeed, learners have different learning styles. Thus, teachers need to find out the learners' learning styles. Thus, the obtained information could facilitate teachers to be more sensitive in understanding the differences of a whole class and to promote meaningful learning (Alif *et al*, 2016).

DePotter & Hernacki (2004) propose three learning styles based on the applied individual modality in managing the information (*perceptional modality*). Those three learning styles are visual (learning by observing), auditory (learning by listening), and kinesthetic learning (learning by moving, working, and touching) styles (Permatasary, 2018)

The other factor to be considered during mathematics learning deals with the sex types of learners (*Gender*). The *gender* differences influence the learners. It causes physiological differences and psychological differences in learning. Thus, both males and females have a different mindset in learning mathematics. Males and females have different patterns in solving mathematics problems.

The *gender* differences could influence the learners' mathematics literacy skills moreover due to the learning style varieties. The learning style and gender influenced the learners' learning achievements (Bhatti & Bart, 2013). Based on the explanation, both males and females had different styles in finding out solutions and determining the applied strategy to solve problems.

The learning model is an important aspect to improve learning quality that could influence problem-solving. The applied model that

supports the improvement of mathematics literacy skills is one of the problem-based learning or PBL. PBL allows learners to be educated by promoting *inquiry*, investigation, study, and revolution.

During the learning, a contextual problem is presented, the learners will work in a group to solve *Real-World* problems (Hidayat, Sugiarto, & Sunarto, 2013). PBL has real problem-centered learning characteristics that encourage learners to actively participate in solving problems (Hung, 2019). Through this PBL, learners actively develop their skills in solving-problems through the promoted learning process.

The formulated problems in this research were how male and female learners' mathematics literacy skills with the visual, auditory, and kinesthetic learning styles are. This research aims to find out how male and female learners' mathematics literacy skills with visual, auditory, and kinesthetic learning styles are.

METHOD

The applied research method was *a mixed-method* meanwhile the design of the research was *sequential explanatory* design. The population of this research consisted of the fifth graders of 023 Pekkabata Public Primary School in the academic year of 2019/2020. The sample was taken by *purposive sampling*. There was only one class, the Melati V class, consisting of learners that were taught by PBL.

The subjects of the qualitative data were 2 learners (male and female) with a visual-typed learning style, 2 learners (male and female) with auditory-typed learning style, and 2 learners (male and female) with kinesthetic learning style. The school had implemented the 2013 curriculum.

The techniques of collecting data were observation, interview, questionnaire, test, and documentation. Besides that, the research instruments consisted of the mathematics literacy skill test question (MLST), the learning style and *gender* questionnaire, and the interview guidance.

The techniques of analyzing data were: (1) the 1-5 scale as the validity data technique of the learning instrument, (2) the data analysis technique of the MLST trial run stage result (consisting of validation, reliability, difficulty level, and distinguishing power), (3) the initial quantitative data analysis technique (the *Kolmogorov-Smirnov* normality test), and the final quantitative analysis (the normality test, the average test with the score of 68 for the standard mastery, the classical completeness proportional test with a percentage of 75%, and the *N-gain* test), and (4) the applied qualitative data analysis technique (data reduction, display, and conclusion).

RESULTS AND DISCUSSION

The descriptions of the findings consisted of planning, promoting, and finding of the research. The explanations are as follows.

Planning the Research

The results of the research plan showed the total average of the syllabus, lesson plan, learning material, the learner worksheet, the TKLM, and the interview guidance of the learners' mathematics literacy skills were categorized excellent.

The result of the questionnaire instrument arrangement showed the validity average score of the learning style questionnaire reached an excellent criterion. Therefore, the questionnaire could be applied.

Promoting the Research

During the promotion, three meetings with materials about distance, time, and speed, and their sub-materials: 1) the distant unit, 2) time unit and 3) speed unit. They were as the focus. By implementing the *problem-based learning* model, there were not found any significant difficulties. The teacher promoted the stages as stated in the arranged lesson plan. The realizations were in line with *the problem-based learning* model stages. Several hindrances engaged by the researcher during the research were dealing with the learners' difficulties in completing the problems in which should have had different answers among one learner to another learner.

By the instruction of the researcher, the learners could overcome the problems. Besides

that, the realization of the group discussion and the presentation took a longer time. Thus, it caused the learning process to exceed the already determined time allotment. It could be solved since the teacher expanded the time allotment for the researcher to complete the learning based on the arranged lesson plan.

Results

From the preliminary data, it showed that the learners' mathematics literacy skills, at Melati V class, were normally distributed with a significant score of the preliminary skill test (0.225) higher than 5% or 0.05. Thus, $\boldsymbol{H_0}$ was accepted.

From the final data, it showed that the learners' mathematics literacy skills, at Melati V class, were normally distributed with a significant score of the final skill test (0.653) higher than 5% or 0.05. Thus, $\boldsymbol{H_0}$ was accepted. Since the data were normally distributed, then the hypothesis tests consisted of:

The mathematics literacy skill average score of the *problem-based learning* model was higher than the minimum mastery standard, 68. It was due to the calculation result t_{count} = 12.13. Since it was $\boldsymbol{t_{count} \geq t_{(1-\alpha)(1-n)}}$, thus $\boldsymbol{H_0}$ was denied with the test criterion of this research. $\boldsymbol{H_0}$ would be denied if $\boldsymbol{t_{count} \geq t_{(1-\alpha)(n-1)}}$ in which $\boldsymbol{t_{(1-\alpha)(1-n)}}$was obtained from the t-distribution list with dk = (36-1) = 35 and the probability of $\boldsymbol{(1-\alpha) = (1-0,05) = 0,95}$ so it was obtained $\boldsymbol{t_{(0.95;35)}}$= 2.0301.

The completeness proportion test was done to find out the learning mastery taught by a *problem-based learning* model toward the mathematics literacy skills classically. The proportional result of the mathematics literacy skill mastery taught by *problem-based learning* was more than 76%. It was obtained from the standard of deviation with $\boldsymbol{\alpha = 5\%}$. It obtained Z_{tabel} = 1.64. The calculation result $\boldsymbol{Z_{(count)}}$ was 3.40. Since it was $\boldsymbol{Z_{count} \geq Z_{(0.5-\alpha)}}$, then $\boldsymbol{H_0}$ was denied.

The Descriptions of the Mathematics Literacy Skills Reviewed from the Learning Styles and *Gender*

Based on the promoted analysis, the data showed the improvement of the learners' mathematics skills. In this case, either male of female learners showed excellent improvement. From 36 learners in Melati V class, those were taken randomly, showed high-category literacy skill improvement based on the learning style and gender. 3 male and 3 female learners represented each learning style: visual, auditory, and kinesthetic learning styles. The descriptions of the mathematics literacy skills reviewed from the learning style and gender were as follow.

Male Learners' Mathematics Literacy Skills with Visual Learning Style

Based on the analysis of the learners' mathematic literacy skill results and the interview results, the male learners with a visual learning style had reached excellent *communication* as one of the indicators. In this indicator, *communication,* that was constructed by the male learners with visual learning style showed better performance and did not have any difficulties in understanding the problems.

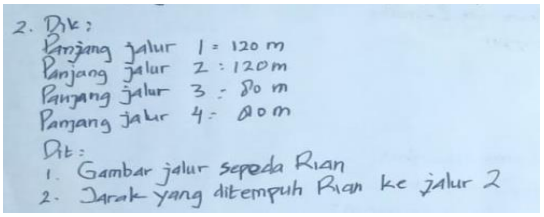

Figure 1. Male Learners' Mathematics Literacy Skills with Visual Learning Style

On all completed indicators, the male learners with a visual learning style converted the real-world problems into mathematic forms by using strategies and symbols. They interpreted the information to clarify the problems and could utilize the mathematics tools better. These achievements could be caused by the learners' learning style. It was found that visual-typed learners tended to solve problems by thinking. They could solve problems systematically. They also used figure displays in their brains and

learned faster by using visual displays (DePorter & Hernacki, 2016).

While working on the questions, the male learners had been maximally providing the reasons to solve the problems. It was also found several notes of clarification indicated that their answers had been right. Thus, it could be concluded that the mathematics literacy skills of male learners with a visual learning style had met all seven mathematics literacy skill indicators. The male learners with a visual learning style could solve the problems of the MLST questions correctly and accurately.

The visual-typed learners focused their attention and concentrated toward the studied materials by observing, looking carefully, and seeing the materials.

Female Learners' Mathematics Literacy Skills with Visual Learning Style

Based on the analysis of the learners' mathematic literacy skill results and the interview results, the female learners with a visual learning style had reached excellent results for all indicators of mathematics literacy skills.

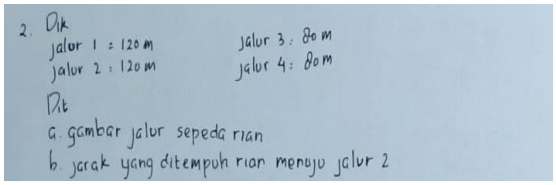

Figure 2. Female Learners' Mathematics Literacy Skills with Visual Learning Style

On the learners' answer sheets, they could communicate the problems, convert the real-world problems into mathematics, interpret, provide the reasons, use strategies to solve problems, use mathematics symbols, and use mathematics tools better. These achievements could be caused by the learners' learning style. It was found that visual-typed learners tended to solve problems by thinking. They could solve problems systematically. They also used figure displays in their brains and learned faster by using visual displays (DePorter & Hernacki, 2004).

According to DePorter & Hernacki (2016:116:115), visual-typed learners relied on their vision and observation. They tended to learn from what they saw. They learned quickly by using visual displays such as diagrams, figures on the textbook, and videos.

Male Learners' Mathematics Literacy Skills with Auditory Learning Style

Based on the analysis of the learners' mathematic literacy skills and the interview results, the male learners with auditory learning styles performed excellent mathematics literacy skills. They were found in *communicating, representing, reasoning and arguing, devising a strategy to solve problems, using symbolic, formal, and technical language, and using mathematics tool.* The learners could communicate the problems in detail and provide the reasons on the answer sheets. The male learners with auditory learning styles applied the more practical strategies to work on mathematics literacy skill questions. The learners could also draw by using the existing mathematics tools properly.

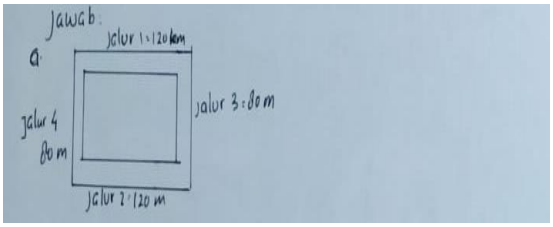

Figure 3. The Results of the Male Learners' Mathematics Literacy Skills with Auditory Learning Style

Some mathematics literacy skill indicators were found still low on the learners. Dealing with the indicator of *mathematizing,* the learners' skills to present real problems into mathematics notations were still low. It was correlated to a characteristic of the auditory-typed learners. They tended to internalize the information by listening. However, they had difficulties to understand written information.

The learners paid attention to what they listened to well. Thus, all explanations spoken by the researcher were indirectly stimulating and used properly by them. Thus, it facilitated the problem-solving process and created a maximum and better result.

Female Learners' Mathematics Literacy Skills with Auditory Learning Style

Based on the analysis of the learners' mathematics literacy skill results and the

interview results, the male learners with an auditory learning style could achieve the *communication and representation* indicators. The learners were able to communicate the problems properly and could re-present a problem or interpret it so that it was clear.

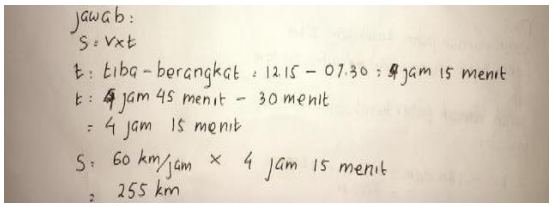

Figure 4. The Works of the Female Learners' Mathematics Literacy Skills with Auditory Learning Style

The female learners with an auditory learning style could write the problems in the questions properly. The learners could use the strategies to solve problems. They could write mathematics symbols based on mathematics principles. They could also change the real-world problems into mathematics notations and could use the mathematics tools properly.

Based on the theory of DePorter & Hernacki (2016:116-118), the auditory-typed learners rely on their success from their listening skills (their ears). The auditory-typed learners could quickly learn by using verbal discussion and listen to what the teachers said.

To facilitate the auditory learning style, it could be done by providing audible media such as interactive multimedia (voices, figures, and writing); radio; music; opportunity for the learners to read aloud; sharing questions; discussion; opportunity to explain with their words; group work; and so on.

Male Learners' Mathematics Literacy Skills with Kinesthetic Learning Style

Based on the analysis of the learners' mathematics literacy skill results and the interview results, the male learners with the kinesthetic learning style had achieved the *communication, mathematizing, and representing* indicators. In this aspect, the constructed communication by male learners was excellent. The learners did not have any difficulty to model the real-world problems into mathematics notations. They also could re-present a problem or an object by interpreting it. Besides that, on several indicators such as *using symbolic, formal, and technical language,* and *mathematics tools* written by the learners on the answer sheets, they had been properly writing the mathematics symbols. They had also used mathematics tools, assisted by a ruler, to work on the questions.

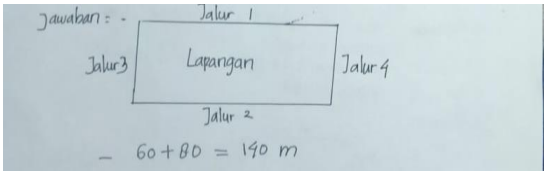

Figure 5. The Works of the Male Learners' Mathematics Literacy Skills with Kinesthetic Learning Style

These learners were also called a demonstration learning style It was due to these learners always applying and utilizing their body movement in the learning process or in understanding something (Suparman, 2010). The researcher assumed this matter influenced the subjects' learning outcome since in the given test did not involve any movement or stimulus to benefit the kinesthetic-typed learners.

Female Learners' Mathematics Literacy Skills with Kinesthetic Learning Style

Based on the analysis of the learners' mathematic literacy skill results and the interview results, the female learners with kinesthetic learning style had reached excellent results on *communicating, mathematizing, and representing.*

Besides that, the indicators such as *using symbolic, formal, and technical language* and *using mathematics tool*s were accurately written by the learners. The learners could write mathematics symbols based on the mathematics principle. They could also use mathematics tools properly. Besides that, the indicator of *devising strategies for solving a problem* was also excellent. In this indicator, the learners were not maximum to work on problems concerning with the strategy implementation.

The finding showed that the learners with the kinesthetic learning style had difficulties due to the group learning promotion done by the teacher. Thus, the role of the learners in the groups was emphasized one to the others. They discussed to find the mathematics literacy

solution by sharing their arguments in a group. Meanwhile, for kinesthetic-typed learners, they required physical activities.

It is also confirmed by De Porter & Hernacki (2016). They found that this learner type had to move, touch, and do something. This learner could not bear to sit for a long time only for listening to the materials. They could learn better when the learning process involved physical activities. De Porter & Hernacki (2016) describe the features of kinesthetic-typed learners such as speaking slowly, responding physically, memorizing by walking or seeing, using their pointing finger to read, preferring to play something that keeps them busy, and reflecting their actions by body movement while reading.

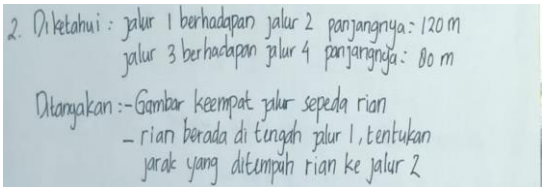

Figure 6. The Works of the Female Learners' Mathematics Literacy Skills with Kinesthetic Learning Style

The findings showed that male and female learners with either visual, auditory, and kinesthetic styles could complete the mathematics literacy skill test. Here are the analysis summary results of the learners' mathematics literacy skills with visual, auditory, and kinesthetic learning styles. It could be seen in Table 1.

Table 1. The Learners' Mathematics Literacy Skill Result Analysis Summary based on Learning Styles and *Gender.*

The Mathematics Literacy Skill Indicators	Visual Learning Style	
	Male	Female
Communication	Learners could understand the given problems.	Learners could understand the given problems.
Mathematizing	Learners could write and model the information into the mathematics notation model.	Learners could write and model the information into the mathematics notation model.
Representation	Learners could re-present the given real problems by connecting the problems with the mathematics concept.	Learners could re-present the given real problems by connecting the problems with the mathematics concept.
Reasoning and Arguing	Learners could create logical reasons concerning the applied stages.	Learners could create logical reasons concerning the applied stages.
Devising Strategies to Solve Problems	Learners could determine the applied strategy to solve problems.	Learners could determine the applied strategy to solve problems.
Using Symbolic, formal and technical language and operation	Learners could select and present problems by using symbolic and formal languages.	Learners could select and present problems by using symbolic and formal languages.
Mathematics tools	Learners had been able to present the figures assisted by mathematics tools (rulers).	Learners had been able to present the figures assisted by mathematics tools (rulers).
The Mathematics Literacy Skill Indicators	Auditory Learning Style	
	Male	Female
Communication	Learners could understand the given problems.	Learners could understand the given problems.
Representation	Learners could re-present the given real problems by connecting the problems with the mathematics concept.	Learners could re-present the given real problems by connecting the problems with the mathematics concept.

Reasoning and Arguing	Learners could create logical reasons concerning the applied stages.	Learners could create logical reasons concerning the applied stages.
Devising Strategies to Solve Problems	Learners could determine the applied strategy to solve problems.	Learners could determine the applied strategy to solve problems.
Using Symbolic, formal and technical language and operation	Learners could select and present problems by using symbolic and formal languages.	Learners could select and present problems by using symbolic and formal languages.
Mathematics tools	Learners had been able to present the figures assisted by mathematics tools (rulers).	Learners had been able to present the figures assisted by mathematics tools (rulers).
The Mathematics Literacy Skill Indicators	Kinesthetic Learning Style Male	 Female
Communication	Learners could understand the given problems.	Learners could understand the given problems.
Mathematizing	Learners could write and model the information into the mathematics notation model.	Learners could write and model the information into the mathematics notation model.
Representation	Learners could re-present the given real problems by connecting the problems with the mathematics concept.	Learners could re-present the given real problems by connecting the problems with the mathematics concept.
Reasoning and Arguing	Learners could not create logical reasons concerning the applied stages.	Learners could not create logical reasons concerning the applied stages.
Devising Strategies to Solve Problems	The learners could not determine the strategy to solve problems.	The learners could determine the strategy to solve problems.
Using Symbolic, formal and technical language and operation	Learners could select and present problems by using symbolic and formal languages.	Learners could select and present problems by using symbolic and formal languages.
Mathematics tools	Learners had been able to present the figures assisted by mathematics tools (rulers).	Learners had been able to present the figures assisted by mathematics tools (rulers).

CONCLUSION

From the research discussion, it could be concluded that:

Problem-Based Learning was effective toward the learners' mathematics literacy skills. It could be seen from the male learners' mathematics literacy skills with the visual learning style at Melati V class of 028 Public Primary School, Pekkabata. They could reach all indicators of mathematics literacy skills and could master them. Thus, the male learners did not have mathematics problems concerning with the literacy skills. It could be seen from the male learners' mathematics literacy skills with the visual learning style at Melati V class of 028 Public Primary School, Pekkabata. They could reach all indicators of mathematics literacy skills and could master them. Thus, the male learners did not have mathematics problems concerning with the literacy skills. The mathematics literacy skills of the male learners with auditory learning style at the class showed excellent achievements on *communication* concerning with communicating problems, *representation* concerning with presenting or describing the problems, *reasoning and arguing*, *devising strategies to solve problems, using symbolic, formal, and technical language and operation,* and *using mathematics tools.* Besides that, there was a low-mathematics

literacy skill indicator of the male learners with an auditory learning style. It was *mathematizing* or modeling the real-world problems into mathematics notations. The mathematics literacy skills of the female learners with an auditory learning style at the class showed excellent achievements on several indicators. They were *communication* concerning communicating problems, *mathematizing* concerning modeling real-world problems into mathematics, *representation* concerning with presenting or describing problems. Besides that, there were also several indicators for the auditory-typed learners that were still low. They were such as *reasoning and arguing* or about giving reasons and arguments. The mathematics literacy skills of the male learners with a kinesthetic learning style at the class showed excellent achievements on several indicators. They were *communication* concerning communicating problems, *mathematizing* concerning modeling real-world problems into mathematics, *representation* concerning with presenting or describing problems. Besides that, there were also several indicators for the male kinesthetic-typed learners that were still low. They were such as *reasoning and arguing* or about giving reasons and arguments and *devising strategies to solve problems* or providing strategies in answering problems. The mathematics literacy skills of the female learners with a kinesthetic learning style at the class showed excellent achievements on several indicators. They were *communication* concerning communicating problems, *mathematizing* concerning modeling real-world problems into mathematics, *representation* concerning with presenting or describing problems. In the indicator of *devising strategies to solve problems*, the shared questions were sufficiently excellent. Besides that, there were also several indicators for the kinesthetic-typed learners that were still low. They were such as *reasoning and arguing* or about giving reasons and arguments.

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