

# Scaffolding-Aided Inquiry Learning For The Improvement Of Students' Mathematics Literacy Skills

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**Abstract.** Mathematics literacy is an individual's ability to formulate, use and interpret Mathematics in various contexts, including the ability to perform mathematical reasoning and to use the concepts, procedures, and facts, as the means to describe, explain and predict certain phenomenon or events. The Mathematics literacy is about mathematical usability or functions that have been studied by a student at the school. The usefulness of this skill is very important to survive in this current information and knowledge era. Inquiry learning is a series of activities that emphasize critical thinking and analytical process to search for and find answers to a questionable problem. Scaffolding is done in form of guidance given by an educator to the learners during the learning process with more focused issues and positive interaction. The purpose of this paper is to provide solutions of scaffolding-aided inquiry learning to improve the students' Mathematics literacy.

**Keywords:** *inquiry learning, scaffolding, Mathematics literacy*

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## I. INTRODUCTION

In this globalization and modern era, every human being is required to have high competitiveness, high scientific and technological skills, and good attitudes. To achieve these conditions, everyone needs education as a means of knowledge formation. Education is a conscious and deliberate effort to create learning atmosphere and learning process, so that the learners will actively develop the potential of their own to obtain spiritual power of religion, self-control, personality, intelligence, good characters, and skills needed by themselves, society, nation and state. One form of education is through the study of Mathematics. Mathematics talks about patterns and relationships, and a road or pattern of thinking.

The success of Indonesian students has been widely assessed only by the domestic people. For example, the success of the students in national exams still becomes the educational assessment standard by the common people, but the real educational process cannot be judged or viewed from a very narrow scope, because most students still have lack or limited solutions to resolve the problems related to their daily life. This is reflected in low average score of Mathematics of the Indonesian students according to an international comparative studies conducted by PISA (Programme for International Student Assessment)

The Programme for International Student Assessment (PISA) is an international assessment held by the Organization for Economic Co-operation and Development (OECD). PISA is a triennial survey that assesses the knowledge and skills of the students aged 15 years (OECD, 2007). PISA is an international study of reading (reading literacy), Mathematics literacy, problem solving literacy, and science literacy, and the latest is financial literacy (OECD, 2012).

According to the PISA, the results achieved by the Indonesian students are far from satisfactory. In the last two years of the implementation of PISA in 2012, Indonesia was only able to reach the position 64 of 65 countries with the score of 375 (OECD, 2013), while on the implementation of PISA in 2015, Indonesia reached the position 62 of 70 participating countries with the score of 386 (OECD, 2016). Almost all of Indonesian students only master the subject materials until 3 of 6 levels maximally, while those in developed and developing countries are able to achieve level 4, 5, and even 6.

The inquiry learning aims to organize the students' knowledge as a strong foundation based on the concept of scientific method. All activities conducted by the learners are directed to seek and find answers of a question by their own, which is expected to foster an attitude of confidence (self-belief). Scaffolding as a learning process is sourced from the theory of socio-cultural theory by Vigotsky and his concept of zone of proximal development (ZPD). The scaffolding prepares individual assistance based on the students' ZPD. The more expert people or more knowledgeable other (MKO) will set up scaffolding or guidance to facilitate the development of the students to build their ability based on their prior knowledge and ability to internalize new information. The purpose of this paper is to provide solutions of scaffolding-aided inquiry learning to improve the students' mathematics literacy. In this case, the role of the teacher in the learning process is very important to create a comfortable learning environment for the students.

## II. DISCUSSION

### 1. Mathematics Literacy

The Mathematics literacy is an individual's ability to formulate, use and interpret the Mathematics in various

contexts, including the ability to perform mathematical reasoning and to use the concepts, procedures, and facts, as the means to describe, explain and predict certain phenomena or events. This means the Mathematics literacy can help individuals to recognize the roles of Mathematics in the real world and as a basis for consideration and determination of decisions required by the community. It includes the ability to use mathematical reasoning and concepts, procedures, facts and functions to describe, explain and describe a phenomenon.

According to the draft assessment framework of PISA (OECD, 2013), the Mathematics literacy is an individual's ability to formulate, implement, and interpret the Mathematics in various contexts, including the ability to perform mathematical reasoning and to use the concepts, procedures, and facts to describe, explain, or predict certain phenomena or events. According to Ojose (2011), the Mathematics literacy is not only a detailed knowledge of calculus, differential equations, linear algebra, abstract algebra and other mathematical formulas, but rather a broad scope understanding.

## 2. Domains of Mathematics Literacy

### 2.1 Domain of Mathematics Literacy Contents

The Mathematics contents contained in the PISA are proposed according to the mathematical phenomena that underlie some problems that have motivated the development of mathematical concepts and specific procedures.

As more details about the Mathematics contents in the PISA, according to the OECD (2013a) are number (quantity), space and shapes, change and relationships, and probability / uncertainty.

### 2.2 Domain of Contexts in Mathematics Literacy

Johar (2012) suggested that the questions given in PISA are presented mostly based on the real world situations, so that the students can take advantages to solve their problems in daily life. The four mathematical contexts by PISA are personal, occupational, community/public (societal), and scientific.

### 2.3 Domain of Process in Mathematics Literacy

This competence can be divided into three groups: reproduction, group connections, and group reflection.

Assessment framework for mathematical literacy in the PISA 2012 stated that the domain of the process involves 7 abilities of mathematical literacy. They are (OECD, 2012):

- a. *Communication*
- b. *Mathematizing*
- c. *Representation*
- d. *Reasoning and Argument*
- e. *Devising Strategies for Solving Problems*
- f. *Using Symbolic, Formal, and Technical Language and Operation*
- g. *Mathematics Tools*

### 2.4 Levels of Mathematics Literacy Abilities

The students' mathematical abilities, according to PISA, are divided into six levels; level 6 as the highest achievement and level 1 the lowest one. Each of these levels indicates the

level of mathematical competence achieved by the students (Johar, 2012).

The six levels of mathematical abilities are presented in the following table (OECD, 2013b).

Table 1 Levels of Mathematics Literacy Abilities

Level	Competence
6	The students are able to hold conceptualization and generalization using the information based on modeling and assessment in a complex situation.
5	The students are able to work using the model for a complex situation, identify the obstacles faced and organize their assumption.
4	The students are able to work effectively using the model in a concrete but complex situation.
3	The students are able to follow the procedures well, including those which require consecutive decisions.
2	The students are able to interpret and identify a situation in the context which requires direct inference.
1	The students are able to answer the questions with general context and identify all the relevant information provided with clear questions.

## 3. Inquiry Learning

Inquiry learning is a famous learning model. Inquiry is derived from the word *to inquire* which means participating or being involved in asking questions, searching for information, and conducting investigations. The inquiry learning aims to develop the students' thinking skills systematically, logically, and critically, or to develop their intellectual abilities as a part of mental development process (Hosnan, 2014).

The type of the inquiry model used in this research is free inquiry. According to Fathurrohman (2015), there are some procedures of inquiry model that should be implemented in the learning activities as follows:

- a. *Stimulation or orientation*  
First of all, the students are faced with something that causes their confusion, followed by not giving a generalization, that will lead them to investigate the problem by themselves
- b. *Problem statement*  
The next step is the teacher provides opportunities for the students to identify as many as possible the agendas of the issues which are relevant with the learning materials, and then one of them is selected and formulated in a hypothetical form (temporary answer upon the question).
- c. *Data collection*  
When the exploration is taken place, the teacher also provides the opportunities for the students to collect as much as relevant information to prove the correctness of the hypothesis.
- d. *Data processing*  
The data processing means processing the data and information obtained by the students from interviews,

observation, and so on. The information obtained are then interpreted, processed, randomized, classified, tabulated, even calculated in certain ways and interpreted at certain confidence level.

e. Verification

On this stage, the students perform a careful examination to prove whether or not the hypothesis set is true using other alternative findings then connected with the results of data processing.

f. Generalization (drawing conclusions)

The generalization stage is a process of drawing the conclusions that can be used as the general principles and applies to all the same events or problems, by taking into account the results of the verification.

4. Scaffolding

Scaffolding in the learning is a teaching strategy that consists of teaching a new skill by getting the students together to complete the task that is considered too difficult for them when they have finished their own (Kurniasih, 2015). Scaffolding as a learning method is derived from socio-cultural theory by Vigotsky and his concept of zone of proximal development (ZPD). According to Aghileri (2006), scaffolding is given by the teachers /more capable students to their peers who have difficulty by providing assistance on the early stages and gradually reduce it until they can be eventually independent and able to complete their own tasks/problems.

Inquiry Learning with Scaffolding Strategy in Literacy Skills.

The inquiry learning includes six steps including stimulation, problem statement, data collection, data processing, verification, and generalization. In the stimulation stage, the teacher divides the students based on their ZPD of literacy skills. The next scaffolding steps provided by the teacher are adjusted to the different students' literacy skills. The steps in the inquiry learning cover the following scaffolding strategies:

Table 2 Steps of Inquiry Learning with Scaffolding Strategy

STEP	ACTIVITIES
1. Orientation of the problem	1) Explaining the topics, objectives and learning outcomes expected to be achieved by the students
	2) Explaining the topics of activities that must be done by the students to achieve the learning objectives
	3) Explaining the importance of learning topics and activities
	4) Determining ZPD
	5) Classifying the students based on their ZPD.
	6) The teacher presents events or phenomena or give the questions that the students are probably able to find and formulate the problems by their own.
	1) The problems should be formulated by the students.

2. Formulation of the problem

2) The problems assessed are those containing the questions whose answers are certainly related with the materials taught.

3) The concepts of the problems must have been firstly identified by the students.

3. Formulation of Hypothesis

1) Proposing various questions that can encourage the students to formulate the temporary answers or formulate various probabilities of the answers of a problem assessed independently within the groups

4. Data collection

1) Proposing the questions that can motivate the students to think and find necessary information

2) The teacher aids the students in form of guidance, motivation, keywords or others that can stimulate them toward learning independency

5. Hypothesis testing

1) Determining the levels of the students' confidence toward the answers given

2) The teacher directs the students with high ZPD.

3) The teacher helps the students with low ZPD.

6. Drawing conclusions

1) Showing the relevant data

2) Concluding the learning and giving assignments

III. CONCLUSIONS

The inquiry learning aims to provide effective way for the students to develop their intellectual skills associated with the process of reflective thinking. The steps of inquiry learning include: 1) stimulation, 2) problem statement, 3) data collection, 4) data processing, 5) verification, and 6) generalization. Those six steps combined with scaffolding can provide better mathematics literacy skills/abilities for the students.

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