

**BUILD OF EFFECTIVE TRAINING MODEL BASED ON  
THE SEARCHING TOWARD COMPETENCE OF TEACHERS  
IN MATHEMATICS TEACHING**

**By:**

Amin Suyitno, Endang Sugiharti, and Emi Pujiastuti

Lecturers of Maths and Natural Sciences Faculty of Universitas Negeri Semarang

Email: amin.mat@mail.unnes.ac.id

**ABSTRACT**

Many teachers found that the training model implemented not match the needs of teachers. Teachers only receive materials while training, testing, and then the training finished. The purpose of this study is to search for and find an effective training model, which is based on the ability to search the competence of teachers in teaching mathematics. This article is based on qualitative research on Elementary School teachers in Semarang. As a result, the teachers do not understand the mathematical literacy, do not quite understand about the application of scientific approach in teaching mathematics that is integrated into thematic. The results were necessary to develop a training model which not only includes lectures in the same direction, but there must be a lecture, discussion, simulation, assistance in the classroom, and reflections. Training is done without interrupting the process of learning and mentoring done by trainers when teacher teaches in the classroom.

**Keywords :** training model, mathematical literacy, scientific approach.

**Introduction**

Teachers need to be improved their competence. This can be done through training by the authorities. Observations in the field, training has been carried out not likely to involve teachers in planning. Teachers only invited, given the material, while training, testing, and then the training finished. Thus, the organizers sometimes forget the initial capabilities that need to be owned by the teachers before implement a training. There is a training that prerequisite of materials for the teachers were supposed to know. But in fact, not necessarily the teachers know.

Training will be effective if the implementation is completely in accordance with the needs of teachers, especially for Elementary School teachers. Elementary School teachers in Indonesia, implementing Curriculum of 2013, which means the learning process to use a scientific approach. In addition, for Elementary School teachers have the ability to deliver to the students in math competitions, so the teachers also need to have mathematical literacy skills. Elementary Schools in Indonesia is implementing the curriculum of 2013 had applied the scientific approach. In addition, the integrated thematic also held from grade I to grade VI.

Work on mathematics, now also begin is characterized by mathematical literacy. In an initial study in year-1 obtained accurate information that turned out to be Elementary Schools teachers: (1) the majority of respondents did not know the meaning of mathematical literacy. Elementary Schools teachers do math as they know when they get the math, (2) teachers do not fully understand the scientific approach, and (3) the

teachers have heard the term of scientific approach and thematic integrated yet find difficulty in preparing their Lesson Plan.

The mathematics learning process required by the Curriculum of 2013 is a learning process carried out by the scientific approach (*Kemdikbud*, 2013a). A new approach, which is also known by most of Elementary Schools teachers, both high grade and low grade. What is meant by low grade is a grade I, II, or III on the level of Elementary School (*SD*) or Islamic Elementary School (*MI*). While the high-grade is a class IV, V, or VI on the level of Elementary School or Islamic Elementary School.

Based on the General Guidelines for Learning that stipulated in *Permendikbud* No. 103 of 2015, in learning through scientific approach, known there are five phases/process namely: observing, questioning, collect of information that could be done through experiments, associating, and communicating. Additionally, in *Permendikbud* No. 53/2015, learning in Elementary Schools should refer to the Integrated Thematic learning. Through integrated thematic, students are invited and trained to associate phenomena with each other phenomena. Such occurrences mathematics learning known as mathematical literacy.

Mathematical literacy skills are very indispensable by teacher. Mathematical literacy is an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena.

This confirms earlier suggestions by Hofer and Beckmann (2009) who wrote in the International journal that: Mathematical literacy is an individual's capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgements and to use and engage with mathematics in ways that meet the needs of that individual's life as a constructive, concerned, and reflective citizen.

Learning in the high classroom, for example with an environmental theme, teacher must be able to associate the number of feet in a set of pet chickens in the home environment by further multiplication concepts who will be explained to the students. Thus, the high-class teacher needs to master of mathematical literacy, according to the cognitive level of students. *Kemdikbud* (2013c) in book on Technical Guidelines on Remedial Education and Enrichment in Elementary Schools give the freedom to Elementary School teachers to enrich the knowledge for the students. Remind that Curriculum of 2013 needs to be implemented, then the research to search for and find an effective training model, which is based on the ability to search the competence of teachers in teaching mathematics through a scientific approach characterized by mathematical literacy is very feasible.

Previous studies no one has touched the needs of teachers in teaching and have not touched the needs of teachers in improving their competence. Studies that already exist mostly focus on the provision of material that has been set without preceded by the real needs of teachers.

Some researchers who studied teacher training has not touched the necessary needs of teachers, although Burns (2011) and Harwell (2003) who studied the training of teachers think that the training was urgently needed to allow teachers to have high quality in development the teaching profession. Therefore, the element of novelty of the results of this study wanted to search for and find an effective training model, which is based on the ability to search the competence of teachers in teaching mathematics, namely through a scientific approach characterized by mathematical literacy .

Issues to be studied in this article are searching for and finding an effective training model, which is based on the ability to search the competence of teachers in teaching mathematics through a scientific approach characterized by mathematical literacy.

### Mathematical Literacy in Elementary Schools

As described in the introduction, mathematics solution are now beginning characterized by mathematical literacy. Sri Wardhani and Rumiati (2011) wrote and confirmed in writing in the book of OECD (2010) that the definition of mathematical literacy by Draft Assessment Framework PISA 2012 is: mathematical literacy is an individual's capacity to formulate, employ, and interpret mathematics in a variety of contexts. It includes reasoning mathematically and using mathematical concepts, procedures, facts, and tools to describe, explain, and predict phenomena. It assists individuals to recognise the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective citizens. Based on that definition, then the mathematical literacy is defined as a person's ability to formulate, implement, and interpret mathematics in various contexts, including the ability to perform reasoning mathematically and using the concepts, procedures, and facts to describe, explain or predict phenomena/events.

Mathematical literacy helps a person to understand the role or usefulness of mathematics in everyday life as well use it to make decisions right as a citizen to build, caring, and thinking. It is actually in line with *Permendikbud* 21 of 2016 on Standard Process that Mathematics Subjects of basic education that mathematics courses intended that students have the following capabilities. (1) Understanding the concepts of mathematics, describes the relationship between concepts and apply concepts or algorithms, are flexible, accurate, efficient, and precise, in problem-solving. (2) Using the reasoning in the patterns and properties, perform mathematical manipulation in making generalizations, compile evidence, or explain mathematical ideas and statements. (3) Solve problems that include the ability to understand the problem, devised a mathematical model, solve the model and interpret the obtained solution. (4) Communicating ideas with symbols, tables, diagrams, or other media to clarify the situation or problem. (5) Having respect for the usefulness of mathematics in life, are curious, attention, and interest in studying mathematics, as well as a tenacious attitude and confidence in problem solving.

So, if the comparison between mathematical literacy with the aim of understanding the mathematics courses on the Content Standards looked their suitability or understandings. Thus, increasing the competence of Elementary School teachers to have the ability how to prepare math problems containing mathematical literacy, has actually been in accordance with the actual demands of Content Standards Math in Indonesia.

### Mathematics Problems that Contains Mathematical Literacy

The following are examples of problems in grade V of negative numbers contained mathematical literacy that highlight the content, process, and context.

#### Sequence Numbers

Three numbers declared by 3-7; 9-6; and 1 - 8. sequence three numbers from the largest value to the smallest value. Explain why you answer like that.

On the matter of the above, appear to contain elements of content, process and context. Content, operation and compares the subtraction of integers. The process, students are expected to apply concepts, facts, procedures, and reasoning da-lam reduction surgery and comparing integers. While the context is personal.

Importance charge of mathematical literacy in math problems as mentioned above is also confirmed by Dahlin, B & Watkins, D (2000) which said that: The understanding is more likely to lead to high quality outcomes than memorizing." The need for mathematical literacy also reinforced by Wachira, Pourdavood, and Skitzki (2013) which in a journal wrote that: Mathematics instruction should provide students

opportunities to engage in mathematical inquiry and meaning making through discourse, and teachers should encourage this process by remaining flexible and responsive to students' response and feedback.

### **Scientific Approach in the Presentation of Mathematics**

Teaching-learning in Indonesia today regulated by the Regulation of the Minister of Education and Culture (*Permendikbud*) No. 20, 21, 22, 23, and 24 of 2016. Regulation No. 20 on Graduates Competency Standards, No. 21 on the Content Standards, No. 22 on Standard Process, No. 23 on the Evaluation Process and Learning Outcomes, and No. 24 on Core Competence and Basic Competence.

While based on the General Guidelines for Learning stipulated in *Permendikbud* No. 103 of 2014 on the Implementation of Curriculum, the core activities of learning through Scientific Approach, do primary school teachers through the process of observing, questioning, collect of information, associating, and communicating. In the activity observed, the teacher opened wide and varied in providing opportunities for students to make observations through: look, listen, hear, and read. In the ask activity, the teacher encourages students to ask questions about what has been seen, listened to, read, or seen. After conducting ask activity, students explore and gather information from the multiple sources through a variety of ways.

. After the information is obtained and processed to find the relationship of the information with other information, found a pattern of linkage information, and take the conclusions of the patterns that found. The next activity is to write or tell what was found on the activities performed by students.

### **Applications in Mathematics Learning in the Classroom**

Curriculum of 2013 will run more effectively if the competence of the teachers in teaching mathematics through a scientific approach characterized by mathematical literacy. To obtain good results in the implementation of Curriculum of 2013 in a high-class/grade, teachers should not only teach facts, concepts, or problems counting repetitive routine for children to be memorized. Math should be deep, understand, and train students to reason effectively. Marton, F & Saljo, R (1976) mentioned that: in mathematics education, there has been tension between deep learning and repetitive learning". Further reaffirmed that: In western culture repetitive learning is often positioned as the opposite of deep learning and understanding.

Additionally, Lie, S (2006) also wrote that: Western educators emphasise the need for students to construct a conceptual understanding of mathematical symbols and rules before they practise the rules. In fact, the competence of Elementary School teachers in mathematics-based Mathematical Literacy through Scientific Approach is required. Watkins, D & Biggs, J.B (2001) also did not agree that learning mathematics is dominated by memorization activities. They found: One aspect of the criticism is that rote learning is known to lead to poor learning outcomes.

Thus, Elementary School teachers need to explore their competence in mathematics is based on Mathematical Literacy through Scientific Approach. This searching is needed in order to make an Effective Training Model based on searching of the teacher competence toward teacher ability in mathematics teaching through scientific approach characterized mathematical literacy. Watson, A & Chick. H (2011) asserted that: Highlight the importance of teachers selecting mathematical tasks and examples with adequate variation to ensure that the critical features of the intended concepts are exemplified without unintentional irrelevant features.

Hopefully, if the ability or competence of teachers to create math problems containing literacy mathematically identified and followed up until the teachers are competent in presenting the material with a scientific approach that is adequate, will obviously have a positive impact in the implementation of Curriculum of 2013, especially in math. Lauder & Brown, P (2006) asserted that: The strength of a nation is

built on human resources developed by its educational institutions which train the brains, provide skill and open a new world of opportunities and possibilities to the nation for economic growth, social justice, and poverty alleviation.

For the students themselves, the results of the generalizations made by the students themselves become tools for learning mathematics more effectively, and is an important component of their mathematical advances in the international arena in days to come. Watson, A & Mason, J (2006) confirmed that: The results of generalizations created by students became tools for more sophisticated mathematics, and are a significant component of their mathematical progress.

### **Studies Support**

Some studies associated with how to teach mathematics through a scientific approach is characterized by mathematical literacy of them are as follows. The research of Suyitno (2012) applying TPS (Think-Pair-Share) in mathematics which contains problems that contain mathematical literacy results show that the students' ability to solve mathematical problems that are solved by scientific approach can be improved. In addition, the research of Sugiharti (2012) also concluded that the application of the Mind-Mapping model in teaching mathematics containing mathematical literacy can improve the ability of students of Junior High School 2 of Semarang in solving problems.

Additionally, Rochmad, Suyitno, and Sugiharti (2013) in a study that conducted in Senior High School 1 of Temanggung concluded that the application of the TPS-based Mouse Mischief in the teaching of mathematics that includes literacy mathematical and follow the step of scientific pattern may actually enhance the ability of Senior High School students 1 of Temanggung in mathematical problems solving.

Furthermore, Suyitno, Sugiharti, and Pujiastuti (2015) in their research had found the draft of a prototype of a training model based on searches competence of the teachers in Semarang in mathematics learning is characterized by mathematical literacy through a scientific approach. This model needs to be tested and analyzed the results of the testing can thus be obtained prototypes training model that can contribute to a fundamental/ essential in the field of science, especially the areas of mathematics.

### **The Benefits of This Research Activity**

The research activity was done with the consideration that the results of this study have the following benefits. (1) That there are efforts to improve the training model that has been frequently carried out, so that similar trainings in the future may change and provide effective results. (2) Provided guide the implementation of an effective training model, which is based on the ability to search the competence of teachers in teaching mathematics through a scientific approach characterized by mathematical literacy. (3) To give the positive fundamental contribution, with Prototypes of New Training Model based on searches competence of the teachers are ready to be applied. (4) There is a fundamental contribution with Scientific Publications, so that the research results are expected to be useful for developing countries that will provide training to teachers.

### **Research Methods**

To obtain the results of the research is a prototype of an effective training model, which is based on the ability to search the competence of teachers in teaching mathematics through a scientific approach characterized by mathematical literacy, then conducted a research with a qualitative approach. The research subjects are selected from Elementary School teachers in Semarang city of Central Java. By referring to Miles and Huberman (1994, 2014), then the research methods include: (1) data reduction, (2) the display data, (3) the data interpretation, and (4) conclusion /verification. Data capturing through intensive



discussions in the FGD, testing prototypes in the primary school teachers in Semarang, observation, questionnaires, and interviews open-intensive, and forwarded by triangulation.

### Treatment of Prototype

To treatment the prototype model of effective training, which is based on the ability to search the competence of teachers in teaching mathematics through a scientific approach characterized by mathematical literacy, conducted in Semarang for Elementary School teachers.



Figure 1: The some of participants of Training photographed together with the Research Team

In order to deepen in order to analyze the results of tests/treatment, have some Elementary School teachers as a research subject who has followed the trial application of the model of training to complete a questionnaire and interviewed intensively.



Figure 2 Some of Research Subjects fill out a questionnaire prior to being interviewed.

Some teachers were taken based on equity considerations, proximity, speed to meet the subject of research, time efficiency, the location of the school, the accuracy of the data, and other considerations. Its follow-up, the discussion in Focus Group Discussion (FGD). The members of FGD are several of Elementary School teachers who were the subject of the study, all of the research team, and two lecturers from the Department of Mathematics Education of Semarang State University.

### Research Activities Performed and Results

The research activities that have been done were as follows. In the preliminary studies have obtained accurate information that: (1) the vast majority of Elementary School teachers who were respondents claimed not to know the meaning of mathematical literacy. Elementary teachers do math as they know when they got

a math lesson, (2) teachers did not fully understand the mathematics teaching practices with a scientific approach, and (3) teachers feel difficulty in preparing the Lesson Plan that contains learning activities with a scientific approach and integrated thematic.

Furthermore, the research team has (1) carry out the drafting of the prototype of a training model that is based on searching of the teacher competence toward teacher ability in mathematics teaching through scientific approach characterized mathematical literacy. (2) Through the Focus Group Discussion, managed to consolidate the results of the draft prototype training model that is based on searching of the teacher competence toward teacher ability in mathematics teaching through scientific approach characterized mathematical literacy. (3) To test/treatment the application of the training model (Figure 1 and 2 above). (4) Found a prototype model of training that is based on searching of the teacher competence toward teacher ability in mathematics teaching through scientific approach characterized mathematical literacy, so that the implementation of Curriculum of 2013 operating effectively.

### Conclusions and Expectations

This article is intended to contribute ideas so that guidance to teachers, especially to Elementary School teachers provide the maximum benefit. One form of the guidance that is through training. Thus, the results raised in an article expected: (1) there are efforts to improve the training model that has been frequently carried out, so that similar trainings in the future may change and provide effective training results; (2) may give the positive contributing fundamentally, with the completion of the training model based on searches competence of the teachers are ready to be applied; (3) there is the idea about change of a model training, so that this research results are expected to be useful for the developing countries that will organize training of the teachers.

### REFERENCE

- Burns, Mary. 2011. *Distance Education for Teacher Training: Modes, Models, and Methods*. Washington, DC: Education Development Center, Inc.
- Dahlin, B & Watkins, D. 2000. The role of repetition in the processes of memorizing and understanding: A comparison of the views of German and Chinese secondary school students in Hong Kong. *British Journal of Educational Psychology*, 70, 65-84.
- Harwell. Sandra H. 2003. *Teacher Professional Development: It's Not an Event, It's a Process*. Texas: Published and distributed by: CORD - P.O. Box 21689.
- Hofer dan Beckmann. 2009. Supporting mathematical literacy: examples from a cross-curricular project. *ZDM Mathematics Education Journal* 41:223-230 DOI 10.1007/s11858-008-0117-9.
- Kemdikbud. 2013a. *Panduan Teknis Pembelajaran Tematik Terpadu dengan Pendekatan Saintifik di Sekolah Dasar*. Jakarta: Dirjen Dikdas Pembinaan SD.
- Kemdikbud. 2013b. *Panduan Teknis Penyusunan Rencana Pelaksanaan Pembelajaran (RPP) di Sekolah Dasar*. Jakarta: Dirjen Dikdas Pembinaan SD.
- Kemdikbud. 2013c. *Panduan Teknis Pembelajaran Remedial dan Pengayaan di Sekolah Dasar*. Jakarta: Dirjen Dikdas Pembinaan SD.
- Lauder and Brown, P. 2006. *Education, globalization, and social change*. Oxford, UK: Oxford University Press.

- Lie, S. 2006. *Mathematics education in diferent cultural traditions: A comparative study of East Asia and the West*. New York: Springer.
- Marton, F & Saljo, R. 1976. *The experiences of learning*. Edinburg, UK: Scottish Academy Press.
- Miles, Matthew B & Huberman, A Michael. 1994. *An Expanded Sourcebook – Qualitative Data Analysis*. Second Edition. London: SAGE Publication.
- Miles, Matthew B & Huberman, A Michael. 2014. *Qualitative Data Analysis – A Methods Sourcebook*. Third Edition. London: SAGE Publication.
- OECD. 2010. Draft PISA 2012 Assessment Framework diunduh dari [http://www.oecd.org /dataoecd/61/15/46241909.pdf](http://www.oecd.org/dataoecd/61/15/46241909.pdf) diakses 6 Maret 2013.
- Permendikbud No. 21 Tahun 2016 tentang Standar Isi Pendidikan Dasar dan Menengah.
- Permendikbud No 103 Tahun 2015 tentang Pedoman Umum Pembelajaran Kurikulum 2013.
- Rochmad, Suyitno, Amin, dan Sugiharti, Endang. 2013. *Application of Conservation Values Through TPS Based-on Using of Mouse Mischief Program as Interactive Media of Mathematics Learning at Grade X of SMA 1 (ISSP) Temanggung to Increase Problem Solving Ability*. Laporan Penelitian Hibah PGMIPABI Unnes.
- Sri Wadhani dan Rumiati. 2011. *Instrumen Penilaian Hasil Belajar Matematika SMP Belajar dari PISA dan TIMSS*. Jakarta: PPPPTK-Kemendikbud.
- Suyitno, A, Sugiharti, E, dan Pujiastuti, E. 2015. *Prototip Model Pelatihan Berbasis Penelusuran Kompetensi Guru-Guru SD Di Semarang dalam Pembelajaran Matematika Bercirikan Literasi Matematis Melalui Pendekatan Sainifik*. Penelitian Fundamental. Simlitabmas.
- Suyitno, Amin. 2012. *Sinkronisasi Pembelajaran TPS Bercirikan Inkuiri dalam Perkuliahan Telkur Matematika 1 Berbahasa Inggris untuk Meningkatkan Kemampuan Memecahkan Masalah bagi Mahasiswa Matematika Program PGMIPABI*. Laporan Penelitian PHKI B Unnes.
- Sugiharti, Endang. 2012. *The Implementation of Mind Mapping based-on Lesson Study to Improve the Ability to Solve Problem and Activity for the Students of ISSP Grade VIII-B of SMPN 2 Semarang in Geometry*. Laporan Penelitian Dirjen Dikti.
- Wachira P, Pourdavood R, dan Skitzki, R. 2013. Mathematics Teacher's Role in Promoting Classroom Discourse. *International Journal for Mathematics and Learning*. <http://www.cimt.plymouth.ac.uk/journal> - diakses 8 Juni 2013).
- Watkins, D & Biggs, J.B. 2001. The paradox of the Chinese learner and beyond. *Teaching the Chinese learner. Psychological and pedagogical perspectives*. Melbourne: ACCER.
- Watson, A & Mason, J. 2006. Seeing an exercise as a single mathematical object: Using variation to structure sense-making. *Mathematical Thinking and Learning*. 8(2), 91-111.
- Watson, A & Chick. H. 2011. Qualities of examples in learning and teaching. *ZDM: The international journal in mathematics education* 43(3).DOI 10.1007/s11858-010-0301-6.