Developing Mathematical Problem Solving to Prepare the Implementation of Lesson Study of Mathematics Teaching in Indonesian Schools of Disaster Area

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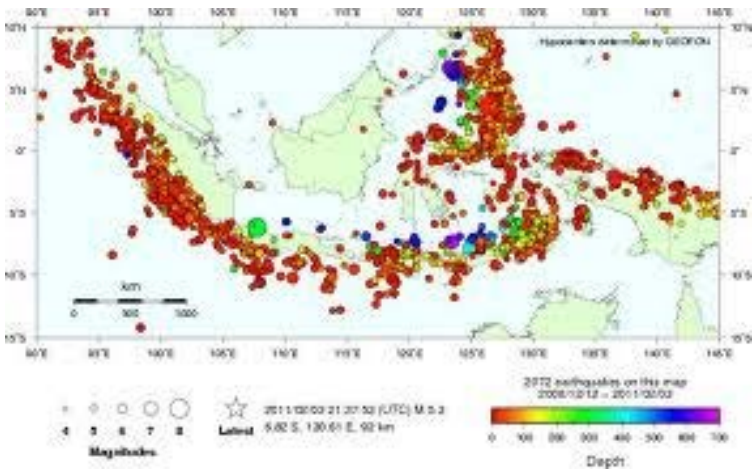
ABSTRACT

Saving the school children from the disaster includes emergency preparedness education in which providing relevant textbooks is important. The relevant textbooks should reflect the situational and contextual problems faced by the students in the schools of the area of disaster. Problem based teaching learning process can be considered as one of the solution in which teaching learning processes based on the real problems face by the students. The students who had various experiences during the earthquake ultimately are able to reflect their own experiences and formulate into mathematical problems. Those are the prospective teachers in this research who contribute to share their knowledge of mathematical problems in the schools area of disaster. By employing their experiences, this program strive to develop problem solving based mathematical textbooks for primary, junior secondary and senior secondary students. In order to get relevant textbooks, this program develops Lesson Study for problem based teaching learning processes in the schools area of disaster.

Key Word: disaster education, problem solving, mathematics textbook,

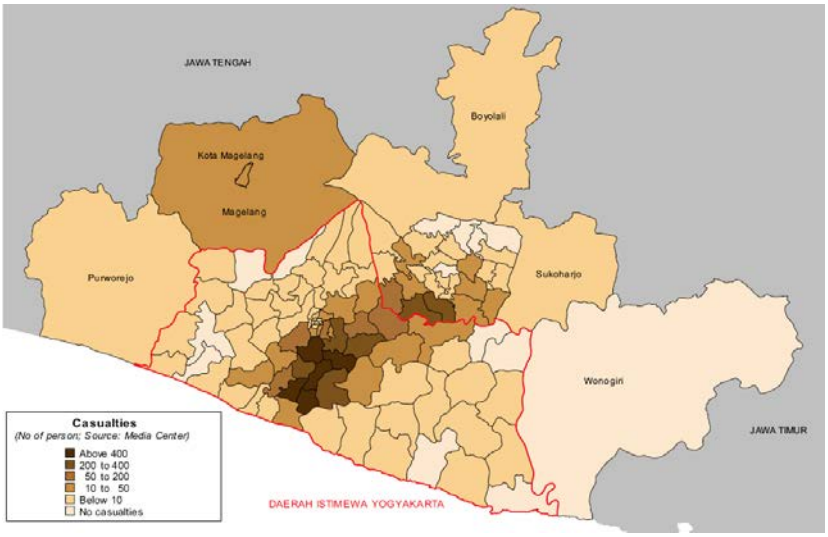
A. Introduction

Indonesia is the world's largest archipelago and the world's most seismically active zones. In recent years, the country has been hit by a series of great natural disasters. Indonesia is located on the Pacific "Ring of Fire," i.e. a series of volcanoes and fault lines encircling the Pacific Basin. In the year of 2006, one of the most disastrous Eartquake happened in Yogyakarta (Central Java). Recorded 5.9 on the Richter scale, it shook Yogyakarta, and in just some minutes, it killed 5,782 people, injured 50,000, and left as many as 600,000 residents of Bantul Regency displaced.



(Source: YMBI, 2011)

This town, where 80 percent of the homes were flattened, suffered the worst of the devastation.



(Source: IRP, 2009)

There are five key priority areas for disaster risk reduction that must be addressed:

1. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation
2. Identify, assess and monitor disaster risks and enhance early warning
3. Use knowledge, innovation and education to build a culture of safety and resilience at all level

4. Reduce underlying risk factors
5. Strengthen disaster preparedness for effective response at all levels

(T. Yoyok Wahyu Subroto, 2009)

(Photo: Rosyidi, et.el, 2008)

It needs to develop the strategic plan to manage, to prepare and to anticipate the earthquake disaster. The awareness should be given as high priorities among policy initiators, decision makers, administrator at national and local levels, professional bodies, financial institutions, NGOs, voluntary organizations and educational sectors. In the case of education, curriculum is centered on a series of ready-to-go lesson plans that help organizations educate youth about important disaster safety and preparedness information. However, in the case of disaster management in Indonesia, we have not yet until to formulate and develop such curriculum. Enjoyable and interactive lesson may ensure that children are having fun while internalizing important life skills through building capabilities in Mathematics on one hand; while on the other hand improve their awareness about earthquake disaster.

B. Various Related Lesson Study Activities in Schools of Disaster Area

1. IMSTEP – before the 2006's earthquake

In Bantul District, before the 2006's earthquake disaster, it was implemented the Lesson Study activities under IMSTEP_JICA project. This project was supported by three universities UPI Bandung, UNY Yogyakarta, and UM Malang. The implementation of lesson study has some impacts as follows (1) collaboration, collegiality, and communication among

teachers and lecturers are formed, (2) Implementation of research lesson is opened to be observed by others, (3) Mathematics lecturers directly involved in mathematics instruction in school, (4) Mathematics teachers association is more empowered

2. SISTTEMS – after the 2006's earthquake

JICA has supported to implement Program for Strengthening In-service Teacher Training for Science and Mathematics (SISTTEMS, 2006-2008), in the disaster area of Bantul. It targeted all junior secondary science and mathematics teachers in three districts and restructured the district level in-service teacher training by introducing Lesson Study(LS). This program takes advantage of results and experiences of the previous projects and programs, and aims to disseminate Lesson Study models extensively in the nation.

3. SBLS (School Based Lesson Study) – after the 2006's earthquake

Lesson Study activities have been diffused in Bantul district after the event of 2006 earthquake disaster. It was conducted by PELITA in collaboration with JICA. Resource Persons are from among the principals, teachers, officials from Dinas P&K, and lecturers from resource universities from three districts who have an eye to observe lessons, who can make good comments on the essence of students' learning in reflection, and who have experience in implementing LSBS activities in their own schools.

C. Developing Mathematical Problem Solving to Prepare the Implementation of Lesson Study in the Schools of Disaster Area

In Indonesia, the curriculum outlines the aims of teaching learning of mathematics are as follows: (1) to understand the concepts of mathematics, to explain the relationships among them and to apply them to solve the problems accurately and efficiently, (2) to develop thinking skills to learn patterns and characteristics of mathematics, to manipulate them in order to generalize, to proof and to explain ideas and mathematics propositions, (3) to develop problems solving skills which covers understanding the problems, outlining mathmatical models, solving them and estimating the outcomes, (3) to communicate mathematics ideas using symbols, tables, diagrams and other media, and (4) to develop appreciations of the uses of mathematics in daily lifes, curiosity, consideration, and willingness to learn mathematics as well as tough and self-confidence.

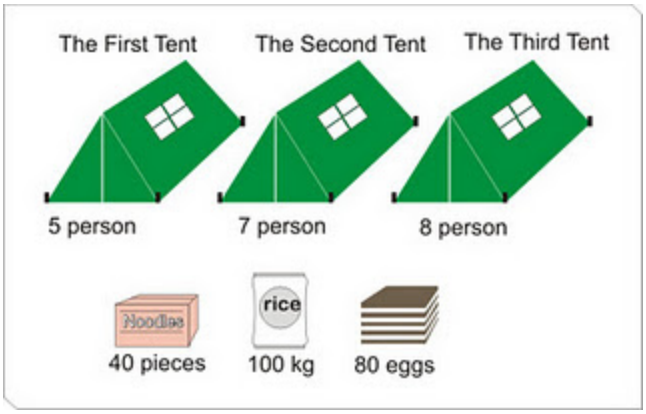
The teachers perceived that in order to promote problem solving activities more effectively, they expected still to have a need: (1) to make good atmosphere for teaching and learning, (2) to promote to implement various teaching methods and teaching learning resources, (3) to give the chances for their students to perform their initiatives, (4) to promote cooperative learning, and (5) to support the students to be the active learner. Meanwhile, Polya (1957) outlined the steps of problem solving activities as follows: (1) Understand the problem, (2) Devising a plan, (3) Carrying out the plan, and (4) Looking back. He suggested that the students should have to understand the problem, to identify the unknown, to collect the data, to understand the condition. The students also need to know whether it is possible to satisfy the condition; whether the condition is sufficient to determine the unknown; whether it is insufficient or redundant, even may be contradictory. In devising the plan, the students need to find the connection between the data and the unknown. They may be obliged to consider auxiliary problems if an immediate connection cannot be found. They should develop a plan of the solution. When the students carrying out the plan of the solution, the teachers may check each step as well as examine the solution obtained.

The method to produce disaster related mathematical problem solving was to give the tasks to the prospective teachers who come from the disaster area. They are now as the Undergraduate students of Mathematics Education Department, Faculty of Mathematics and Science, Yogyakarta State University. For the total number of 40 prospective teachers, they have been given such a procedure to produce disaster related mathematical problems and their solution, as follows: 1) to in-depth study about the nature of mathematical problem solving, 2) to memorize and record their disaster experiences related to mathematical problems, 3) to produce disaster related mathematical problems, and 4) to solve each own problem. Followings are the samples of earthquake disaster related problems and their solutions produced by prospective teachers:

Problems to be developed	**Developed solution**
Problem 1: The goverment has calculate the budget about Rp 11 billions for two village which be the victim of earthquake. The budget for the first village Rp 4,5 billions, and for the second village Rp 6,5 billions. The first village consist of 295 broken houses in easy category and 162 broken houses in	**Solution:** For example the broken houses in easy category is x and the broken houses in serious category is y. Therefore the mathematical models are $295x + 162y = 4500000000$ $518x + 192y = 6500000000$ Then, the ellimination method

serious category. The second village consist of 518 broken houses in easy category and 192 broken houses in serious category. So, how much the number of help which will be received for every broken houses in easy and serious category.	$295\,x + 162y = 4500000000 \quad \times 192$ $518\,x + 192y = 6500000000 \quad \times 162$ $56640\,x + 31104y = 864000000000$ $83916\,x + 31104y = 1053000000000$ (-) $-27276x = -189000000000$ $x = 6929168{,}5$ $x = 6929168{,}5$ To find the value of y, we can use the substitution method. Sustitute value of x in first equation. $295\,x + 162\,y = 4500000000$ $295(6929168{,}5) + 162\,y = 4500000000$ $204410478 + 162\,y = 4500000000$ $162\,y = 4500000000 - 204410478$ $162\,y = 2455895293$ $y = 2455895293 : 162$ $y = 15159847{,}48$ Therefore, every broken house in easy category gets about Rp 7 billions and every broken house in serious category gets about Rp 15 billions.
Problem 2: The earthquake which happened in Yogyakarta about five years ago made a lot of victims. More than one hundred thousand people were dead, and more than one thousand houses were broken. Goverment help the victim of Earthquake in Yogyakarta by a lot of way. One of them is give the victims money to build up again their home. If a home can finished about sixty days with twelve bricklayers. Because something reason, a home have to finish for 40 days. How many bricklayers have to seek to make a home? how to solve this problem??	**Solution:** To solve this problem, we need mathematics. We knoew that a home can be finish about sixty days with twelve bricklayers. But, we must finish a home for fourty days. To solve this problem, we use the way: Days | Bricklayers 60 | 12 40 | x the multiplisation days (1) equals to days (2) so $60 \,.\, 12 = 40 \,.\, x$ $x = 60.12/40$ by cancel out sixty and fourty, we find that x equals to one point five times twelve So, $x = 1{,}5 \,.\, 12$ $x = 18$ that is the last of equality ($x = 18$). So, a home have to finish for 40 days with 18 bricklayers. We have twelve bricklayers. So, we must find six bricklayers again to help twelve bricklayers the other. That us all, so simple and interesting. It is because mathematics.

Problem 3: In 2006 an earthquake occurred quite terrible in Yogyakarta are children / toddlers. Many refugees everywhere, covering an area of refuge is an area of 350 m2 only inhabited by 5600 people. 15% resi% of them are parents / seniors. What is the density of the inhabitants of refugee camps and how many people whether refugees are teenagers and adults?	**Solution:** Broad camps: 350 Number of refugees: 5600 Percentage of children under five: 15% Percentage of seniors: 20% Question: The density of refugees in the refugee camps and how many of are teenagers and adult ? Answer: Density = the number of refugees displaced / refugee area Displacement density = 5600 / 350 = 16 people per square meter Percentage of refugee teens: 100% - (15% + 20%) = 100% - 35% = 65% The number of displaced adolescents and adults 65% × 5600 = 3640 people
Problem 4: An earthquake is a vibration or shocks that occur in the earth's surface due to release a sudden energy that creates seismic waves. And an earthquake measuring 6.7 on the Richter scale (SR) that occurs in Subulussalam, Aceh on the morning of 6 September 2011 has resulted in damage to several public facilities.Subulussalam city secretary, H. Damhuri, mentions that there are 12 school units, 4 units health centers, and three bridges damaged. As a form of concern, then 5 days after the quake, the city government to provide assistance with direct Subulussalam provides 84 workers to do school improvement, and 28 workers to make improvements and puskesdes health centers, and 30 workers to do repair damage to the bridge. If 5 workers can complete the job for two weeks for each unit of public facilities were damaged. Then, how long repairs could be done at each facility were damaged?	**Solution:** # 12 schools Number of workers = 84 : 12 = 7 workers for one unit of school. Number of workers | Time 5 | 2 weeks (14 days) 7 | P The multiplication results of each row should be the similar, so we have an inverse proportion as follows : $5 \times 14 = 7 \times p$ <=> $p = \frac{5 \times 14}{7} = 10$ It is conclude that it can be done in 10 days for one unit of school. # 4 health centers Number of workers = 28 : 4 = 7 workers for one unit of health center. Number of workers | Time 5 | 2 weeks (14 days) 7 | Q The multiplication results of each raw should be the similar, so we have an inverse proportion as follows : $5 \times 14 = 7 \times q$ <=> $q = \frac{5 \times 14}{7} = 10$ It is conclude that it can be done in 10 days for one unit of health center. # 3 bridges Number of workers = 30 : 3 = 10 workers for one unit of bridge.

	<table><tr><th>Number of workers</th><th>Time</th></tr><tr><td>5</td><td>2 weeks (14 days)</td></tr><tr><td>10</td><td>z</td></tr></table> The multiplication results of each raw should be the similar, so we have an inverse proportion as follows : $5 \times 14 = 7 \times z$ <=> $z = \frac{5 \times 14}{10} = 7$ It is conclude that it can be done in 7 days for one unit of bridge.
Problem 5: In a natural disaster victims will inevitably arise that need help, either in money or materials. In an earthquake there were approximately 300 victims who have not had time to save their possessions and forced to flee to a place of refuge. Of course the government should participate in funding assistance to the victims. In terms of food, the government should provide adequate funding so that all victims can eat 3 times a day. If the government has 135 million rupiahs to funds the foods for the victims in a month, then what price a maximum of 1 pack of rice so that each victim can eat 3 times a day in a month?	**Solution:** Number of victims = 300 Eat frequency = 3 times Number of funds = 135000000 The length of victims displaced = 30 days asked: Maximum price of rice packets to every victim can eat three times a day? completion: Will look for the maximum price of rice packs that every victim can eat three times a day. Maximum price of rice packets is directly proportional to the available funds and inversely proportional to the number of victims, frequency of meals, and duration of displaced victims. In mathematics can be formulated as follows: Take any variable to represent the maximum price of rice packs, eg "A". then: A= Number of funds divide by (number of victims times eat frequency times the length of victims displaced) $= \frac{135000000}{300 \times 3 \times 30}$ $= \frac{135000000}{27000}$ $= 5000$ So, the maximum price of rice packets is 5000 rupiahs.
Problem 6: In the little region had been happen earthquake. The houses of the people in there break down. Then they build evacuation tents. The total of the tents is three. In the first tent dwelt by five person, the second tent dwelt by seven person, and the third tent dwelt by eight person. In the next day, a donor bring 40 pieces of noodles, 100 kg of rice, and 80 eggs. Then he wants to apportion his contribution and he calculates it. How many the donor give his contribution to each tent?	**Solution:**  First, the total of the contribution for the first tent as follows:

	- noodles: (5/(5+7+8)) x 40 pieces = (5/20) x 40 pieces = 10 pieces - rice : (5/(5+7+8)) x 100 kg = (5/20) x 100 kg = 25 kg - eggs : (5/(5+7+8)) x 80 eggs = (5/20) x 80 eggs = 20 eggs Second, the total of the contribution for the second tent as follows: - noodles: (7/(5+7+8)) x 40 pieces = (7/20) x 40 pieces = 14 pieces - rice : (7/(5+7+8)) x 100 kg = (7/20) x 100 kg = 35 kg - eggs : (7/(5+7+8)) x 80 eggs = (7/20) x 80 eggs = 28 eggs Third, the total of the contribution for the third tent as follows: - noodles: (8/(5+7+8)) x 40 pieces = (8/20) x 40 pieces = 16 pieces - rice : (8/(5+7+8)) x 100 kg = (8/20) x 100 kg = 40 kg - eggs : (8/(5+7+8)) x 80 eggs = (8/20) x 80 eggs = 32 eggs So, the first tent gets 10 pieces of noodles, 25 kg of rice, and 20 eggs. The second tent gets 14 pieces of noodles, 35 kg of rice, and 28 eggs. And the third tent gets 16 pieces of noodles, 40 kg of rice, and 32 eggs.

Tabel : Disaster related mathematics problem to be developed by prospective teachers

D. Preparing Lesson Study to develop problems solving based mathematical textbooks for the schools of disaster area.

In order to motivate the students, the teachers perceived that mathematics textbook should have a good lay out, supporting references, clear cognitive scheme, clear applications of mathematics, examples of daily life, and history of mathematics. The teachers indicated that mathematics textbook should be based and oriented on students' learning activities; therefore, they suggested that it develop student's autonomous, mathematics drill, and problem solving. It is important that it also should be based on school-based curriculum. Further, such a textbook should support the students in achieving their competencies.

Relating to the needs for developing flexible teaching learning method, the teachers perceived that such a textbook should facilitate all students without any exceptionally. It should be used by the students both individually or collaboratively. Furthermore, it also should make the students feel confident and joyful. To make it happens the textbook should be arranged hierarchically and supported by on line internet resources. Step by step of finding the formulas may fulfill the students' need to learn mathematics. However, it is important to note that it provides various quiz and enough exercises and story problems. To make the students feel more confident it should contain answers for each problem.

It is realistic that every developed single book should deal with students' difficulties in learning mathematics. To overcome such condition, such a book should provide various ways to solve the problems. It was suggested that it provides such a space to get students feedback in order to communicate their ideas with their teacher. Therefore, the teachers though how to develop communicative textbook. The writer of textbook should consider how the students are able to understand the procedures. Short and not long sentences can be employed. The combination of good developed teaching content, curriculum based cognitive schema and the clear of the guidance make the students have their ability to develop their cognitive schema in learning mathematics.

The further crucial point of developing mathematics textbook is about its orientation. Presently, there is no further important point to be considered except that the textbook should be based on students learning activities. To meet this criteria such a textbook should employ realistic approach in which the students learn mathematics from the concrete daily life to get direct experiences and useful schema to prepare their activities in developing various model and mathematical procedures. However, there is still an ultimate question on how the textbook do encourage the students to solve mathematics problems?

1. **Aim of Lesson Study**

   To develop mathematical problem solving based textbook that suitable to be used for the schools of disaster area

2. **Subject of Lesson Study**

   The subject of Lesson Study consists of 6 schools i.e. 2 Primary Schools, 2 Junior High Schools and 2 Senior High Schools. The Lesson Study activities will be the collaborations among the teachers in the schools site and the Team from University to carry out the following: 1) to plan the steps of teaching learning processes, 2) to carry out teaching learning processes and to use the developed draft of problem solving based mathematical textbook, 3) to reflect the teaching learning processes, 4) to improve the initial plan, 5) to re-implement teaching learning processes, 6) to reflect the teaching learning processes, 6) to share the experiences to other teachers

3. **Formulated Problem**

   a. How to develop primary problem solving based mathematical textbook for the schools area of disaster.

b. How to develop Junior Secondary problem solving based mathematical textbook for the schools area of disaster.

c. How to develop Senior Secondary problem solving based mathematical textbook for the school are of disaster.

4. Developed Scheme

(1) Form a Lesson Study team,

(2) Focus the Lesson Study,

(3) Plan the study lesson,

(4) Prepare for the observation,

(5) Teaching and observing the lesson,

(6) Debriefing the lesson,

(7) Reflect and plan the next step".

5. Personal/Team Work

People from QITEP (2) , YSU (5), and from the schools

6. Schedule

Step	Activity	Year 2012					
		Feb	**Mar**	**April**	**May**	**June**	**July**
Plan	Establish team work	●					
	Share the ideas	●					
	Develop Lesson Plan, Student Work Sheet, Draft of TextBook	●					
	Develop instrument for observation, questionnaire, interview, etc	●					
Implem en- tation	Collect data in the Open Class in the scheme of Plan-Do See		●	●	●	●	
	Analyses the data		●	●	●	●	
Report	Publish and present the results						●

E. Conclusion

Through Lesson Study, the specialists are to develop problem solving based mathematical textbook for the school area of disaster. The APEC-Tsukuba International Conference VI is the starting point to share ideas on preliminary knowledge of various problems emerging from the context of education in the disaster area. Various skills and experiences as well as capability to do collaboration is the important factors to achieve the goal. In order to be able to produce the relevant textbooks, we suggest that the team members should:1) Develop skills and experiences on problem solving based teaching; (2) Find committed group to participate intensively in lesson study activities; (3) Be realistic about the problems emerging from the site of disaster schools; (4) Develop the timeline for entire process of producing mathematical textbook for the schools area of disaster; (5) Develop mathematical textbook as a broad goal and problem solving based teaching as specific objectives; (6) Implement efficient meetings among the Team members; (8) Develop recording system for lesson study activities and textbook development; (9) Develop detailed and comprehensive teaching materials for Lesson Study activities; (10) Prepare the students in order to make sense of disaster solution; (11) Develop relevant and comprehensive research approach; (12) Develop the scheme in order to be flexible to contextual mathematical problems

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