

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

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Challenges to Emergency Preparedness for Mathematics

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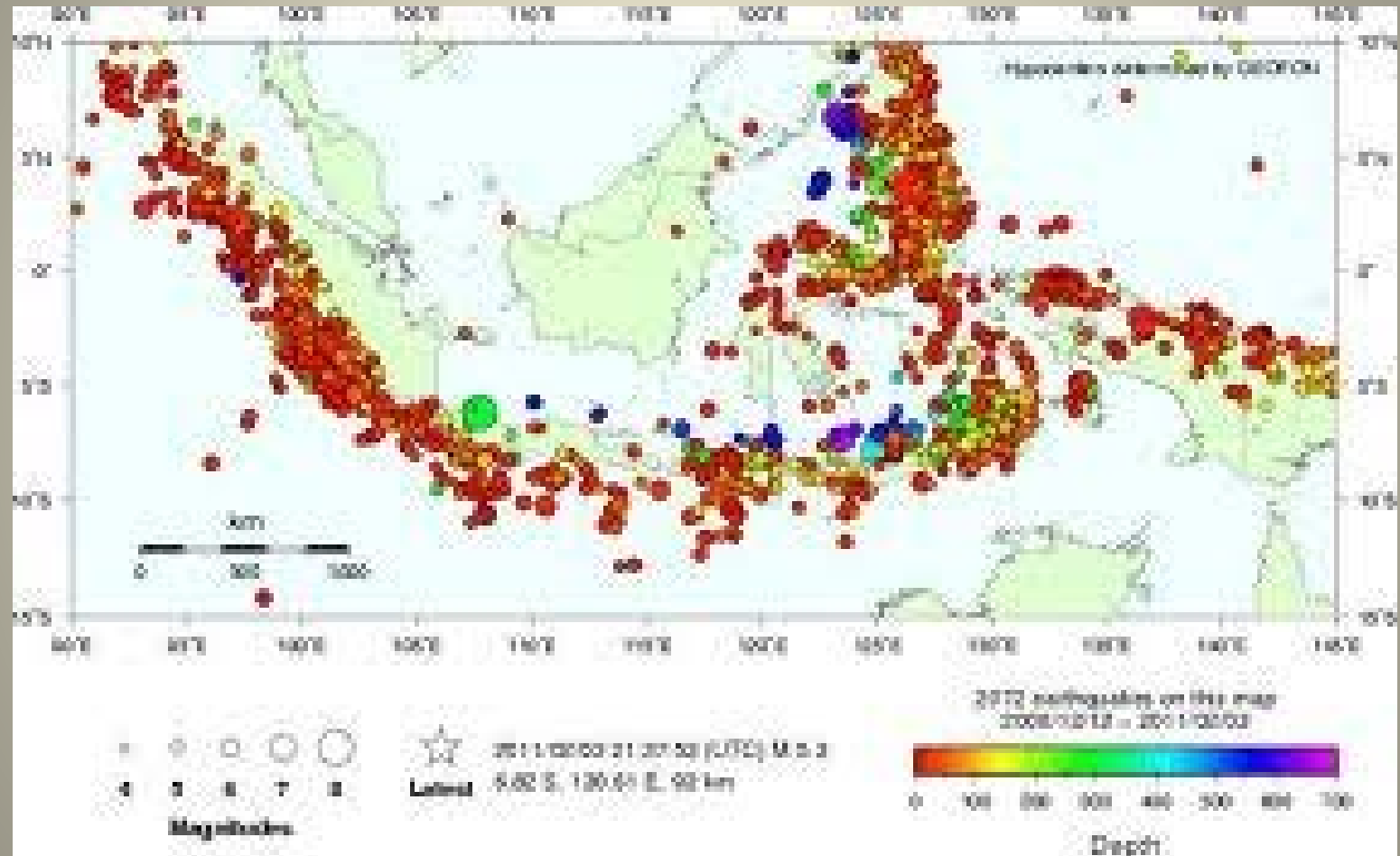
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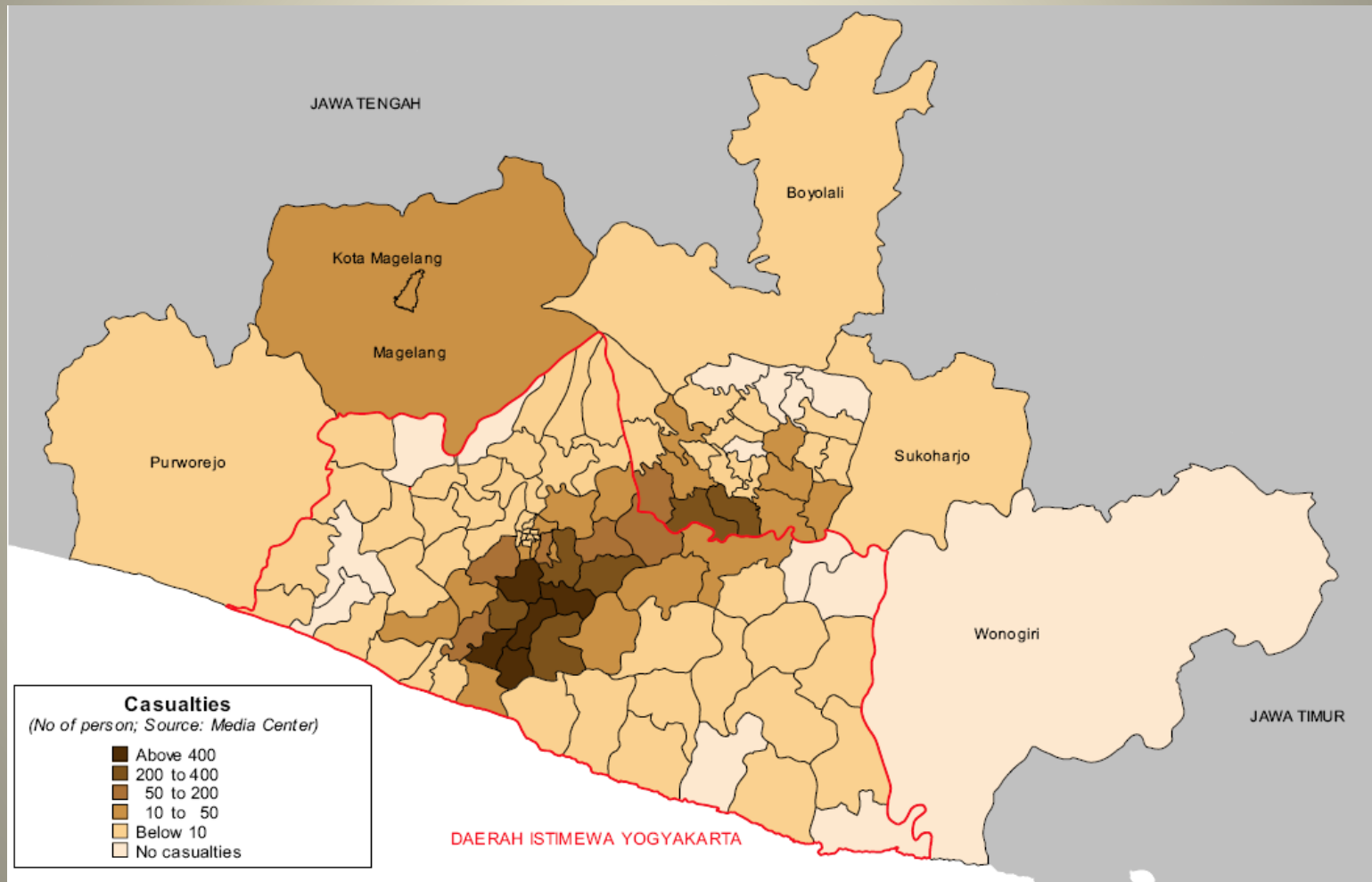
Data of Earthquake in Indonesia at the Last Century

(Source: YMBI, 2011)



Data of Casualties in Bantul's Earthquake 2006

(Source: IRP, 2009)



Damage and Impact of Yogyakarta and Central Java Earthquake (Bantul) 2006

(Source: Bappenas in Yoyok Wahyu Subroto, 2006)

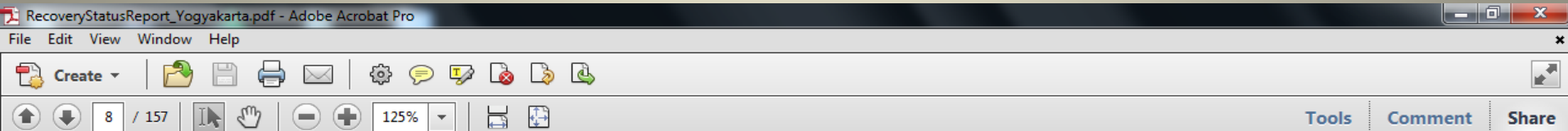
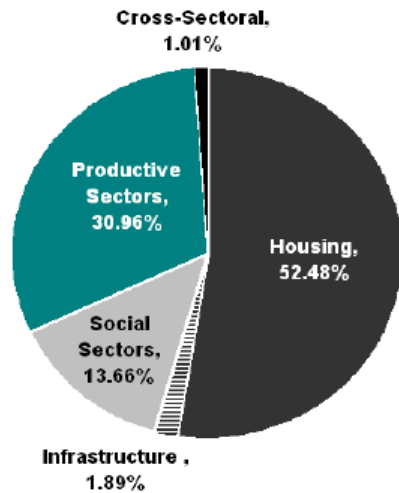


Table1. Damage and Impact of Yogyakarta and Central Java Earthquake 2006



Item	Quantity
Affected Districts	11
Most Affected Districts	2
Affected People	880,000
Deaths	5,716
Injured	37,927
Displaced	600,000

Sector	Disaster Effect				Ownership	
	Damages	Losses	Total	%	Private	Public
Housing	13,915	1,382	15,297	52.48%	15,296	0
Infrastructure	397	154	551	1.89%	76	476
• Transport and Telecommunications	90	0	90	0.31%	0	90
• Energy	225	150	375	1.29%	0	375
• Water and Sanitation	82	4	86	0.30%	76	10
Social Sectors	3,906	77	3,982	13.66%	2,112	1,870
• Education	1,683	56	1,739	5.97%	584	1,154
• Health and Social Protection	1,569	21	1,590	5.45%	1,030	560
• Culture and Religion	654	0	654	2.24%	498	156
Productive Sectors	4,348	4,676	9,024	30.96%	8,854	170
• Agriculture	66	640	706	2.42%	700	5
• Trade	184	120	304	1.04%	138	165
• Industry	4,063	3,899	7,962	27.31%	7,962	0
• Tourism	36	18	54	0.19%	54	0
Cross-Sectoral	185	110	295	1.01%	48	274
• Government	137	0	137	0.47%	0	137
• Banking, Finance	48	0	48	0.16%	48	0
• Environment	0	110	110	0.38%	0	110
Total in IRD	22,751	6,399	29,149	100%	26,386	2,763
Total in Million US\$	2,446	688	3,134		2,837	297

Source: Preliminary Damage and Loss Assessment, Bappenas 2006



Damage and Impact of Yogyakarta and Central Java Earthquake (Bantul) 2006



Priority areas for disaster risk reduction that must be addressed:

- Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation
- Identify, assess and monitor disaster risks and enhance early warning
- ***Use knowledge, innovation and education to build a culture of safety and resilience at all level***
- Reduce underlying risk factors
- Strengthen disaster preparedness for effective response at all levels

(T. Yoyok Wahyu Subroto, 2009)

Various Related Lesson Study Activities in Schools of Disaster Area

IMSTEP – before the 2006's earthquake (1999-2004)

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

Various Related Lesson Study Activities in Schools of Disaster Area

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.

Various Related Lesson Study Activities in Schools of Disaster Area

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.

Indonesian Competencies on Mathematics

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 mathematical models, solving them and estimating the outcomes,
- (4) to communicate mathematics ideas using symbols, tables, diagrams and other media, and
- (5) to develop appreciations of the uses of mathematics in daily lives, curiosity, consideration, and willingness to learn mathematics as well as tough and self-confidence.

Developing Problem Solving Based Teaching Learning Processes for Schools in Disaster Area

To promote problem solving based mathematics teaching learning processes in the schools of disaster area, we 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.
6. to improve awareness of problem solving approach.

Strategies for Problem Solving Activities

The strategies for problem solving activities in mathematics consist of:

1. Trial and Error,
2. Making diagram,
3. Trying the simple problem,
4. Making Table,
5. Finding the pattern,
6. Breaking down the goal,
7. Considering the possibilities,
8. Thinking Logically ,
9. Reversing the Order, and
10. Identifying the impossibility.

Polya and Pasmep (in Fajar Shadiq:2004:13)

The Criteria for the Problem Solving based Mathematics Textbook

Problem solving based mathematics textbook should meet the following criteria:

- It should motivate the students to learn mathematics
- It should develop students' oriented teaching learning of mathematics
- It should support of achieving learning objective
- It should employ flexible teaching learning method
- It should facilitate students' need to learn mathematics
- It should facilitate the students to do exercise mathematics
- It should dealing with the students' difficulties in learning mathematics
- It should consist of summary
- It should as a communicative writing
- It should develop the cognitive schema of learning mathematics
- It should be as a students' learning oriented
- It encourage the students to solve mathematics problems

Prospective Teachers are to Identify the Mathematical Problems Arising from the Area of Disaster

Prospective Teachers:

1. They are undergraduate students of Mathematics Education Department, Faculty of Mathematics and Science, Yogyakarta State University
2. They are the inhabitant of disaster area of earthquake
3. They had various experiences of life as the impact of earthquake disaster in Bantul district.

The Prospective Teachers Were Preparing to Develop Mathematical Problems Reflecting their Own Experiences of Earthquake Disaster



Samples of Developed Disaster Related Mathematics Problems and Its Solution

Problem 1:

The government 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 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.

Samples of Developed Disaster Related Mathematics Problems and Its Solution

- **Solution of Problem 1:**

- 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 elimination method

- $295x + 162y = 4500000000 \quad \times 192$

- $518x + 192y = 6500000000 \quad \times 162$

- $56640x + 31104y = 864000000000$

- $83916x + 31104y = 1053000000000 \quad (-)$

- $-27276x = -189000000000$

- $x = 6929168,5$

- $x = 6929168,5$

- To find the value of y , we can use the substitution method. Substitute value of x in first equation.

- $295x + 162y = 4500000000$

- $295(6929168,5) + 162y = 4500000000$

- $204410478 + 162y = 4500000000$

- $162y = 4500000000 - 204410478$

- $162y = 2455895293$

- $y = 2455895293 : 162$

- $y = 15159847,48$

- Therefore, every broken house in easy category gets about Rp 7 billions and every broken house in serious category gets about Rp 15 billions.

Samples of Developed Disaster Related Mathematics Problems and Its Solution

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. Government 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?

Samples of Developed Disaster Related Mathematics Problems and Its Solution

- **Solution of Problem 2:**

- To solve this problem, we need mathematics. We know that a home can be finish about sixty days with twelve bricklayers. But, we must finish a home for forty days. To solve this problem, we use the way:

Days	Bricklayers
60	12
40	x

- the multiplication days (1) equals to days (2)

so $60 \cdot 12 = 40 \cdot x$

$$x = 60 \cdot 12 / 40$$

by cancel out sixty and forty, we find that x equals to one point five times twelve

So, $x = 1,5 \cdot 12$

$$x = 18$$

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.

Samples of Developed Disaster Related Mathematics Problems and Its Solution

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% 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?

Samples of Developed Disaster Related Mathematics Problems and Its Solution

- **Solution for Problem 3:**

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 = $5600 / 35 = 16$ people per square meter

Percentage of refugee teens: $100\% - (15\% + 20\%) = 100\% - 35\% = 65\%$

The number of displaced adolescents and adults

$65\% \times 5600 = 3640$ people

Samples of Developed Disaster Related Mathematics Problems and Its Solution

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 fund 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?

Samples of Developed Disaster Related Mathematics Problems and Its Solution

Solution for Problem 5:

Number of victims = 300

Eat frequency = 3 times

Number of funds = 135000000

The length of victims displaced = 30 days

To be asked:

Maximum price of rice packets to every victim can eat three times a day?

Solution:

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:

$A = \text{Number of funds} \div (\text{number of victims} \times \text{eat frequency} \times \text{the length of victims displaced})$

$$A = 135000000 : (300 \times 3 \times 30)$$

$$A = \frac{135000000}{27000}$$

$$A = 5000$$

So, the maximum price of rice packets is 5000 rupiahs.

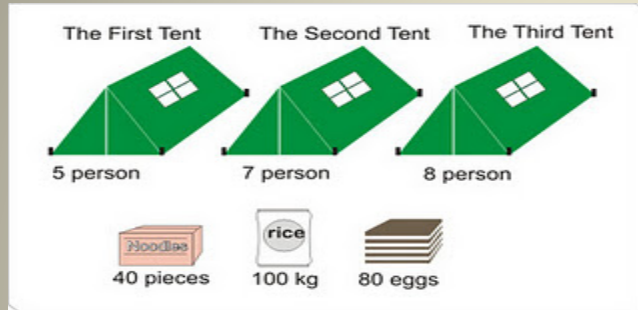
Samples of Developed Disaster Related Mathematics Problems and Its Solution

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?

Samples of Developed Disaster Related Mathematics Problems and Its Solution

Solution for Problem 6:



First, the total of the contribution for the first tent as follows:

- noodles: $(5/(5+7+8)) \times 40$ pieces = $(5/20) \times 40$ pieces = 10 pieces
- rice : $(5/(5+7+8)) \times 100$ kg = $(5/20) \times 100$ kg = 25 kg
- eggs : $(5/(5+7+8)) \times 80$ eggs = $(5/20) \times 80$ eggs = 20 eggs

Second, the total of the contribution for the second tent as follows:

- noodles: $(7/(5+7+8)) \times 40$ pieces = $(7/20) \times 40$ pieces = 14 pieces
- rice : $(7/(5+7+8)) \times 100$ kg = $(7/20) \times 100$ kg = 35 kg
- eggs : $(7/(5+7+8)) \times 80$ eggs = $(7/20) \times 80$ eggs = 28 eggs

Third, the total of the contribution for the third tent as follows:

- noodles: $(8/(5+7+8)) \times 40$ pieces = $(8/20) \times 40$ pieces = 16 pieces
- rice : $(8/(5+7+8)) \times 100$ kg = $(8/20) \times 100$ kg = 40 kg
- eggs : $(8/(5+7+8)) \times 80$ eggs = $(8/20) \times 80$ 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.

Proposed Lesson Study for Developing Problem Solving Based Mathematics Textbook

Aim of Lesson Study

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

Proposed Lesson Study for Developing Problem Solving Based Mathematics Textbook

The steps of proposed Lesson Study activities:

1. to plan the steps of teaching learning processes,
2. to carry out teaching learning processes and to use
3. the developed draft of problem solving based
4. mathematical textbook,
5. to reflect the teaching learning processes,
6. to improve the initial plan,
7. to re-implement teaching learning processes,
8. to reflect the teaching learning processes,
9. to share the experiences to other teachers

Proposed Lesson Study for Developing Problem Solving Based Mathematics Textbook

Formulated Problem

- How to develop primary problem solving based mathematical textbook for the schools area of disaster.
- How to develop Junior Secondary problem solving based mathematical textbook for the schools area of disaster.
- How to develop Senior Secondary problem solving based mathematical textbook for the school are of disaster.

Proposed Lesson Study for Developing Problem Solving Based Mathematics Textbook

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	●					
Implemen-tation	Collect data in the Open Class in the scheme of Plan-Do See		●	●	●	●	
	Analyses the data		●	●	●	●	
Report	Publish and present the results						●

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