ACHIEVEMENT OF INDONESIAN STUDENT IN ASSESSMENT BY USING ONLINE MATHEMATICAL PROBLEMS

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Abstract

This paper presented the student achievement when they had assessed by using online mathematical problems (OMP). The aim of this research is to classify the ability of student when they answered OMP like PISA. The data collected by using online test and interviews which are administered to twenty student grade 10th at KusumaBangsa, Palembang, Indonesia. The method are used in this research is development research which consist of three stage namely; preliminary,prototyping, and assessment. But for this paper focus only result of online test and interviews to 5 students after they were solved online mathematical problems on field test. In field test, 20 problems are tested to the student. Based on the result of analysis, only 32,28% of students who solved problems level 2, 29,16% for level 3, 22,5% for level 4, and 5% for level 6.

Key Words: OMP, PISA, Student Achievement

Introduction

The development of science and technology caused a revolution in teaching and learning(Kertayasa&Sukayasa, 2013).For example, in PISA(Programme for International Student Assessment), assessment by using paper and pencil test, now can be replaced by using Computer-Based Assessment of Mathematics (CBAM) (Stacey, 2012).Using computer is a reflection of the importance of Information and Communication Technologies (ICTs) for working mathematically in modern societies and by using computer provides a range of opportunities for designers to write test items that are more interactive, authentic and engaging, and which may move mathematics assessment away from the current strong reliance on verbal stimuli and responses, enabling different student abilities to be tapped (Stacey, 2012; OECD, 2013).

PISA was being conducted every 3 years. All OECD (Organization for Economic Co-operation and Development) members participated in this event. Indonesia is a partner country also participated since 2000. Along five times contributed in PISA, the achievement of Indonesian students is disappointing. The following are Indonesian ranking in PISA for mathematics literacy.

Table 1. Indonesian Achievement in PISA

Year	Indonesian Ranking	Number of Countries have Participated
2000	39	43
2003	38	41
2006	50	57
2009	61	65
2012	64	65

(Wikipedia, 2013; OECD, 2013)

Some of the factors which causedlow performance of Indonesian students in PISA i.e.; Firstly, weakness in solve non-routine problems (Novita, Zulkardi, & Hartono, 2012). In PISA, problems were tested consists of 6 levels (Level 1 is the lowest level. Level 6 is the highest level). While Indonesian 15-year-olds are not yet reaching top two levels (Stacey, 2011). The second, evaluation system in Indonesia, which still used low-level problems (Novita, Zulkardi, & Hartono, 2012)?The Weakness of problem solving skills was influenced by the evaluation system in Indonesia. Tests were carried out either by the teacher or the government (National examination) used level 1 and level 2 if compared with PISA problems. So for high level problems, Indonesian students could not reach it. Thirdly, students are accustomed getting and using formal mathematics knowledge in the class (Wu, 2011). In the learning process, teachers usually give the students a formal formula and ask them to use it, without they knew, how to get the formula? What is the formula usefulness in everyday life? The last, lack of PISA problems in Indonesian (Kertayasa, 2014). If we are searching information about PISA in internet, most of PISA problems were provided by OECD in English. So online mathematical problems are important to introduce and assess kinds of PISA problems to all students in Indonesia.

Theoretical Framework

PISA

PISA (Programme for International Student Assessment) is an international assessment of the skills and knowledge of 15-year old (Shiel et al, 2007; OECD, 2009). There are five kinds of skill and knowledge are assessed in PISA i.e. mathematics literacy**,** reading literacy**,** science literacy, problem solving literacy and financial literacy (OECD, 2003; OECD, 2009; Stacey, 2011, OECD, 2013) The first time, this international scale assessment had been conducted on 2000 by Organization for Economic Co-operation and Development (OECD)(Shiel et al, 2007; OECD, 2009; OECD, 2010; OECD, 2013). PISA is conducted every 3 years and many countries participated in PISA, include Indonesia.

The purposes of mathematics literacy are to improve 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 recognize the role that mathematics plays in the world and to make the well-founded judgments and decisions needed by constructive, engaged and reflective citizens (OECD, 2013).

Mathematics literacy in PISA is usually designed by give contextual problems. Context related to personal contexts, societal context, occupational context, and scientific context. All

contexts above can be drive to four contents in PISA such as quantity, uncertainty and data, change and relationships, and space and shape (OECD, 2012; OECD 2013). The following is model of mathematical literacy in practice.

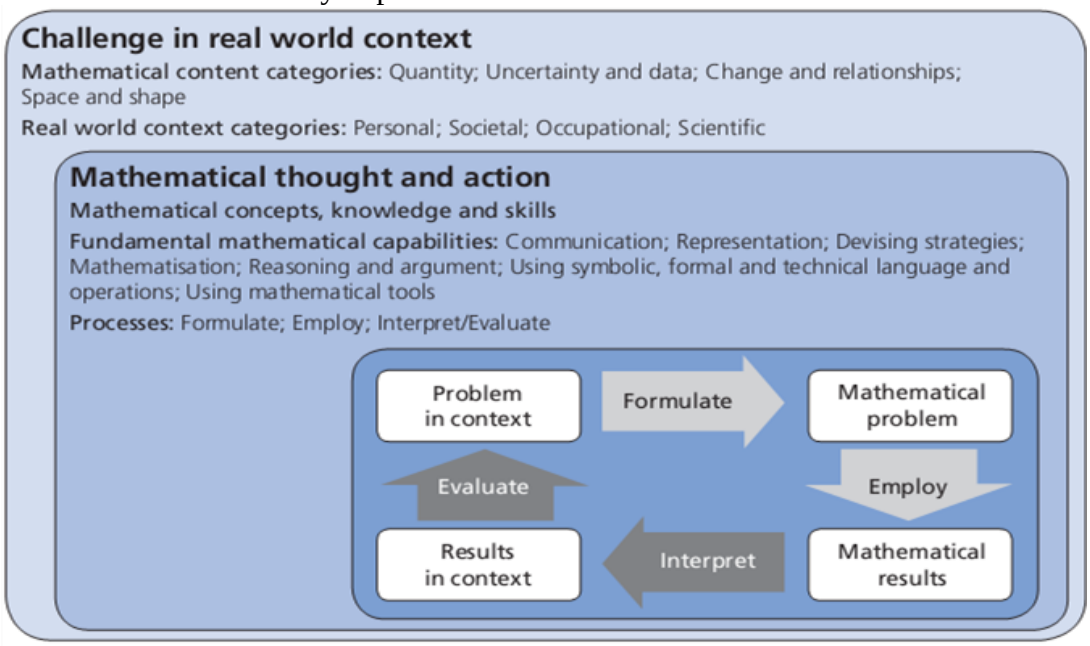


Figure 1. Model of mathematical literacy in practice (OECD, 2013)

Level in PISA

In PISAthere are six levels which are assessed to know the student proficiency in mathematics. The following are six scale in mathematics with its description.

Table 1.Proficiency scale descriptions for mathematics

Level	Description
6	At Level 6 students can conceptualize, generalize and utilize information based on their investigations and modeling of complex problem situations. They can link different information sources and representations and flexibly translate among them. Students at this level are capable of advanced mathematical thinking and reasoning. These students can apply their insight and understandings along with a mastery of symbolic and formal mathematical operations and relationships to develop new approaches and strategies for attacking novel situations. Students at this level can formulate and precisely communicate their actions and reflections regarding their findings, interpretations, arguments and the appropriateness of these to the original situations.
5	At Level 5 students can develop and work with models for complex situations, identifying constraints and specifying assumptions. They can select, compare and evaluate appropriate problem-solving strategies for dealing with complex problems related to these models. Students at this level can work strategically using broad, well-developed thinking and reasoning skills, appropriate linked representations, symbolic and formal characterizations and insight pertaining to these situations. They can reflect on their actions and formulate and communicate their interpretations and reasoning.
4	At Level 4 students can work effectively with explicit models for complex concrete situations that may involve constraints or call for making assumptions.

	They can select and integrate different representations, including symbolic, linking them directly to aspects of real-world situations. Students at this level can utilize well-developed skills and reason flexibly, with some insight, in these contexts. They can construct and communicate explanations and arguments based on their interpretations, arguments and actions.
3	At Level 3 students can execute clearly described procedures, including those that require sequential decisions. They can select and apply simple problem-solving strategies. Students at this level can interpret and use representations based on different information sources and reason directly from them. They can develop short communications when reporting their interpretations, results and reasoning.
2	At Level 2 students can interpret and recognize situations in contexts that require no more than direct inference. They can extract relevant information from a single source and make use of a single representational mode. Students at this level can employ basic algorithms, formulae, procedures, or conventions. They are capable of direct reasoning and making literal interpretations of the results.
1	At Level 1 students can answer questions involving familiar contexts where all relevant information is present and the questions are clearly defined. They are able to identify information and to carry out routine procedures according to direct instructions in explicit situations. They can perform actions that are obvious and follow immediately from the given stimuli.

OMP

To produce OMP which are assessed by using computer, there are three applications which were used in this research namely Adobe flash, Blog/web-blog, and Google Form.

By using adobe flash, the researcher could create more interactive and authentic picture. Because of flash can manipulate vector and raster graphics, and supports streaming of audio and video. It contains a scripting language called ActionScript (Adobe, 2013). ActionScript is easily the most widely used language in new media. Its functionality is applicable in industries such as web design, game design, courseware development, and enterprise-level application development. Developers or graphic designers possessing a keen sense of proper ActionScript usage open a whole new level of opportunity for their career (Milbourne, Kaplan, & Oliver, 2009).

Blog/web-blog are is a website that is maintained by an individual or group with regular updates of information; this information could include diary entries, descriptions of events or in this case educational material. In most blogs readers can supply comments to blog entries, this allows them to ask questions, add information to the blog post or simply comment on a good/bad post (Curran et al, 2011). Blog/website as a useful tool of providing learning experiences to students in the process of enhancing students' knowledge retention thus improve their academic performances.

Blogs differ from traditional websites and provide many advantages over traditional sites, including:

- Easy creation of new pages, since new data is entered into a blog usually through a simple form and then submitted with the blogger (or person adding the entry to the blog website) updating the blog with little or no technical background — blogs have thus become the novice's web authoring tool.

- Filtering of content for various blog entries, for example by date, category, author, or one of many other attributes.
- Most blog platforms allow the blog administrator to invite and add other authors, whose permissions and access are easily managed.
- Providing a personal writing space that is easy to use, sharable, and automatically archived.
- Ability to link and inter-link to form learning communities.
- Opportunity to serve as a digital portfolio of students' assignments and achievements.
- Extensions into fully featured content management systems.

(Duffy &Bruns, 2006)

Google Forms is a useful tool to help you plan events, send a survey, give students a quiz, or collect other information in an easy, streamlined way. A Google form can be connected to a Google spreadsheet. If a spreadsheet is linked to the form, responses will automatically be sent to the spreadsheet. Otherwise, users can view them on the "Summary of Responses" page accessible from the Responses menu (Google, 2013). Kim (2011) claimed that adding Google Forms to the learning activities has resulted in more time on task for students and more engagement with other students and teacher, and with the course material. Moreover, more students complete their homework assignments on time, and test scores have also improved for many students.

PISA's Problems on CBAM

CBAM was developed in this research adopting the first research about CBAM (Stacey, 2012). All information about first research about CBAM can be accessed at *http://cbasq.acer.edu.au/index.php? cmd=toMaths.* Meanwhile, within this research all problems and writing rules can be accessed at *http://www.indonesiapisacenter.com/*. In this website, the student can see all questions, use the animation to help understood the problem, and submitted the answer.

In Indonesia, Indonesia PISA Center is the first website provided problems like PISA where the students able to solve problems through online. In this website also published previous PISA problems which are tested internationally on 2006 and 2012. The figure below is appearance of CBAM which was developed by researcher.

Figure 2. CBAM appearance

Explanation of Figure 2:

1. Title of website. It is consist of title and subtitle respectively Indonesia PISA Center and Mathematics Web for PISA
2. Menu dropdown appearance
3. Title of problem. For example folding paper
4. The animation of folding paper. The student can use it to know number paper that are produced when the folding a paper. The animation was created by using *adobe flash* CS 4 and *action script 3* as language programming.
5. Question of problem
6. Space for input the answer
7. Additional menu for short cut menu or classified category of posts.

Method

Method was used in this research is development studies that has focus on result of field test. The research was conducted in three phases; preliminary stage, prototyping stage, and assessment stage (Zulkardi, 2002; Nieveen&Plomp, 2007). In the preliminary stage, the researcher conducted analysis curricula, analysis subject, analysis supporting media, and made instrument for collecting data such as PISA questions, rubric, interviews guidance, and sheet of walk through. These processes produced first prototype (prototype I). On prototyping stage, 4 phases would be passed i.e. self-evaluation, expert review, one-to-one, small group, and field test. Figure 3 is flow chart of formative evaluation.

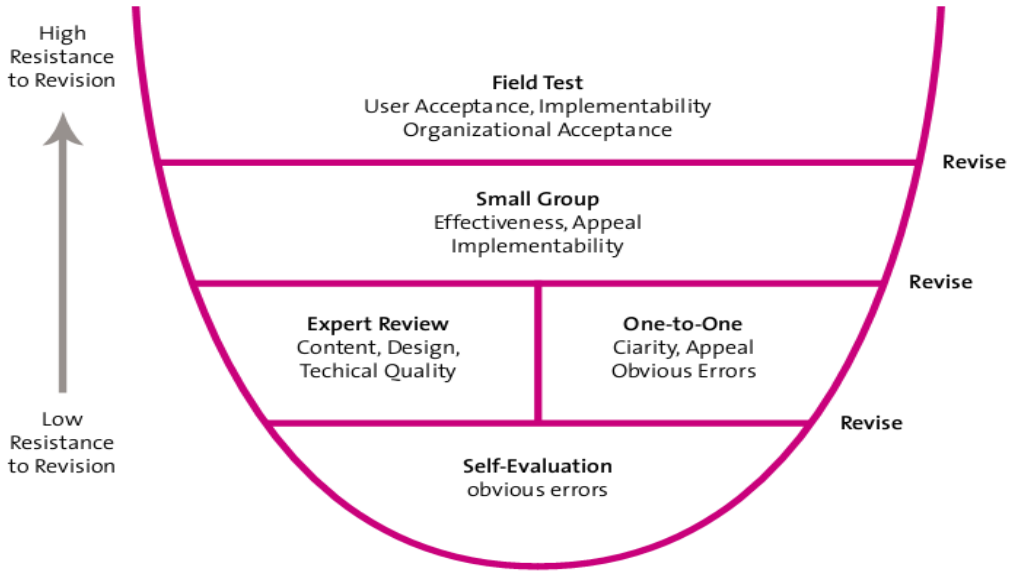


Figure 3.Flow chart of formative evaluation.

Data collected through online test. Online test was administered to 20 student.After online test was conducted, the data about student's work analyzed to know student ability or achievement when he/she did OMP. Subject for this research is SMA KusumaBangsa Palembang, Indonesia.

Result and Discussion

For this paper, the researchers only gave result and discussed data which were collected in field test through online test. On field test, there 20 student were chosen to answer through online by access all prototype 3 questions at www.indonesiapisacenter.com. After that, all students' answers have analyzed to know student achievement in each level. On this test, number of question for each level is different. For example there are 7 questions for level 2, 6 questions for level 3, 4 questions for level 4, and 1 question for level 6. The table below is student achievement on field test.

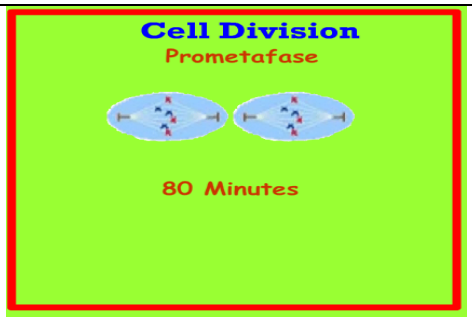
Table 2. Student Achievement on Online test

Level	Percentage
2	32,28%
3	29,16%
4	22,5%
6	5%

Based on result on table 2, we know that achievement of Indonesia student decrease from the lowest level to the highest level. Although, in this research is not using true proficiency level in PISA, but only prediction level. It is caused by to produce true proficiency level in PISA, the instrument should be tested to many students and then analyzed by using Rasch Model. Using higher than level 1 for this research caused by Indonesian 15-year-olds is not yet reaching top two levels (Stacey, 2011). The result above also supported by achievement of Indonesian student in PISA 2012, the

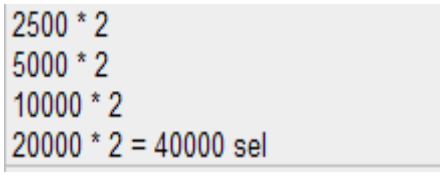
percentage of low performers in mathematics (below proficiency Level 2) is one of the highest among PISA-participating countries and economies. (75.7 %, rank 1/64) and the percentage of top performers in mathematics (proficiency Level 5 or 6) is one of the lowest among PISA-participating countries and economies (0.3 %, rank 63/64) (OECD, 2013). If we compared result of field test and result of PISA 2012, Indonesia student got higher achievement in this test than result of PISA 2012. Some factors which affected it such us in online test, the student could use animation to help her/him to understand the problems and the picture on website more clearly than picture on paper and pencil test.

When they were complete all question in field test, the student also gave various strategies to solve the problem. For example for Unit Cell Division that accompanying with animation, the student has different ways to solve it.



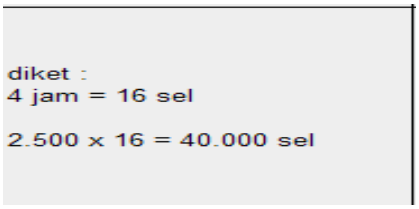
There are 2500 cells separated altogether. How many cells occur in 4 hours? Show your work!

The question above is about cell division, the student seen the animation to know relation between time and number of cells occur. For this question 1 cell divided become 2 cells in 1 hour, or 1 cell divided become 4 cells in 2 hours.



Means:
2500 x 2 = 5000 (in 1 hour)
5000 x 2 = 10000 (in 2 hours)
10000 x 2 = 20000 (in 3 hours)
20000 x 2 = 40000 (in 4 hours)

(a)



Means:
1 cell in 4 hours become 16 cells
So, 2500 cells x 16 = 40000 cells

(b)

Figure 3.Various of student answers for cell division problems

If we see the Figure 3, the student wrote the solution inappropriate ways. They knew the solution but they used false symbol. For example they wrote “4 hours = 16 cells”, as we know it is false syntax. These problems caused by National examination in Indonesia used multiple choices. So, the last result is more important than the process. It also caused by write symbol on computer more difficult than on paper

Conclusion

On Field test, 20 problems are tested to the student. Based on the result of analysis, only 32,28% of students who solved problems level 2, 29,16% for level 3, 22,5% for level 4, and 5% for level 6. The achievement of Indonesian student by using OMP higher than paper and pencil test, it is caused by student can use animation and picture on website clearer.

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