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STUDENTS' RESPONSES TO THE REALISTIC MATHEMATICS TEACHING APPROACH IN JUNIOR SECONDARY SCHOOL IN INDONESIA

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Abstract.
Contextual learning materials for mathematics based on the realistic teaching approach were designed and implemented for junior secondary school classroom environment in Indonesia, specifically for Bandung area. Prior to the implementation stage, the materials have been tried out at the students of pre-service teacher training of mathematics both in Indonesia (UPI students) and in Australia (LTU students). The results indicated that two cohorts of pre service teacher students recommended to implement the materials for Indonesian classroom context.

During February-April 2005, the materials were implemented for 9 year-8 classrooms among the 13 randomly selected classrooms. Beside the students' achievement in mathematics to be measured, some qualitative data with respect to students' responses and students' reactions to the materials were collected by using an interview guidelines, daily journal, and field note.

The overall results of the studies indicated that the students like the materials and they expected that the materials can be used continuously for Indonesian classroom context. Generally the students said that the contextual learning based on the realistic approach emphasized reasoning, not mathematical formulas. They said that they like this approach because it was different from the previous approaches that usually taught by their teachers. For example one student commented "I remember, I like this approach because I could use my own strategies, I could express what I imagined which ultimately that the elephant was the winner … the elephant moved to the left, and finally I could make a decision". Another student commented "No longer mathematics was a difficult subject. Using this new teaching approach, I have more understanding how to solve the problem and we could discuss the solution in a group work, so it worked easily".

From the students' comments about their impression toward mathematics teaching using the contextual learning based on the realistic approaches, the data indicate that generally students enjoyed the change. They were more interested in this new teaching approach for various reasons: that their ability was tested, that it was different from previous teaching approaches, that it was not boring, that it helped them become more interested in mathematics, and that it motivated the students to be more creative in learning mathematics by finding a new solution method.

Keywords: Contextual learning, realistic teaching approach, students' responses

1. INTRODUCTION

Innovations in mathematics education in Indonesia constitute an integral part of its educational system. Some innovations which particularly focus on the teaching and learning of mathematics can be used as models, for example, the perspectives of Wood and Berry (2003), Romberg (1992), De Lange (2000), Gravemeijer (2000), Miller and Hunt (1994), Lewis (2000) and Stein (1998). Learning and teaching strategies of mathematics which challenge students to learn mathematics need to be tested and monitored to yield the best and the most effective ways to learn and teach mathematics. This can be done by using "design research" (Wood & Berry, 2003), "development of new instructional techniques or program" (Romberg, 1992), "developmental research"(De Lange, 2000; Gravemeijer, 2000), "collaborative learning experience in action research" (Miller and Hunt, 1994), "Japanese Lesson Studies" (Lewis, 2000), or "reflective practice groups and communities of practice" (Stein et al., 1998).

All these types of innovation are guided by the strategies advocated by the Netherlands' experts in mathematics education (Goffree & Dolk, 1995; Jan de Lange, 1987; Freudenthal, 1991; van den Heuvel-Panhuizen, 2000) which is relevant the Standard and Evaluation Curriculum (NCTM, 1989), Professional Standard for Teaching Mathematics (NCTM, 1991), Assessment Standard for School Mathematics (NCTM, 1995), Open Ended Approach (NCTM, 1997), and Australian Statement for School Mathematics (AEC, 1990).

According to Zamroni (2000), Indonesian education orientation has traditionally been characterized by several points, namely, a tendency to treat students as objects, put the teachers as the highest authority holder, present courses as subject-oriented, and place management as centralized. As a consequence, educational practice is isolated from real life, with no relevance between what is taught and what is needed in the market place; and it needs a stronger focus on the intellectual development of the students. In contrast, the new paradigm of education focuses on learning rather than teaching, education is organized in a more flexible structure, the learners are treated as individuals with certain characteristics, and education is a continuous process and interacts with environment (Zamroni, 2000).

Introducing a new teaching approach requires research to monitor and validate it. Regarding mathematical competence as an instructional goal, there is a common agreement that the final goal of student learning is the acquisition of a mathematical disposition rather than an accumulation of isolated concepts and skills. Accordingly, the way students acquire mathematical knowledge and skills should be re-organized. It must involve students in active learning (Verschaffel & Corte, 1996)

The international trend noted above leads to many new approaches to the teaching and learning of mathematics, such as realistic mathematics (De Lange, 1996), contextual learning (Hirsh, 1996), open-ended (Becker & Shimada, 1997), and problem solving (Silver, 1988; NCTM, 2000).

This paper examines the students' responses toward the realistic teaching approach which was introduced to the students in Indonesian junior secondary school. It is part of Ph.D. thesis at Latrobe University, Victoria Australia.

A. Background and Literature Review

A number of projects prior to the current study give a positive impact to the students' and the teachers' impression towards mathematics. However, the instructional design of realistic mathematics has not implemented for junior secondary students in Indonesia. There were some obstacles regarding the implementation of new teaching approaches prior to the current study, some of them were unsuccessful to be implemented (Rakajoni & Semiawan, 1993). For example, design of SPP/CBSA (students active learning). Under ideal conditions, the SPP/CBSA projects were effective in changing how to teach subjects (mathematics, sciences, social studies, languages) (Aarons, 1989), but when these teaching approaches were disseminated in a wider context they were unsuccessful (Rakajoni & Semiawan, 1993)

The JICA-IMSTEP project is a long term project to be implemented eventually at the national level. The university that was involved in it was described as "Growth-

Centered" (Shimozawa, 1995). This project focused on the improvement at all school levels through the improvement of teaching strategies in teacher training colleges. This project is still taking place in Bandung (West Java), Yogyakarta (Daerah Istimewa Yogyakarta) and Malang (East Java). Most of activities in the JICA-IMSTEP project during 2003-2006 were pilot studies or what in the Japanese tradition is called Lesson Study (Lewis, 2000), a try-out of mathematics and sciences teaching strategies in junior as well as senior secondary schools. The results of the project indicate that the teachers involved in the studies have improved their awareness of the new approaches. There are other promising results, but these are not specifically in mathematics.

Contextual Teaching and Learning in Sciences, Mathematics, English, and Social Studies projects were developed in Surabaya (Umaedi, 2003). Mathematics in this framework was not based on the RME theories. This project emphasized the development of students' materials (books) for many subjects. Though this project has not shown optimal results, this project seems applicable to a wider context.

PMRI (Pendidikan Matematika Realistik Indonesia) was introduced in 2002. The 10-year project, which deals with the innovation of primary mathematics instruction based on the realistic perspective, was conducted in the three different cities, Bandung, Yogyakarta, and Surabaya (PMRI, 2002), and now become wider context in several area in Indonesia. The results of the project indicate that this teaching approach is being positively accepted by both students and teachers. It is improving teachers' confidence to teach mathematics and developing students' democratic attitudes. The teaching is becoming student-centered, and the teachers are becoming better helpers, more aware of classroom management, collaborative work, learning processes, and constructivist perspectives. The early results of the project are promising (Zulkardi, 2003, Furqon, 2004).

Several small studies were conducted to investigate the effect of the realistic mathematics teaching approach on the students' attitude toward mathematics. These were case studies, with data gathered by interviewing and observing the learners and teachers in the classroom. The results indicated that the students were motivated to learn more about mathematics, and the students also responded to the teaching strategies used by the teachers. All these small studies used trainee students as teachers (Turmudi, 2001; Turmudi & Dasari, 2001; Turmudi & Sabandar, 2002).

The SPP/CBSA model positively influenced teachers to change from the teacher-centered to the student-centered approach. The JICA-IMSTEP Lesson Study model seemed to have a positive impact on the growth of awareness to adopt an innovation in mathematics and sciences.

The development of realistic mathematics education (RME) at primary school level has also indicated positive results, such as improving the teachers' self-confidence, developing students' democratic attitudes, and changing the way of teaching towards becoming more of a helper. The RME project was conducted at primary school level. I was interested in replicating these findings at junior secondary level. The findings motivated me as a researcher to examine whether a professional development program on the RME teaching approach has a positive impact on junior secondary students' achievements and attitudes toward mathematics.

With regards to this main study, this paper examines the various students' responses toward the RME at junior secondary school in Indonesia.

Traditional Teaching vs New Teaching Approaches

In the more traditional views, mathematics is perceived – by most people – as a fixed, static body of knowledge (Romberg & Kaput, 1999), and the corresponding teaching approach is viewed as a careful sequencing of tasks designed to enable students to accumulate bits of knowledge by drills on number facts and computations (Senk & Thompson, 2003). Manipulating numbers and algebraic symbols mechanically and giving proofs of axiomatic geometry are also characteristic of this approach. How students obtain mathematical knowledge in the traditional teaching approach has been called the 'copy method' by Koseki (1999). However, students who memorize facts or procedures without understanding are often not sure when or how to use what they know and such learning is often quite fragile (Bransford, Brown, & Cocking, 1999).

This traditional view of mathematics can also constrain the scope of the mathematical content and pedagogy covered by the curriculum. Romberg and Kaput (1999) described traditional mathematics classes as mostly consisting of three segments:

> …an initial segment where the previous day's work is corrected. Next, the teacher presents new material, often working one or two new problems followed by a few students working similar problems at the chalkboard. The final segment involves students working on an assignment for the following day (p.4).

Regarding the textbooks used in the traditional mathematics classroom, Senk and Thompson (2003) conclude 'each topic was usually introduced by stating a rule followed by an example of how to apply the rule; then a set of exercises was given' (p.5). Senk and Thompson add that when a traditional textbook is used in a class, typical teachers 'demonstrate how to do something and students work individually to reproduce what the teacher has shown them' (p. 15).

Paul Ernest (2004) critiqued the traditional class as follows: the classroom tasks instruct learners to carry out certain symbolic procedures; to do but not to think; to become automatons, not independent exercisers of critical judgment (p.12). Similarly, Silver (1989) argued that daily activity for most students in mathematics classes consists of watching a teacher work problems at the board and then working alone on traditional problems provided by the textbooks or by a worksheet (p.280).

Classroom activities in the traditional framework often involve students copying what the teacher has demonstrated. Moreover, most students in the traditional framework 'view mathematics as consisting mainly of memorizing rules, and fail to view that it is a creative activity' (Brown, Carpenter, Kouba, Lindquist, Silver & Swafford, 1988).

Traditional mathematics as taught in the classroom is commonly associated with certainty, with knowing, and with being able to get the right answer quickly (Heaton & Lampert, 1993).

Despite the introduction of some innovative programs and practices described in the previous section, this traditional pattern of teaching mathematics is still common in Indonesian classrooms (Somerset, 1996; Suryanto, 1996).

Wardiman Djojonegoro, a former Minister of Education and Culture in the Republic of Indonesia, stated at the opening ceremony of the International Seminar in Mathematics and Science (Djojonegoro 1995):

> Most schools and teachers treat students as a 'vessel' something to be filled with knowledge… Another well known example is the tendency towards right-answer/fact-based learning. School and teachers focus on getting the right answer from the students at the cost of developing the processes that generate the answer. As a result, students resort frequently to superficial accomplishments. Rote learning falls into this category (p. 36).

Throughout the more recent mathematics education research literature, there have been expressions of growing dissatisfaction with the limitations of the traditionally formal ways of teaching mathematics. For example, Glenda Lappan (1999, cited in Senk & Thompson, 2003, p 16) argued 'We've had the longest running experiment in human history about whether rote memorization of facts and skills works. And it doesn't. Students are coming to universities and into the work place not understanding mathematics. Why wouldn't I want to try something new?'

Mathematics Education Reform

Mathematics teaching innovation tends to deal with three things: how to perceive mathematics, how to teach mathematics and how to assess mathematical understanding. There has been persistent criticism of previous views of mathematics in which mathematics was perceived as a fixed and static body of knowledge (Romberg & Kaput, 1999), as formal systems, rules, and procedures (Clarke, Clarke, & Sullivan, 1996), as a set of rules and correct procedures (Ernest, 2004), or as a large collections of concepts and skills to be mastered (Verschaffel & De Corte, 1996). Advocated instead is a view of mathematics as a dynamic subject, as a human activity (Freudenthal, 1991; Romberg & Kaput, 1999), as a human-sense and problem solving activity (Verschaffel & De Corte, 1996), or as humanized and anti-absolutist (Cockcroft, 1982; NCTM, 1980, 1989).

These innovative views also influence how teachers approach mathematics teaching and how they assess students' mathematics learning. This includes dealing with students' questions related to mathematical ideas, introducing mathematical concepts, encouraging and promoting discussion and cooperative group work, feeling dissatisfied with the current teaching approach, keeping up-to-date with the publications of a new movement on mathematics instruction, and assessing students' understanding of mathematics.

Realistic Mathematics Education (RME)1

Realistic Mathematics Education is a broad term for a teaching and learning theory which is based on using problems taken from day-to-day experiences rather than on abstract mathematics rules. RME incorporates views of what mathematics is, how students learn it, and how it should be taught. An important driving force is to facilitate the view of mathematics as 'a human activity (Freudenthal, 1991) rather than as subject matter which should be transferred to learners (Freudenthal, 1968). Mathematics should

1 Those working with the program consider that the development of the RME program has not yet finished. The process has been described as a "work in progress" rather than as a "fixed or finished theory" (van den Heuvel-Panhuizen, 2000, p. 3).

not be presented as a ready-made product (de Lange, 1987; Becker & Selter, 1996), nor begin with the formal system of rules and procedures; rather, students should be encouraged to re-invent key ideas in mathematics for themselves (Clarke, Clarke & Sullivan, 1996, p. 1225).

The approach has been studied in the framework of developmental research since the late 1960s (de Lange, 1987; Freudenthal, 1991; Panhuizen, 1996). Developmental research is a type of educational research whereby design of instructional materials is an integral part of the research method (Amerom, 2000); in a cyclic process of anticipating and testing new ideas in teaching and learning, mathematics are developed and tried out in classroom experiments (p.2).

The effort of realistic mathematics education has not been influenced by the perspective of structuralism. Van den Heuvel-Panhuizen (2000) states, 'the realistic mathematics project's first merit was that Dutch mathematics education was not affected by the "new mathematics" movement' (p.3).

Initially RME was developed as a mathematics program for the primary level. The first RME project, the Wiscobas project, was initiated by Wijdeveld and Goffree in 1968 (van den Heuvel-Panhuizen , 2000). Mathematics was not perceived as a closed system, but instead as an activity of mathematical processes.

Treffers (1978, 1987) distinguished between two types of mathematization in mathematics education: horizontal mathematization and vertical mathematization. In horizontal mathematization the students come up with mathematical tools which can help to organize and solve a problem set in a real world situation (Becker & Selter, 1996). In contrast, vertical mathematization is the process of reorganization within mathematics itself (Treffers, 1987; van den Heuvel-Panhuizen , 2000; Becker & Selter, 1996). Horizontal 'mathematization' involves going from the world of daily life to the world of symbols, whereas vertical mathematization involves moving within the world of symbols. Freudenthal (1991) argued that the two types of mathematization should be valued equally.

In general, reform of mathematics education in the RME context aims at shifting away from 'teaching by telling' and replacing it by students 'constructing' or 'inventing', shifting from what 'teachers do' to what 'students do' (Gravemeijer, 2000). To do this, Mathematics lessons should give students guided opportunities to re-invent mathematics by doing it; students begin with contexts, rather than abstract mathematics rules. As Van den Heuvel-Panhuizen (1996) argues, 'Rather than beginning with certain abstractions or definitions that are to be applied later, one must start with rich contexts demanding mathematical organization.' (p.12). RME is a reform of mathematics curricula which is intended to empower learners to be actively involved in a re-invention' process of mathematical concepts and principles. The critical word here is 'actively', and one of the teaching principles in RME is an 'interactivity principle' (Gravemeijer, 1994; Treffers, 1991). Freudenthal (1991) suggests that students should be given the opportunity to experience a process similar to the process by which a given piece of mathematics was invented.

Attitudes toward Mathematics

Studies about the students' attitudes toward mathematics and mathematics

teaching are usually closely related to the students' achievement in mathematics. For example, Hatano (2000) describes 'mathematics achievement' as a whole consisting of cognitive achievement and affective domain. So it is appropriate to evaluate students' learning of mathematics based on both the cognitive and the affective domains, as Suydam and Weaver (1975) noted:

> Teachers and other mathematics educators generally believe that children learn more effectively when they are interested in what they learn and that they achieve better in mathematics if they like mathematics. Therefore, continual attention should be directed towards creating developing, maintaining, and reinforcing positive attitude (p. 45).

For students to behave positively towards mathematics, there is a need to promote teaching strategies that are attractive to learners, motivate them to study, give them feelings of security, and let them enjoy the subject. Stipek et al. (1998) argue that the mathematics reform literature promotes practices presumed to enhance motivation, because high motivation is considered both a desirable outcome itself and a means to enhance learning.

Aspects of the affective domain are values, attitudes, and emotions. Beliefs, values, attitudes, and emotions can be viewed as lying on a continuum representing decreasing levels of cognitive response and increasing levels of affective response (Schuck & Grootenboer, 2003).

Way and Resnick (1993) commented that 'although definitions of attitudes vary, they generally include the ideas that attitudes are learned, manifest themselves in one response to the objects or situations concerned and can be evaluated as either being positive or being negative' (p.581).

Attitudes toward mathematics cannot be observed directly, but can be inferred.

As was noted by Leder (1987, cited in McLeod, 1992, p 581) 'Attitudes toward mathematics are not a uni-dimensional factor; there are many different kinds of mathematics as well as variety of feeling about each type of mathematics'.

With regard to this study, the students' attitudes toward mathematics and the RME teaching approach were probed through the administration of a questionnaire to find whether this teaching approach seemed to improve their feelings toward the subject.

B. Study Design and Methods

This study takes as its central focus the realistic mathematics approach to education (RME). RME is a teaching and learning approach to mathematics based on problems taken from day-to-day experience rather than on abstract rules (De Lange, 2000). It incorporates views of what mathematics is, how students learn it, and how it should be taught (De Lange, 2000: p.4).

This approach is used in this thesis to develop and monitor learning materials incorporating RME for junior secondary schools in Indonesia. To examine these students' responses toward the RME approaches, the qualitative data analysis is used.

Students were expected to build their knowledge of mathematics by making models and schemas, as well through symbols and informal mathematics notation. But it is only possible for the students to do these kinds of activities when an opportunity is provided for them. This is the second principle of RME theory (Freudenthal, 1991,

Streffland, 1991; Gravemeijer, 1994a, 1994b) and is relevant to the standard of mathematics 'to gain mathematical power students need to make conjectures, abstract properties and relationship from problem situations, explain their reasoning, follow arguments, validate assertions, and communicate results in a meaningful form'(Silver, 1989, p.279).

Qualitative Data

Rather than statistical analysis, this paper would present the qualitative data. This section presents the data acquired from interview sessions, the daily journal, and the open-ended question on the survey. The data are analyzed based on thematic, content analysis regarding the tendency of students' attitude toward mathematics in general and in the teaching strategies of mathematics using the RME approaches.

Interview

Interview sessions were conducted to reveal the students' general attitude toward mathematics and the teaching strategies of mathematics as well as specific questions regarding the students' experience of the teaching approaches used by the teacher. The main focus here was on the students' comments about the RME approach. The purpose of this interview is to uncover students' opinion regarding mathematics teaching using the RME approach. Students' statements were recorded and then transcribed for further analysis. Students' statements were translated into English for the analysis need. From the point of view of the experiment students, generally students were happy to learn mathematics using the RME approach. The following are some comments from the students regarding the RME approaches:

> Using the [RME approach], I can easily understand it. We can use our logic in solving mathematical problems (Fjr, CS-1 student)
> It is kind of easy and I am happy learning using this approach ((Itn,CS-1)
> There are… side-effects of learning using this approach. Sometimes we have to search for ourselves, since we do not give a fixed solution (Ltfh, CS-1).
> It is kind of fun, since it is not hard to apply this approach to solve the problems and it does not bore me (Ma, CS-3)
> I am so happy. The problems are different from what we used to have, and it is easy to solve the problems using this approach (Adk, CS-3)
> Happy. At first I was confused since I did not understand. But, once we had already learnt the strategy, I could easily solve the problem using our logic (Ans, CS-3)

Generally the students said that the RME approach emphasized reasoning, not mathematical formulas. They said that they like this approach because it was different from previous approaches usually taught by their teachers.

With regard to the differences between the RME approaches and previous teaching approaches, further comments follow:

> In my mind, there were differences between mathematics as I usually learn, and this teaching approach. Previously mathematics was taught literally, page by page from mathematics textbook. But, using this approach [the RME approach], reasoning was involved. For instance "Aha... this was correct". Though it was inappropriate with the book, students could find the solution by using their own strategies" (AN, CS-3 student)

One of the reasons they liked the RME approach was expressed by a experiment students as follows:

> I remember, I like this approach, because I could use my own strategies, I could express what I imagined which ultimately that the elephant was the winner…the elephant moved to the left, and finally I could make a decision (DP, CS-5).

From the students' explanation and the students' interview data, it can be said that the students were interested in the RME teaching approaches for several reasons: differing from previous teaching approaches, not emphasizing mathematical formulas, and students using reasoning, using their own strategies, and being able to imagine what process should be followed.

Open-Ended question- RME teaching approach

The open-ended question regarding the students' impressions toward mathematics and mathematics teaching based on the RME approach was included in the post-attitude survey.

Some of the reasons students gave for why they were interested in the RME approach included that their performances on mathematics were tested, it was different from previous approaches, it was not boring, not complicated, the starting point to be persistent to love mathematics, motivating to be more creative. There was a space for the students to "re-invent" a new solution method which was similar to the existing solution.

The following quotations were representative of the students' impressions of the RME teaching approaches.

> I like this new teaching, though the solution method was little bit complicated I understood, but I like it very much. This motivated me to have a correct solution to solve a bit complicated problem (ANB, CS-1).
>
> It was different from the usual approach. It made me understand more and was not boring, this approach did not make me confused. (SUR, CS-3)
>
> My impression toward this approach was that my mathematics was learnt faster. I was interested in learning mathematics more. Previously I did not like mathematics, but after this new approach, I like mathematics, and I started to persistent in learning mathematics. (DKS, CS-4).
>
> We learn mathematics using different ways. Using this approach, we were motivated to be more creative and to find the solution of the problems, try to find a new solution method. My impression was that I like this new approach (VF, CS-4).
>
> No longer was mathematics a difficult subject. Using this new teaching approach, I have more understanding how to solve the problems and we could discuss the solution in a group work, so it worked easily (INDR, CS-5).
>
> Before using the RME approach, sometimes I got confused, but after using this approach, I had a feeling that mathematics was not boring. We can collaboratively solve the problems by using our own solution (IDS, CS-5)
>
> I preferred to use the RME approach than using x and y variables. I hope that in learning mathematics for the next topics we would use the RME approach (MIK, NCS-7).

> Though we used cooperative groups in the RME approach, in my mind mathematics was still difficult, but a lot of problems in this approach made my brain work (TCH, NCS-9).

Daily Journal

The daily journal was written by the experiment group students. The purpose of the daily journal was to record the development of their feelings about their lessons using the RME approach. Some themes recorded were about enthusiasm, reasoning, discussion, expressing ideas, different solution strategies, and active and creative learning; these themes were consistent with data collected from the open-ended survey question and interviews.

Students' feelings about the RME approach

To make them easier to interpret, the students' feelings about the RME approach were categorized into several themes: interesting, not boring; reasoning; group work and discussion; expressing their ideas; different and various solutions; thinking further, accurately and deeply; relaxing, easy and starting to love mathematics; context; daily life situation diagrams, pictures, symbols; less speaking and more respect from the teacher; puzzles and games.

Easy, interesting, not boring

The first theme was about students' feelings towards this teaching approach. Most students felt that through using this approach mathematics became easier to understand. It did not bore them, because mathematics made sense to them. It reduced their difficulties in learning mathematics, and improved their enthusiasm. The students expected that this new approach needed to be maintained and implemented for the next mathematical topics. Table 5.53 indicates the students' impressions toward the RME approach on this theme:

Reasoning

Reasoning is a component of mathematics learning. Being able to reason is essential to understanding mathematics (NCTM, 2000). However, reasoning cannot simply be taught by only in a single unit, such as by 'doing proofs' in geometry.

The students admitted that this approach led them to develop their reasoning rather than rely on formulas they previously learnt from their teachers. In the students' perceptions, the teaching approaches reduced complicated calculations.

Group Work and Cooperative learning

Working collaboratively is a strategy associated with RME theory.This is ensured by the principle that learning should engage the interactivity principle. Within group discussions, interactivity among students, as well as between students and teacher, leads to a different kind of communication. Two-way communication between students and the teacher needs to be built up. The students said that collaborative work and discussion was interesting because it improved their ability to argue about mathematics. They could share their mathematical ideas in the discussion forum.

This new teaching approaches were interesting, because it could be conducted by using discussion strategies, using group cooperative, therefore it can improve our ability to argue in mathematics.

The students felt that this approach was relaxed, less formal. They felt that they can share their mathematical ideas. The smarter students can contribute their experiences to the group work discussion.

Expressing their ideas freely

The students felt that this approach supported their notion to easily express their ideas in

learning mathematics. It also developed their social relationships with other members of the classroom. By using this approach, a respectful feeling was built to create a condition that learning mathematics can easily take place. Using this new approach the students can easily express their ideas, their reason of the solution of the problems.

This new approach developed a social relationship, and respected the other's ideas.

Different and various solutions
A various solution method or result is a characteristic of mathematics learning using the RME approach. Using this approach, the students recognized various solutions and various solution processes for the problems. They said that the RME approach was good because most mathematical problems could be solved by using more than one strategy. They were challenged to "re-invent" a possible solution strategy. Using this approach, the students recognized various solutions as well as various solution processes of the problems.

Think further, deeply, and accurately
Using this approach the students said that they were encouraged to think mathematically, deeply, and accurately, and to be more active and creative.

These new (RME teaching) approaches lead the students to think more accurately, to be more active in learning mathematics, to be more creative.

Relaxing, more understandable, starting to love mathematics
The students felt that learning mathematics using these approaches was more relaxing, more understandable, and less formal. They also discovered that through RME, they were "starting to love" mathematics where previously they had disliked it.

Context, daily life situation, illustration, diagrams, and symbols
Learning mathematics using contexts made it easier for students to study mathematics. By creating combination diagrams to solve linear equation systems, the students had more fun and enjoyment with mathematics. They also developed patterns to guide them to solve the problems. The students felt that using pictures, diagrams, or symbols helped them to understand mathematical concepts better.

Teachers talk less, more respectful; Puzzles and games
Using this new approach, the students felt that teacher talked less and was more respectful of the students' efforts to solve the problems. The students felt more interest in mathematics because they could use a puzzle or game to solve a problem.

From the interview data, open ended question data, and daily journal data, it can be summarized that the RME approaches were interesting for several reasons. Each reason is given in the summary Table below (Tabel 1)

The themes appearing from the student data (interview, open-ended question, and daily journal) are relevant to the indicators of the RME approach, as suggested by de Lange (1987), Treffer (1991), Gravemeijer (1994), particularly in that RME teaching uses five principles:

- using context as starting point to learn mathematics
- models, schemas, symbols, are used to facilitate learning
- students' own production and students' own solution are anticipated to contribute to the classroom
- interactivity is a characteristic of mathematics learning using the RME
- intertwining (connecting) among the concepts (or topics) of mathematics.

Table 1: Summary of Themes that Appeared during Data Collection

Data collection techniques	Themes that appeared	Common themes
Interview	The students like to use the RME, because: used reasoning is different from the previous strategies not emphasizing on formula use students' own solution students can imagine the process they found	used reasoning (**) was different from the previous strategies (**) not emphasizing formula used students' own solution students could imagine the process they found their ability was tested was not boring students became more interested the students were motivated to be more creative and active (**) generated enthusiasm used discussion could express ideas used different strategies of solution relaxed used context, pictures, diagrams, symbols less talking and more respect from teacher fun and games
Open-ended question	The students like to use the RME for several reasons: their ability is tested mathematics was different previous approach was not boring students become more interested in the students were motivated to be more creative	
Daily Journal	The students were interested to learn matematics using this approach, with several reasons: enthusiasm use reasoning use discussion can express their ideas use different strategies of solution active and creative learning relaxed using context less speaking and more resfectful	

(**) appears twice either in interview, open-ended survey, or in daily journal data collections.

3. CONCLUDING REMARKS

By looking at the findings, we can conclude that the realistic mathematics education (RME) enable students in Indonesia to be aware to start for loving mathematics. For university students of mathematics teachers either in Australia or in Indonesia and mathematics teacher in Indonesia, they like the way mathematics to be taught by using the RME approaches. They also felt that mathematics is useful and meaningful for them.

The results of the pilot study suggest that the students' materials used were interesting, challenging, and encouraging (motivating) students to learn mathematics. There were some differences in the appraisals of the Australian and Indonesian samples. Australian teachers, according to the Australians, would not need to have specific (RME) training. But Indonesian teachers, according to Indonesians, considered the need to participate in training sessions for the RME approach before implementing the materials in teaching. Both samples validated the materials and believed that the junior secondary students would be happy using the materials.

From the students' comments about their impression toward mathematics teaching using the RME approaches, the data indicate that generally students enjoyed the change. They were more interested in this new teaching approach for various reasons: their ability was tested, it was different from previous approaches, it was not boring, it helped them become more interested in mathematics, and it motivated to be more creative in learning mathematics by finding a new solution method.

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