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Published in:
Journal of Mathematics Teacher Education

DOI:
10.1007/s10857-007-9058-4

Citation for published version (APA):

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Preparing Vietnamese student teachers for teaching with a student-centered approach

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Published online: 13 December 2007
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Abstract The Vietnamese curriculum reform which trends toward a student-centered approach requires Vietnamese teacher educators to prepare student teachers for teaching using this approach. In this article, we present a case study of three Vietnamese student teachers working in groups in a methods course to explore Freudenthal’s theory of realistic mathematics education (RME). The course emphasized students’ knowledge construction in meaningful contexts. Transcripts of class discussions and group discussions, interviews, student teachers’ lesson plans, and journal writings were the main data sources that were used to investigate the development of student teachers’ views on mathematics and mathematics education during the course. The deliberation about teaching strategies of three subjects working in a group to design lesson plans were also analyzed. The findings showed that the three student teachers explored new meanings of mathematics teaching that caused them to shift from their traditional point of view to a student-centered one. The student teachers were able to adapt the texts of their lessons to suit the student-centered approach. It is noted that among three subjects, there were two student teachers who questioned the realization possibilities of the student-centered approach in the Vietnamese educational context where the social and political conditions are not favorable for teaching with this approach.

Keywords Teacher education · Conceptual change · Realistic mathematics education

Introduction

Trends in Vietnamese mathematics education

For many years, Vietnamese students have consistently outperformed their counterparts in Asian, Western, and American countries in the Annual International Mathematics Olympiad. Vietnamese students are highly successful at all levels when they study...
abroad (Hoang, 2000; Nguyen, T. 2003). Given this superior performance, one would have expected Vietnam to have a superior mathematics education, but a review of the literature on the Vietnamese mathematics classroom does not support this expectation. The system worked well for the elite students, but not well for students experiencing difficulty.

In Vietnamese education, mathematics has been seen as a system of rules and algorithms taught to students without references to its origin and cultural setting. Mathematics is taught from the so-called *mechanistic* point of view, providing pupils with static and clear-cut knowledge (Wubbels, Korthagen, & Broekman, 1997). The curriculum is content-oriented and examination-driven. All schools are asked to use the same textbooks. Students’ achievements are evaluated by national examinations which focus on students’ abilities to memorize mathematics rules and principles and to use “tricks” to solve academic problems which are similar to those in textbooks and examinations. In order to achieve well at school and in examinations, students attend extra examination preparation classes throughout the year, even in school holidays. Students expend much effort to learn because they wish to satisfy their teachers and families. Due to the influence of Confucianism on Vietnamese society, academic achievement is considered as a means of bringing honor to one’s parents, family, and ancestors (Le, 2001). The ways Vietnamese students learn mathematics make them good at mathematics, but in the process they also become *receivers* of knowledge (Hoang, 2000; Nguyen, T. 2003). Thus, in 1996, the Vietnamese government started a top-down educational innovation across the country, from elementary to high school level. The specific goals of the reformed mathematics curriculum are to provide students with basic knowledge that can help them to solve problems of daily life, and to educate them to become active and creative citizens in Vietnamese society (Nguyen & Vu, 2001; Ton, 2000). The government stipulated that teachers should use more student-centered approaches than has been the case in the past.

Challenges of Vietnamese mathematics education

The Vietnamese elementary and secondary education system consists of twelve grades (ages 6–18). Currently, and during the implementation of this educational innovation, Vietnamese mathematics education is confronted by many challenges.

First, there is a lack of teaching materials suitable for a student-centered approach, and earlier textbooks are unsuitable. The replacement of mathematics textbooks was planned to occur from grade 1 (ages 6–7) to grade 9 (ages 14–15), although the replacement of textbooks for grade 10 was delayed until 2008. Meanwhile, in order to improve the quality of learning at high school level (grades 10–12, ages 15–18), where the replacement of textbooks has not started yet, teachers are encouraged to redesign lessons from current textbooks, with the aim of providing pupils with opportunities to learn in active ways. This creates a challenging task for teachers to design their own approaches distinct from the traditional curriculum.

Second, Vietnamese schools are the poorest in the region compared to other Asian countries such as China, Thailand, Indonesia, and Malaysia. This constrains efforts to change teaching methods (Nguyen, C. 2003; Tran, 2001). For example, in rural schools, 30 students share one computer; 45–50 students share a 60 m² classroom.

The third and greatest challenge involves changing teachers’ pedagogical practices.
Vietnamese teacher education

Vietnamese teacher education, established in 1951, has provided the country with teachers prepared for traditional education approaches. However, following the latest national educational innovation, demands have been placed on teacher education institutions to provide teachers who are knowledgeable and proficient in delivering a student-centered approach.

The program, which is applied in all Vietnamese pedagogy universities, consists of 8 semesters of courses in mathematics (101 credits), general courses (86 credits), and courses in general education and mathematics education (36 credits). Student teachers first visit schools only in the fifth semester. In all Vietnamese teacher education programs, methods courses introduce teaching skills and methods without considering theories of teaching and learning.

Further, Vietnamese teacher education lacks a discourse on conceptual frameworks of learning to teach and of supervision. For four decades it has been common for Vietnamese teacher educators to apply the “telling and listening” and “demonstrating and imitating” modes. Thus, it is common in teacher education programs for teacher educators to explain teaching techniques to student teachers, for student teachers to practice these teaching skills in peer-teaching on campus in microteaching courses and in practicums, for student teachers to listen to the instruction of their school supervisors on how to teach a lesson, and to observe their supervisors’ teaching, and ultimately to try to imitate them (Nguyen, T. 2003).

It is assumed that the way mathematics is taught is generally strongly influenced by the teacher’s opinions on questions relating to the philosophy of mathematics and mathematics education, such as “What is the nature of mathematics?” and “How should mathematics be taught and learned?” (Hersh, 1979; Korthagen, 2001; Simon, 1995). The lack of specific theories of teaching and learning of mathematics subjects using a student-centered approach, inhibits teachers in meeting the challenges of the national curriculum reform (described in the previous section).

The research

Aims of the research

The overall research project, of which the results described in this article are a part, had the following aims:

1. To introduce a theory of teaching mathematics using a student-centered approach to Vietnamese mathematics student teachers. With regard to the first aim, we selected the framework of realistic mathematics education (RME).
2. To develop a conceptual framework for learning to teach relevant for Vietnamese teacher education.

Educational research cannot be separated from the context in which it takes place. The context has a strong influence on student teachers’ learning, so the third aim of the research was:

3. To identify factors which influence Vietnamese student teachers’ attitudes toward RME and their performance as teachers.
Realistic mathematics education

The underlying framework was RME. In considering the nature of mathematics, Freudenthal (1971, 1991) presented an epistemology of mathematics that challenged the traditional view of mathematics as a closed system. According to Freudenthal, mathematics is not a system of rules and algorithms but a human activity. He argued that mathematics should not be seen as a subject created by mathematicians to be transferred to pupils, but as knowledge created by pupils. According to Treffers (1991), Gravemeijer (1994), and De Lange (1996), Freudenthal preferred to speak of the mathematics learning process as a connected process which involves a reflective interchange between mathe-
matizing reality and matematizing mathematics.

Realistic mathematics education (RME) emphasizes the construction by children of their own mathematical knowledge and the development of positive attitudes toward mathematics learning by giving meaning to problems (De Lange, 1996; Gravemeijer, 1994; Treffers, 1991). Teachers give students opportunities to create mathematics using mathematics inquiry and reflection, group work, and hands-on activities (Gravemeijer, 1994).

RME was developed in the Netherlands in the 1970s, and sought to make learning mathematics interesting and meaningful to students by introducing them to real world problems. In Asia, there is research on introducing RME in South-Korean (Kwon, 2005) and Indonesian schools (Widjaja & Heck, 2003). Since the philosophy of RME is consistent with the goals of Vietnamese mathematics educational reform, and because RME has had good results in other Asian developing countries, RME was introduced to Vietnamese teachers to provide them with a framework for improving the quality of their mathematics teaching.

Research on the introduction of RME to teacher education

This research took place in the context of Vietnamese student teachers’ learning of RME, building on results from similar studies elsewhere.

Wubbels et al. (1997) experimented with a realistic approach in a teacher education program at Utrecht University. To develop students’ conceptions of mathematics and mathematics education, the program gave them opportunities to experience RME as learners, stimulated them toward an inquiry-oriented approach, and promoted their reflection. The data were collected from a group of 10 student teachers who followed the teacher education program during a four and half year period. The results showed that these student teachers changed their views of mathematics education toward an inquiry-oriented approach.

Zulkardi (2002) studied the development and evaluation of a RME learning environment for 34 mathematics student teachers in UPI Bangung in Indonesia. The learning environment consisted of three components: RME web support, RME course materials, and exemplary RME lesson resources. Ten student teachers were selected to be the subjects of the research. Zulkardi concluded that the 10 student teachers gained knowledge of RME and applied it to redesign RME lesson materials for teaching in schools. It appeared that they achieved good results in their lessons and their students were satisfied with the RME teaching process.
Research questions

With regard to the aims of this specific study, the research questions were:

1. In what ways do Vietnamese student teachers construct understanding about the theory of RME?
2. How do Vietnamese student teachers interpret and respond to RME?
3. In what ways do Vietnamese student teachers reflect upon their learning experiences with, and their understanding of, RME, and does this change their points of view about learning and teaching mathematics?
4. In what ways do student teachers apply RME in the Vietnamese context?

Theoretical framework

To create a theoretical framework of learning to teach for our research study, we adapted the following notions about learning to teach from studies on teacher education:

1. Student teachers’ points of view about teaching and learning are strongly influenced by the way in which a certain subject was taught to them in school when they were students (Clark, 1994; Lortie, 1975).
2. Knowledge about teaching cannot be seen as a created subject but as a subject to be created (Korthagen, 2001).
3. Reflection is a means by which knowledge about teaching is constructed and reconstructed (Korthagen, 2001; MacKinnon, 1993).

Based on these notions, we hypothesized that learning to teach with a student-centered approach by Vietnamese student teachers raised with traditional methods, can be compared to a process of conceptual change. Thus, we took the conceptual change in teaching sequences for science teaching by Driver and Oldham (1986) and Gil-Pérez’s (1996) three basics steps of conceptual change in learning sciences: elicitation, reconstruction, and application as starting points for a framework. Our conceptual framework can be described in the following basic steps:

1. An elicitation phase of student teachers’ ideas about teaching and learning, making them aware of the rationality of those ideas.
2. A reconstruction phase, using cognitive conflict, in which there are opposing ideas, opinions, or feelings that cannot be satisfied at the same time. Cognitive conflict can be created through discrepant events which generate students’ dissatisfaction or disagreements with their current ideas and prepare them for the construction of new understanding about teaching and learning. In this, students then engage in discussions with peers and instructor about ideas that can help them to deal with their cognitive conflicts.
3. An experimentation phase, which gives student teachers opportunities to apply their new understandings in different contexts.
4. A reflection phase whereby student teachers conduct “the mental process of structuring or restructuring an experience, a problem or existing knowledge or insights” (Wubbels et al., 1997, p. 5).
These phases are not mutually exclusive, rather they point to four analytically distinct features of a learning process that blend together in the end. Figure 1 describes the interactive relationship of the phases and shows how knowledge about teaching can be constructed and reconstructed through a cycle of conceptual change.

In the following section, we present how our conceptual framework of learning to teach was applied.

**Methodology**

**Context of the research**

The research was a 4-year project, in which data were collected from September 2002 to May 2004 at Cantho University, Vietnam. Cantho University has around 17,000 students in 9 schools. In the academic year 2003–2004, 4041 student teachers followed a Bachelor program in the School of Education. After finishing the program, mathematics student teachers acquire a Bachelor degree in Mathematics Pedagogy and are allowed to teach mathematics at the upper level in high schools (Grades 10–12; ages 15–18).
The effect of RME was examined by providing student teachers with learning activities which exposed them to: conflict situations; opportunities to exchange ideas; to clarifying understandings; and to apply them to different contexts.

The research was carried out in three courses of the mathematics teacher education program at Cantho University: the methods course in the fifth semester, the microteaching course in the seventh semester, and student teachers’ practicum in last semester. In the methods course, the theory of RME was introduced. Then, students practiced planning and teaching microlessons. Finally, student teachers experienced teaching using RME in Vietnamese schools.

The research plan, based on a developmental research methodology (Gravemeijer, 1994; Van den Akker, 1999), consisted of cycles of thinking through a hypothetical teaching-learning trajectory, designing instructional materials, and experimenting with these materials in classrooms. Reflection on the outcomes of the previous teaching experiment resulted in new insights and revised teaching materials for the next.

Subjects

From a cohort of 83 mathematics student teachers who enrolled in the methods course in the fall semester of the school year 2002–2003 at Cantho University, three were selected to be the subjects during the first phase of the research presented in this article. Their anonymity has been maintained by using the pseudonyms: Quy, Khoi, and Tam. These student teachers worked together as a group during the course. Two criteria were used for selection:

1. They volunteered to participate in the research.
2. Their average scores in mathematics courses were high in comparison with the rest of the class to ensure that their learning of RME would not be hindered by a lack of mathematical knowledge.

Researchers’ position

The first named researcher was the instructor of the methods and microteaching courses. During these courses, the instructor-researcher served as a model of a teacher as a facilitator of learning, working with the students as a university supervisor who cooperated with school supervisors.

Procedures

In this article, we only present and analyze the results of the first phase of the research project, which took place during the teaching of the methods course. A part of the data, consisting of student discussions, written work by the groups or individuals (lesson plans, lesson plan analyses, journal writings), and informal interviews, was used as the basis of analysis. The group discussions were audio-recorded and divided into episodes to search for important parts of their learning trajectory exemplified by the point where new understandings of RME were established. Student teachers’ plans for their microteaching lessons, as well as their school lessons, were analyzed to determine how they used RME.

The student teachers’ journals were analyzed to seek insights into how they reflected on their lesson planning and how their teaching experiments influenced their development.
during the course. Informal interviews were conducted when relevant to extend the data. Informative excerpts were selected and transcribed verbatim for detailed analysis.

A qualitative approach was used for data analysis; the intent was to look for trends. The validity of the data was tested by triangulation which is used to strengthen a finding by showing that independent measures of it agree with it or, at least, do not contradict it (Miles & Huberman, 1989). For example, the data on student teachers’ points of view about teaching were collected from different sources: student teachers’ discussions; their lesson plans; their journal writing; and informal interviews. The translation of the data from Vietnamese into English was checked by a professional translator.

Organization of the methods course

In order to provide student teachers with opportunities to exchange ideas throughout the methods course, few of the classes took the form of lectures; instead, most classes consisted of individual or group activities supervised by the group or the instructor.

During the methods course, student teachers worked on prototypical examples of RME, which aimed at:

1. exposing student teachers to conflict situations to lead them to question their previous ideas about learning and teaching mathematics;
2. providing student teachers with opportunities to experience RME as a learner;
3. demonstrating how to redesign lessons in Vietnamese textbooks in accordance with the notions of RME; and
4. demonstrating teaching using RME.

Since teaching on videotapes may help student teachers to review their conceptions about teaching (Lasley, 1980), videotape recordings of three lessons in high schools were presented. The first taped lesson, about perpendicular lines, was taught using a direct lecturing approach. A part of the second lesson and the whole third lesson were taught using the realistic approach. In the third lesson, high school students were invited to work with the “Pyramid problem.” The teacher gave students cardboard pyramids and asked them to discuss in groups, ways to determine the height of a real pyramid without climbing or entering it. With the help of the teacher, students discovered the relationship between the length of the sides, the angles, and the altitude of a pyramid. The activities with cardboard models enabled students to transfer a real-world problem to a mathematics problem and then, reinvent the mathematics model.

Journal writing was used as a tool to stimulate and foster student teachers’ reflection on their learning experiences. According to Yinger and Clark (1981), journal writing, can stimulate student teachers to think about four important things about themselves: “What they know,” “What they feel,” “What they do” and “Why they do it,” leading them to think about the relationship between educational notions they learn and the practice of teaching.

Findings

Utilizing the conceptual framework of learning to teach, this section outlines the development of the student teachers. Some data revealing important aspects of their learning are presented.

With regard to the first and second research questions, we present:
(1) The ways in which student teachers constructed understandings about RME and appreciate RME.

With regard to the third research question, we present:

(2) How student teachers’ reflections contributed to their own learning process.
(3) The changes in student teachers’ points of view about mathematics and mathematics teaching.

With regard to the fourth research question, we present:

(4) The ways in which student teachers adapted texts to suit the student-centered approach.

Student teachers’ points of view about “a good mathematics teacher” at the start of the course

Based on the view that knowledge about teaching is constructed on student teachers’ previous experiences as students themselves (Grimmett & Crehan, 1990), the methods course started with an investigation into student teachers’ previous conceptions about teaching mathematics, by asking:

What do you think a good mathematics teacher is? Please reflect on your own learning experiences to answer the question.

The following student teachers’ answers collected from the class discussion were typical of the responses overall that often showed that they considered the role of teacher as one of transferring knowledge to students:

S/he has good methods to transfer mathematical knowledge to students.

and that effective teaching is about explaining completely what has already been presented in textbooks:

S/he is able to create a good atmosphere for students to work in her/his class and completes her/his explanation of what is introduced in the textbooks in time.

Two important points about student teachers’ previous experiences of teaching and learning should be mentioned here. First, they generally held a mechanistic point of view about mathematics and mathematics education. Second, because they were asked to base their answers on their own learning experiences, their answers evidenced that they themselves experienced learning mathematics passively.

Coconut candy problem: promoting cognitive conflict

According to our theoretical framework for learning to teach, conflicts can cause students to question their previous ideas about learning and teaching. To engage student teachers in conflict situations, they were invited to work in groups to experience learning mathematics with RME. As a prototypical example, we used the coconut candy lesson.

The coconut candy lesson took the form of an economics project consisting of three cooperative learning stages: Proposal Stage, Sale Stage, and Analysis Stage. In the
Proposal Stage, an announcement by the Dong A company—a favorite coconut candy company in Vietnam—was given to students. This announcement calls for a competition for a proposed policy for the sale of 100,000 coconut candy bags in the month before Lunar New Year. The Lunar New Year period is a time in which sweet things (candy, fruit snack, cookies, etc.) are consumed. Facts about the trade competition, company requirements, and customers’ interests are given. Some examples:

- 60% of the customers buy less than 5 bags, 30% of them buy from 5 to 10 bags, and 10% of them buy over 10 bags each time.
- The proceed of the sale is between 100,000,000 and 200,000,000 VND (1 USD is about 15,000 VND).

Here, to demonstrate how the task could be solved, we present a simple solution made by a group of student teachers in class.

First, student teachers worked with logical reasoning and the concept of function when they were developing a proposal. Combining the given information that a sales promotion policy can stimulate customers to increase the amount of products they buy and the information about the customers’ interests and company’s expectation of money obtained from the sale presented above, student teachers came to the proposal: “We shall sell each candy bag for 2,000 VND, but if one buys more than five bags the cost from the sixth bag will be 1,500 VND and the cost from the eleventh bag will be only 1,000 VND.”

Second, they described the rule in words and then by symbols. They drew 3 groups of 5 cycles on papers and wrote the prices 2,000 VND, 1,500 VND and 1,000 VND next to each group. Finally, for this specific case, they produced the following formula for the rule:

\[
f(x) = \begin{cases} 
2000x & \text{if } x \leq 5 \\
10,000 + 1500(x - 5) & \text{if } 5 < x \leq 10 \\
17,500 + 1000(x - 10) & \text{if } x > 10 
\end{cases}
\]

where \( x \) is the number of bags sold and \( f(x) \) is the amount of money paid. The student teachers also had other suggestions; for example, they proposed bonus gifts. After the students presented and discussed their proposals, they got the letter of invitation from Dong A company to cooperate with the company in the “Sale Stage.” They were asked to make posters for advertisements and a sale guide to help sellers calculate prices. Finally, the students were invited to continue working for the company in the “Analysis Stage” where they received tables reporting weekly sales data. They referred to reports from sales agencies, which presented the number of coconut candy bags sold over a particular period of time, to draw graphs to present the results of the sale, analyze the graphs, and suggest solutions to improve the current sales policy.

Characteristics of the coconut candy lesson

The coconut candy problem can be seen as an RME problem for two reasons. First, it was perceived by student teachers as a problem of personal interest. In recent years, Vietnamese people have become proud of the success of Dong A company in international trade. Thus, student teachers solved the coconut candy problem with the hope that they could help the company.
Second, it is a real life task in which mathematics is applied to a practical situation. A rule for sale must be a function from the set consisting of the number of bags sold to the amount paid. The learning activities were *mathematizing reality*, for example, transferring an economic task—a real world problem—to a mathematics problem, and of *mathematizing mathematics*, for example, formulating the function.

Although mathematical knowledge, which learners need for working on the coconut candy problem, can be found in secondary Vietnamese textbooks (grades 9–11, ages 14–17), it can be seen that the problem is not only a task for secondary pupils to develop their mathematical knowledge, but also for university students to apply and develop theirs. The problem involved student teachers in an authentic learning process that provided them with learning experiences with RME. Through our observation, we realized that student teachers were enthusiastic about defending their solutions, suggesting that they thought their solutions were useful for the company.

**Students’ opinions about the coconut candy problem**

The following excerpts from student teachers’ journal writings show the development of diverging points of view, including some cognitive conflicts prompted by the coconut candy problem:

Tam: I think it is not a mathematics task but really an economic task… I do not see how this problem is fruitful to me in learning mathematics or mathematics teaching methodology.

Beside disagreements with the view that a mathematics problem can be real, student teachers were confused by the learning activities which could not be solved directly:

Tam: We had difficulties in doing the tasks of the coconut candy problems such as to formulate a rule for sale, to design advertisements, to transfer from Vietnamese to others currencies. Sometimes, we discussed a long time but we could not make a choice among possible solutions. What is *the solution* to the problem?… We were really disappointed.

In contrast, there were student teachers who were attracted by the realistic characteristics of the coconut candy problem. For example:

Quy: I felt the coconut candy problem was very unfamiliar to me the first time I read it. But then, when I was gradually involved in working out the solution, I realized that the coconut candy problem is very realistic, it stimulated my curiosity and caused me to be interested in working with mathematics problems of real life.

Others learned that how they were challenged in the process of doing mathematics activities both individually and in groups:

Khoi: After several discussions, we formulated the rule for sale but then, when we went on details of the proposed rule; we realized that our proposed rule still had unacceptable weaknesses. At that moment, not one of us could find a way to improve our proposal. We stopped the discussion and kept thinking about how to improve our proposal policy. One week later, we met to discuss again and were successful in
working out the solution to our problem. I saw that working in the group generated opportunities to cooperate with others to solve problems. I also recognized that group discussions are very necessary in the learning process.

Two characteristics of student teachers’ learning can be seen here. First, student teachers’ reflections were triggered by their surprise about the learning experiences provided by the coconut candy problem. The reflection provided them with understanding of the characteristics of RME. Second, although student teachers perceived the characteristics of the coconut candy problem, these characteristics were not always meaningful to them. Instead, conflicts arose because of their current perceptions about mathematics and mathematics education. We expected this.

Student teachers frame challenges about RME in the Vietnamese context

After the first stage of the coconut candy problem, reading materials introduced RME and prompted a sequence of discussions about RME along with the development of the rest of the problem. We had two reasons for this. First, it is not productive for student teachers to continue working with problems they find dissatisfying. Second, the discussion about RME prior to working on the second and last stage of the problem allowed student teachers to test their understanding about RME.

Student teachers’ contributions to the class discussion were recorded. First, student teachers examined the consistency of RME with the Vietnamese mathematics curriculum. On the one hand, they considered RME consistent with the goals of the reform curriculum:

Quy: RME suggested that teachers provide students’ opportunities to learn in active ways. So, this theory is suitable with the goals of the Vietnamese educational innovation.

Khoi found a social reason for RME to be appreciated:

Khoi: Since our country is poor, most of our people are practical, when students come to schools, they and their families expect that their school knowledge can be applied to solve the problems of daily life. RME, which can show students how mathematics is useful for the real life, can show the students how to do that.

On the other hand, some realized the constraints of the current curriculum:

Tam: I think RME cannot be developed in Vietnamese schools because of many reasons, such as the lack of curriculum materials, computer labs and other teaching facilities; the larger number of students in class; the time pressure, etc.

Fuller and Bown (1975) argued that student teachers have concerns about the varied demands made on them. Further, they are concerned about the limitations and frustration in their teaching situations and their survival in school contexts. This can be seen in the quote above. Although such concerns might constrain their attitudes toward a student-centered approach, these concerns were evidence of student teachers’ reflection on the characteristics of RME which led them to a critical view on the possibility of adapting RME into the Vietnamese curriculum. We consider this as evidence of student teachers’ construction of knowledge of a student-centered approach.

After exchanging ideas, the class raised two questions:
(1) How can a student teacher redesign the current mathematics curriculum in order to teach with RME?
(2) How can we teach mathematics with RME in the Vietnamese context?

We used these questions as background on which we built the course. The first question was explored in lesson-planning activities (presented in the next section). The second question was investigated in the microteaching course and the student teachers’ practicum. Our answers to the second question are presented in Nguyen (2005).

Student teachers’ deliberations about different teaching approaches

In this section, we focus on our analysis of the development of the conceptions of mathematics and mathematics teaching of the group of Quy, Khoi, and Tam. The following themes were identified when they were planning a lesson on prisms.

Theme one: the teacher-centered approach

At the beginning of the discussion, Quy proposed a teacher-directed approach:

Quy: I think we should introduce the lesson as follows… First, we should show the students some cardboard models of rectangular parallelepiped. Then we ask them: ‘What shapes of these models are they?’ Students would say: ‘These models are rectangular parallelepiped.’ Then we show them models of parallelepiped that are not rectangular parallelepipeds…I mean…the sides of those parallelepipeds are not perpendicular to their bases…Then we ask the students: ‘What are the shapes of these things?’…They could not know what shape the later models are. Then, we tell the students that these models are the models of prisms…We introduce the name ‘Prisms.’ We will continue by presenting the models of other prisms such as quadrangle prisms and a pentagon prism… Perhaps both right and skew prisms. Then we introduce the definition of Prism to the students.

These procedures Quy emphasized “showing” and “telling” modes, which are traditional and popular in Vietnamese schools. It seemed Khoi and Tam agreed with Quy’s suggestion because they did not suggest any changes. The only thing that Khoi and Tam wanted to change in the plan was to replace the cardboard models with real life objects. Khoi suggested:

Khoi: Hey…can we use an empty matchbox and then we press it skew to model a skew prism…?

Everyday, when Vietnamese farmers go to work in their fields, they bring matches with them for smoking or cooking. To conserve pocket space, they press a matchbox with only few match-sticks until it becomes flat and then, cover it with a paper. The idea of pressing a matchbox seemed to emerge from Khoi’s life experiences, because he came from the countryside. That idea was appreciated by Tam because Tam saw the element of transformation in the action of pressing a box.

Tam: I think we can do that…I like the “transformation” here…I see the element of transforming…something is transforming.
Khoi also made a progression toward giving students opportunities to reinvent knowledge themselves, when he suggested an activity for students to generalize and formalize after observing models:

Khoi: I think…we should let the students produce the definition themselves.

Since in Vietnamese mathematics education students have never been given opportunities to construct mathematics definitions, Khoi’s suggestion can be seen as an innovative move toward a student-centered approach. However, later at the end of the discussion when Quy summarized the plan, he rejected the activity of letting students make the definition themselves and again restated the teacher-centered approach; others in the group agreed with him. The reasons were explored in an informal interview with the group afterward:

Quy: I do not think we should do that [he means that students will state the definition themselves] because it is a very difficult task, I do not think students can do that and…letting students to do that consumes a lot of classroom time.

It was obvious that student teachers tried to adapt the student-centered approach to their lesson plan, but they did not develop the approach completely. Grimmett and Crehan (1990) give a possible explanation of the student teachers’ behavior:

Teachers derive the important concepts they use to structure their world and experiences, not analytically, whether in the technological or deliberative modes of knowing or in the instrumental or conceptual approaches to decision making, but through experimental metaphors that permeate their thinking (p. 219).

Similarly, Wubbels et al. (1997) argued that “student teachers are confronted from the first day with an approach that differs largely from their experiences at high schools and thus, they may become reluctant to follow their teacher educators” (p. 23). The three Vietnamese student teachers, whose conceptions about teaching were constructed in their own experiences of teacher-centered education, are experiencing some uncertainty. They are moving between their traditional perspective and adopting the recommended approach.

Theme two: a shift toward the student-centered approach

Theme two is identified by the group’s intention to shift from the direct instruction method to the student-centered approach. After the student teachers finished the first version of their lesson plan, the students viewed the videotape examples (see the methodology section). The following can be seen as representative of the ideas of the three student teachers about the lessons in the videotapes:

The traditional class was boring. Teacher explained and students copied and that’s all.

I like the pyramid and exponential function lessons most. Pupils in these classes were active…they presented, exchanged and justified ideas with others.

After comparing the traditional class and the one taught with a student-centered approach, Quy, Khoi, and Tam decided to revise their lesson plan. They planned to provide students with concrete activities of cutting cardboard to make prisms; observing the cardboard prism and non-prism models to find the characteristics of their faces and sides, and comparing these characteristics to produce definitions of prism themselves. Then, the
teacher could help students to correct their definitions. Here, the group decided to apply the realistic approach to the lesson. In his journal writing, Khoi wrote:

Will students be interested, if I provide them with activities such as measuring, drawing, paperfolding, cutting, glueing etc. Should I introduce the definition to students or let students produce it by themselves?

This is evidence of the student teachers’ concern about their pupils. Quy wondered about students’ pre-knowledge and mathematics level, which is the basis of learning with the realistic approach. He also asked himself how to help students do the classroom tasks:

What is students’ pre-knowledge of the topic that is going to be taught in the lesson? Do I overestimate the students’ reasoning and realizing ability?

Some important changes in the three student teachers were recognized in the theme. First, the three students teachers inclined to make a shift from teaching with the traditional approach to those of the student-centered one. That was seen when they put forward two criteria for their lesson plan: a good classroom atmosphere and activities for students to do and construct knowledge. Second, the three student teachers had beliefs and image about pupil’s construction of knowledge.

Theme three: deliberation among teaching strategies

At the end of the course, the second lesson planning assignment was posed.

Assignment:
Select a topic from a high school textbook and suggest a plan to teach that topic.
Write a paper to analyze your lesson plan.

Quy, Khoi, and Tam did not start by selecting a topic but tried to find real life problems as a starting point of a mathematics lesson in high school. At the beginning of the discussion, Tam suggested an idea that the instructor previously presented in the class, for a lesson on arithmetic progression. The “saving box” problem is a story about a child who decides to save money in a box. He plans to increase the amount of money saved every week. Students are asked to calculate the number of weeks it takes to save the amount of money he wants. In this problem, students can reinvent the concept and formulas of progression, and learn to solve equations. At the next stage, one of the students proposed another idea:

Quy: I have another idea… I shall call for a competition… a project… to design the stairs of Stand A of Cantho Stadium… something like the coconut candy problem… I will call for a competition to design the steps… when students design the stairs… its sides are progression…

Later in the discussion Quy explained how the project provides students with mathematizing activities.

Quy: If I ask them to draw separately each step, not only the height but also the width and length are progressive…. And the second phase, the “estimation stage,” I shall ask students to make an estimation for building the steps, they have to make tables, work with functions. After that, at the “building stage” I shall ask them to draw the frame of the installation of iron wires for concreting the stand. They will work with prisms…
For example, when students design the stand (see Fig. 2), they are asked to make a table to describe its sides. A possible solution is:

When making a table (see Table 1), students work with functions from the set of numbers \( n \) to the set of numbers \( h, d, \) or \( l \). These functions are arithmetic progressions, which is the mathematics concept Quy intended to teach.

It should be noted that Cantho Stadium, built in 1984, is a favorite place for citizens of the city, especially children and teenagers. Students usually go there to play football in their leisure time. In recent years, the physical condition of Cantho stadium deteriorated. Citizens in Cantho city, including students, are keen to improve the stadium. Thus, Quy’s idea can be seen as a realistic problem, because it would be perceived by students in Cantho as a problem of personal interest to them.

Another RME characteristic of the Cantho Stadium project is analyzed by Quy after he analyzed the lesson in his paper:

The Stadium project arose from a real life situation. This is one of historical contexts in which human beings invented mathematical knowledge such as arithmetic progressions, and procedures to calculate the sum of the numbers of a progression. Humans worked out the rules and principles of mathematics, then, generalized and formalized these into established mathematics. I give pupils opportunities to work through the various stages of the Stadium project in order to give them experience in solving real life problems and construct their knowledge themselves.

Yet not all students adapted this approach. For example, Tam and Khoi did not suggested basing their teaching on a student project. They indicated their reasons for disagreement that were shown in an informal interview after the discussion. Tam was concerned about the time pressure and examinations:

<table>
<thead>
<tr>
<th>Step (n)</th>
<th>High (h)</th>
<th>Wide (d)</th>
<th>Length (l)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20 m</td>
<td>30 m</td>
<td>50 m</td>
</tr>
<tr>
<td>2</td>
<td>19.5 m</td>
<td>29 m</td>
<td>50 m</td>
</tr>
<tr>
<td>3</td>
<td>18 m</td>
<td>28 m</td>
<td>50 m</td>
</tr>
<tr>
<td>4</td>
<td>17.5 m</td>
<td>27 m</td>
<td>50 m</td>
</tr>
<tr>
<td>…</td>
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</tr>
</tbody>
</table>
Tam: We agree that it is good for pupils, but we cannot allow pupils to work so long on the tasks because we do not want to “burn” our lesson plan…Pupils also need to be taught static knowledge and solve academic problems that prepare them for examinations.

Khoi questioned his ability to teach using student projects and agreed with Tam to teach the “saving box” instead:

Khoi: Quy’s idea is really interesting, but it is difficult for a student teacher to teach a lesson like this at the beginning of teaching…It is rather unfamiliar to school teachers…The saving problem can also provide students with learning in active ways.

In summary, all three student teachers considered real life problems as an important way to start a lesson and had fewer difficulties in finding real life contexts for their lessons than we had originally assumed. They were also inclined to adapt texts to suit the reform approach. However, there were differences in their views: Quy focused on giving pupils opportunities to construct knowledge themselves. In contrast, Khoi’s and Tam’s greatest concern was how to survive in the schools. This might have led to differences in appreciation of RME among the three student teachers, which were seen in their journal writing at the end of the methods course.

Contributions of RME to student teachers’ changes of conceptions about teaching

In order to investigate student teachers’ appreciations of RME, the following question was posed for the journals:

Question: What do you think is the most important thing you got from the course?

Quy reconstructed his point of view about teaching, he wrote:

I think the most important thing I learned in the course is the point of view about learning and teaching. …I had thought teaching is simple; in order to teach, the teacher only needs to understand what is presented in textbooks and then give a good explanation to students. That was why I used to think that after finishing high school, one could become a teacher at high school. Now, I think that in order to become a good teacher, I need to have good knowledge of the subject I teach and of education.

Tam emphasized the meaningful learning achieved through real life contexts:

RME is meaningful to me: there were some moments I was very bored with learning because I thought that mathematical knowledge I have learned is not useful in real life. Through what I learned from RME, I thought about my knowledge more deeply and found it was interesting.

Khoi mentioned the new teaching methods, which he thought could motivate students to learn:

I have learned new teaching methods, which I think are very interesting. I will try to teach with these new methods.
It became apparent that Quy changed in his views on the role of teacher from being merely an instructor, passively explaining ideas from a textbook, to that of a more sophisticated teacher who is aware of and uses a variety of pedagogical tools and techniques to convey a deep understanding of the subject to his students. Although, during the course, Tam and Khoi questioned the potential of RME for Vietnamese classrooms, at the end they appreciated the effectiveness of using real world problems and situations in teaching mathematics, and were more inclined to use this in their future teaching.

Conclusion

Changes in the conceptions of student teachers of mathematics and mathematics education

Changing conceptions about a subject domain or about teaching is always difficult (Turk & Speers, 1983), especially if these conceptions have been constructed over years and have originated from personal school experiences (Kargan, 1992; Stofflett & Stoddart, 1994). In using RME as a context for teaching the student-centered approach to Vietnamese student teachers, we found that the three student teachers gradually changed their conceptions of mathematics and mathematics education from the traditional to the student-centered approach. This change was evident when student teachers decided to provide constructivist activities, and when they raised concerns about students’ learning and interests. Our findings agreed with those of Huibregtse, Korthagen, and Wubbels (1994): that teacher education programs can be improved if student teachers’ previous conceptions are dealt with directly and are included in program design. It should be noted that, the changes in student teachers’ conceptions of mathematics and mathematics teaching were stimulated and fostered through the learning activities described in the conceptual scheme.

During the elicitation phase students expressed their ideas which in turn were reconstructed by the cognitive conflicts raised by the prototypical examples presented in the video programs and in the Coconut Candy problem. During the experimentation phase students were willing to consider student-centered approaches, but they were reluctant to do so because of the perceived constraints of the Vietnamese mathematics classroom.

The three student teachers used reflection to construct knowledge of the student-centered approach. Reflective activities led the students to explore new meanings for their mathematics learning. The student teachers perceived mathematics as a human activity where mathematical knowledge could be used to solve real problems. In this respect, they considered RME as a strong theoretical framework for developing their views about mathematics education, especially when providing meaningful contexts and activities and when assisting students to actively construct knowledge.

Factors influencing student teachers’ learning of the student-centered approach

Although Vietnamese mathematics student teachers completely lacked experience with student-centered education when they came to the methods course, their ensuing learning experiences were powerful enough to provide a background for constructing their understandings about student-centered education in general and about RME in particular.
Also significant is the role played by the reflective journal format in nurturing the development of student teachers’ reflection. Further, journal writing became an efficient tool enabling meaningful dialog and intellectual empathy between student teachers and their instructor. This was evident when student teachers became enthusiastic about communicating their personal feelings, thoughts and emotions about teaching and learning in their journal writings. Vietnamese student teachers, normally hesitant to share their personal ideas in a large group situation, were more willing to write their opinions in personal journals.

However, the less successful aspects of the course should also be analyzed. The central problem of the methods course was that student teachers, such as Khoi and Tam, hesitated to select RME for their teaching. These student teachers perceived RME as a legitimate theory yet were not convinced that it was applicable to Vietnamese classroom practice. Although this was an initial expectation, several reasons contribute to their uncertainty.

First, teaching a student-centered approach such as RME requires teachers to act as a coach for pupils’ learning. Effective teacher communication and interaction with students is essential for this to occur. Vietnamese student teachers lack experience in classroom communication such as presentations, discussions, and group work. Some teachers, who were not confident in their ability to communicate, were less willing to teach using the student-centered approach such as RME.

Second, there was the social and curriculum pressure on student teachers’ choice of teaching approaches. Although a national innovation in education started in Vietnam years ago, it has not made significant progress. Student-centered education was not introduced to Vietnamese teachers effectively and the national examination still focuses on asking pupils static knowledge and employing tricks to solve academic problems. As a result, many of the schools which provide student teachers with teaching practice and later employment still work with traditional teaching methods. Like other countries where Confucianism is widely entrenched and strongly influential, Vietnamese parents and pupils still approve the traditional teaching methods (Le, 2002). Thus, student teachers are concerned that the student-centered approach such as RME may not be approved by the people who supervise and evaluate their teaching.

Discussion

There were some critical issues raised by the research. First, it seems necessary for supervisors to nurture student teachers’ development in a practicum setting by means of “establishing a climate of trust and a non-defensive posture.” (MacKinnon & Erickson, 1988, p. 131). Having a secure and trusting environment for Vietnamese student teachers to work in schools will enhance the chances of the reformed approaches from their teacher education being adopted in schools.

Second, there would be advantages in student teachers embarking on a student-centered approach being trained in effective communication strategies before and during teaching activities. Vietnamese student teachers who infrequently present or exchange ideas in public need opportunities to practice and improve their communication strategies in teacher education programs.

Black and Ammon (1992) and Labosky (1996), concluded that learning to teach is a life-long process of construction. It is clear that the theoretical framework applied in the methods course supported experiences and gave tools to student teachers to construct knowledge about teaching. We hope that these experiences and tools will encourage them
to continue constructing personal knowledge throughout other parts of the teacher education program and in their teaching careers. We also hope that our student teachers will similarly regard the learning experiences in the high school curriculum as a construction process for their pupils.

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References


