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TEACHING MATHEMATICS AT HIGH SCHOOL IN THE DIRECTION OF DEVELOPING PRACTICAL PROBLEM-SOLVING COMPETENCIES THROUGH THE EXPLOITATION AND USE OF PRACTICAL CIRCUMSTANCES

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INTRODUCTION

1. The topic choice rationale

One of the most important goals of general education is to help human beings develop a comprehensive personality, in which personality is understood to be a combination of individual characteristics, psychological attributes, showing character and social value of human beings. On the other hand, actuality, personality education is simply understood as the necessary qualifications and competencies of each person, including the thinking competency (thinking competency of persons) and action competency (ability of performance).

From the aspect of appearance or "posing" any problem to learners, it can be seen that problem solving is conceived in two connected directions, namely:

(i) Problem solving within the internal learning aspect, which is reflected in student's application of the acquired knowledge, skills, learning attitudes and personal experiences for continuing to solve any new problem during their study;

(ii) Problem solving from practical circumstances, which is reflected in in student's application of the acquired knowledge, skills, learning attitudes and personal experiences for explanation and solving practical circumstances, in daily life.

In actuality, with the approach of develop competencies-directed education, the problem-solving in the second direction has currently been noticed in many countries, that is, paying attention to the fact that whether and how students may solve any practical issues. This is one of important reasons that the establishment and implementation of the general education curricula in all countries have been considered as the orientation of implementation, especially the use of practical situations in teaching and learning, and evaluating to form and develop learner's competencies. The development of competencies of problem solving in the second direction is also concerned to the implementation of some purposes of this thesis; It not only develops competencies but also reinforces the perception of the practical origin of knowledge, role of application, and the applicability of any subject into practice, especially in mathematics.

Thus, the problem-solving comptencies of high school students is established and developed when mathematics can be considered as the competence of solving "theoretical" problems (exercises) and practical problems (of course, it is suitable to level of the students). So, when the requirements for establishment and development of problem-solving competencies are met, it must concurrently be directed to such both "components". This thesis directs toward the second component (solving practical problems with mathematical toolsclosely related to the development of competence of applying mathematics in practice by high school students - the approach of this thesis is to consider the development of practical problem-solving competencies regarding the nature to the extent of competence of applying mathematics in practice.

Teaching mathematics to develop the practical problem-solving competencies can be carried

out by various solutions related to components of teaching process, from any adjustment, concretization of objectives and standards, selection and addition of contents, especially looking for appropriate teaching methods and, finally searching reliable ways of assessment. However, the topic of this thesis is mainly the content that specifically focuses on the development of practical mathematic exercises and applies such exercises in teaching mathematics at schools. These exercises firstly have meaningful important role in contributing to the enhancement of mathematical application in mathematical education at high school ; they help students acknowledge thoroughly the practical origins of mathematics, extremely profound applicability of mathematics in areas of social life ; however, it is important to help students with excellently favourable opportunities to practice, develop the competency of applying mathematics in solving practical problems, a core learning competency that is needed and should be developed for every student.

The actuality shows that the exploitation of practical mathematic exercises for the above-mentioned purpose have not been studied fully and systematically in our country.

For above reasons, the author has chosen the topic: "***Teaching mathematics at high school in the direction of developing practical problem-solving competencies through exploitation and use of practical circumstances***".

2. Overview of researched issues

2.1. In foreign country

2.1.1. Theory

The tendency that the mathematical education must combine more with the practice, real world (*Realistic Mathematics Education - Freudenthal Institute of the University of Utrecht Netherlands, or RME*), dated back to the 1970s, attached to one of famous name, Freudenthal (Netherlands) and some project study teams, Wiskobas. Such teams have studied different trends in mathematical education in the world, with three phases: "discovery" (1971 - 1973), "integration" (1973 - 1975), and "development" (1975 - 1977) with mathematical orientation associated with the real world (as a philosophy). RME philosophy is also shown in many textbooks at high schools in the United States. The "Mathematics in context" book is one of series of US textbooks that express the relationship between mathematics and practice. RME philosophy has also been studied by many educators and included in undergraduate mathematics programs such as Rasmussen & King (2000), Kwon (2002), Ju & Kwon (2004).

RME thought is based on 5 principles, connected by the different levels of thinking that Van Hiele mentioned in mathematical learning: Use of context; Use of model; Products of students; Interaction; Combined knowledge of mathematics. Principles of which contents related practical mathematic exercises are: *i) Use of context; ii) Use of model.*

2.1.2. Regarding establishment and use of practical mathematic exercises

The design of practical mathematic exercises and their use in teaching in countries around the world are also of great interest. The consideration and statistics of such mathematic exercises in mathematis textbooks in countries shall show such trend. In the general education curricular of Australia (2008) and New Zealand (2007, the presentation of illustrative examples of standard levels includes practical mathematic exercises attached to the contents

prescribed in mathematics. In addition, one of the most noteworthy phenomena is the use of mathematical practical exercises, such as NAEP, NAPLAN, PISA, in some of the world's most recognized assessment programs.

General assessment: The tendency of combining theory with practice in general and applying mathematics in practice in particular is more and more interested in. Textbooks in many countries and many well-known assessment programs use the practical mathematic exercise. It is also worth noting that among such exercises, some take data from the reality but many exercises use assumption situations, many of which connect mathematics with other subjects.

2.2. In Vietnam

2.2.1. Regarding problem - solving competencies

For many current years, there have been a lot of researches on competencies and problem-solving competencies. This thesis shall update the the research results in this field.

Psychologically, Nguyen Cong Khanh states that: Competence *is the ability to master the knowledge, skills, attitudes and operations systems (connect) suitably in successful implementation of duties or solving effectively any problem in life*. Many authors have studied the competencies and problem-solving competencies as well as mathemati problem-solving competence. Nguyen Thi Lan Phuong has recommended the structure of competencies including of (i) Identify and Understand the Problem; (ii) Set problem space; (iii) plan and present solutions; (iv) Evaluate and reflect solutions. The draft general education curriculum of the Ministry of Education and Training also identifies the structure of problem-solving competency, including: (i) Detect and clarify problems; (ii) Propose and select solutions; (iii) implement and evaluate measures of problem-solving; (iv) Recognize new ideas; (v) Form and implement new ideas; (vi) independent thinking.

Regarding the assessment of students' problem-solving competencies, Phan Anh Tai has reached the results as follows: (i) Define basic purposes and objectives of assessing the students' problem-solving competencies in teaching mathematic at high school; (ii) Identify components of problem-solving competencies in the direction of approaching process of problem-solving; (iii) Introduce new methods for assessing students' problem-solving competencies in teaching mathematics at high school on the basis of assessing identified components and competencie; (iv) Propose solutions of assessing the students' problem-solving competencies in teaching mathematics at high schools according to the recommended methods of assessment in order to improve the quality of teaching mathematics at high schools.

In spite of diversification, the conclusions show that authors in Vietnam have a fairly consistent view on problem-solving and problem-solving competencies.

2.2.2. Regarding practical mathematic exercises

Since the 1970s, author Tran Kieu, the Mathematics Department of Institute of Educational Sciences has studied quite systematically the mathematical application circuits in mathematics programs at high schools prepared for the implementation of general education curriculum in the 3rd education reform. The main contents include: i) importantly meaning existence of mathematical application circuits in mathematical curriculum at high schools; ii) relationship

between the mathematical application circuit and the other knowledge and skills circuits in the general mathematics curriculum; iii) How to make clear the mathematical application circuit through teaching mathematics, which emphasizes the solution to construct a system of practical mathematic practical exercises because of its significance and importance in clarifying the value of mathematical application in the life, practicing skills of mathematical application. However, it is not concerned with the contribution of developing practical problem-solving competencies (in teaching mathematics) for students, mainly in the 1990s, last century.

Throughout the review, it is possible to see the trend of attaching mathematics with the dominant application of teaching innovation. Researches have focused on making important points directly related to the requirements of how to teach mathematics with the purpose of teaching the application. Practical mathematic exercises have also become a research subject, but research systematically, update in current context with new requirements, still needs to be met.

3. Purpose of reseach

Based on research of the practical problem-solving competencies and teaching mathematics in order to develop the problem-solving competencies and propose the methods of exploring practical mathematic exercies and establish some pedagogical approaches to develop the students' practical problem-solving competencies through use of such exercises in teaching mathematics at high schools.

4. Contents of research

The thesis researches the following issues:

- Existence, meaning and specific expression of mathemactic application circuits in the Mathematics Curriculum at high schools and relationship with purpose of application and teaching the development of practical problem-solving competencies in mathematic at schools
- Concepts of competencies, problem-solving competencies, practical problem-solving competencies;
- Role and significance of practical mathematic exercises in teaching, contributing to develop the students' practical problem-solving competencies.
- Actual status of exploitation of practical mathematic excercises and the use of practical mathematic excercises in teaching mathematics at high schools in Vietnam in the direction of developing practical problem-solving competencies.
- Method of exploitation and use of practical mathematic excercises in teaching mathematics at high schools to develop students' practical problem-solving competencies.

5. Methods of research

During the research, the following methods shall be used: Theorical research; Survey; Expert solution; Statistics; Experiment.

6. Scientific assumptions

The establishment of methods of exploitation to diversify more practical mathematic exercises, then recommend suitable pedagogical measures to use practical mathematic exercises practical mathematic exercises in teaching mathematics at high schools shall

contribute to the development of students' practical problem-solving competencies.

7. Contributions of thesis

- Systematize some theoretical issues related to the development of practical problem-solving competencies.
- Clarify the meaning and important role of system of practical mathematic exercises on the implememtation of targets of teaching mathematics at high schools on the basis of clarifying the meaningful application role of mathematics in practice.
- Clarify the actual status of exploitation and use of practical mathematic exercises (from awareness to implementation by teachers and students), determine reasons and conclude;
- Recommend methods of exploitation and use of practical mathematic exercises for teacher's and student's reference during the teaching and learning of mathematics at high schools.
- Establish some methods of teaching mathematics by using practical mathematic exercises in order to contribute to the development of students' practical problem-solving competencies at high schools.

8. Arguments

- Opinions on the way of exploitation and use of practical mathematic exercises in teaching mathematics at high schools.
- Orientations and methods of teaching mathematics using practical mathematic exercises in order to develop students' practical problem-solving competencies.
- Meanings, roles and effects of practical mathematic exercises for the establishment and development of students' practical problem-solving competencies in teaching mathematics.

CHAPTER 1. THEORETICAL AND PRACTICAL BASIS OF EXPLOITATION AND USE OF PRACTICAL MATHEMATIC EXERCISES IN TEACHING MATHEMATICS AT HIGH SCHOOL IN THE DIRECTION OF DEVELOPING PRACTICAL PROBLEM-SOLVING COMPETENCIES

1.1. Regarding requirements of strengthened combination of mathematics and practice

1.1.1. Trend of combination of mathematics and practice

The dialectical relationship between mathematics and practice is determined that mathematics is derived from practice and serves practice. Practice is the basis for the appearance, development of mathematical theories; Practice sets mathematic problems and mathematics is considered as an effective tool to solve such problems. The dialectical relationship between mathematics and practice is also reflected in the cognitive rule law that has been pointed out by V.I.Lenin: "From living perception to asbtract thought, and from this to practice, such is the dialectical path of cognition of truth". Combination of mathematic education with practice is always a trend in the world, from time to time, in different contexts where the trend is adjusted accordingly, some specific manifestations of this trend have been presented in the overview. The remarkable thing is how to demonstrate such trend in practical teaching mathematics at high schools. The comprehensive orientation is to make students be aware of the practical origins of mathematics and the immensely diverse applicability of mathematics and life . Various diversified orientations which students contact, research - solve practical

mathematice exercises can be considered as one of effective measures.

1.1.2. Strengthen to contact to practical teaching of mathematics at high schools to satisfy with requirements of current education reform in Vietnam

The trend of linking mathematical education with practice has been interested in by Vietnamese educators since the last decades, expressed by the requirements of strengthening the application of mathematics in teaching mathematics, the establishment and implementation of mathematic education programs at high schools in Vietnam.

One of remarkable issues when the mathematic education program at high schools as mentioned above is established, is that how to show students the practical origin of mathematics with its diversified applications in all aspects of life. The current mathematics curriculum in our country states that one of the guiding principles of teaching mathematics is to increase the practice and application, implementation of teaching mathematics in combination with practice. As specified in the mathematic education program at the high schools, in addition to the requirements of training the students the basic skills related to the use of the knowledge learned in the program, there are requirements of training and development of skills of reasoning, proof, mathematic exercise solving and especially "*apply mathematical knowledge in study and life*." As such, it can be realized that the requirements for mathematic applications in practice for secondary students have been formally defined in the mathematic education program and are considered as goals of mathematics at high schools. Thus, it can be realized that the available mathematic education program at high schools has given specific requirements for linking "pure mathematics" knowledge to the application in study and life, in which emphasizes the application of mathematic knowledge to solve problems in practice.

The current trend of education reform is teaching towards development of learners' competencies, in which, regarding mathematics, the problem-solving competencies are in the most interest. Consistent with such trend, in combination with the requirements of developing the competence of mathematic application n practice, during the teaching of mathematics, the relationship between mathematics and practice must be given the utmost attention. .

We agree with Freudenthal's view that it is necessary to incorporate the practical problems into life in the teaching and learning program at high schools (Freudenthal (1991)). However, it is required to pay attention to special characteristics and difference of mathematics against other sciences. According to Freudenthal, there are two approaches in teaching mathematics:

- The first approach considers mathematics as a purely scientific product (axioms, propositions, theorems, consequences, equations, inequalities, ...).
- The second approach considers mathematics as a product - result of human activity. Freudenthal focuses on the second approach. The product of mathematical activity is understood not only as the axioms, theorems, the consequences of which the proof, the mathematical argument, ... are stored in the human brain, in which mathematization is a fundamental characteristics of mathematical activity. From then, Freudenthal opposed the teaching of mathematics by only offering the scientific products of "available" mathematics (Freudenthal (1973)), (Freudenthal (1983)), (Gravemejier & Terwel (2000)); students need that

to learn mathematics as re-discovery of a knowledge. According to this approach, students shall re-discover knowledge in accordance with the "process of human invention" where they are given the opportunity to rediscover the knowledge as guided such as formation of assumptions, verification, comparison of mathematic exercises with practice in life. From then, he said that students need to learn how to find and explore knowledge in the way that mathematical knowledge is created (derived from practice and serve practice).

Freudenthal views that "mathematics is closely related to practice" and "mathematics is the result of human activity." Therefore, learning mathematics is not the acquisition of available knowledge but the process of setting up and solving problems from practice or in-the-mathematics to establish mathematic knowledge; and he calls that process as mathematicization.

We consider this to be a very interesting concept in teaching mathematics in Vietnam both in terms of the meaning, purpose and nature of mathematic learning; all relationship between theory and mathematical applications. This view needs to be mastered throughout the mathematic teaching and hence also provides the correct way to enhance the mathematical application circuit at high school in Vietnam. Basing on purpose of this thesis, mathematicization in general and horizontal mathematicization as referred to above are considered as key theoretical points.

1.1.3. Direction of strengthening the combination of mathematics and practice in practical teaching of mathematics at high schools

For mathematical education when applying the dialectical relationship of the path of consciousness (V.I.Lenin), mathematical education should clarify the true origin of mathematical knowledge, the application scope of mathematics and especially for students themselves use the knowledge and mathematical skills required to solve real situations, especially to solve practical mathematic exercises.

Based on the theoretical study of mathematical integration with practice, with three issues as mentioned in paragraph 1.1.2 (mathematics is derived from practice; reflects the practice and is an effective tool for practical problem solving); on the other hand, based on 5 principles of combining mathematics with real world recommended by RME as described in the overview, in this thesis, we suggest that in teaching mathematics, it is required to:

i) Place the lesson knowledge in the practice context, leading to place the problem in the practice situation, thereby generating the need for solving the problem to establish mathematic problems.

ii) Derived from the need to address a specific situation in practice that leads to the establishment of model to solve such problem. Since, this model is further generalized to solve similar situations. It can be said that this is the process of mathematical modeling and solving by the general mathematical method.

iii) For mathematical knowledge to be considered as a "rediscovered" product of a student, the problem should be addressed in relation to the practice that arises knowledge and mathematical methods. Then, the solution of such exercises will enable them to participate in the process of creating mathematical knowledge for themselves.

iv) The use of practice situation to build mathematic problem for the students shall strengthen the interaction among students, and the interaction between students and practice during the mathematic problem solving.
v) Within the internal mathematics, integrated knowledge circuits in which this knowledge can create practical mathematics learning or foundations or cases for other knowledge to form and develop. On the other hand, mathematical knowledge is associated with the need to solve problems arising from other disciplines (exploited from the close relationship between mathematics and physics, chemistry, biology, etc.), and actual life. According to the program's development orientation after 2015, the mathematics program must aim to achieve the ultimate goal of enabling students to achieve a defined level of general competencies and specific mathematical competencies, including problem-solving competencies and modeling competencies (problems given from practical circumstances).
It fits with the author's view that the practice situation in teaching mathematics is not only indicative of relationships with other subjects and real life but also with the need to play Development of mathematics itself. This has been realized through many measures, however this thesis only focuses on is the exploitation of practical mathematic exercises which are tools and teaching methods for developing practical problem-solving competencies.
In summary, the clarification of "application circuit of the mathematic knowledge at high schools in practice is primarily through the solving of practical mathematic exercises plays an important meaning in helping students see the relationship between mathematics It is also a great way for students to enjoy the excitement of learning math, active and creative learning in high school math. In addition, it also helps to shape and develop the students competencies, especially the competence of appying mathematical knowledge and skills in solving practical problems.

1.2. Practical problem – solving completencies in teaching mathematics

1.2.1. Concept of competency

The establishment and development of competencies play a huge role in the development of every human being. Many researches have presented quite diverse, diverse perspectives on competencies in terms of accessibility.

Within the framework of this thesis, we endorse and use the OECD (Organization of Economic Cooperation and Development) concept of competencies, whereby competency is considered as an individual ability to meet the complicated requirements and successful implementation of tasks in a specific context.

1.2.2. Competencies to be formed and developed through teaching mathematics in high school

There are many ways to list competencies that are formed and developed through mathematical learning due to different perspectives.

According to Tran Kieu, necessary competencies which are developed through mathematics include: thinking competency; problem-solving competency; mathematic modeling

competency; communication competency; competency of using mathematic tools; self-study competency.

Regarding this kind of competency, there may be differences in the definition by different countries in the world, but the program in some countries or in perceptions of some organizations (NAEP, NAPLAN, OECD, ..), the author states that problem-solving competency and mathematic modeling are highly consented by countries.

1.2.3. Problem-solving competency

1.2.3.1. Problem

A problem (in the field of learning) represented by a clause and question, or a system of clauses, questions (or requirements for action) that satisfies the condition: Up to the present time students have not acquired enough knowledge or solution to answer the question (in other words, not having learned an algorithmic algorithm to answer the question or fulfill the requirement).

1.2.3.2. Problem-solving competency

Problem-solving in the usual sense is to find adaptive solutions to solve problems and obstacles. With a particular problem there may be some resolution solution, which may have optimal solution. Branford J. D. (1984), when discussing the Ideal Problem Solver, proposed five components of the Problem Solving Process: 1) Identify the problem; 2) Find out the difficulties; 3) Offer a solution; 4) Implementation of the solution; 5) Evaluate the performance.

The thesis author suggests that the problem solving activity in today's mathematics can still be based on G. Polya's mathematical problem solving paradigm, which is accessible from a number of psychological and pedagogical perspectives with easy-to-apply modern accomplishments. Over time, from the viewpoint of problem-solving as a method or type of teaching, it has gradually shifted to its purpose, the content of its learning, its method of thinking, and is now considered to be leaners' competencies. It can be said whether in what form - the content of teaching, teaching methods, learning methods, thinking skills or problem-solving competencies has become the focus of general mathematics education. In Vietnam.

1.2.4. Practical problem-solving competency

The practical problem-solving competences in mathematics requires the student to take steps (as a process), but also need flexible manipulation: practical situations (contained in an assignment or a task assigned) $\rightarrow$ Find the mathematical model of the situation $\rightarrow$ Use mathematical methods to find the solution on the model $\rightarrow$ Review and accept the result.

With this approach, we conceived:

Practical-problem solving competency is understood as the competency to address the practical problems posed to secondary school students and, from this point of view, is considered to belong to the competency of applying mathematics in practice (in the scope and conditions of the students at high schools). Therefore, practical problem-solving competency

is the competency to answer the questions, solve problems from practical situations in learning mathematics, in learning other subjects in high school and in life.

Based on the diagram of the practical mathematic exercises, the students' practical problem-solving competencies will include the following components: (1) competency to understand the problem, obtain information from practice; (2) competency of transfering practical information to mathematic model (in the form of practical mathematic exercises); (3) competency of seeking strategies to solve mathematic models (way of mathematic exercise solving from mathematic view); (4) competency of implementing strategies to find out results; (5) competency of moving the results of the mathematical model to the solution of practical mathematic exercises; (6) competency of giving other mathematic exercises (if possible).

1.2.5. Orientation of teaching to develop practical problem-solving competencies

A number of specific activities in the process of teaching aim to develop and develop students' practical problem-solving competencies. These activities are described in Table 1.1 below.

Table 1.1. Activities of developing practical problem-solving competencies

Practice	*Component competencies*	*Learning activities upon practical problem-solving*
1	Competency to understand the problem, obtain information from practice	1a – Survey and determine problem which must be solved
		1b – Determine mathematical information (list mathematic data related to the exercises)
2	Competency of transfering practical information to mathematic model	2a – Connect related knowledge and information
		2b – Express problem by mathematic language
3	Competency of seeking strategies to solve mathematic models	3 – Use the acquired knowledge and skills to find out strategies for solving mathematic models
4	Competency of implementing strategies to find out results	4a – Select and use suitable mathematic methods and tools to solve given problems in the form of mathematic models
		4b – Present close and logic solution
5	Competency of moving the results of the mathematical model to the solution of	5a – Consider and select found-out results in accordance with circumstances in mathematic exercises.

Practice	*Component competencies*	*Learning activities upon practical problem-solving*
	practical mathematic exercises	5b – Respond requirements of mathematic exercises
6	Competency of giving other mathematic exercises (if possible)	6 – Use overview malnipulation or similar to give new mathematic exercises.

1.3. Practical circumstances and practical mathematic problems in mathematics at high school

1.3.1. Practical circumstances

1.3.2. Practical mathematic exercises

Within the scope of teaching mathematics, each problem is addressed to students' solution, and is often referred to as an exercise for them. As such, it is possible to consider in terms of teaching, the problem for students is given as a mathematic exercise. There are many ways to classify mathematic exercises, according to different criteria.

Based on the research purpose of this dissertation, mathematical exercises are classified into two categories: "pure mathematic" exercises and practical mathematic exercises.

• The "pure mathematic" exercise is a mathematical problem solving only in internal mathematics, with requirements such as solving, calculating function values, finding the greatest value and only involving Mathematical knowledge One of the most important values of " pure mathematic" exercise is to help the student to better understand or deepen the mathematical knowledge that he or she is learning that facilitates the training of the skills needed to solve math problems. Well solving these math problems also contributes well to the mathematical application in practice.

For example, give $T = 98.(1+0,084)^n$. Find T(5).

• Practical mathematic exercises

According to Bui Huy Ngoc, "Practical mathematic exercise is a problem that in the hypothesis or conclusions has the content related to practice." The author Phan Thi Tinh also poses the notion of "practice mathematic exercise is a problem that in the content of the hypothesis or conclusion contains elements related to practical activities." Thus, it can be seen that practice mathematic exercise is a problem in the assumption or factual data of a problem that contains situations that occur from the practical life or, more broadly, from the study Study other subjects. In other words, practice mathematic exercise is a problem that requires or needs to be addressed that addresses the problem that practice situations set.

However, the boundary between the "pure math" problem and the practice mathematic exercise is just as relative. In fact, in the reality of school mathematics, many mathematical exercises are based on the practice of the development and implementation of the mathematics curriculum (for the purpose of gaining access to the student, perceive and apply mathematics on demand at the universal level).

On the basis of this analysis, we apply Van den Heuvel-Panhuizen's (2003) point of view, placing "practicality" in relation to the student's approach to problem solving. A practcal situation is a situation that a student can imagine, or it is a practical issue that is relevant to a student's standards and living experienses.

In summary, in this respect, G. Polya's opinion is very satisfactory: "In practical mathematic exercises, they are all more complex and not as clear as in "pure mathematics". That is the basic difference between the two types of problems and hence the difference, but the basic arguments and methods for the solution are the same in both types of problems. "

1.3.3. Role and meaning of practical mathematic exercises

Math learning, broadly understood, can be thought of as learning math (the "pure mathematic" exercises, practical mathematic exercises), in teaching each problem is used for certain purposes and functions. Some roles and meanings can be found in practical mathematic exercises as follows:

- Create inspiration and give motive of learning Mathematics for students (with attractiveness of practical circumstances, excite curiosity and desire for problem solving, realize the connection between practice and mathematics and learners).

- Help students realize the role as effective tools of mathematics in social life (diversified), reinforce their correct awareness of practical origin and value of mathematics.

- Contribute to develop general competencies as well as specific competencies for mathematics, but firstly and directly, the practical problem-solving competency (a necessary competency for Vietnamese students currently)- Contribute to implement the leading important role of mathematic education which is to teach the application of mathematics.

- Collection and design of practical mathematic exercises shall increase understanding level mathematic teachers for the mathematic science itself and Mathematics at high schools, contribute to renovate the teaching method and assess learning results of students.

1.3.4. Classification of practical mathematic exercises

Practical mathematic exercises in terms of realistic reflections can be categorized into two main categories: the assumptive mathematic exercises and practical mathematic exercises, although the distinction is of a relative nature.

This thesis focuses on the exploitation and use of Practical mathematic exercises in both types of hypothetical and real situations.

1.3.5. Complexity of practical mathematic exercises

According to Nguyen Thi Tan An (2014), the complexity of the situation is assessed by mathematication under five factors: Context; Information; Number of elements to be converted; Computing technology; Tutorials, suggestions.

The complexity of the situation is closely related to the student's practical problem-solving competencies. From the results of research by Nguyen Thi Tan An (2014), we consider and describe in detail the manifestations of each degree of complexity (difficulty) of the practical mathematic exercises. The problems are divided into 3 levels of increasing complexity from 1 to 3, as shown in the table below.

Table 1.2. Levels of practical mathematic exercises

Components	Level 1	Level 2	Level 3
Context	Practical circumstances were familiar to students in daily life and study	Practical circumstances are relatively unpopular	Practical circumstances are new
Information	Mathematic exercises contain few information, clear	Mathematic exercises have moderate and clear information, without complex	Mathematic exercises have much information, too complicated
Number of elements to be converted	Few, simple, clear	moderate and clear information, without complex	much information, too complicated
Computing technology	Simple, less calculation, forms of mathematic exercises are easy and familiar to students	Not too complicated, not much forms of mathematic exercises	Complicated, difficult
Tutorials, suggestions	Clear, specific	General suggestion	Without any instruction o suggestion

Level-1 problems are fairly simple and should only be introduced to students who are familiar with how to solve practical mathematic exercises. Level- 3 exercises are difficult, too

complicated to students for a limited time. This is also a concern in the process of exploiting the practical mathematic exercises. Based on the student's level of proficiency and classification under level, teachers shall provide mathematic exercises for the appropriate group or individual students. Levels are also an important basis for teachers to present situations that suggest a student to develop practical mathematic exercises. Considering the level of factors such as context, information, the number of elements to be transformed, the calculation technique will create a variety of suggestions and this will create opportunities for development of exercises in different ways, thus creating a variety of problems.

1.4. Actual situation of explantion and use of practical mathematic exercises in teaching mathematics to develop students' practical problem – soloving competencies

The actual situation shows:

- Teachers have seen the importance of using situations, practical mathematic exercises in teaching mathematics as well as the necessity of using them; Being properly aware of the role of practical mathematic exercises in the development of practical problem-solving competencies. However, most of teachers are still confused in collecting and designing practical mathematic exercises, especially many teachers do not have the knowledge and skills necessary to exploit the relationship between mathematics and practice in the course of teaching as well as lack of guidance materials to explore, expand understanding of the practical applications of mathematics.

- Students are also aware of the role of practical mathematic exercises in developing their competencies. Although interested in solving the practical mathematic exercises, but because the teachers do not attach importance to the practical mathematic exercises, students do not have good skills to solve such problems.

- Through the statistics and survey of teachers and students, they show the teacher's book, workbook have few circumstances and practical mathematic exercises to serve the teaching.

Some of the causes of this condition may be as follows:

- Factors are considered asobstacles to teachers:

+ Obstacle from awareness: In current teaching, there is still "what to examine shall be taught". It is this thought along with the questions that do not have practical mathematic exercises should lead to the use of practical situations that are ignored or even ignored.

The problems require high rigidity, while factors, phenomena, things, relationships in practice are relative, such that it is difficult to find any line, a side of rectangle land lot which is a line, ... So many teachers assume that putting practical mathematc exercises is not reasonable, not strict.

Many teachres claim that there is no need for practical mathematic exercises because the textbooks contain few forms of such mathematic exercises, whether they are few important in exams.

Technically speaking, finding a practical situation to illustrate a lecture requires the teachers to have a lot of research, positive thinking, and a lot of time. Moreover, the understanding of the field of life of the teachers limited. Teachers do not have the means to exploit practical mathematc exercises in teaching mathematics and use them to contribute to develop the students' practical problem-solving competencies.

- Obstacles to students:

+ Students' learning is still aimed at responding to examiniation: The exams do not have practical mathematic exercises, they do not provide motive for students to be active to solve these exercises.

+ To solve practical mathematic exercises, students must have the skill of transforming from natural language into mathematical model; however, students seldom practice such skill, limited practical experiment, so this is an obstacle for them.

- Awareness of managersat high school is still limited to the implementation of requirements in the training and development of capacity for students, especially for the purpose of teaching mathematics in schools (disregard the application of mathematics to life, focus on dealing with the examination).

- Programs, materials and textbooks have not paid much attention to the development of practical problem-solving exercises. The content of the current mathematic program is too biased theoretical knowledge, lightweight practice.

Current teaching methods reveal some basic limitations that need to be overcome in order to promote the positive, active and creative nature of the students.

1.5. Conclusion

Through theoretical study and field survey, it can be seen that the exploitation and use of practical mathematic exercises in the course of teaching mathematics at high schools is necessary to develop the students' practcal proble-solving competencies. The results of the study show that teaching mathematics associated with practice is a trend, helping students to better understand the dialectical relationship between mathematics and practice, thereby determining that to contribute to change. In the new education, it is necessary to strengthen the connection between practice and teaching mathematics. The theoretical and practical research will be an important basis for the thesis author to propose the contents of chapter 2.

CHAPTER 2. EXPLOITATION AND USE OF PRACTICAL MATHEMATIC EXERCISES IN TEACHING MATHEMATICS AT HIGH SCHOOLS TO DEVELOP STUDENTS' PRACTICAL PROBLEM-SOLVING COMPETENCIES

2.1. Orientation for exploitation and use of practical mathematic exercises in teaching mathematics at high schools

2.1.1. Orientation 1: Exploit and use practical mathematic exercises during the teaching of teachers and learning of students

2.1.2. Orientation 2: System of practical mathematic exercises is built on the basis of collection of existing practical mathematic exercises; At the same time, from the previous exercises, to find others in other areas of life but share the mathematic model, improve and use the problem in a form suitable for the content of teaching mathematics, aiming at compnents of competencies to detect and solve practical problems.

2.1.3. Orientation 3: Exploit and use practical mathematic exercises to understand the interdisciplinary view of the school, both in the classroom and in extracurricular, theoretical and practical.

2.1.4. Orientation 4: Try to exploit the advantages of practical mathematic exercises in teaching mathematics by use them in all stages of teaching in class to fulfill the requirements of mathematical education.

2.2. Exploring practical mathematic exercises in teaching mathematics at high schools

2.2.1. Collect practical mathematic exercises

Based on the contents of the lesson, topic of subjects, teachers may search for suitable practical mathematic exercises by:

- Collect from the materials, textbooks, reference books of Mathematics in our country, as well as the textbooks of other subjects, mainly the natural science books;

- Refer to books, books, reference books, and other relevant foreign documents. In these documents, the number of practical mathematic exercises is often large with rich contents in the fields of economy, society, life, etc. Communication or libraries;

- Collection from the textbooks, reference books of other subjects, mainly natural sciences;

- Collecting from the Internet; there are now many website of mathematics, many articles on various topics, including the topic of practical mathematic exercises (for example, www.realmoney.com/website/index). Php / thi-du-thuc-tien);

- You can also find many practical mathematic exercises by reading, studying the history of mathematics.

2.2.2. Form new practical mathematic exercises from available ones

This is the exploitation activity that helps teachers upon determination of mathematic model of given practical mathematic exercises.

Such activity consists of 2 steps:

- *Step 1*: Solve the available practical mathematic exercises then determine the mathematical model of the given exercises;

- *Step 2*: Recommend new practical mathematic exercises.

In this way of exploitation, it is necessary first to find out available practical mathematic exercises. These can be assumptive or practical problems. In step 1, it is necessary to solve the known problem using the knowledge and skills available and the data given in the problem to

determine the mathematical model and then complete the next step. This helps the designer to clearly see the mathematical nature of practical mathematic exercises. Then, in step 2, based on the solved practical mathematic exercises (with the mathematical model defined), the operators can search for, connect appropriately the practical situations (assumption) has the same mathematical model in place to create new problems in the principle of a model, multiple situations. This design can be used for teachers and students. However, for each object, the requirements for step by step implementation are different. For a teacher, only mathematical models can be identified so that they can find out practical mathematic exercises with corresponding mathematical models.

To do so, you can use the following ways:

- Way 1: Change factors, phenomena, things, relationships… mentioned in exercises
- Way 2: Change the relationship, the nature of factors, phenomena, things, relationshipsin exercises
- Way 3: Change assumption or conclusion of exercises.

For example: Consider a problem (Temporarily called LOTTERIA Restaurant Problem)

LOTTERIA is a series of fast-food restaurants, of which the first restaurant was opened in Tokyo, Japan on 9/1972. The name LOTTERIA is derived from its parent company, Lotteria group, available in Japan, Korea, Indonesia, Vietnam and Myanmar.

In Vietnam, it often opens from 10:00 - 22:00 daily; morning shift from 10:00 - 18:00 and afternoon shift from 14:00 - 22:00.

Hourly wage (table).

Time of work	Wage/hour
10:00 - 14:00	10,000 VND
14:00 - 22:00	12,000 VND

For operation of each restaurant, a minimum of 6 employees is required between 10am and 2pm, a minimum of 24 employees during peak hours of 14: 00-18: 00 and no more than 20 employees in about 18 00-22: 00. As the number of night guests is often higher, the restaurant needs at least double the number of employees. Help the restaurant chain owner in Vietnam mobilize staff for each shift so that the cost of daily wages is minimal.

2.2.3. Form practical mathematic exercises from “pure mathematic” exercises

From the aforementioned orientations, where possible, derives from the mathematical model that has been available for the development of practical mathematic exercises, or the

formulation of practical mathematic exercises from “pure mathematic” exercises with specific activities as follows.

The design of practical mathematic exercises comes from "pure mathematic” exercises, which can be done in four steps:

Step 1: Study topics of teaching the theorems, formulas, rules under that topic to search for mathematical models.

Step 2: Find the situations relating to real life compatible with the indentifiel problems Step 3: Determine conditions of the quantities and adjusted factors to match the practical situation.

Step 4: Expressing exercises related to real life

2.3. Some measure of teaching to develop practical problem – solving competencies through use of practical mathematic exercises

2.3.1. Measure 1: Use practical mathematic exercises in all stages of teaching mathematics at high schools

a) Purpose and meaning of the measure:

In teaching mathematics, we have often paid attention to the transmission of knowledge without providing instructions for students to the link mathematical knowledge with practice, including the knowledge of the origin of practice leading to mathematical knowledge and applications of knowledge into practice. It is important foundation to contribute to improvepractical solving-problem competencies, that spirit must always be demonstrated in all periods as well as stages of each period.

In other words, to contribute to develope students’ practical problem-sovling competency, it is required to provide opportunities for students to contact regularly practical mathematic exercises, then develop components of such competencies.

b) **Measure implementation plan*:***

To contribute to the development of practical problem-solving competencies, there is various ways and opportunities, for example, in teaching:

- Originated from a practical situation directly related to knowledge for posing any issue in period;

- Search images, models in practice attached to mathematic knowledge during the teaching;

- Introduce applications of mathematic knowledge (need to be imparted) in practice.

It is necessary to pay attention to the use of practical mathematic exercises in daily life around students, in social activities, in learning other subjects; In economics, engineering, defense, ...

For example: When teaching the function of a function in class 10, to review the knowledge of quadratic functions, instead of introducing a quadratic function, then ask the student to recall the properties, how to find the great value the smallest, the smallest function of a function above or a certain segment, teachers may issue the following problem: "A real estate

company in Hanoi has 50 apartments for rent. Know that if renting each apartment for $ 8 million a month, every apartment has tenants and every time the rent increases each apartment to 250,000, there are two apartments are vacant (no tenant).). Q. How much do I need to rent each apartment for a month? "

In addition to addressing the requirements set forth above, putting this problem into review will help students realize the meaning of mathematics that can be applied in business operations. Also, students may be able to solve similar situations in practice or in other words, to contribute to the development of students' practical problem-solving competencies.

2.3.2. Measure 2: Selection and suitable use of practical mathematic exercises to practice the elements of practical problem-solving competencies.

a) Purpose and meaning of the measure:

Practical problem-solving competencies consist of various components; to develop such competencies, it is required to pay attention to develop each specific components. Practical mathematic exercises, depending on its contents, may contribute to increase one or some components. Therefore, the selection of exercises aiming at each or various components is very necessary and then, use them in correct purposes of selection during the teaching.

b) Measure implementation plan:

In order to train students to develop the components of problem-solving competencies, teaching should provide the opportunity for students to carry out the activities mentioned in *Table 1.1*. These activities (components) both closely related and relatively independent. Therefore, in the process of teaching mathematics, through the activities, teachers may be interested in developing each corresponding element or a combination of different elements.

2.3.3. Measure 3: Instruct students to collect their own mathematical applications in order to transfer the practical circumstances while learning other natural sciences in the curriculum under the model of practical mathematic exercises

a) Purpose and meaning of the measure:

This is also a concrete manifestation of the positive teaching concept, maximizing the subjective role of students in learning. Students are active in every form, every action. In addition, students are able to do this (mainly collectors but not limit their "processing", "composition") to get as many practical mathematic exercises in many areas as possible). Applications of mathematics that students can directly receive and must learn and solve first of all through learning content in general and especially subjects closely related to mathematics (natural scientific subjects), contribute to implementation of inter-subject principle in teaching.

In addition to collection of exercises in other subjects which require the use of mathematic tools for solution, it is required to form students' self exploitation of practical mathematic exercises in all aspects of life.

b) Measure implementation plan:

In order to provide the opportunity for the student to collect, exploit practical mathematic exercises in general, the following requirements may be considered necessary:

Firstly, learners need to have necessary mathematical knowledge required.

Secondly, learners need to have a good understanding of the age and experience level, natural language ability, the ability to convert to mathematical language or vice versa.

Thirdly, learners must recognize the underlying mathematical knowledge in the practical situation in general and the subject situation in particular. Know to associate mathematical knowledge with knowledge in practice in other subjects, with your own experiences in real life.

2.3.4. *Measure* 4: Use practical mathematic exercises in practical activities, extra-curricular activities for students at high schools.

a) Purpose and meaning of the measure:

These are activities to help students directly connect mathematics with practice through learning. It is the opportunity for students to practice the knowledge of mathematical theory, apply knowledge to solve practical problems. This also helps students find the meaning and value of mathematical knowledge in the application, then speed upthe motivation of learning math. The need for math practice is confirmed in the Guide to Teaching Methods under the program in the training of the MOET's textbook: "Good preparation of methods for real hours Mathematical work to ensure the requirements of practicing practical skills, apply mathematical knowledge to practice, improve the interest of the learner "Ensure a comprehensive assessment, not of memory or theory; Attention must be paid to the development of mathematical thinking, creative ability in learning and solving, practical ability, application to situations, especially real situations.

Learning together with action is not something new in theory that really has become a principle recognized by the world for a long time. But here, we would like to emphasize the positive effect of practical activity on contributing to a positive change in practical problem-solving competencies an effective combination (if well-organized) between thinking and acting, manipulation, theory and practice.

In addition to assuring and enhancing mathematical practice, extracurricular forms of mathematics also have positive implications for the exploitation of practical mathematic exercises. If well-organized, enthusiastic and enthusiastic volunteer participation by members, activities such as math clubs, collectibles, math journals, ... practical mathematic exercises as well. It is a very valuable source of exercise for teaching and learning math. From many decades of last century, our country's mathematical education tried to ensure that these activities (practice, extracurricular activities) and achieve good results. However, due to the circumstances of the war and especially due to the pressure of the college exams, the exam questions only included theoretical problems along with a number of other reasons that extra-curricular mathematics was considered. Lightweight, even dropped out plan of teaching

mathematics in many schools. It's time to put practice, extra-curricular activities back to their proper place and meaning.

b) Measure implementation plan:

- Organization of extracurricular activities:

Teachers may organize extracurricular activities by: studying, doing homework; Investigation and survey; Making mathematical papers (practice); Mathematical exchange; Organize visits to production facilities that have mathematical applications that can be visited.

- Organization of practical activities:

First and foremost, it is good practice to teach the prescribed practice hours, while seeking more practical opportunities from mathematical topics. When practice can be organized by practice in the classroom and practice outside the classroom.

+ Practice in the classroom (doing meaningful practical exercises). With this form, the teachers can set up situations related to practice in the form of exercises (in consolidation and rehearsals, these exercises may not be in the textbooks). To attract students to participate in and give meaningful exercises, exercises should be linked to specific situations, specific phenomena in practice.

Practical activities in the classroom and outside the classroom should be implemented by the teachers at an appropriate time in the distribution of the Program at the beginning of the school year; It is possible to arrange elective classes as these activities. In addition, teachers can add extra practice outside the classroom and extracurricular activities.

2.4. Conclusion

In this chapter, the directions for designing the practical mathematic exercises have been presented by: i) Collect practical mathematic exercises; ii) Develop a new practical mathematic exercise from available practical mathematic exercises; iii) Develop practical mathematic exercises from the "pure mathematic" ones. From these three orientations, the author of the thesis was interested in the design of new problems, the collection of available problems is only the basis for the design of new problems; two ways of designing practical mathematic exercises, one that arises from practical mathematic exercises and is derived from the problem of "pure mathematic" exercises. After presenting the steps to be taken, the author of the dissertation has presented illustrative examples through specific topics in the General Education Program of mathematics at high schools.

In order to develop practical mathematic competencies, during the teaching of mathematics, the thesis proposed four pedagogic methods on teaching of mathematics to help teachers use practical mathematic exercises in teaching for development of students' practical problem-solving competencies. The four methods are:

+) Method 1: Use practical mathematic exercises to help students contact between mathematics and diversided practice (origins and applications of mathematics) in the course

of teaching mathemaics at high schools.

+) Method 2: Selection and use of practical mathematic exercises to practice the suitable elements of practical problem-solving competencies

+) Method 3: Guide students to collect their own mathematical applications to translate the practical circumstances while learning other natural sciences in the curriculum based on the practical mathematic exercises.

+) Method 4: Use practical mathematic exercises in practical activities, extra-curricular activities for high school students.

These measures will be tested through the organization of teaching in some high schools to test the feasibility.

CHAPTER 3: PEDAGOGIC EXPERIMENT

3.1. The of experiment purpose

Pedagogic experiment is conducted to:

• Evaluate the feasibility and effectiveness of exploitation methods (collection, design) of practical mathematic exercises.

• Assessment of the rationality and feasibility of the teaching methods in order to contribute to asserting the role and effect of practical mathematic exercises.

3.2. Oranniza of experiment

For the purpose of experiments above, the thesis has identified and implemented experimental content with two types of participants are teachers and students. The organization implementation is specific to each object.

3.3. Evaluation of experiment results

The dissertation uses the qualitative assessment method (mainly through the teacher's comments and judgments - expressed through the questionnaire or interview results, through the author's survey, with special focus on the attainment levels of practical problem-solving competencies. In addition to the quantitative assessment (processing of data from teachers and students assessment cards, results of tests for students).

3.3.1. Regarding the instruction of the exploitation of practical mathematic exercises

The experimental process showed that the teachers initially spent a great deal of time in proposing the problem, since no suitable practical circumstances was found. When it is suggested to focus on examples, some specific topics, the teacher has come up with the idea of building a new problem from the exploitation of existing problems. The problems were collected, initial design was not really reasonable in situations and figures, but when adjusted the teacher has many better problems. Through direct communication, 100% of the teachers affirmed the good implementation of the exploitation of the practical mathematic exercises.

Some suggestion of teachers focuses on providing materials for the exploitation more quickly. teachers need sources of practical mathematic exercises and at the same time disseminate them how to find sources, how to create new problems, and how to use them in mathematical education.

3.3.2. Regarding use of teaching methods

Teachers themselves evaluate the teaching is satisfactory, psychological comfort, not much pressure, students enjoy the lesson. The problems brought into the teaching by the teachers themselves should also create the teacher's confidence in teaching, mastering teaching hours so that high efficiency. Another reason for being effective is due to thorough training. Teachers also argue that through the lessons taught by the implementation of suggestions, orientations in the measures, by qualitative observations and comments it may be assumed that the student's problem-solving competency will well developed, reflected in the fact that many students have shown great interest and have remarkable impressions of the signs of the above competencies in the practical problem-solving (not just in the experimental periods but Also see the link between the "pure mathematic" content and the real life situations, see many applications of mathematical knowledge in life. .

3.3.3. Assess the development of students' practical problem-solving competencies

In addition to the qualitative assessment of the results of the performance of two experimental sessions, the student performance assessment of the student is assessed on a 10-point scale for each experimental test. (each mathematic exercises get 5 marks)

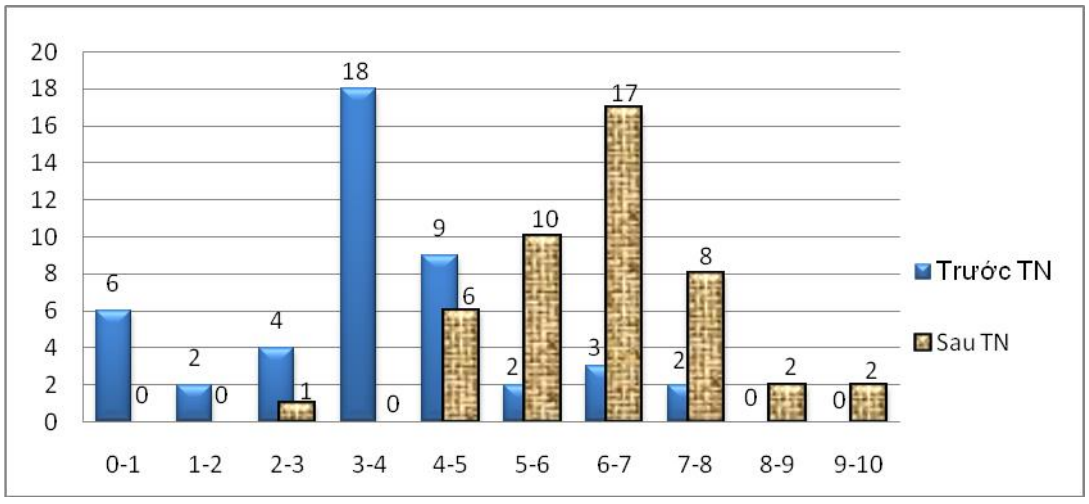

Figure 3.1. Distribution of marks before and after experimental of experimental class

The empirical process has shown that, the implementation of methods of exploiting the practical mathematic exercises helps the student see the mathematical content in different situations of practical life. It is also through the experiments that students are very active and interested in the implementation of the above steps. Through this, the student identifies the mathematic essence of practical mathematic exercises, acquiring certain skills in the transfer of practical mathematic exercises to "pure mathematic" exercises and vice versa. This has contributed to the development of students' practical problem-solving competencies.

3.4. Conclusion

The results obtained after this experiment are very interesting for the teachers, and some of the quality practical mathematic exercises have been developed, which can be added to the system of examples and exercises according to the compatible topics in textbooks and workbooks.

Lessons of the teachers have been evaluated by the teachers themselves as satisfactory, psychologically comfortable, without much pressure. Students are interested in studying and think that the application of the methods of exploitation of practical mathematic exercises is realizable and feasible.

Based on the results of the teachers who attend experimental lessons, it is shown that most of the teachers are highly appreciative of experimental teaching. The use of practical mathematic exercises enriches mathematical hours and attracts students' interest in mathematics, which has helped students realize the bond between the ants. It contributes to the development of problem solving skills for students. This show that pedagogic methods as mentioned in Chapter 2 are feasible and suitable.

In short, although the experiment was conducted on a narrow scale, the empirical results show that the scientific hypothesis of the research problem was tested and initially had positive results on the feasibility of Exploitation and use of practical mathematic exercises to develop students’ practical problem-solving competencies.

THE THESIS CONCLUSION

The thesis has obtained the following main results:

- Clarify the theories related to topic, including: (i) Clarification of the mathematical application circuits in the general education of mathematics at high schools, meaning, role of applying mathematics to the achievement of mathematics goals; (Ii) Clarification of some concepts of competencies, problem-solving competencies, practical problem-solving competencies, practical mathematic exercises or circumstances; (iii) Propose some elements of practical problem-solving competencies.

- Initially, a general picture of the current state of exploitation of practical mathematic exercises and the reality of teaching mathematics by using practical mathematic exercises;

- Propose ways to exploit practical mathematic exercises for teachers and students to use in the teaching and learning of math.

- Give guidelines and measures for teaching and learning, using practical mathematic exercises, contributing to the development of practical problem-solving competencies in teaching mathematics.

- Esablish some practical mathematic exercises as defined in the PRESCRIBING general education program of mathematics at high schools for reference to by teachers and students.

The process of doing the thesis also shows that:

- Exploiting the practical mathematic exercises will not only help students identify and review basic knowledge but also help students to connect math and life to life, thus seeing the necessity and role of mathematics for the practical life. This helps students find the meaning and importance of mathematical knowledge.

- The use of practical mathematic exercises helps students to be more interested in learning math. This gives them the motivation to explore the world around them and find ways to solve problems in life, which is also an important factor that contributes to the opportunity for them to develop the practical problem-solving competencies.

- Through the exploitation of practical mathematic exercises, the teachers and the students can make a source of practical mathematic exercises. This is very significant in teaching because both the teacher and the learner determine the meaning of mathematics in life, see the mathematical issues of practice and determine the basic mathematical content to solve any practical problems.

- Results related to the dissertation have been presented in some articles published in the Journal of Educational Sciences, Journal of Mathematics in the school, 4 workshops in the country; Two ISIMED international seminars were held in Indonesia and the ICME was held in Hanoi.

DECLARED RESEARCH RESULTS OF THE AUTHOR RELATED TO THESIS

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