THAI NGUYEN UNIVERSITY
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DEVELOPING MATHEMATICAL MODELING COMPETENCE FOR HIGH SCHOOL STUDENTS IN ALGEBRA TEACHING

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LIST OF RELATED PUBLICATIONS

International publications (03)

1. Tran Viet Cuong, Le Hong Quang (2020). *Math Modeling and Case Solving in Real Context: Case Study at Xuan Giang High School, Soc Son District, Hanoi City, Vietnam.* Universal Journal of Educational Research, Vol. 8, No. 12 (SCOPUS)
2. Tran Trung Tinh, Le Hong Quang (2019). *Integrating Art with STEM Education-STEAM Education in Vietnam high schools*. Annals. Comput er Science Series. 17th, Tome 1st. (B+), Romania. Pp. 203-213.
3. Tran Viet Cuong, Le Hong Quang (2017). *Teaching Mathematical Modelling: Connecting To Classroom And Practice*. Annals. Comput er Science Series. 15th, Tome 2st, Romania. Pp. 24-28.

National Publications (04)

1. Le Hong Quang (2019). *Research about mathematical modeling capacity framework of high school students.* Educational Sciences, HNUE Journal Of Science. 2019, Vol. 64, Iss. 7, pp. 120-129.
2. Le Hong Quang (2019*). Current situation of Mathematical modeling capacity of high school students.* Educational Sciences, HNUE Journal Of Science, Vol. 64, Iss. 4, pp.137-153.
3. Tran Viet Cuong, Le Hong Quang (2018). *Developing a problem-solving teaching process through the creative experiences of high school students.* HNUE Journal of Science, Vol. 63, Iss. 9, pp. 42-52
4. Le Hong Quang (2016). *Mathematical modeling in a problem-solving learning context.* Journal of Psychology, Vol. 10 (2016), p. 89-98.

Researches (03)

The PhD student has conducted 3 research projects at ministerial level

1. Title of project: Autonomy and accountability of high-quality high schools in Vietnam today.

Reference No: B2020-HVQ-09

Year of project implementation: 2020-2021

Role of PhD student: **Leader of project**

2. Title of project: Teacher's STEAM capacities development at high schools;

Reference No: B2018-HVQ-06

Year of project implementation: 2018-2019;

Role of PhD student: **Leader of project**

This project has been accomplished and approved

3. Title of project: Proposed models of specialized classrooms at high schools to meet the requirements of the new curriculum;

Reference No: B2018-HVQ-07.

Year of project implementation: 2018-2019;

Role of PhD student: Member of project

This project has been accomplished and approved

Introduction

1. Rationale

The general trend that advanced math education in the world not only assesses knowledge but also examines students' ability to apply their knowledge and experience to practical problem solving and what can be done based on the knowledge already learned.

The process of modeling Mathematics shows the relationship between practice and problems in textbooks from the perspective of mathematics. Therefore, it requires students to be proficient in manipulating mathematical thinking such as analysis, synthesis, comparison, generalization, abstraction ... In high school, this approach helps Students' Math learning becomes more practical and meaningful, creating motivation and passion for Math learning.

The current High School Mathematics Textbook curriculum inherits and promotes the tradition of teaching Mathematics in Vietnam, approaching the high school math education level of developed countries in the region and above world. The content is compiled according to the spirit of choosing basic, practical, systematic and streamlined mathematical knowledge; show interdisciplinarity and integration of teaching content; demonstrating the instrumental role of Mathematics, at the same time enhancing practice and applying, implementing teaching associated with practice. Particularly, Algebra creates great conditions in developing mathematical modeling competencies for students.

There have been several studies on mathematical modeling applied in teaching Mathematics in high schools. Typically, the works "*Research and apply modeling method in teaching mathematics in high schools"* by author Nguyen Danh Nam, "*Contributing to the development of mathematical modeling competence for high school students. general education through teaching Algebra and Calculus* "by Phan Anh [12]," *Using*

mathematics to develop quantitative understanding capabilities of students in grade 10 "by Nguyen Thi Tan An, "*Application of differential calculus (derivative part) to solve extreme exercises with interdisciplinary and practical contents in teaching Mathematics of high school grade 12*" by author Nguyen Ngoc Anh, "*Enhancing the exploitation of Practical content in teaching arithmetic and algebra to improve the ability to apply mathematics in practice for junior high school students* "by Bui Huy Ngoc [11]. However, there is no in-depth research on developing mathematical modeling competencies for high school students.

For the above reasons, the research topic for the thesis was selected: **"Developing mathematical modeling competencies for high school students in algebra teaching ".**

2. Research purposes

The purpose of the thesis is to research and determine the characteristic elements of the competence for mathematical modeling with the object of high school students; on that basis, proposing pedagogical measures to contribute to enhance this competence in learners through algebra teaching.

3. Research tasks

Theoretical review of the contents: Research viewpoints on mathematical modeling; Mathematical modeling competence of high school students.

Practical research: The reality of math modeling competence of students in a number of high schools; The situation of developing mathematical modeling competencies of high school students.

Clearly defined: The component competencies of the mathematical modeling competence of high school students; The contents will equip and foster high school students to improve their mathematical modeling competence.

The pedagogical measures towards improving mathematical modeling competence of high school students.

Pedagogical experiment: Organizing pedagogical experiment in both width and depth to test the feasibility and effectiveness of the proposed measures.

4. Object and subject of study

+ *Object of research:* Math teaching process at high schools.

+ *Subject of research:* The process of developing mathematical modeling competencies for high school students.

5. Scientific hypothesis

If the basic elements in the mathematical modeling competence of high school students can be identified and appropriate pedagogical measures are proposed, it will contribute to improving students' mathematical modeling competence, thereby , improve the quality of math teaching and learning in high schools.

6. Research method

Theoretical research method; Methods of surveys; experts interviews; Experimental pedagogy.

7. Scientific arguments will provide defense

+ Evaluate the current situation of high school students' mathematical modeling competence in several high schools and the developing of mathematical modeling competencies for high school students.

+ Proposing the competency framework for mathematical modeling of high school students is necessary and feasible.

+ Pedagogical measures for developing competencies in mathematical modeling for high school students are consistent with the new High School Education (2018) program and orientation.

8. Expected contributions in the thesis

+ *Theoretically:* The components of mathematical modeling competence of high school students; The content will foster high

school students to improve their mathematical modeling competencies.

+ *Practically:* Evaluate the status of the components of the mathematical modeling competence of high school students and the actual situation of developing this competence for students at high schools; Pedagogical measures to improve mathematical modeling competence of high school students; The products of the thesis can be used in teaching Mathematics in high schools.

Chapter 1
THEORETICAL AND PRACTICAL BASIS

1.1. Literature review

1.1.1. The situation of developing mathematical modeling competencies for students in teaching Mathematics in the world

There is increasing evidence in the literatures that a problem-focused approach including a mathematical context, a "real world" setting or both can drive the learning of both skills and concepts. In a comparative study, for example, with high school curriculum comprising richly applied problem situations, students scored better than students compared to algebraic procedures. and significantly better in problem-solving and conceptual tasks (Schoen & Ziebarth, 1998) [14].

Considering some countries teaching mathematical modeling: Finland; Australia; Netherlands; UK; America; France.

1.1.2. The situation of developing competencies in mathematical modeling in mathematics teaching in Vietnam

The author (Phan Anh, 2012) [12] researches to identify the characteristic components of the mathematicalization competence of practical situations with subjects as high school students; on that basis, propose pedagogical measures to contribute to the development of this competence in learners through teaching Algebra

and Analysis; Bui Huy Ngoc (2003) [11], with the study "Strengthening the exploitation of practical content in teaching arithmetic and algebra to improve the ability to apply Mathematics into practice for junior high school students" ; Author Huynh Huu Hien (2016) [10] explores the mathematical modeling process; explore students' modeling competence; consider the competence for math modeling of grade 10 students when studying according to context; learn some of the student's advantages and disadvantages when learning in context; consider students' attitudes while conducting Mathematical modeling activities in the contextual learning environment; Ha Xuan Thanh (2017) [9] researched "Teaching mathematics at high schools in the direction of developing the ability to solve practical problems through the exploitation and use of practical situations".

Thus, through studying local documents, I found that studies related to mathematical models, mathematics of practical problems, ... also mentioned the problem of developing competence of students. born; The previous studies with the research samples were not large enough to give affirmation about the mathematical modeling ability of students; lack of a detailed assessment of the mathematical modeling competency components, the lack of wide-scale assessment of the reality of mathematical modeling competence. However, new studies only focus on helping students improve their ability to solve problems.

Therefore, it is still necessary to have a specific and in-depth study on developing mathematical modeling competencies for high school students, in which, building a student's competence framework for mathematical modeling, propose feasible measures for developing mathematical modeling competencies in high school students.

1.2. Basic concepts

1.2.1. Competence

1.2.2. Mathematical competence

1.2.3. Model

1.2.4. Mathematical model

1.2.5. Mathematical modeling

1.2.6. Mathematical modeling competence

There are many different definitions of researchers in terms of modeling competence and it includes many component skills.

From the above studies, the author of the thesis thinks that, Mathematical modeling competence is the ability to fully perform the stages of the modeling process (mathematics, problem solving, understanding, comparison.) to solve the problem in question.

1.3. The role and significance of mathematical modeling in teaching Mathematics in high school

1.3.1. Enhance the connection of Mathematics with practice

1.3.2. Develop learning projects

1.3.3. Strengthen group cooperation

1.3.4. Develop competence to solve practical problems

1.3.5. Develop skills in using information technology

1.4. Mathematical modeling process

There are many mathematical modeling processes that have been studied, published, and used extensively by mathematicians and educators in recent decades. Typical examples are: From the review of modeling from research (Pollak 1979; Blum (2005); Stillman (2007); OECD / PISA (2006); Ok-Ki Kang Ji Hwan Noh (2012)) [67]; Mette Sofie Olufsen, 2003). The author of the thesis proposes a mathematical model to teach in Vietnam (Figure 1.7).

1.5. Students' Mathematical modeling competence

1.5.1. The ability to identify situations of the mathematical model from a practical context

1.5.2. The ability to use language in the process of mathematical modeling

1.5.3. Competence in building mathematical models

1.5.4. Competence to work with mathematical models

1.5.5. Competence assessment, model adjustment

1.6. The potential of Algebra teaching towards developing mathematical modeling competencies for students

The thesis author looked at elementary Algebra in the math program and found that algebra is generally considered necessary for any mathematical, scientific, or engineering research, as well as other applications. as medicine and economics. Algebra allows to describe functional relationships; Algebra can "algebraic geometry" ... In other words, algebra is a basis for many in-depth mathematical studies, to form mathematical tools to solve problems of mathematics. and other related scientific fields; give students the ability to reason inference, contribute to the development of logical thinking, the ability to create mathematics and form the ability to use algorithms.

Therefore, the author of the thesis affirms that algebra in high school curriculum has a lot of potential to develop mathematical modeling competencies for students.

According to the above analysis, the author of the thesis said that in order for students to perform the successful mathematical modeling process, they need to be developing a number of activities: Language activities; Activities to identify situations; Activities to mobilize knowledge, practical experience, problem solving skills; Activity to learn and explain practical problems through mathematical modeling.

Conclusion Chapter 1

From studying international and domestic literatures on mathematical modeling in teaching and learning in high schools. In Chapter 1, the thesis author proposes the components of the student's mathematical modeling competence. The author will apply this proposed competence framework to survey the current situation of students' mathematical modeling competencies.

Chapter 2. PRACTICAL RESEARCH

2.1. Research methods

2.1.1. Objectives of the study

This study is designed with the aim of:

- Assess the current situation of high school students' mathematical modeling competence (Through case studies at 10 high schools)

- Learn about developing competencies in mathematical modeling for students in high schools.

2.1.2. Research sample

The survey was conducted on a sample of 06 educational experts; 05 educational managers; 126 teachers directly taught Mathematics at 10 high schools and 500 students at the above high schools.

2.1.3. Research tools

In addition to the questionnaires tool, we also consult directly with experts, teachers, and students.

We process the data using algorithms of mathematical statistical method to calculate the weighted average of the levels to be assessed for a criterion that must be evaluated according to the following formula:

$$\overline{X_j} = \frac{\sum_{i=1}^{n} f_i x_i}{\sum_{i=1}^{n} f_i}$$

2.1.4. The process of data collection

In the process of researching the current situation, the research team is carried out through the following steps: (1) Establishing a research team; (2) Members discuss the proposed survey content; (3) Apply the math modeling competency description of students (in Chapter 1); (4) Consulting and answering questionnaires; (5)

Evaluation; (6) Find out how to foster math modeling competencies for students at some high schools.

2.1.5. Data analysis

2.2. Situation of high school students' mathematical modeling competence

2.2.1. Situation of the ability to identify practical situations that can be applied to the mathematical model

2.2.2. Situation of language proficiency in mathematics

2.2.3. Situation of competence in building mathematical models

2.2.4. Competence of working with mathematical models

2.2.5. Situation of assessment competence and model adjustment competence

2.3. The situation of developing mathematical modeling competencies for students of t high school Mathematics teachers

Thus, the practical application of mathematics and interdisciplinarity in which mathematics plays an instrumental role has been explicitly mentioned in the secondary curriculum. However, the issue of teaching modeling has not received considerable attention in Vietnam. Modeling teaching is not emphasized in curriculum and textbooks in Vietnam. We only find traces of modeling in the application of mathematical knowledge to some practical problems. In high school math textbooks, these are rare and are often placed in the extra reading section or at the beginning of some chapters as a guide to new knowledge.

Through consultation with teachers involved in the research and teaching experiment, control. We have received negative results in the problem of developing math modeling competencies for high school students.

With the question: According to teachers (teachers), do students need to foster math modeling competencies?

I received 7 out of 19 unnecessary teachers; 4/19 says it is less necessary; 3/11 teacher deemed necessary; and with 5/19 teachers affirmed that developing competencies in mathematical modeling for high school students is very necessary.

With the question: According to teachers, does the competence for mathematical modeling support self-training and self-development and improve students' math learning results?

I got 6/19 teachers saying no support; 4/19 said that it had support but to a small extent; 5/11 the teacher said that, the ability to model mathematics supports self-training and self-development and improve students' Math learning results; and with 4/19 teachers affirming that developing the competency of mathematical modeling for students is necessary, it greatly supports each student in practical problem solving skills, applying personal experience and mathematical knowledge to perform the task.

With the question: In your opinion, is it practical to develop the competence of students' mathematical modeling through training and developing the modeling ability in Algebra?

Teachers have different confidences and shares. Mechanism 3/19 teachers said that it was not practical; 5/19 said, it is less necessary real; However, there are still 11/19 teachers who say that it is very practical and practical to develop students' ability to model mathematics through training and developing modeling skills in Algebra. Many teachers say that while they know the benefits of mathematical modeling, it is very good that students can model math. However, due to many objective and subjective reasons, teachers do not have strong motivation to perform the developing competence for mathematical modeling for high school students.

Continuing to consult with math teachers involved in research and experimentation, the majority of teachers said that they have not had time to train students' ability to model math through Algebra content,

they said that , the ability to model mathematics that students demonstrate is because students practice themselves in class hours and practice through practical contexts.

2.4. General evaluation on the situation of developing mathematical modeling competencies for high school students

Strengths

Based on the survey results, specifically in some core competencies, I see that high school students have several advantages, namely:

Confident and actively participate in learning activities inside and outside the classroom.

Passionate, explore, explore problems in real context.

Having advantages in learning with the application of information and communication technology, quickly knowing how to use technology products for learning activities and life.

Most of them have experienced capital, sometimes applied them in solving problems.

Therefore, when given the opportunity to foster math modeling competencies, almost all students in the class will be very excited to participate, because they think they will solve practical problems, they experienced, challenged.

Weaknesses

Based on teaching practice, survey results, I see high school students, besides their advantages, there are some limitations:

On the side of students: While solving real problems, students sometimes focus too much on non-essential phenomena, ignoring the essential element of the object. From there, the transition from real problems to mathematical models has been difficult and sometimes failed; Many students lack perseverance, when converting from real problems to mathematical models if it is difficult to stop and ignore.

That is, the student's ability to change language in life with mathematical language and vice versa is not good, this is the first basic step students need to overcome in solving problem situations in real context.

Students have difficulty defining solving strategies when faced with problem situations that need solving.

In fact, the competence factors that the thesis author boldly outlined in Chapter 1, and through the survey process. We found that the above elements will not be clearly separated in the process of applying mathematical modeling to solve situations in the real context. These abilities are used at some point when students are problem solving. Therefore, to foster the components of the competence of modeling, according to the author of the thesis, we need to focus on allowing students to learn to solve problematic situations in real contexts, and select student, evaluate the solution. Because of the current situation, students are weak in this activity, they do not have to come up with a solution to the problem of completing a task, solving situations in real context also need to consider what solutions that can be done. be in practice or not! On the teacher's side: The work of developing mathematical modeling competencies for students seems to be forgotten in the teaching process. In schools, there is no specific regulation on developing math modeling competencies for students, so it is not possible for teachers to actively foster this competency for students.

Causes of weaknesses

Based on the results of the survey and analysis, I found that the reason for some of the above limitations is due to the following reasons:

Many students have not seen the usefulness of mathematical modeling in practice. Therefore, students have not found the

excitement and motivation to self-study and foster their own modeling capabilities.

Finding problem situations in a real context suitable for age, knowledge, and educational objectives, in which there is a hidden pedagogical intention, the mathematical knowledge to be occupied is very laborious. competence, time, and equipment available.

There are no specific regulations or requirements for teachers of Mathematics to foster math modeling competencies for students.

In high schools, there is a lack of movements to apply the knowledge learned to solve practical tasks, so students have very little conditions to learn, experience and practice.

With the current learning style in high schools in Vietnam, most students study with a huge amount of knowledge, but the time for students to apply them to solving practical tasks is too little. , not commensurate with theories learned in class.

Currently, there are still several high school math teachers still confused about the concept of mathematical modeling, so how can we foster math modeling competencies for students. This is a shortcoming that the thesis author himself thinks should have a way to overcome.

Conclusion Chapter 2

In this Chapter, the author analyzes the current situation of students' mathematical modeling competencies and activities of developing this competency. In which, the author of the thesis pointed out the strengths, as well as weaknesses, in developing competencies in mathematical modeling of students. The results of this survey are an important proof for the author of the thesis to propose competency frameworks (after adjustment) and impact pedagogical measures, to overcome the current limitations of students in the mathematical modeling.

Chapter 3
PROPOSED MATHEMATICS MODELING COMPETENCE FRAMEWORK AND PEDAGOGICAL MEASURES FOR DEVELOPING MATHEMATICS MODELING COMPETENCE AMONG HIGH SCHOOL STUDENTS IN ALGEBRA TEACHING

3.1. Mathematical modeling competence framework for high school students

Table 3.1. Mathematical modeling competence framework of students

The ability to identify mathematical model situations in a practical context	
Criteria	Indicators
I1. Observations	I1.1. "Observe the real situation" I1.2. Observe influencing factors
I2. "Associating, connecting mathematical ideas with practical elements".	I2.1. Form relationships between what students see and know. I2.2. Increase knowledge capital.
I3. "The ability to estimate, predict the results of the situation".	I3.1. Predict the results of each settlement stage. I3.2. "Predict the results of mathematical modeling situations".
The ability to use language in the process of mathematical modeling	
Criteria	Indicators
L1. Expressing real-world problems	L1.1. Identify math problems, using related math knowledge. L1.2. "Rephrase the situation in concise, precise natural language".

L2. "Using the language of mathematics"	L2.1. "Accurate and coherent logic in studying and studying Mathematics". L2.2. "Acquire knowledge, understand and use correctly mathematical terms, symbols and representations". L2.3. "Developing logical thinking in the Math learning process".
L3. "Expressing a problem in many different forms"	L3.1. "See the problem from many angles, state the problem in different ways". L3.2. "Evaluate your own level of using natural language and mathematics in the learning process".
Competence in building mathematical models	
Criteria	Indicators
B1. Problem detection	B1.1. Summary of problem content. B1.2. Identify the main audiences that influence the nature of the problem. B1.3. "Discover the law of the real situation".
B2. Identify the target audience in a real-world context	B2.1. "Determine the central factor of the situation". B2.2. "Establish a relationship between the objects in the problem".
B3. Representation	B3.1. "Representing the elements (quantities) practically by symbols, mathematical concepts". B3.2. "Expression of relationships by mathematical propositions, expressions containing variables". B3.3. "Expression of relationships by graphs, graphs, .."

Competence to work with mathematical models	
Criteria	Indicators
P1. Describe the problem	P1.1. Briefly and accurately summarize the problem in natural language. P1.2. "Identify the central object of the problem, properties, relationships between objects".
P2. Apply a mathematical system	P2.1 "Determine applicable mathematical knowledge system". P2.2. “Building mathematical relationships between mathematical objects. Solve math problems ”.
P3. Results interpretation	P3.1. "Interpret the results according to the process of solving the problem". P3.2. Explain practical results. P3.3. Compare and explain results between mathematical solutions and practice.
P4. Expansion problem	P4.1. Proposing related problems that can be modeled. P4.2. "Changing the initial data of the real problem, proposing appropriate mathematical model correction for the problem".
Model adjustment and assessment competence	
Criteria	Indicators
A1. Check and compare results	A1.1. Give results for solving math problems. A1.2. Interpret math results and practice results.
A2. Criticism, detection of the limits of the model	A2.1. Indicates current model constraints. A2.2. Analyze the reasons for the limitations in the model.
A3. Model adjustment	A3.1. Proposal to improve the model.

3.2. Measures to develop mathematical modeling competencies for high school students through algebra teaching

3.2.1. Measure 1: Developing the ability to convert mathematical language into natural language and vice versa

The goal of the measure is aimed at students who have a good ability in natural language conversion to mathematical language and vice versa.

3.2.4. Measure 2: Train students about solving strategies in the field of mathematical modeling

The goal of the approach: Students can propose an appropriate solution for problem solving in real contexts.

3.2.3. Measure 3: From problematic situations, practice for students to evaluate and select solutions suitable to the real context.

This measure aims to: Students acquire mathematical knowledge through problems associated with practice, which conceal the pedagogical intention in the problem solving process; Students have the opportunity to improve problem-solving skills through practice working on mathematical models; Students improve their ability to reevaluate the solutions of problems, compare math results with the desire to solve problems in real context. From there, select the solution towards meeting the desired practical needs.

Conclusion Chapter 3

The main contents of Chapter 3, the author of the thesis proposes two main issues:

Mathematical modeling competence framework of high school students

In Chapter 1, the author describes the student's mathematical modeling competence, in Chapter 2, the author investigates the reality of mathematical modeling competence according to this description. Based on the survey results, based on comments from

educational experts, based on the opinion of teachers teaching Mathematics in high schools. From those bases, the author adjusts the competency components in Chapter 1, as well as the descriptions of their manifestations.

However, to confirm the necessity and effectiveness of the proposed mathematical modeling competency framework in Chapter 3, the last chapter of the thesis will evaluate its necessity and feasibility.

Measures to develop mathematical modeling competences for high school students in teaching algebra

To improve the mathematical modeling competence for high school students, the author of the thesis proposes 03 measures to foster this competence for high school students (with narrow scope through algebra teaching). Specifically, the following measures: (1) Developing the ability to convert mathematical language to natural language and vice versa; (2) Train students on solving strategies in the field of mathematical modeling; (3) From problematic situations, practice for students to evaluate and select suitable solutions to the real context.

To confirm that the measures proposed by the thesis author are necessary and feasible, the author will conduct the experiment in Chapter 4.

Chapter 4
TESTING THE NECESSITY AND FEASIBILITY OF THE COMPETENCE FRAMEWORK AND SUGGESTED PEDAGOGICAL MEASURES

4.1. Testing the necessity and feasibility of the proposed competence framework

4.1.1. Testing methodology

The purpose of the test is to collect assessment information about the necessity and feasibility of the proposed high school math modeling competency framework. On that basis, we continue to adjust the inappropriate capacities and confirm the reliability of the assessed capacities.

4.1.2. Testing results

Through the research results on the necessity and feasibility of the proposed competence framework, we realize that the competence framework that we have included includes elements that are considered fundamental to the competence of modeling. mathematics of high school students. Although the level of assessment varies among the elements, the general statement still shows the necessity of the proposed competency framework and the feasibility of this competency framework for training math modeling competency. study of high school students.

4.2. Testing the necessity and feasibility of the proposed measures

4.2.1. Testing methodology

The purpose of the test is to collect assessment information about the necessity and feasibility of the proposed measures for developing mathematical modeling competencies of high school students, on that basis to adjust the measures are not suitable and confirm the reliability of the assessed measures.

4.2.2. Testing results

Measure 1 (developing the ability to convert mathematical language with natural language and vice versa) we find that, when teachers help students learn through simple practical examples, students learn how to convert object relationships in a life problem to mathematical objects and their mathematical relationships. The students' ability to convert math and natural language has been gradually improved.

Measure 2 (Train students about solving strategies in the field of mathematical modeling), I noticed that, for students to have the ability to implement solving strategies, teachers should create more opportunities to students work to deal with situations in real contexts, so they will find appropriate solution strategies

Measure 3 (From problematic situations, practice for students to evaluate, select solutions suitable to the real context), According to the author of the thesis, in the teaching process, teachers should include combine each piece of content about practical applications, discuss them in lessons, so that students find that, sometimes the results of the math solutions will not be applied in real situations. .

4.3. Measures testing: From problematic situations, train students to evaluate and select solutions suitable to the real context.

4.3.1. Testing purposes and contents

The purpose of the experiment: To collect information about the assessment competence, select the solutions of students through solving some problematic situations in real context.

Experimental contents: Content 1 (Teacher prepares some problematic situations in the real world, students perform problem solving); Content 2 (The author of the thesis has asked the in-charge teacher to create conditions for students to self-search for problem situations in the real context, students solve problems).

4.3.2. Testing methods

+ Participants: 03 students (Grade 10 A, Xuan Giang High School, taught by Teacher Le Hong Nam in Mathematics) (Group 1) are influenced by the methods proposed by the thesis author, the students together solve tasks in content 1; In content 2, the group self-searches the situation in real context to solve.

03 students (Grade 10 C, Xuan Giang High School, taught by Teacher Do Thanh Son in Mathematics) are not affected by any measures proposed by the author of the thesis in this thesis (Group 2)

4.3.3. Test findings analysis

4.3.4. Post-test results

We get the following comments:

For both Group 1 and Group 2, students also have strong points, that is, the student has a passion for engaging in specific problem situations. However, each group of students' abilities to solve problems is that there is a big difference in the way they are solved and what they think after solving it.

For group 2 (the group is not affected by the proposed measures in the thesis), the students solve the situations mainly of pure mathematics, lack of creativity when proposing solutions, also as yet re-examining whether that solution is appropriate in the practical context or not.

Group 2 does not select the solution and does not consider whether the solution given by the group can be applied in practice or not.

For Group 1 (the group is affected by the measures proposed by the author of the thesis in the learning process), we see a significant increase in mathematical modeling competence in general and in particular. All students in the group can convert this practical situation into math task, thus, about the ability to convert everyday language to math language and vice versa, according to us, we have achieved the pepper set out. Students have enthusiastically

exchanged, proposed some strategies for problem solving, evaluated strategies, selected, and coordinated appropriate strategies for problem solving.

One bright spot, in the results of group 2, but in our opinion, it is that students not only give solutions to solving math problems, students have considered the solutions compared with the actual results. Whether this math result can be converted to practice and applied in a specific context! Students boldly exchange, propose ideas for model improvement, change solutions, find acceptable solutions in best practice. Obviously, the goal of teaching math is not only to help students absorb mathematical knowledge, the aim is to use their knowledge and life experiences to solve practical problems.

Thus, it is evaluated that for group 2, students affected by the measures proposed by the thesis author have developed the competence of mathematical modeling, improving learning outcomes. math practice in general.

Conclusion Chapter 4

After meeting and discussing about the competency framework for mathematical modeling and measures of developing mathematical modeling competencies for students, educational experts, and math teachers of high schools that the author thesis We have obtained positive results: Most of the teachers questioned said that the proposed measures had new to themselves and feasible and effective. Based on those measures, teachers have proposed one to three Algebra problems associated with practice. The author believes that, high school Math teachers support them and accordingly, they can design a number of Algebra problems in particular associated with practice to use them in teaching Algebra in high schools; Contrary to the problems in life, teachers have the idea of bringing them into lessons that bring about solving practical problems.

Experimental results show that: Students in the process of experiment are more interested in learning, they understand more and can apply knowledge of Mathematics in general and Algebra in particular to solve problems. better practice. The lessons associated with mathematical modeling always create an exciting learning atmosphere because students are more excited to learn, think and discuss. Thereby shows that the proposed measures are effective.

CONCLUSION OF THE THESIS

The thesis has obtained some of the following main results:

Study views on mathematical modeling; Mathematical modeling competence of high school students. The author has given his own viewpoint of mathematical modeling competence, proposed mathematical modeling process.

Regarding practical research, the author assesses the current situation of the mathematical modeling competence of students in several high schools; The situation of developing mathematical modeling competencies of high school students. From there, it is the fulcrum for further editing and proposing the competency framework for mathematical modeling of high school students. The component competencies of high school students' mathematical modeling competencies are assessed as necessary and should be fostered.

From the actual results, there are 3 suggested pedagogical measures aimed at improving math modeling competence of high school students.

Measure 1: Developing the ability to convert mathematical language into natural language and vice versa.

Measure 2. Practice for students solving strategies in the field of mathematical modeling.

Measure 3: From problematic situations, practice for students to evaluate and select solutions suitable to the real context.

The test shows that the competency framework for mathematical modeling and proposed measures for developing mathematical modeling competencies for students has brought efficiency and improved mathematical modeling competence for students. and the growth of high school students in general.

Thus, it can be confirmed that, the research purpose has been realized, the research task has been completed and the scientific hypothesis is acceptable.