

MINISTRY OF EDUCATION AND TRAINING  
VIETNAM INSTITUTE OF EDUCATIONAL SCIENCES  
-----000-----

**DO THI HONG MINH**

**INTERACTIVE TEACHING IN MATHEMATICS  
IN HIGH SCHOOL THROUGH EQUATION  
AND INEQUATION THEMES**

**Major: *Theory and Teaching Methods of Mathematics***

**Code No.: *62.14.01.11***

**DOCTORAL THESIS SUMMARY OF EDUCATIONAL SCIENCE**

**HA NOI – 2015**

The thesis was completed in:  
VIETNAM INSTITUTE OF EDUCATIONAL SCIENCES

**Science instructor: Associate Prof. Dr. Ton Than**

**Reviewer 1: Associate Prof. Dr. Vu Quoc Chung**

**Reviewer 2: Associate Prof. Dr. Vu Duong Thuy**

**Reviewer 3: Associate Prof. Dr. Do Tien Dat**

The thesis will be defended before Institute Level Thesis Assessment Council in:  
VIETNAM INSTITUTE OF EDUCATIONAL SCIENCES- 101, Tran Hung Dao, Ha Noi

*At.....date.....month.....year 2015*

*For more details of the thesis, refer in:*

- **National Library**
- **Library of Vietnam Institute of Educational Sciences**

**LIST OF THE WORKS PUBLISHED BY THE AUTHOR**  
**RELATED TO THE THESIS**

1. Do Thi Hong Minh (2011), *Applying teaching methods to detect and solve problems in teaching geometry exercise 11*, Journal of Education, No. 266 Term 2 (7/2011), p. 42-43.
2. Do Thi Hong Minh (2011), *Training capacity to generalize, specialize, similar in teaching mathematics for high school students*, Science Announcement - Haiphong University, No. 10/2011, p. 97-103.
3. Do Thi Hong Minh (2013), *Applied teaching methods to improve perceptions of students in Teaching Mathematics in High School*, Journal of Educational Sciences, No. 88 (1/2013), p. 24-27.
4. Do Thi Hong Minh (2013), *Applying teaching methods to detect and solve problems in exercise types of finding point sets satisfying the vector equation in Class 10 - High School*, Journal of Sciences - Hanoi National University of Education, No. 58 (Special Issue publishing seminar works "Research in Mathematics Education during the integration"), p. 154-161.
5. Do Thi Hong Minh (2014), *Viewpoint of interactive pedagogy in teaching mathematics in high school*, Journal of Educational Sciences, Special Issue (1-2014), p. 2-3, 29.
6. Do Thi Hong Minh (2014), *Applying the Interactive Pedagogy perspective in teaching mathematics in high school to help develop the capacity of students*, Proceedings of the National scientific seminar on Mathematics Education Research towards Capacity Development of the learners in the period of 2014-2020, Hanoi National University of Education Publishing House, p. 59-68.
7. Do Thi Hong Minh (2014), *Applied interactive Pedagogy in teaching mathematics in High School*, Journal of Sciences – Hai Phong University ( 5/2014), No. 03, p. 89-95.
8. Do Thi Hong Minh (2014), *Equipping students majoring in Mathematics Education University with Interactive Pedagogy perspective through teaching module "Mathematics teaching methods" in Hai Phong University*, University Level Scientific Research Theme (accepted in 12/2014).
9. Do Thi Hong Minh (2015), *Applying the Interactive Pedagogy perspective in teaching mathematics in high school to help develop the capacity of students*, Scientific Seminar Proceedings for developing professional capacity of High School Mathematics Teachers in Vietnam, Hanoi National University of Education Publishing House, p. 193-199.

## INTRODUCTION

### 1. Reason for choosing the topic

According to the basic and comprehensive innovation of education, the Resolution of Conference XI by the Vietnamese Communist Party clarified that: *"In the education process, it is a principle which should always be remembered that the students are in the center. The changes in teaching and studying methods are difficult and complex which have influence to all stages from contents, program, text-books, educational levels, examinations to assessment and quality control. These are the tasks which concern all the components of education, therefore, it is necessary to have a synchronous innovation from contents to methods to reach the target for basic and comprehensive educational innovation."*[98]. Thus, the duties for teachers are to change the teaching methods in order to develop students' self-study ability, self-discovery and meet the demands of human training as provided in the educational targets. Moreover, with the continuous development of an intellectual economy, the improvement of education and training quality need to be focused in depth.

In study, not all knowledge and skills are formed by individual activities. The classroom is an environment of communication between the teachers and students, which creates interaction and cooperation among the individuals in the path to new knowledge. Through new interaction, discussion, group negotiations, each individual can express ideas, adjustment, confirmation or refusal. The group members can share ideas, experience, personal understanding and together build up new concept and attitude. By speaking out their inner feelings, each person can estimate the knowledge about a topic and what to learn more. The lesson becomes more interesting since everyone learns from one another without passive reception; the students can also learn from friends new knowledge, skills and be trained about integration, mutual understanding, criticism and participation.

Interaction teaching is a new direction in teaching methods nowadays. In the book titled: *"Learning – the treasure within"* by Jacques Delors, the author gave a new concept that in the new century, the teacher – student relationship (teacher – student interaction) is the central method in school. The role of interaction is also reflected in the research *"Teaching and teaching methods in school"*, the author Phan Trong Ngo compared the knowledge arising from interaction as *"Fire does not come from the pile of wool or stones but from stones rubbed to each other"* [61, p.295]. When writing the introduction for the work *"Towards an interactive pedagogical method"* by Jean – Marc Denomme & Madelein Roy, researcher Pham Minh Hac emphasized that: *"The supportive interaction, cooperation towards a path of receiving, understanding, skills and attitude and turn them into the personal experience, living skills and form the foundation for personality and capacity of each person – become a human, be a human and live in life."* [38, p.12]

During modern teaching process, interaction relationship is considered significant. In a certain aspect, it must be viewed as a key principle of modern teaching. It means whoever the teaching target is, whatever the content of teaching is, to ensure good teaching, it is necessary to have active interaction between learners and teaching

elements. In teaching mathematics at high school, there is interaction in teaching but not quite obvious. The interaction is mostly one way, from teachers to students. The mutual interaction among learners and environment is not clear enough. So can we apply interaction teaching of mathematics in high schools of Vietnam at the moment? How should the role of teachers, students and environment in interaction teaching? Which method should we use to achieve effectiveness? These questions are still open for satisfactory answers.

Equation and inequation is one of the basic contents in the mathematics program of high school. This is also an important content to improve students' intellectual capacity. Finding another solution to an equation and inequation will enable students to be more flexible in choosing their own solution of this content. It also stimulates dialectical thinking and creativity of the students. However, if we focus more in depth into the equation and inequation, it is necessary to have a suitable method to achieve good results. Application of interactive teaching in equation and inequation can help the students to become more active in their study. In the school of innovating education nowadays, there are many active teaching methods which have been applied in teaching mathematics in high school but there have been no study about interactive teaching in equation and inequation.

For the above reasons, we decided to pick up the research topic as: *“Interactive teaching in mathematics in high school through equation and inequation themes”* with the hope to bring this theme into practice to improve the quality of mathematical teaching in high school.

## **2. Purpose of research**

On the basis of theory and practice in interactive teaching, proposing some methods for interactive teaching of mathematics through teaching equation and inequation to improve the mathematical teaching quality at high school.

## **3. Subject and objective of study**

- Subject of study: Teaching process of mathematics at high school.
- Objective of study: Interactive teaching process of mathematics at high school.

## **4. Scientific hypothesis**

If it is possible to propose some solutions for teaching mathematics which are suitable for the real situation of teaching at high school, it can help students to study more actively and creatively and promote the effectiveness of mathematical teaching at high school.

## **5. Research tasks**

- Researching some theoretical issues in interactive teaching, the relationship between interactive teaching and other teaching methods and the application of interactive teaching in teaching mathematics.
- Proposing the requirements to be implemented during the organization of interactive teaching of mathematics at high school.

- Proposing some solutions for interactive teaching of mathematics through equation and inequation.

- Pedagogical experiment to test the feasibility and effectiveness of the proposed interactive teaching methods through teaching equation and inequation at high school.

## **6. Scope of research**

Doing research on application of interactive teaching of mathematics through equation and inequation at high school.

## **7. Research method**

In this research, we use 05 research methods which are: observation investigation; pedagogical experiment; expert; mathematical statistics.

## **8. Contents for defense**

- The conceptions of the research author about interactive teaching, situations of interactive teaching and types of interactive situations with scientific base which are suitable for practice;

- The stages of organizing interactive teaching, methods of interactive teaching in teaching mathematics at high school which are feasible and effective.

## **9. New contribution of the research**

- Systemizing and making clear the theoretical issues on interactive teaching and application of interactive teaching in teaching mathematics at high school.

- Proposing the requirements for the organization stage of interactive teaching of mathematics at high school and drawing some pedagogical conclusions.

- Proposing some interactive methods in teaching mathematics at high school through equation and inequation.

## **10. Structure of research**

Apart from the introduction, conclusions, reference and index, the contents include 4 chapters:

Chapter 1. Interactive teaching for mathematics;

Chapter 2. Organization of interactive teaching for mathematics at high school;

Chapter 3. Some solutions for interactive teaching of mathematics at high school through equation and inequation;

Chapter 4. Pedagogical experiment.

### **Chapter 1. INTERACTIVE TEACHING FOR MATHEMATICS**

#### **1.1. Overview of the research on interactive teaching**

##### ***1.1.1. Study results in the world***

The concept of interactive pedagogy has been the topic of research by many researchers. In the pedagogical document of Russia, German before, people mentioned a lot about interactive teaching – studying. The Russian educators such as : N.V. Savin, T.A. Ilina, B.P. Esipop, Iu.K. Babanxki,... evaluated the multi-element characteristics in teaching process (three elements: Teaching – Content - Studying). In the 1990s of the 20<sup>th</sup> century, a

group of French authors who are Guy Brousseau, Claude Margolinas, Claude Comiti,... had also done studies about the interaction among the elements of teaching activities in the situational theory of mathematics [81, p. 115].

Jean- Marc Denommé and Madeleine Roy are the authors of the book “*Towards a pedagogical interactive method (the three elements: Student - Teacher - Environment)*” [38] had initiated a pedagogical approach which is called the interactive pedagogy.

Recently, in the book “*The construction of new mathematical knowledge in classroom interaction*”, the author Heinz Steinbring [101] also proposed an approach to teaching based on this pedagogical opinion.

At present, the world is using a tool in teaching to create highly interactive environment which is the Activboard.

Among the forms of interactive teaching, using the software and multi-functional with internet connection or intranet proves to be more advantageous and be interested widely in the world. Combining the form of conference and group essay, interactive teaching creates a comprehensive development and increase the quality of teaching.

### **1.1.2. Research results in Vietnam**

Interactive pedagogical method has become popular in Vietnam since 1992 in Hue and 1995 in Ho Chi Minh University of Education in the Didactic conference among the French speaking countries. Despite this fact, this pedagogical term is also a new term in Vietnam.

In recent years, Vietnamese teachers have talked much about this new concept. Particularly in the book: “*Application of theory into practice of teaching mathematics at high school*” [59] by Bui Van Nghi; doctor of Education “*Organizing teaching according to the interactive pedagogical opinion in school (department) of education managers and education nowadays*” [88] by Nguyen Thanh Vinh; “*Teaching and teaching methods at school*” [61] by Phan Trong Ngo; “*Traditional and innovative teaching method*” [81] by Thai Duy Tuyen; “*Teaching method and technology in interactive pedagogical environment*” [27] by Pho Duc Hoa,...Most recently, interactive teaching is mentioned in a doctoral thesis “*Teaching based on interaction in educating primary teachers at tertiary level*” [78] defended in 2013 by Pham Quang Tiep. Moreover, there are also many other thesis and reports about interactive teaching.

Nowadays in Vietnam, this method has been used but not widely at some high schools. The application of interactive teaching is reflected most clearly through the contest for solving mathematical problems through the internet for primary students by using Interactive Mathematics Learning Resources of Hoang Khanh Hoa which was introduced on the Internet [99]. Interactive Mathematics Learning Resources attracted the participation of many primary and secondary students as well as parents.

It can be said that, research about interactive teaching domestically and internationally has achieved many good results both in theory and practice. However, as we know, there has been no in-depth research about interactive teaching in Mathematics, especially interactive teaching about a concrete subject as equation and inequation.

In developing the research achievements in interactive teaching, the world and Vietnam is applying step by step the theories in interactive teaching of a particular subject. It can be synthesized in the three following orientations:

First, the school of Interactive pedagogy by J.M. Denomme and M.Roy. SPTT has a close relationship with the situations in Didactic. Second, the majority of people follow interactive teaching in a modern concept (Interactive learning). According to this concept, interactive teaching is a pedagogical approach which combines teaching technology and digital tools. The third school is more synchronous, which is interaction in the class (Interactive classroom). In this thesis, we shall follow this school.

### ***1.1.3. Practicality of interactive teaching for mathematics in high school***

Interactive teaching is a modern teaching approach which has been applied successfully in some countries all over the world and has achieved many good results. However, the application of interactive teaching in Vietnam at present, especially for teaching mathematics at high school is still difficult. It is because the learners in study environment are still passive, and the interest is not always stimulated and maintained. In other words, the means for interactive teaching is still limited in our country.

## **1.2. Teaching and interaction**

### ***1.2.1. Teaching and teaching process***

We agree with the author Do Ngoc Dat's idea that: *“Teaching is a concept which identifies the common activities of the teacher and student, the two activities exist parallel and develop in a synchronous process which is teaching process”* [13, p. 50].

According to Phan Trong Ngo, *the teaching process is a continuous chain of teaching activities of the teacher and the student interact with each other in a certain pace and time, in order to implement the tasks for teaching and studying.*[61, p. 89]

### ***1.2.2. Interaction***

During the teaching process, it can be understood that *interaction is the direct activities between teacher and students in an educational environment to implement the tasks for studying and teaching which were identified.*

### ***1.2.3. Concept about interactive teaching***

There are many conceptions about interactive teaching. In this thesis, we understand that: *“Interactive teaching is the two-way interaction among the elements of teaching process including: the students, teacher and environment.”*

*Interactive teaching in mathematics is a teaching activity in which the teacher uses the teaching techniques, means of teaching, especially information and technology and communication, etc... to create an interactive environment with teaching situations to help the students master mathematical knowledge, practice the skills for mathematical application, develop thinking through interaction, discussion, cooperation among student, teacher and environment.*

### ***1.2.4. Scientific base of interactive teaching***

Interactive teaching has a firm scientific based on the development of many scientific branches such as psychology, education, philosophy, etc... and is applied in



education. The analysis about scientific base of interactive teaching helps the teacher to have more foundation and orientations to choose the appropriate teaching method to achieve good results.

### **1.2.5. The elements in interactive teaching**

1.2.5.1. Student- active individual

1.2.5.2. Teacher- supporter, instructor

1.2.5.3. Environment – having influence during the teaching process

#### **Some environmental elements in interactive teaching**

In the framework of this thesis, we only consider some environmental factors which are particularly important and having great impacts to the interactive teaching process, including: *knowledge, situations of interactive teaching and means of teaching* which includes information and technology and communication.

In interactive teaching, we believe: ***“The situations of interactive teaching are the situations which identify the lessons and demands for interaction among the elements: student, teacher and environment to achieve the targets.”***

The situations for interactive teaching must meet the following requirements:

- Stimulating the learner’s interest and the demands to solve the tasks in study;
- Approaching a lesson objective which is suitable for the learner;
- Creating the two-way interactions among student, teacher and environment;

There are three types of interactive teaching:

1. *Interactive teaching through actions ;*

*Example:* After introducing the definition of “Equivalent equation”, the teacher can create the following situation:

Consider if the following two equations are equivalent?

a)  $\sqrt{2}x^2 - (\sqrt{2} + \sqrt{3})x + \sqrt{3} = 0$  (1) and  $(\sqrt{6} - 2)x^2 - x + 3 - \sqrt{6} = 0$  (2)

b)  $x^2 + x - 1 = 0$  (3) and  $x^2 - 4x + 3 = 0$  (4)

The students must “act” by solving the above equations to find the set of roots. The students can give different solutions such as: analyzing the left-side polynomial into factors; Using the root formula or a quadric equation or applying Viet theorem, etc... Through interaction among students, they can choose and decide the best solutions. For example, in sentence a) Equation (2) is Equation (1) after multiplying the two sides with  $(\sqrt{3} - \sqrt{2})$ . In sentence b) Equation (4) has a root  $x = 3$  but it is not a root of Equation (3).

2. *Interaction situations through communication;*

*Example:* To enhance the concept of equivalent equation, the teacher can give some questions as follows:

- a) Give some different ideas about the concept of equivalent equation.
- b) Are two equations which do not have root equivalent? Why?
- c) Are two equations which have uncountable roots equivalent? Why?

In this situation, the students have the demands to express and communicate with each other and with the teacher. For example, in sentence a) The student can express the concept in the following ways:

“Two equations are considered equivalent if they have a common “set of roots” or two equations are considered equivalent if they have an equal “set of roots” or “Two equations are considered equivalent when the root of this equation is also the root of that equation and vice versa”.

Sentence b) is not difficult for the students but in sentence c) there are possible arguments. The teacher can interact with students by requesting: “Consider two equations having uncountable roots:  $|x|=x$  and  $|x|=-x$ . By doing this, the teacher will help students find the correct answer. It can easily be seen that both equations have uncountable roots but the equation  $|x|=x$  has a set of roots which is  $[0;+\infty)$ , and the equation  $|x|=-x$  has a set of roots which is  $(-\infty;0]$ . Thus, the two equations do not have the same set of equations and are not equivalent.

### 3. Interactive situation through confirmation.

*Example:* To remind the students when consider the equivalence of equations, it is necessary to consider that they are equivalent in which set of roots. The teacher can introduce the following interactive situation:

“ Consider  $x^2 - 1 = 0$  (1) and  $2x^2 - x - 1 = 0$  (2)

An confirms that the two equations are not equivalent while Binh is “in between”: The equations can be equivalent or non-equivalent Please give your comments about their ideas.”

In this situation, the students must communicate to confirm and check the knowledge about equivalent equation. In case all students confirm that An is correct, the teacher shall interact by pointing out that Binh is also reasonable if we consider the equations in different set of number. The students will see that the above equations are equivalent in  $Z^+$ , but not in  $Z, Q, R$ .

From that, considering the equivalence of the equations means that we need to consider they are equivalent in which set. In case the equations have the same set of roots  $D$  and equal set of roots, we can say that the equations are equivalent in  $D$ .

The position and relationship of student, teacher and environment can be shown in the following map: [38, p. 40]

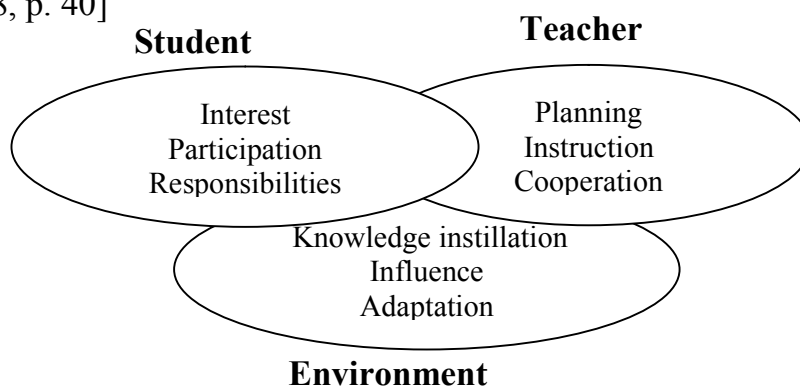


Figure 1.3. Map of location and relationship among teacher-student-environment

### 1.2.6. The interaction between elements in interactive teaching

There are three kinds of interaction occurring during teaching process which are: Teachers-Students; Students-Environment; Teachers-Students-Environment.

The interaction among three elements are reflected in:[81, p.131-133]

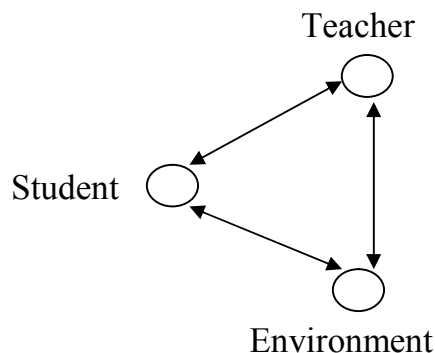


Figure 1.4. The interaction among three elements in interactive teaching

### 1.3. Communication activities in learning Mathematics

We will only mention integrated activities of mathematics communication in interactive teaching, including the means of expression and communication methods when participating in the interaction situations.

#### 1.3.1. Means of expression

The means of expression in mathematics communication is mathematics language. The mathematics language includes the symbols, terms, signs and the rules to connect them into a mean of expression in a logical and clear way. According to L.S. Levenbeg [48], “mathematics language also includes writing signs such as: drawings, models, figures, graphs, table, etc...”

#### 1.3.2. Means of communication

The means of communication is mathematics communication activities expressed in mathematical dialogues. According to Catherine, “*dialogue in teaching mathematics is a dialogue in which the participants use connection, questions, agreement or disagreement of a certain mathematical problem through communication (words, writings, body language) to explore or develop the problem during the process of teaching mathematics*”[100, p. 285]

Mathematical dialogue has different forms, corresponding to the forms of interaction in the following table:

Table 1.5. The forms of dialogue corresponding to the interaction forms

Forms of dialogue	Expressions in class	Forms of interaction
Student and Teacher	A student discusses with a teacher (the rest listen to the dialogue)	Student-Teacher
Student and Student	A student discusses with another students	Student – Environment
Student with the group or the	A student discusses with a group of	

whole class	students or the whole class	
Self-dialogue (working with books, solving mathematical problems on the Internet, etc..)	The student gives opinions of himself about mathematical knowledge (reflection is usually in form of writing).	

In summary, the mathematical communication has a close relationship with interactive teaching of mathematics in high school. To promote and maintain the interaction in teaching, it is necessary to combine with effective organization of communication activities.

#### 1.4. The relationship between interactive teaching and other teaching methods

Interactive teaching has a close relationship with other teaching methods. These teaching methods are inter-related in the field that they take students at the center, but they are different in the implementation. In terms of differences, interactive teaching focuses on interaction among three elements: student-teacher-environment, besides, there is another major difference that it promotes the influence of environment to the teaching process. To achieve good Interactive teaching, it is necessary to have support and association of the above mentioned teaching methods. The *basic characteristics of interactive teaching* can be identified as follows:

- 1) Interactive teaching is implemented through interactive situations.
- 2) Interactive teaching focuses on creating the interactive environment in which there are activities, interaction of student and student, student and teacher, student and environment, student and means of teaching (document, text-books, computers, internet, etc.,...) which have direct impacts to teaching and studying.
- 3) Promoting the active role of each student in interaction with other students, teacher and environment.
- 4) The assessment of study results is implemented through interaction of each student with group of students and teacher.

#### Conclusions of chapter 1

Based on research results on theory and practice, we have some conclusions as follows:

Interactive teaching is based on the interaction among the three elements in teaching process including: student, teacher, and environment. In which, the student is an active individual, the teacher plays a role as instructor, the environment creates impacts and be influenced directly or indirectly during teaching-learning process.

1. Interactive teaching has a base of philosophy, psychology and education. In terms of philosophy, interactive teaching bases on the common connection of things and phenomena. In terms of education, it is suitable with teaching principles, promoting teaching plan and indicating the role of targets in teaching process, making clear the pedagogical methods and tools, paying attention to the importance of assessment. In terms of psychology, interactive teaching focuses on impacting the closest development area in the development roadmap of learners.

2. Interactive teaching is not a form, technique or certain method but a teaching orientation belonging to open pedagogy, based on the interaction of three elements: student, teacher and environment. However, interactive teaching is more flexible since it utilizes the elements from other pedagogical schools, in which there is a school which considers learners as the center of pedagogical activities.

3. Interactive teaching has a close relationship with other active teaching methods, between interactive teaching and other active teaching methods, there are many similarities which are taking the students as the center. However, the biggest difference of Interactive teaching is that it exploits the interaction among student-teacher-environment. In order to achieve good results in study and teaching, the teachers need to have flexible cooperation in interactive teaching and other teaching methods.

## **Chapter 2. ORGANIZATION OF INTERACTIVE TEACHING FOR MATHEMATICS AT HIGH SCHOOL**

### **2.1. Organization of interactive teaching**

#### **2.1.1. Concept of organization of interactive teaching**

*Organizing interactive teaching in the class is understood as a common cooperated activity among the teacher, students and environment, in which all supports of teachers must impact the close development area in the development roadmap of the learners to reach the set targets in teaching.*

#### **2.1.2. The requirements for interactive teaching.**

\* Having form, concise lessons which clarify the main activities which the students and teachers need to perform.

\* Creating the vibrant and friendly atmosphere in class, ensuring the interest and participation of the learners.

\* Organizing activities to involve the participation and interaction between the learners and teacher.

#### **2.1.3. The characteristics of organizing interactive teaching**

*\* Interactive teaching includes the interaction between teaching and studying in a teaching environment;*

*\* Interactive teaching shall initially focuses on the learners;*

*\* Interactive teaching is implemented through interaction among teacher, students and environment to support and develop teaching and studying activities.*

### **2.2. The organizational Phases of Interactive Teaching**

#### **2.2.1. Preparation phase**

##### **2.2.1.1. Developing lesson plan**

Here, we would like to propose process of planning lessons for interactive teaching, including the following steps:

**Step 1:** Learn about the learners;

**Step 2:** Define objectives, lesson content, choose the form of teaching to suit each unit of knowledge, determine the time for student assessment;

**Step 3:** Identify interactive form and establish interactive content.

2.2.1.2. *Studying the lecture design to create excitement for learners and stimulate the participation and responsibility of the learners.*

There are several ways to cause excitement in learning mathematics in high school as follows: *Create challenge; Create curiosity (curiosity); Create imagination; Create competition; Create cooperation; Create recognition.*

### **2.2.2. The implementation phase of interactive teaching**

2.2.2.1. *Interactive activities in teaching mathematics at high school*

\*) The Interactive Activities mainly in teaching mathematics.

Interactive activities primarily in teaching mathematics are teacher - students Interaction, Students - environment Interaction, and interaction between teacher - Students - environment.

\*) The favorable situations for interactive activities in mathematics teaching and learning in order to improve teaching quality.

- Contents of lesson are related to reality;
- Contents of lesson are open with many options to solve;
- Contents of lesson can use visual models and simulation software.

\*) Some points to consider when building interactive activities in the teaching process.

To organize interactive teaching process successfully, ensure the following conditions:

- About the teacher

*First*, the teacher must master the theoretical basis of interactive teaching strategy.

*Second*, the teacher needs to get specific teaching models to implement this teaching strategy correctly and efficiently.

*Third*, the teacher must master a number of interaction-based teaching skills and techniques.

- About the students

*First*, to learn effectively, students must first have the right learning motivation.

*Second*, students must know how to learn. Specifically here, students must have the skills to participate in interactive education organized by teachers or self-organized itself to dominate the knowledge, form and develop necessary skills.

*Third*, students have to be willing to learn in patience, persistence.

- About the environment

For interactive teaching process is successful, the teaching environment must ensure the following requirements:

*First*, must ensure the basic requirements of facilities such as classrooms, light, sound, common teaching technologies etc. ...

*Second*, ensure other teaching resources such as programs, materials ...

*Third*, there should be a mechanism for organization, management towards enhancing interaction in teaching of units related to teaching and training process such as schools, department, library, IT center, etc. ...

*Fourth*, the relationship between the entities of the teaching process must be open, friendly and sociable; attitude of tolerance, generosity, support of teacher for students and among students with each other.

*2.2.2.2. Stimulating cooperation between the members of the class, mobilizing experiences of students in the process of acquiring and obtaining knowledge*

Here are a few methods that have been applied more in teaching other subjects, but can be applied effectively to interactive teaching in mathematics:

- \*) Group discussion;
- \*) Small Group Activity;
- \*) Game Method.

*For example:* After finishing the knowledge about Vieta's Theorem, Equation attributed to quadratic equation (Algebra 10 [21]), in order to consolidate knowledge for students, the teacher builds an interactive environment as a system of Multiple choice exercises with increasing difficulty levels preinstalled on the computer. The students do exercises through game participation "Finding treasure". Journey closer to "treasure", students will have to questions with increasing difficulty levels. If student fails a question, he/she will lose the right to participate and give playing field for others.

**The questions at Level 1:**

*Question 1:* Find the smallest k integer so that Equation:  $2x(kx-4)-x^2+6=0$  has no solution:

- (a) -1      (b) 1      (c) 2      (d) 3      (e) 4

*Question 2:* How many values a has so that Equation  $x^2+ax+1=0$  and  $x^2-x-a=0$  has a common solution?

- (a) 0      (b) 1      (c) 2      (d) 3      (e) countless

**The questions at Level 2:**

*Question 3:* If solutions of Equation  $x^2+px+q=0$  are cube of solutions of Equation  $x^2+mx+n=0$ , then:

- (a)  $p+q=m^3$   
(b)  $p=m^3+3mn$   
(c)  $p=m^3-3mn$   
(d)  $\left(\frac{m}{n}\right)^3=\frac{p}{q}$   
(e) Other.

*Question 4:* If a, b, c, d is the number other than 0, knowing that c and d are solutions of Equation:  $x^2+ax+b=0$  and a and b are solutions of Equation:  $x^2+cx+d=0$ , then:  $a+b+c+d$  is:

- (a) -2      (b) 0      (c) 2      (d) 4      (e)  $\frac{-1+\sqrt{5}}{2}$

**The questions at Level 3:**

**Question 5:** If  $m, n$  are solutions of Equation:  $x^2 + mx + n = 0$ ,  $m \neq 0, n \neq 0$ , sum of solutions is:

- (a)  $-\frac{1}{2}$       (b)  $-1$       (c)  $\frac{1}{2}$       (d)  $1$       (e) Not determined.

**Question 6:** For Equation:  $x^2 + px + q = 0$ , in which  $p > 0, q > 0$ . If the difference of solutions of Equation is 1,  $p$  is:

- (a)  $\sqrt{4q+1}$       (b)  $q-1$       (c)  $-\sqrt{4q+1}$       (d)  $q+1$       (e)  $\sqrt{4q-1}$

#### **The questions at Level 4:**

**Question 7:** How many integer values  $m$  has so that Equation:  $x^2 + (2m+6)x + 4m+12 = 0$  has two distinguished solutions greater than  $-1$ ?

- (a) 0      (b) 1      (c) 2      (d) 3      (e) 4

**Question 8:** Knowing that Equation:  $x - 2 + \frac{x+a}{x-1} = a$  has unique solution and that solution is an integer solution. So that solution is:

- (a)  $-2$       (b)  $-1$       (c)  $2$       (d)  $3$       (e) Other.

It is also an interactive situation through action, in this game, the interaction of students with the environment is expressed through their choice and determination of answer when joining the game. Through this game, students not only learn but also play, increasing the interest in learning and reinforcing newly learned knowledge about Vieta's Theorem in considering solutions of quadratic equation.

#### **2.2.3. Assessment Phase of learning outcomes**

### **2.3. Organizational form Interactive teaching in Mathematics at High School.**

There are three forms of interactive teaching organization, as follows: Learning by Individuals, Learning by groups, learning by class.

### **2.4. Interactive teaching Techniques in Mathematics at High School**

#### **\* The concept of teaching technique**

*Teaching Techniques in interactive teaching are using teaching methods, teaching facilities, .... of the teacher according to certain requirements of the lesson objectives to increase the impact, mutual interaction between students and teacher and the environment, facilitate teaching activities effectively.*

#### **2.4.1. Organizational Techniques of Teaching Activities**

- "Learning by Corner" Technique;
- "Coverlet" Technique;
- "Puzzle pieces" Technique;
- KWL Chart (Knowledge – Want - Learn);
- Mind map .

#### **2.4.2. Techniques of creating situations and raising issues**

#### **2.4.3. Techniques of using questions**

#### **2.4.4. Techniques of assessment**



### ***2.4.5. Techniques of using teaching facilities***

## **2.5. Information technology in interactive teaching**

### ***2.5.1. Role of Information technology in interactive teaching***

Interactive teaching organization with the support of the IT in order to build an interactive teaching environment has the following basic features:

- Create a completely new learning environment in which the initiative and creativity of students are best developed. Students have conditions to develop the ability to analyze, speculate and process information efficiently.
- Create an environment that allows diversification of two-way interaction relationship among teacher and students.
- Create a flexible, open teaching and learning environment.

However, for IT's effective support in interactive teaching, it is necessary to ensure safety principles, right time, right place, enough intensity, consistent with program content, new teaching method and the ability of the student comprehension when used.

### ***2.5.2. Information technology application in interactive teaching***

Some typical activities on IT application in teaching, creating interactive environment has been successfully implemented and brought high efficiency, as follows:

- Look up information in service of learning, teaching, research, and find materials for study and lecture preparation;
- Use support software for lecture preparation to compose electronic lectures like MS Powerpoint, Violet, Spring Presenter, ...
- Use support software for making examination tests, examination and assessment of student learning outcomes as McMix, Quest, MS Excel, Moodle, ...
- Use forum, email as a means to communicate and exchange learning experiences.

And higher, with E-Learning, Teaching and Learning Activities are taking place today anytime, anywhere.

Some IT tools are often used in teaching mathematics to create an interactive environment in teaching.

\* *Software for slideshows, presentations:* MS PowerPoint, Violet, Prezi, ...

\* *Software for creating practices and exercises:* MS PowerPoint, Violet or special software: Exe learning, Hot Potatoes, ...

\* *Software for drawing Mind Maps:* MS PowerPoint, MS Word or specialized software like Freemind, Inspiration or Emindmaps.

\* *Software for creating simulation:* Excel, Graph, Sketchpad, Cabri, or Maple.

IT has helped to create a completely new interactive environment, enhance interactive relationship among Students - Teacher - IT environment. However, because of the particularities of math knowledge, the IT tools should be selected as appropriate, used in the right time to promote the best the advantages and disadvantages of software.

## Conclusion of Chapter 2

1. Interactive teaching organization is a very important issue in interactive teaching, in order to create reciprocal relationship among Students - Teacher – environment, create lively, friendly atmosphere in the classroom and ensure excitement and participation of students.

2. Based on theoretical basis of interactive teaching, to organize effectively interactive teaching, the teacher must base on the objectives and contents of lesson, exploit aspects of knowledge contents to create interactive teaching situations, flexibly apply interactive teaching techniques, use appropriate interactive teaching forms to plan lecture, and also understand how to implement the organizational phases of interactive teaching namely: preparation phase, the implementation phase of interactive teaching; Assessment Phase of learning outcomes.

3. IT application in interactive teaching appropriately and effectively will improve teaching and learning quality. However, we also need to specify that IT is only a means to facilitate the effective deployment of interactive teaching, but not sufficient condition. Not abuse IT if we do not positively impact the teaching process.

4. Teaching software and its advantages have significantly contributed to improve interactive in teaching. If teacher uses reasonably use this means in interactive teaching process, this will create excitement for students and the access to the knowledge for students becomes easier, saving time in the classroom.

## Chapter 3. SOME INTERACTIVE TEACHING MEASURES IN MATHEMATICS IN HIGH SCHOOL THROUGH EQUATION AND INEQUATION TOPICS

### 3.1. Equation and Inequation topics in Mathematics in High School

#### 3.1.1. *Position and role of equation and inequation*

Equation and inequation topics have important positions in mathematics program in High School. The knowledge of the equation and inequation is also the key to solve many problems of most knowledge topics of algebra, calculus and geometry, especially analytic geometry.

#### 3.1.2. *Requirements for knowledge, skills*

#### 3.1.3. *Interactive teaching potential in equation and inequation topics*

By studying textbooks and high school mathematics program, we have noticed that high school mathematics in general and equation and inequation contents in particular have the conditions to apply interactive teaching in organizing learning activities if the teacher knows how to exploit.

### 3.2. Orientation to build and implement measures

– Measures must cause and maintain the excitement and promote learning activeness of students.

– Measures must create an interactive situation among students, teacher and environment.

– Measures can apply interactive teaching in Mathematics in High Schools, especially equation and inequation contents.

– Measures must be feasible in teaching practice in conformity with the teaching conditions in our country.

### **3.3. Several interactive teaching methods in equations and inequations.**

#### ***3.3.1. Measure 1: Create an exciting, friendly and cooperative learning environment in the teaching process.***

##### *2.5.2.1. Purpose*

This measure is to impact on environment.

##### *3.3.2.1. Scientific Basis*

1. Based on the goal of "building friendly schools, active students" in the high schools of the Ministry of Education and Training, launched in 2008.

2. Base on theoretical basis presented in Chapter 1 of the thesis, interactive teaching enhances the role of the environment in the teaching process.

##### *3.3.2.2. Implementation organization*

We can strengthen the interaction between the learners and the environment by:

- *Fully equip with facilities for teaching:* such as projectors, online classrooms,.....
- *Create an open relationship between the learners and teacher;*
- *Use visuals and IT applications;*
- *Use objective multiple choice questions.*

##### *3.3.1.4. Some notes when implementing measure*

When using IT in the design of teaching activities, pay attention not to abuse absolutely into the computer if we do not positively impact on teaching process. Avoid the use of slides just to replace the whiteboard but it is regarded as IT application lesson.

#### ***3.3.2. Measure 2: Create opportunities for students to do, to communicate, and to show their abilities***

##### *3.3.2.3. Purpose*

This measure is to impact on students.

##### *3.3.2.4. Scientific Basis*

1. "Teaching mathematics is teaching activities on mathematics" [104] is an argument which has been recognized. This argument is also entirely consistent with a proverb of the Chinese:

*"You listen, you forget,  
You look, you remember  
You do, you understand".*

In psychology there are similar assertions, such as: Capacity can only be formed and developed through activities.

2. Interactive teaching as well as some other positive teaching methods always consider students as the center of the teaching process.

##### *3.3.2.5. Implementation organization*

\* *Diversify the presentation and description of teaching content:*

\* *Organize activities to create more opportunities for learners to create learning content:*

Because of this, when designing learning activities, teacher should base on:

*First base: The role and significance of the types of activities to occupy knowledge in Mathematics teaching activities in general;*

*Second base: The objective of teaching;*

*Third base: Function of activity;*

*Fourth base: Demands in the innovation orientation of current teaching methods.*

*Fifth base: The interaction of the activities when occupying knowledge.*

### 3.3.2.6. Notes when implementing method

\* Teaching content must ensure continuity in the interconnectedness at high level:

\* Pay close attention to the feasibility of activities realizable in real conditions of the teaching process.

\* Pay attention to ability of students when implementing activity.

### 3.3.2.7. Illustrated example

*Example:* After completion of training equivalent transformations of the equations, to reinforce just learned knowledge, teacher can organize students to discuss in identifying and detecting mistakes when transforming equivalent equations. Specifically, consider the following transformations whether they are equivalent transformations or not?

a) Transforming  $\sqrt{x^2} + \sqrt{x(x+3)} = \sqrt{x(x+8)}$  into  $\sqrt{x} + \sqrt{x+3} = \sqrt{x+8}$

b) Transforming  $\sqrt{(2x-1)(x-1)} = 2x-1$  into  $\sqrt{x-1} = \sqrt{2x-1}$

c) Transforming  $\begin{cases} x^2 - 1 \geq 0 \\ x + 1 \geq 0 \end{cases}$  into  $\begin{cases} x - 1 \geq 0 \\ x + 1 \geq 0 \end{cases} \Leftrightarrow x \geq 1$

d) Transforming  $\sqrt{x-2} = 1$  into  $x - 2 = 1$

\*) *Analyzing:*

a) This transformation is not equivalent because we do not know whether  $\sqrt{x}$  is different from 0 or not, we cannot cancel two sides. On the other hand, we have not set up conditions for x, we cannot know x belonging which range, so it is not sure that:

$$\sqrt{x(x+3)} = \sqrt{x} \cdot \sqrt{x+3}, \sqrt{x(x+8)} = \sqrt{x} \cdot \sqrt{x+8}$$

Note that:  $f(x) \cdot h(x) = g(x)$ .  $h(x) \Leftrightarrow f(x) = g(x)$  on D if  $h(x) \neq 0$  on D

$$\sqrt{A \cdot B} = \sqrt{A} \cdot \sqrt{B} \text{ if } A \geq 0, B \geq 0.$$

b) Not equivalent (explained like part a)

c) Not equivalent because of being mistakenly thought that  $\begin{cases} A \cdot B \geq 0 \\ A \geq 0 \end{cases} \Leftrightarrow \begin{cases} A \geq 0 \\ B \geq 0 \end{cases}$ , the

solution is missing  $x = -1$

$$\text{Note that: } \begin{cases} A \cdot B \geq 0 \\ A \geq 0 \end{cases} \Leftrightarrow \begin{cases} A > 0 \\ B \geq 0 \\ A = 0 \end{cases}$$

d) This is the equivalent transformation because

$$\sqrt{f(x)} = g(x) \Leftrightarrow \begin{cases} g(x) \geq 0 \\ f(x) = [g(x)]^2 \end{cases}, \text{ but because } 1 > 0, \sqrt{x-2} = 1 \Leftrightarrow x-2 = 1$$

### 3.3.3. Measure 3: Create interactive teaching situation when using positive teaching methods

#### 3.3.3.1. Purpose

This measure is to impact on teacher in interactive teaching.

#### 3.3.3.2. Scientific Basis

1. On the theoretical basis of chapter I which have presented some important elements of the interactive environment as knowledge, interactive situations, and teaching facilities.

2. No teaching method is considered universal. Moreover, in the first chapter of the thesis, the author presents that interactive teaching has intimate relationship with the positive teaching method.

#### 3.3.3.3. Implementation organization

Based on 3 types of interactive teaching situations described above (interactive situations through action, interaction situations through communication, interaction situations through confirmation) that teacher design interactive situations accordingly.

#### 3.3.3.4. Notes when creating situations for interactive teaching

When designing an interactive teaching situation, it is necessary to check three conditions to be satisfied of an interactive teaching situation as described above.

*Example 1:* In teaching the review session of exponent equation, inequation and logarit equation, inequation, the teacher may create an *interactive situation through the action* as follows:

Divide the class into small groups, each group includes 6 to 8 students, groups together join competing game for solving mathematical problems among groups, there will be a reward for the winning group, the group solving fast, accurately, and presenting beautifully will be the winner.

Round 1: Solve quickly the following mathematical problems:

1)  $2^{3/x} > 0$

2)  $0 < 3^{x^2-x-6}$

3)  $\left(\frac{1}{2}\right)^{4x^2-15x+13} < \left(\frac{1}{2}\right)^{4-3x}$

Requirements in this round include: groups self- discuss within 10 minutes, and then in turn each group appoints three persons to present on the board (each person in the group will present in a "relay" manner).

Round 2: In the following answers, which is true? Which is false? Why?

Solve the equation:  $\log_2 \log_3 x = \log_3 \log_2 x$

Answer 1: Condition:  $\begin{cases} \log_2 x > 0 \\ \log_3 x > 0 \end{cases} \Leftrightarrow x > 1$

Given equation is equivalent to

$$x^{\log_2 \log_3 x} = x^{\log_3 \log_2 x} \Leftrightarrow (\log_3 x)^{\log_2 x} = (\log_2 x)^{\log_3 x}$$

$$\Leftrightarrow \log_3 x = \log_2 x \Leftrightarrow x = 1$$

Because  $x = 1$  not satisfying the condition of the mathematical problem, the equation does not have any solution.

Answer 2: We have:  $\log_2 x > 0$  and  $\log_3 x > 0$  therefore  $x > 1$ .

Then  $\log_2 x > \log_3 x \Rightarrow \log_2 (\log_2 x) > \log_2 (\log_3 x) > \log_3 (\log_3 x)$

$\Rightarrow$  The equation does not have any solution.

Answer 3: Set  $\log_2 \log_3 x = \log_3 \log_2 x = t$ . The given equation becomes:

$$2^{3^t} = 3^{2^t} \Leftrightarrow 2^t = 3^t \log_3 2 \Leftrightarrow \left(\frac{2}{3}\right)^t = \log_3 2 \Leftrightarrow t = \log_{2/3} (\log_3 2).$$

From which the equation has a unique solution  $x = 3^{2^{\log_{2/3} (\log_3 2)}}$ .

Requirements in this round include: groups self-discuss, and then write opinions on a "coverlet" handed out to the groups. After 10 minutes of discussion, groups submit the "coverlet" for teacher to comment and review each opinion of the groups.

In this game, the interaction of students with the environment is expressed through the action of involving in the game, through cooperative actions of students in the group associated with the decision to choose a representative in the group for presentation, ... Therefore, this interactive teaching situation is the interaction through actions.

### 3.3.4. Measure 4: Implement organizational stages of interactive teaching

#### 3.3.4.1. Purpose

This measure is the interactive synchronicity of three factors student - teacher - environment in interactive teaching. This measure is to implement organizational stages of interactive teaching in teaching equation and inequation.

#### 3.3.4.2. Scientific bases

Section 2.2 of this thesis has presented stages of interactive teaching in mathematics including three stages as follows:

- 1) Preparation stage;
- 2) Implementation stage;
- 3) Examination and assessment stage.

In which, each stage has specific steps on how to organize the implementation of the lesson plan.

#### 3.3.4.3. Implementation organization

We propose procedures for implementing lesson plans to apply interactive teaching in mathematics at high school in a specific way as follows:

**Step 1:** *Examine the old lesson, introduce the new one;*

**Step 2:** *Create appropriate interactive situations, stimulate senses of students, encourage students to learn;*

**Step 3:** *Students perform interactive tasks, accumulate knowledge for themselves;*

**Step 4:** *Students report the result;*

**Step 5:** *The teacher summarizes, consolidates knowledge.*

#### 3.3.4.4. *Note when implementing the measure*

Above is the organization process of teaching mathematics which has general nature and does not intend to impose. Depending on the content of each lesson as well as purpose of the lesson, steps may be adjusted accordingly.

#### 3.3.4.5. *Illustrative examples*

Five prepared interactive teaching lessons illustrate how to organize the implementation of interactive teaching [Annex 1]

### **Conclusion of Chapter 3**

1. Based on the research findings of contents and Mathematics textbook program at high school today, we find that equation and inequation topics in particular and mathematics curriculum contents in general at high school contain potential that can apply interactive teaching in organizing learning activities for students.

2. To implement the application of interactive teaching in teaching equation and inequation topics, the following measures may be undertaken:

- Measure 1: Create exciting, friendly and cooperative environment in the teaching process;

- Measure 2: Create opportunities for students to perform activities, communicate, and express their own capacities;

- Measure 3: Create interactive teaching situations when using positive teaching methods;

- Measure 4: Implement stages of interactive teaching organization.

However, to ensure the implementation of effective measures, in addition to efforts of the teacher and students, the conditions of facilities and teaching equipment must ensure requirements at the requested level for one hour of interactive learning.

3. Interactive teaching is a basic and active teaching approach in accordance with the process of information processing of students. Therefore, in the process of applying interactive teaching, the teacher needs to flexibly utilize organization plans of various teaching activities, applying interactive teaching techniques in connection with different forms of teaching, appropriate teaching methods and applying information technology, ... to strengthen the interactive relationships which can stimulate interests, promote the positiveness, self-discipline, activeness and creativity of students, mobilize a lot of inherent potentials of students involved in the process of knowledge production, formulate and train skills for students.

## **Chapter 4. PEDAGOGIC EXPERIMENT**

### **4.1. Overview of pedagogical experiment process**

#### **4.1.1. Purpose and requirements of experiment**

- Test scientific nature of the hypothesis, verify the feasibility and effectiveness of applying interactive teaching measures in Mathematics at high school.

- Ensure the objectivity of experiments;

#### **4.1.2. Experiment subjects**

Experiments are conducted at Kien An high school and Phan Dang Luu high school of Kien An District, Hai Phong City.

#### **4.1.3. Experiment contents**

The process of experiment was carried out under two phases:

\* *Experiment round 1 : was conducted in 03 sessions on :*

- 1) Quadratic in equation of one unknown;
- 2) Practice trigonometric equation;
- 3) Exponent and logarit equation, inequation.

\* *Experiment round 2: we carried out teaching experiment of five lessons on three grades 10, 11, 12:*

- 1) Basic trigonometric equation (lesson 1, 2) - Algebra and Analytics 11;
- 2) Symmetric equation toward  $\sin x, \cos x : a.(\sin x + \cos x) + b.\sin x \cos x + c = 0$  (lesson plan of teaching elective lesson – Advanced Algebra and Analytics 11);
- 3) The exercises of practicing methods for solving trigonometric equations (Algebra and Analytics 11);
- 4) First degree inequation of one unknown (Algebra 10);
- 5) Chapter review exercises on exponent and logarit equation, inequation (Analytics 12).

#### **4.1.4. Experiment Procedures**

##### **4.1.4.1. Experiment round 1**

- Time for implementing: this round was conducted from 2/2013 to 4/2013 and continued from 9/2013 to 10/2013.

##### **4.1.4.2. Experiment round 2**

- Time for implementing: this round was conducted from 2/2014 to 4/2014 and continued from 8/2014 to 10/2014.

#### **4.1.5. Measuring and processing data**

##### **4.1.5.1. Standard and scale in experiments**

1. Level of perceiving knowledge;
2. Level of developing skills;
3. Character formation;
4. The influence of interactive environment for learning and teaching.

##### **4.1.5.2. Measuring instruments**

To assess the above contents, we use four instruments:

1. Tests;
2. Survey form for students and teachers;
3. Class observation;
4. Interview.



### 4.1.5.3. Processing data

Using formulas for calculating characteristic statistical parameters and testing the reliability of experimental results.

## 4.2. Assessment of experiment results

### 4.2.1. Results of experiment round 1

4.2.1.1. Actual exploration results of applying interactive teaching in teaching Mathematics and understanding of teachers on interactive teaching.

When surveying about the knowledge of teachers in interactive teaching, almost all teachers are unknown, there are a few young teachers who have heard about this view, but their understanding of interactive teaching is not much.

4.2.1.2. Results of acquiring knowledge of students

To compare the studying results of students in experimental class with reference class through lessons, we use multiple choice tests and written tests after each experiment lesson. Results are as follows:

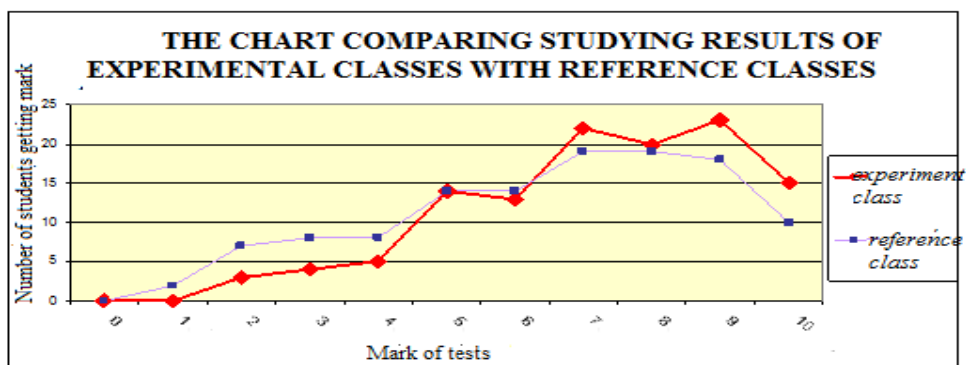


Figure 4.1. The chart comparing the studying results of experimental classes with reference classes (Round 1)

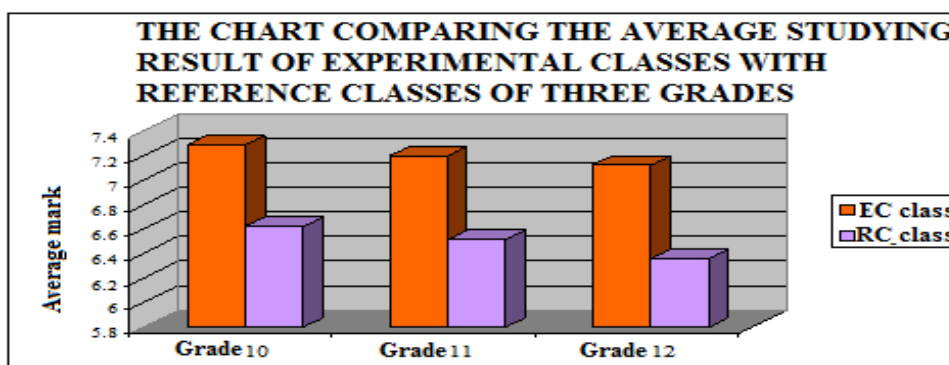


Figure 4.2. The chart comparing the average studying result of experimental classes (EC) with reference classes (RC) under grades (Round 1)

Below is the synthesis result of statistical parameters as follows:

Table 4.3. Summing results of the statistical parameters under test marks of students in lessons (round 1)

Statistical parameters	Experimental class (EC)	Reference class (RC)
Number of tests (n)	119	119
Average mark ( $\bar{x}$ )	7.2	6.5
Variance ( $\sigma^2$ )	4.161	5.611
Standard deviation ( $\sigma$ )	2.04	2.37
Mean deviation (m)	0.187	0.217
Coefficient of Variation ( $C_v\%$ )	28.32	36.47
Testing quantity ( $t_d$ )	2.463	

Although the experiment round 1 with small quantity and not much impacts of interactive teaching, the experiment results partially show that the application of this view in teaching also has certain impacts to learning results of students.

#### 4.2.2. Results of experiment round 2

##### 4.2.2.1. Results of acquiring knowledge of students

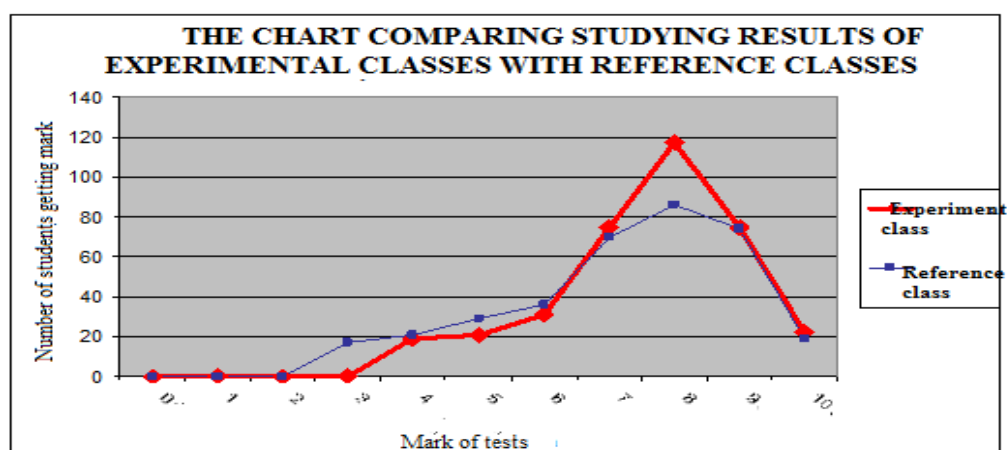


Figure 4.3. The chart comparing the studying results of experimental classes with reference classes (Round 2)

Table 4.6. Summing average studying results of experimental classes and with reference classes in all three grades (round 2)

	Grade 10	Grade 11	Grade 12
Experimental class	7.485294	7.6166667	7.6057692
Reference class	7.08209	7.2758621	7.2254902

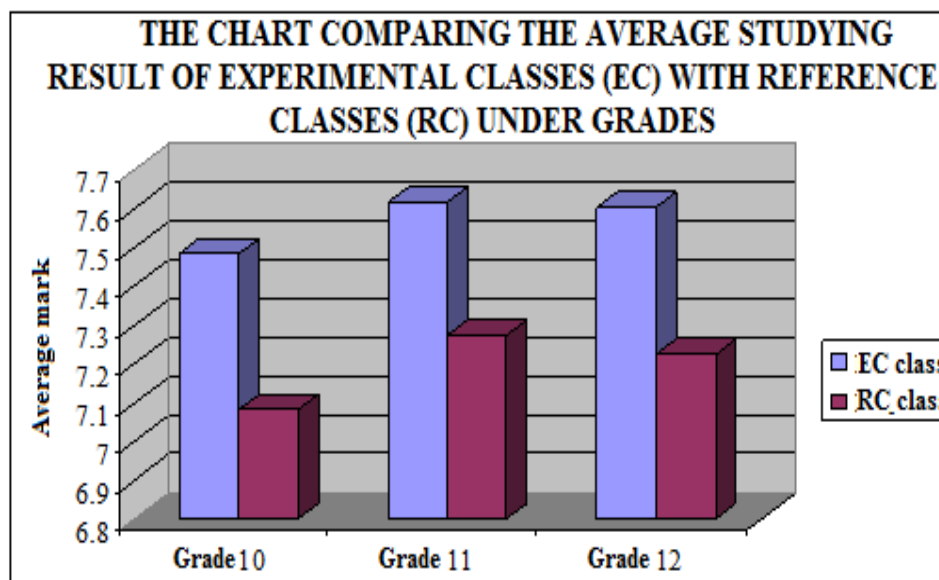


Figure 4.4. The bar chart comparing the average studying result of experimental classes (EC) with reference classes (RC) under grades

It can be seen from the bar chart that average test mark of three grades in experimental class is much higher than that of reference class. Below is the summary of the statistical parameters relating to data collected in the experiment round 2:

Table 4.7. Summing results of the statistical parameters under test marks of students in lessons (round 2)

Statistical parameters	Experimental class (EC)	Reference class (RC)
Number of tests (n)	360	352
Average mark ( $\bar{x}$ )	7.564	7.188
Variance ( $\sigma^2$ )	2.185	3.277
Standard deviation ( $\sigma$ )	1.48	1.81
Mean deviation (m)	0.078	0.097
Coefficient of Variation ( $C_v\%$ )	19.54	25.19
Testing quantity ( $t_d$ )	3.035	

Thus it can be said that the application of interactive teaching in teaching Mathematics can help to increase students' cognitive ability, creating opportunities for the poor students to grow and creating interests in learning for most students.

#### 4.2.2.2. Results of developing skills of students

##### a) Interactive skill in the process of learning

The interactive skill was assessed by four criteria with the following results:

Table 4.8. The survey results on interactive skill of students

Criteria	Assessment contents	Level 1 (%)	Level 2 (%)	Level 3 (%)	Level 4 (%)	Level 5 (%)
3	In the lesson, students usually give personal opinions contributing to the learning content	0	0	17.391	50	32.609
4	Students are ready to discuss, explain questions with others when the teacher allows.	0	0	6.5217	34.783	58.696
5	Students want members in their group to be ready to explain the group's conclusion when studying in group	0	0	6.5217	19.565	73.913
6	Students always find a way to explain their opinions to others.	0	8.6957	8.6957	41.304	41.304

This proves that when learning in an interactive environment, students have clearly shown their positiveness in learning, it is the interaction in learning. Through the expression, explanation of their personal opinions and as well as listening to opinions of others, students may acquire knowledge and formulate interactive learning skill.

*b) Communication and integration skill with the collective*

This skill is assessed by two criteria with the following results:

Table 4.9. The survey results on communication and integration skill with the collective of students

Criteria	Assessment contents	Level 1 (%)	Level 2 (%)	Level 3 (%)	Level 4 (%)	Level 5 (%)
8	After interactive learning, students get better interaction and communication skills with the surrounding environment.	0	0	0	30.435	69.565
9	After interactive teaching lessons, students find themselves more interactive with the class collective	0	0	6.5217	30.435	63.043

Almost all students surveyed confirm that after interactive learning, students find that their communication and interaction skills with the surrounding environment are much better.

#### 4.2.2.3. Results on the personality formation of students

##### a) Responsibility for their own learning

Responsibility for their own learning is surveyed by criteria 7 with the following results:

*Table 4.10. The survey results of responsibility for students' learning*

Criteria	Assessment contents	Level 1 (%)	Level 2 (%)	Level 3 (%)	Level 4 (%)	Level 5 (%)
7	During interactive learning, students realize that they need to take responsibility for their own learning (doing homework, submitting in time, self-learning, ...)	0	4.3478	8.6957	23.913	63.043

It can be seen from the table that the majority of students think that they should be responsible for their own learning in interactive learning process.

##### b) Ability to self-assert

Ability to self-assert is assessed by two following criteria:

*Table 4.11. The survey results of ability to self-assert of students*

Criteria	Assessment contents	Level 1 (%)	Level 2 (%)	Level 3 (%)	Level 4 (%)	Level 5 (%)
3	In the lesson, students usually give personal opinions contributing to the learning content.	0	0	17.391	50	32.609
11	Students are more encouraged and confident after interactive lessons	0	0	17.391	36.957	45.652

This indicates that while learning with the interaction, most of students boldly offering their own ideas to contribute to the learning content. So that they feel confident, encouraged after interactive lessons, students have opportunity to assert themselves.

#### 4.2.2.4. The results on impacts of interactive environment to students

##### a) Students' attitude of interactive learning

Students' attitude of interactive learning was tested through survey questionnaire in combination with interviewing students after the end of each lesson. The statistics are as follows:

*Table 4.12. The survey results on students' attitude of interactive learning*

Criteria	Assessment contents	Level 1 (%)	Level 2 (%)	Level 3 (%)	Level 4 (%)	Level 5 (%)
1	Students want teachers to hold interactive lessons as the last lesson.	0	2.1739	13.043	54.348	30.435

2	When learning in an interactive environment, students enthusiastically participate in.	0	0	10.87	34.783	54.348
---	--	---	---	-------	--------	--------

Thereby, we realize that students are really interested in the teacher's interactive learning organization. When learning under this teaching point of view, most of students are eager to join. When asked about the lesson, students said that the lesson was very fun and lively. In a comment on the things which students like best in the lesson, many students have similar opinion, one of the students also commented that "*we are learning by playing, playing by learning*", ...

b) Interactive learning helps students learn a lot from other students and the environment

This is assessed through criteria 12 with the following results:

*Table 4.13. The survey results on interactive learning that can help students learn a lot from other students and the environment*

Criteria	Assessment contents	Level 1 (%)	Level 2 (%)	Level 3 (%)	Level 4 (%)	Level 5 (%)
12	Students learn a lot from their friends and surrounding environment	0	2.1739	6.5217	26.087	65.217

Through direct interviews with some students in the class about their feelings after finishing the interactive lesson, some students said that after the interactive lesson, they have learned a lot of things, in addition to knowledge, they learned how to work in groups and share their knowledge to other students

c) Interactive learning creates opportunity for students to show their ability

This is assessed by the following criteria:

*Table 4.14. The survey results on interactive learning that can create opportunity for students to show their ability*

Criteria	Assessment contents	Level 1 (%)	Level 2 (%)	Level 3 (%)	Level 4 (%)	Level 5 (%)
10	During interactive learning, students have the opportunity to show their abilities.	0	4.3478	19.565	32.609	43.478

In all criteria surveyed, these criteria are evaluated at the lowest level by students. However, this figure still confirms that the majority of students think that in interactive lessons, they have opportunity to show their ability.

#### **Conclusions of chapter 4**

Experimental results in two years 2013, 2014 in experimental classes containing 350 students, through four measurements by survey questionnaire, observation and

interviews with teachers and students on issues of interactive teaching, allow to give the following comments:

1. Applying interactive teaching in Mathematics at high school is feasible. Through sources of information obtained, we may initially affirm that stages of teaching organization and teaching techniques applying interactive teaching proposed in the thesis are effective. Applying interactive teaching not only makes the classroom atmosphere lively, but also attracts the participation of all students in the class in the teaching process organized and instructed by the teacher. Therefore, lessons have initially received considerably positive effectiveness.

2. Applying interactive teaching in Mathematics at high school not only enables students to acquire good knowledge but also helps them know how to learn, cooperate and interact with the surrounding environment, and develop capacity of thinking and cooperating, and their spirit of responsibilities.

### **CONCLUSIONS**

Through the process of researching on the theme, we have obtained some results as follows:

1. Interactive teaching is a teaching orientation, which is implemented via a two-way interaction between the student, the teacher and the environment. In which, the student becomes a true subjectivity of cognitive process with excitement, active participation and learning responsibility; the teacher acts as an instructor and assistant; the environment affects the entire teaching process with the influence and adaptation.

2. To organize interactive teaching in Mathematics at high school effectively, the teacher needs to understand stages of interactive teaching, how to inspire the learning, how to use techniques and forms of interactive teaching organization, simultaneously combine with the exploitation of IT application creating interactive teaching situations, in order to develop the interaction between the student, the teacher and the environment in the teaching process.

3. Interactive teaching contributes to the promotion of the student's positiveness, activeness, creativity. The thesis has brought out orientations and formulated four measures of interactive teaching via equation and inequation topics, applying interactive teaching to design some lessons on the topic of equation and inequation in Mathematics program at high school. Initial experimental results illustrate the feasibility and effectiveness of the proposed measures.

4. However, no method of teaching is multipower. The promotion of all strengths of interactive teaching depends on the contents and objectives of teaching, facilities and equipment sufficiently to meet the minimum requirements of interactive teaching. In addition, interactive teaching should be combined with other active teaching methods so that the teaching will get effectiveness, enhance the quality of teaching at high school.

Theoretical and practical results obtained allow to draw the conclusion: the scientific theory of the thesis is acceptable; the research purpose and tasks are completed, and the issues for defense are confirmed.