

# Training and Developing the Ability to Predict and Solve Problems through the Teaching of Finding and Correcting Mistakes of Real Problems in Vietnam

Ngoc-Giang Nguyen<sup>1,\*</sup>, Thi-Ngoc Tham Nguyen<sup>2</sup>

<sup>1</sup>Faculty of Economic Mathematics, Banking University Ho Chi Minh City, Ho Chi Minh City, 28, Vietnam

<sup>2</sup>Ho Chi Minh City, 28, Vietnam

Received February 8, 2021; Revised March 12, 2021; Accepted April 22, 2021

## Cite This Paper in the following Citation Styles

(a): [1] Ngoc-Giang Nguyen, Thi-Ngoc Tham Nguyen, "Training and Developing the Ability to Predict and Solve Problems through the Teaching of Finding and Correcting Mistakes of Real Problems in Vietnam," *Universal Journal of Educational Research*, Vol. 9, No. 5, pp. 1072 - 1082, 2021. DOI: 10.13189/ujer.2021.090520.

(b): Ngoc-Giang Nguyen, Thi-Ngoc Tham Nguyen (2021). *Training and Developing the Ability to Predict and Solve Problems through the Teaching of Finding and Correcting Mistakes of Real Problems in Vietnam*. *Universal Journal of Educational Research*, 9(5), 1072 - 1082. DOI: 10.13189/ujer.2021.090520.

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**Abstract** In Vietnam today, the general education program has shifted from teaching focusing on content and knowledge to teaching towards the development of students' competencies and qualities. Therefore, the ability to predict and solve problems is of special concern. However, the high school graduation exam format is multiple-choice. This results in the students' relatively weak ability to reason and solve problems. Besides, students are quite surprised when getting used to real problems. Our research is done to analyze the factors that affect students' erroneous reasoning as well as identify common errors in real problems. We surveyed 47 teachers and 163 students in Ho Chi Minh City by questionnaire. Research has shown that 65.96% of teachers and 50.92% of students think that it is very necessary to practice and develop the ability to predict and solve problems through teaching to predict and correct mistakes in real-world problems, but most teachers do not fully understand the ability to predict and solve problems in teaching practical problems. Students' manifestations of each type of mistake in teaching the ability to predict and solve problems are not high and uneven. The research results also show that there are two main groups of factors affecting the ability to predict and correct mistakes through practical problems: first, the problem is not true to reality; Second, mistakes in reasoning to solve real problems. Findings from the research have important implications for renewing

teaching methods in Vietnam.

**Keywords** Ability to Predict and Solve Problems, Real Problems, Predict and Correct Mistakes, High School Students

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## 1. Introduction

Competence is a concept dating back more than 3,000 years. In one study, Hoge, Tondora, and Marrelli argued that it was when the Chinese held examinations to recruit officials to serve the court, replacing the recommendation of the high ranking officials. Horton found that the Middle Ages in Europe spawned the notion of apprenticeship. A person who wants to do a certain job must go to school to be certified that he is capable of doing that. However, the concept of competency is most strongly explored and researched in the twentieth century. In 1911, Taylor divided labor into two categories. One is unskilled labor, the other is intellectual labor. Intellectual labor requires the employee to know how to calculate, manage and control the work in the most optimal way. These factors are some of the main factors that make up the concept of competency. When World War I broke out, a pressing imperative in the military at that time was how to train merchants and

technical staff to be capable of re-teaching skills to military amateurs. The concept of competency at this time was initiated in such a vocational field. [1]

The term “competence” first appeared in an article written by R.W. White in 1959. Competence is understood as a concept for the performance of doing a job[2]. This term caught the spotlight in 1973, David McClelland wrote an article titled: “Testing for Competence Rather Than for Intelligence”[3] in arguing that capacity is more important than intelligence. The term “competence” is more popularized by Richard Boyatzis and many others[4]. For example, T.F. Gilbert (1978) used this concept in relationships to improve performance[5].

Competence is a concept that has many different definitions. Competency is the combination of an individual's unique attributes following the specific requirements of a certain activity, to ensure successful completion in that area of activity[6]. Competence is the ability to respond to complex requirements and successfully carry out tasks in a specific context[7]. Competency is a personal attribute formed and developed through existing qualities and the process of learning and training, allowing people to mobilize the synthesis of knowledge, skills, and other personal attributes such as interest, belief, will, ... successfully implement a certain type of activity, achieve desired results under specific conditions.[8]

Competency is a personal attribute that allows an individual to successfully perform certain activities, achieving desired results under specific conditions.[9]

Competency is a personal attribute formed and developed by the available qualities and the process of learning and practicing, allowing people to successfully perform a certain type of activity, achieving desired results under specific conditions.[10]

From the above points of view, we realize that “capacity” is a combination of practical knowledge, theory, cognitive skills, and behavior to perform an effective activity or to improve productivity. Competence is an important concept that any field or profession is interested in researching and applying. Competence is a complex and extensive concept. Different scientists have different definitions of competency. In other words, capacity is not a concept that has a unique understanding. Depending on each specific object and field, the approach is also not uniform.

## 2. Methods

### 2.1. Mathematical Literacy

According to the Program for International Student Assessment (PISA), “Mathematical Literacy of high school students is the ability to study, comprehend, and research mathematics in the high school curriculum;

recognize the meaning and role of mathematical knowledge in life; apply and develop mathematical thinking to solve practical problems, respond flexibly to meet the needs of present and future life; is the ability to analyze, reason, generalize, and exchange information through posing, formulating and solving mathematical problems in different situations and circumstances, in which the emphasis is on process, knowledge, and activities”. [11]

Not only individuals but many organizations also pay special attention to mathematical competencies. The Association of Mathematics Teachers in America said: "Mathematical competencies are ways to capture and use content knowledge of math". [12]

“Mathematical competence is defined by the European Recommendation as the ability to develop and apply mathematical thinking to solve a wide range of problems in everyday situations and considered as a guideline for lifelong learning in European countries, " writes the European Recommendation. [13]

The mathematical competency structure consists of four groups: acquire mathematical information, process information, store information, and generalize information [14]. Each of the above groups has the following elements. First, acquiring mathematical information: Perceptual capacity to formalize mathematical documents, capacity to grasp the formal structure of the problem. Second, processing mathematical information: Capacity of logical thinking, capacity of thinking by mathematical symbols; capacity to generalize; reduction capacity, thinking capacity by reduced structures; flexibility of thinking processes in mathematical operations; towards the clarity, simplicity, economy, and rationality of the solution; the ability to adjust and correct the direction of the thinking process, the ability to change from the forward thinking process to the reverse thinking process. Third, storing mathematical information: Mathematical memory (Memory for generalization of mathematical relationships, type characteristics, inference and proof diagrams, math solutions, principles, and math solution methods). Fourth, the ability to apply mathematics in solving problems: The ability to apply mathematical knowledge (mainly standard knowledge) as tools in learning; the ability to solve some typical practical problems; the ability to apply mathematical knowledge, mathematical thinking methods into practice; tendency, the ability to mathematize situations.[15]

Thus, mathematical competency emphasizes factors such as thinking and reasoning, modeling, communicating, performing, etc. Especially when it comes to mathematical competencies, people pay attention to the effectiveness of math activities that learners perform, that is, learners actively mobilize all skills, knowledge, attitudes, and supporting tools to absorb and solve math problems. Learners are immersed in real-world situations. From there, learners must know how to handle these practical situations

with mathematical tools.

## 2.2. Ability to Predict and Solve Problems

### 2.2.1. Problem solving capacity

Problem-solving capacity is understood as the mobilization of the student's knowledge, skills, attitudes, and emotions to solve practical situations in a specific context where solutions are not immediately available. Problem solving capacity is demonstrated through activities in the problem solving process.[16]

Problem-solving capacity is the individual's ability to effectively use cognitive processes, actions and attitudes, motives, and emotions to solve problem situations in which processes, procedures, and the common solutions are not available.[17]

Problem solving based on common understanding is to set up appropriate methods to solve problems and obstacles. Problem-solving capacity is the individual's ability to use his or her own insights and emotions to discover problems, find solutions, and implement solutions to solve them effectively.[18]

*Problem solving capacity is the combination of individual psychological attributes in accordance with the specific requirements of an activity and ensuring the effectiveness of this activity and is understood as the ability of an individual to perform activities effectively in order to solve the problems raised in the activities.[19]*

The student's problem solving capacity in teaching is the student's personal ability to effectively use knowledge, skills, attitudes, ... to solve situations that contain unresolved problems by conventional solution.[20]

### 2.2.2. The Structure of Problem Solving Capacity

By X. T. Ha[21], the structure of students' ability to solve practical problems in teaching Mathematics in junior high school includes four component competencies such as problem exploration, math model establishment, planning and implementing solutions, evaluating and reflecting solutions.

The structure of problem solving capacity includes finding out problems, proposing problem solving plans, solving problems, evaluating implementation results.[22]

M. Wu said that the problem solving capacity in mathematics consists of four component competencies which are reading comprehension, mathematical reasoning, performing calculations and applying knowledge in problem solving in practice.[23]

The structure of problem solving capacity includes 4 main components: Finding the problem; forming scientific hypotheses; planning and proceeding to solve problems; evaluating and reflecting the solution.[24]

In education for each grade level, each element of core mathematical competency needs to have manifest criteria along with the requirements to be met to set performance and evaluation goals. The capacity to predict and solve problems is no exception and is presented in Table 1.

**Table 1.** Criteria of the capacity to predict and solve problems and requirements at each educational level[25]

| Competence   | Primary school  | Secondary school  | High school  |
|--|---|---|--|
| Recognize and predict problems that need to be solved mathematically.                                | Recognize the problem to be solved and ask questions.                 | Predict the problem to be solved.                                   | Identify problem situations, collect, organize, explain and evaluate the reliability of the information, and share the understanding of the problem with others. |
| Select, propose ways and solutions to solve problems.  | Describe how to solve the problem.                                    | Determine ways and solutions to solve the problem.                  | Select and establish ways and processes to solve problems.   |
| Use compatible mathematical knowledge and skills (including tools and algorithms) to solve problems. | Implement and demonstrate how to solve the problem at a simple level. | Use equivalent mathematical knowledge and skills to solve problems. | Implement and present solutions to solve problems.   |
| Evaluate the proposed solution and generalize to the same problem.                                   | Check out the solution done.  | Explain the solution.   | Evaluate the implemented solutions, reflect the value of the solution; generalize to the same problem.   |

Each person is a separate individual, with different personal characteristics and thoughts, so the ability to predict and solve problems will also have different levels of manifestation in each person. From the common points in Table 1, we have the analysis to clarify some of the following manifestations:

- *Analyzing situations* in learning, in life to find out the problem.
- *Problem prediction*: identify, predict, and address problems in problem situations. This is one of the main manifestations of your ability to predict and solve a problem.
- *Collection and clarification of information*: selectively collect information related to the problem discovered in the situation; link and apply information and general knowledge to propose different new methods and measures.
- *Proposing solutions*: think and apply knowledge to find out how to solve arising problems and choose the optimal solution for implementation. Self-consideration and selection of suitable solutions demonstrate the independence, confidence, and assertiveness of learners.
- *Making an implementation plan*: determine the progress of steps to take to implement the selected solution to solve the problem.
- *Problem-solving*: is the most important manifestation of the ability to predict and solve problems. The learner is the subject in the process of performing the activity. Educators are people who support and help learners.
- *Evaluation, generalization, and adjustment*: evaluate the performance of problem-solving objectively, determine advantages, disadvantages, and limitations of the implementation process; generalize new knowledge from the problem solved; adapt themselves to apply in similar situations.

#### 2.2.3. Some principles of fostering problem solving competencies for students in teaching

First, build teaching content and topics to meet the requirements and objectives of the curriculum in terms of knowledge, skills, and attitudes. Second, enhance the design of diverse situations and activities for students, especially specific activities of the subject. Third, create favorable conditions for students to have motivation and good learning attitude through experiential activities related to real life. Fourth, the form and method of assessment and testing towards the development of students' competencies: using a variety of forms and methods of assessment and testing; process evaluation and final evaluation; coordinate teacher and student assessment; evaluation inside and outside the school. Fifth, teachers are the ones who direct, organize activities, and support students in the learning process.[26]

## 3. Results

### 3.1. The Purpose of Training and Developing the Ability to Predict and Solve Problems through Teaching Students to Predict and Correct Mistakes through Practical Problems on the Topic of Exponents and Logarithmic Functions

The purpose of training and development is to foster students' ability to predict and solve problems through some common mistakes. Students find, correct mistakes, and learn for themselves through real problems on the topic of exponents and logarithmic functions and will master and understand the essence of the problem or knowledge. Thereby, students will be trained and develop critical thinking.

### 3.2. Scientific Basis

In teaching, predicting and correcting mistakes that students make is an essential and indispensable activity. By Polya, people need to learn from their mistakes and shortcomings. [27]

According to I.A.Komensky, any mistake can make students worse if you don't pay attention to the mistake to fix it. Teachers need to guide students to recognize and correct mistakes. [28]

A.A.Stoliar affirmed that teachers should have teaching methods based on the mistakes of students when they appear and do not miss the time to analyze those mistakes for students. [28]

Thus, students need to learn from their mistakes and analyze them to find the cause and nature of those mistakes. From there, students overcome and promote their judgment ability, helping themselves no longer encounter obstacles when approaching knowledge. Finding and correcting mistakes is one of the teaching activities that contribute to training the best ability to predict and solve problems.

### 3.3. Example to Illustrate the Training and Development of the Ability to Predict and Solve Problems through Teaching Students to Predict and Correct Mistakes through Practical Problems on the Topic of Exponents and Logarithmic Functions

We find that in the process of solving math problems, students often make some mistakes in terms of knowledge, reasoning methods, or computational techniques, ... In this thesis, we will present some common mistakes students make while solving real problems on the topic of exponents and logarithmic functions.

*Mistakes of practical knowledge* are mistakes that can be encountered in the essay or arguments and conclusions. For example, the loan interest rate exceeds 21% / year compared with the actual interest rate, the savings interest rate is more than 10,5% / year in 2020 ...

**Example 1.** (*The problem is not true*) At the beginning of 2019, Mr. Binh deposited 500 million VND into a bank account in Vietnam with an interest rate of 20% in the form of continuous compound interest. How long does it take for Mr. An's account balance to double?

The solution of one student:

Applying the formula for calculating compound interest continuously, we have:  $A = Pe^{rt} = 500e^{0,2t}$  (million dong).

To double the account balance, that is,  $A = 1000$  (million dong), solve the equation for  $t$ :

$$\begin{aligned} 500e^{0,2t} &= 1000 \Leftrightarrow e^{0,2t} = 2 \\ &\Leftrightarrow \ln e^{0,2t} = \ln 2 \\ &\Leftrightarrow 0,2t = \ln 2 \\ &\Leftrightarrow t = \frac{\ln 2}{0,2} \approx 3,47. \end{aligned}$$

So the account balance will double after about 3 years and 6 months.

Find the mistakes in the above problem and solution.

After considering the problem and its solution, students will usually assume that the solution is correct. Therefore, teachers need to conduct teaching activities to show students clearly the subtle mistakes in this problem. Teaching activities can be carried out as shown in Table 2.

From the activities in the example, the students will notice that the data given can also be wrong from reality. Students need to be careful, carefully consider the problem and also the arguments and conclusions in the solution or other factors related to the problem. Through it, students will discover and grasp the knowledge of reality; They are trained to be careful in how to see, comment, or evaluate problems.

**Mistakes in solutions, arguments, and conclusions** are often wrong in the method of reasoning and proving, assessment lack of cases, lack of conditions, incorrect application of rules and properties, lack of knowledge leading to incorrect values and wrong conclusion due to haste and lack of basis.

**Table 2.** Teaching activities according to the orientation of developing the capacity to predict and solve problems of actual knowledge mistakes

| Teacher  | Students   |
|--|--|
| Read the problem and solution carefully, and comment on whether the problem is right or wrong.   | The problem is right.  |
| What does the problem refer to? Which knowledge is involved with?  | The problem is about the bank interest rate. We can relate to knowledge about interest rates.  |
| What formulas and precautions can we apply to this problem?  | The formula for continuous recurring interest can be applied because the topic is about savings account in the form of continuous compound interest. |
| Do you have any comments about the interest rate for savings?  | The 20% interest rate is quite high, so it is very beneficial and will quickly get the desired amount.   |
| Is the 20% interest rate reasonable and consistent with the reality?   | Think to answer the question.  |
| After studying, we can easily find some information related to the banking sector as follows: From the beginning of 2019 until now, the lending interest rates in banks in Vietnam range from 7 - 21% / year, this figure depends on the lending bank, the form of loan ... For the form of savings, the interest rate ranges from 2 - 10,5% / year depending on the bank and the form of savings. | Listen carefully.  |
| Again, compare and comment on the problem.   | In this problem, the data is not true to the fact that the interest rate on savings is greater than 10,5% in 2019.                                   |
| How can we fix the above mistake?  | We can edit the problem data so that the interest rate is below 10,5%.   |

**Example 2.** (Error in reasoning and argument) *Under ideal conditions, a certain bacterial population doubles every three hours. Initially, there are 100 bacteria in a population.*

- a) Find a pattern for the bacterial population after  $t$  hours.
- b) How many bacteria are there after 10 hours?
- c) When will the number of bacteria reach 1000?

The solution of one student:

- a) The population for time  $t$  is represented by the following function:  $n(t) = 100 \cdot 2^{3t}$ , where  $t$  is expressed in the unit of hours.
- b) After 10 hours, the number of bacteria is:  $n(10) = 100 \cdot 2^{10 \cdot 3} \approx 1,07 \times 10^{11}$  (bacteria)
- c) For bacteria to reach 1000, we have  $n(t) = 1000$ . Solve the equation:

$$1000 = 100 \cdot 2^{3t}$$

$$\Leftrightarrow 10 = 2^{3t}$$

$$\Leftrightarrow \log 10 = \log 2^{3t}$$

$$\Leftrightarrow 1 = 3t \log 2$$

$$\Leftrightarrow t = \frac{1}{3 \log 2} \approx 1,11.$$

So the number of bacteria reaches 1000 in about 1 hours 7 minutes.

Find the mistake in the above problem and solution.

The teaching activities can be carried out as shown in Table 3.

The example will help students identify mistakes in reasoning about the time they might make about the cell division or population growth problem.

The examples above are intended to help students be aware of some mistakes they may make in learning and solving math problems. Through it, students are trained to think critically, know how to check problems to predict, correct, and self-correct mistakes. Students will also self-review the knowledge as well as master its nature. In the process of organizing learning activities and guiding students to predict, correct, and overcome difficulties through practical problems on the topic of exponents and logarithmic functions, we need to note the following. First, when teaching, teachers need to pay attention to definitions, theorems, rules, properties, and possible cases in the problem. This helps students master knowledge. Second, teachers learn and create situations that contain mistakes so that students can understand and learn from the mistakes they make. Attention should be paid to choosing the wrong situations appropriately, not too difficult compared to the knowledge threshold of students. Third, teachers let students discover mistakes by themselves, discuss to point out the mistakes, the cause of the mistakes. Finally, the teacher monitors and observes the students' activities to timely correct them and if students do not discover them, the teacher will help and support them.

**Table 3.** Teaching activities oriented to develop the ability to predict and solve problems about mistakes in solutions, arguments, and conclusions

| Teacher  | Students   |
|--|--|
| See the above problem and judge if it is right or wrong. | Wrong answer.  |
| Please point out the wrong and explain.                  | The formula for representing the bacterial population after $t$ hours is $n(t) = 100 \cdot 2^{3t}$ . That argument is incorrect in that the determination of the time value is $3t$ due to the combination of the fact that "population doubles every three hours" with after $t$ hours.   |
| Present correct arguments and answers.                   | <p>a) Since "population doubles every three hours", after <math>t</math> hours, the time would be: <math>\frac{t}{3}</math> hours.</p> <p>So the population in time <math>t</math> is represented by the following function: <math>n(t) = 100 \cdot 2^{\frac{t}{3}}</math>, where <math>t</math> is calculated in the unit of hours.</p> <p>b) After 10 hours, the number of bacteria is: <math>n(10) = 100 \cdot 2^{\frac{10}{3}} \approx 1008</math> (bacteria).</p> <p>c) For the number of bacteria to reach 1000, we have <math>n(t) = 1000</math>. Solve the equation:</p> $1000 = 100 \cdot 2^{\frac{t}{3}}$ $\Leftrightarrow 10 = 2^{\frac{t}{3}}$ $\Leftrightarrow \log 10 = \log 2^{\frac{t}{3}}$ $\Leftrightarrow 1 = \frac{t}{3} \log 2$ $\Leftrightarrow t = \frac{3}{\log 2} \approx 10.$ <p>So the number of bacteria reaches 1000 in about 10 hours.</p> |

**Table 4.** Teachers' opinions about the role of teaching the ability to predict and correct mistakes in real problems for students in the direction of developing problem-solving and prediction capabilities.

| Unnecessary |   | Less necessary |      | Necessary |       | Very necessary |       |
|-------------|---|----------------|------|-----------|-------|----------------|-------|
| Quantity    | % | Quantity       | %    | Quantity  | %     | Quantity       | %     |
| 0           | 0 | 3              | 6,38 | 13        | 27,66 | 31             | 65,96 |

**Table 5.** Students' opinions on the role of teaching the ability to predict and correct mistakes in real problems

| Unnecessary |   | Less necessary |      | Necessary |       | Very necessary |       |
|-------------|---|----------------|------|-----------|-------|----------------|-------|
| Quantity    | % | Quantity       | %    | Quantity  | %     | Quantity       | %     |
| 0           | 0 | 12             | 7,36 | 68        | 41,72 | 83             | 50,92 |

## 4. Discussion

### 4.1. Surveying the Situation

We have collected the opinion of 47 high school teachers in Ho Chi Minh City, Vietnam through the questionnaire: "In your opinion, is it necessary to develop the ability to predict and solve problems on the topic of exponents and logarithmic functions for students through teaching in the direction of predicting and correcting the mistakes of real problems?". We get the results shown in Table 4.

From the survey data, we see that the percentage of teachers who think that teaching to develop the ability to predict and solve problems on the topic of exponents and logarithms for students through teaching in the direction of predicting and correcting mistakes is very necessary, accounting for 65.96% and necessary, accounting for 27.66%. From there, it is possible to conclude, teachers attach importance to developing the ability to predict and solve problems on the topic of exponential functions, logarithmic functions for students through teaching in the direction of predicting and correcting the mistakes of real problems.

Besides, we also surveyed over 163 students in two high schools in Ho Chi Minh City, Vietnam with the following question: "In your opinion, how important is the practice of developing the ability to predict and correct mistakes in real-world problems?". We have obtained the results in Table 5.

Students believe that the teaching of predicting and correcting mistakes of real problems is very necessary (50.92%) or necessary (41.72%), accounting for more than 90%, much higher than the proportion of people saying that this is less necessary (7.36%) and no student choosing the unnecessary item.

### 4.2. Experiment

We have experimented in the school year 2020-2021 at Nguyen An Ninh High School (District 10, Ho Chi Minh City, Vietnam) under the advanced study program in Vietnam.

- Experimental class (TN) 12A16 includes 45 students. Math Teacher: Tran Dai Nghia.
- Control class 12A14 includes 44 students. Math Teacher: Tran Dai Nghia.

These schools are not talent ones. They are normal. Two classes are not talent ones. They are quite similar to

competence. The members of these class usually join the activities of their schools such as the sport and intellectual competitions.

#### 4.2.1. Analyzing before the experiment

We collect and evaluate the learning outcomes of the two classes by learning from the homeroom teacher and the class subject teacher about the average scores of the previous school year (2019-2020 school year) of the two classes. After entering scores into SPSS software, we obtained the following results:

**Table 6.** Frequency distribution table of Mathematics average scores for experimental and control classes from the previous school year in SPSS

|        |     | class        |         | Total |
|--------|-----|--------------|---------|-------|
|        |     | Experimental | Control |       |
| Scores | 5,0 | 4            | 5       | 9     |
|        | 5,1 | 2            | 0       | 2     |
|        | 5,7 | 0            | 1       | 1     |
|        | 5,8 | 0            | 1       | 1     |
|        | 5,9 | 1            | 0       | 1     |
|        | 6,0 | 2            | 2       | 4     |
|        | 6,1 | 4            | 1       | 5     |
|        | 6,2 | 1            | 2       | 3     |
|        | 6,3 | 0            | 2       | 2     |
|        | 6,5 | 1            | 0       | 1     |
|        | 6,7 | 0            | 1       | 1     |
|        | 6,8 | 2            | 1       | 3     |
|        | 6,9 | 0            | 2       | 2     |
|        | 7,0 | 4            | 1       | 5     |
|        | 7,2 | 1            | 3       | 4     |
|        | 7,3 | 0            | 3       | 3     |
|        | 7,4 | 3            | 0       | 3     |
|        | 7,5 | 3            | 2       | 5     |
|        | 7,6 | 0            | 1       | 1     |
|        | 7,7 | 1            | 2       | 3     |
|        | 7,8 | 3            | 0       | 3     |
| 7,9    | 1   | 2            | 3       |       |
| 8,0    | 0   | 4            | 4       |       |
| 8,1    | 2   | 0            | 2       |       |
| 8,1    | 1   | 0            | 1       |       |
| 8,2    | 0   | 1            | 1       |       |
| 8,3    | 2   | 0            | 2       |       |
| 8,6    | 1   | 1            | 2       |       |
| 8,7    | 1   | 0            | 1       |       |
| 8,8    | 1   | 1            | 2       |       |
| 8,9    | 1   | 0            | 1       |       |
| 9,0    | 2   | 0            | 2       |       |
| 9,2    | 0   | 1            | 1       |       |
| 9,3    | 1   | 2            | 3       |       |
| 9,4    | 0   | 1            | 1       |       |
| 9,5    | 0   | 1            | 1       |       |
| Total  | 45  | 44           | 89      |       |

From Table 6, we obtain table 7 of the characteristic parameters of statistics as follows:

**Table 7.** Table of typical parameters of the Mathematics GPA of the experimental and control classes from the previous school year in SPSS

|       |              | scores |          |                    |
|-------|--------------|--------|----------|--------------------|
|       |              | Mean   | Variance | Standard Deviation |
| class | Experimental | 7,13   | 1,52     | 1,23               |
|       | Control      | 7,17   | 1,62     | 1,27               |

From Table 7, we have the following comments:

- The GPA in Math of the previous school year of the experimental class is 7.13 points.
- The GPA in Math of the previous school year of the control class is 7.17 points.
- The standard deviation and variance of the experimental class are smaller than that of the control class, it shows that the scatter of points around the mean of the experimental class is lower than that of the control class.

However, we need to conduct a T-Test (see Table 8) to accurately assess the similarities or differences between the average scores of the two classes. We test hypothesis  $H_0$ : "Average scores in Mathematics of the previous school year of the experimental and control classes are similar", with a significant level  $\alpha = 0,05$

Reading the results from Table 8, we have the following conclusions:

- Levene test has value  $Sig. = 0,974 > \alpha = 0,05$ , so the variance of the two classes, though there is a difference, it is not significant, should be considered equivalent, using the Independent-samples T-test results corresponding to the case of equal variances assumed from two classes.
- Independent-samples T-test test,  $Sig.(2-tailed) = 0,883 > \alpha = 0,05$  should accept the hypothesis  $H_0$ , the average score of Mathematics in the previous school year of the experimental class and the control class are equivalent.

4.2.2. Analyzing after the experiment

a) Qualitative assessment

We conducted experimental teaching while observing the progress and interviewing to make the following comments:

Before experimenting: through quick interviews with students and teachers, we found that students in both classes did not have much access to practical problems on the topic of exponentials and logarithmic functions. Therefore, although students are very interested in practical problems, students are still superficial in researching and learning about this topic as well as practical math problem skills are not good.

During the experiment: students are excited to learn practical problems through questions, raise questions; the experimental class atmosphere is more exciting; students actively study, pay attention to practical problems, so they voluntarily participate in activities, actively raise their hands to speak, contribute to building lessons, absorb knowledge more effectively; students are familiar with the approach to practical problems so they are very active in learning; After that, they are more active in giving opinions, raising hands or researching and asking questions and discussing with classmates and teachers about practical problems related to the lesson.

After experimenting, through observing the students' signs and interviewing the teacher and the students, we noticed some changes in the students, as follows: Students in the experimental class no longer make some common mistakes in solving real problems; gradually forming a sense of research and checking problem data as well as considering whether the results are true or not. Students in the experimental class have many positive changes, actively learn from real-life problems more than before; do more practical problems. At the end of the class, some students contacted teachers to learn more, exchange questions, and answer questions about real problems.

Thus, after learning by the experimental lesson plan, students have shown and changed positively in the right direction of formation and development, as well as the ability to predict and solve problems that teachers have instructed. However, to ensure the objectivity of the judgments about the effectiveness of the measures, we will conduct quantitative analysis and evaluation using Mathematical statistics through SPSS software.

**Table 8.** T-test checklist of Math GPA of experimental and control classes from the previous school year in SPSS

|        |                             | Independent Samples Test                |       |                              |        |                 |                 |                       |   |         |
|--------|-----------------------------|---|-------|------------------------------|--------|-----------------|-----------------|-----------------------|---|---------|
|        |                             | Levene's Test for Equality of Variances |       | t-test for Equality of Means |        |                 |                 |                       |   |         |
|        |                             | F                                       | Sig.  | T                            | Df     | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |         |
| scores | Equal variances assumed     | 0,001                                   | 0,974 | -0,147                       | 87     | 0,883           | -0,03912        | 0,26563               | -0,56709                                  | 0,48885 |
|        | Equal variances not assumed |   |       | -0,147                       | 86,753 | 0,883           | -0,03912        | 0,26572               | -0,56729                                  | 0,48905 |

b) Quantitative assessment

We conduct a quantitative analysis of students' 45-minute test results using SPSS software to verify the effectiveness and feasibility of the experiment. First, we have the score summary in Table 9.

From the data (table 9), we have table 10 showing typical parameters of statistics.

From the data (table 10), we have the mean and variance of the two classes with clear differences.

The average grade of the two classes is:  $\overline{X_{TN}} = 8,11$ ;  $\overline{X_{DC}} = 7,59$ . The experimental class has a higher GPA than the control class.

Variance:  $S_{TN}^2 = 1,10$ ;  $S_{DC}^2 = 1,67$ . Comment: The experimental class has a higher concentration around the mean than the control class because of the lower standard deviation and variance.

From there, we can observe that the experimental class's score is higher than that of the control class.

However, to ensure the accuracy of the difference (big or small) between the average scores of the two experimental classes, we conduct the average test between the two classes, with a significant level of  $\alpha = 0,05$  shown in Table 11 with the following two assumptions:

Hypothesis  $H_0$ : "The average scores of the experimental class and the control class are similar".

$H_1$ : "The average score of the experimental class is higher than that of the control class".

Reading the figures in Table 11, we have:

- Levene test has value  $Sig. = 0,081 > \alpha = 0,05$ , we have the same variance of two classes, using the results of the Independent-samples T-test test corresponding to the case where the variance of two samples is equal.
- Independent-samples T-test test has  $Sig.(2-tailed) = 0,040 < \alpha = 0,05$ , so we reject hypothesis  $H_0$ , accept hypothesis  $H_1$ . Therefore, the average score of the experimental class is 5% higher than that of the control class.

In summary, after experimenting between two classes with equivalent performance, the test and evaluation results show that the experimental class, after being taught in the direction of predicting and correcting mistakes in real problems, the number of students with common mistakes dropped and test scores on real-world problems improved, and GPA was higher than the control class. The restriction of our research is that, we survey the experiments at a school in Ho Chi Minh city, so we do not have the condition to survey on other schools, especially rural schools. We need more some research on this thing. However, it can be said that this experiment is completely effective and feasible in teaching.

**Table 9.** Table of the frequency distribution of post-experimental test scores of experimental and control classes in SPSS

|       |              | scores |     |     |     |     |     |     |     |     |      | Total |
|-------|--------------|--------|-----|-----|-----|-----|-----|-----|-----|-----|------|-------|
|       |              | 5,5    | 6,0 | 6,5 | 7,0 | 7,5 | 8,0 | 8,5 | 9,0 | 9,5 | 10,0 |       |
| class | Experimental | 0      | 2   | 1   | 8   | 6   | 9   | 5   | 7   | 4   | 3    | 45    |
|       | Control      | 2      | 8   | 3   | 6   | 4   | 8   | 2   | 5   | 5   | 1    | 44    |
| Total |              | 2      | 10  | 4   | 14  | 10  | 17  | 7   | 12  | 9   | 4    | 89    |

**Table 10.** Table of the characteristic parameters of the statistics on post-experimental test scores of experimental and control classes in SPSS

|       |              | scores |          |                    |
|-------|--------------|--------|----------|--------------------|
|       |              | Mean   | Variance | Standard Deviation |
| class | Experimental | 8,11   | 1,10     | 1,05               |
|       | Control      | 7,59   | 1,67     | 1,29               |

**Table 11.** T-test checklist of post-experimental test scores of two experimental and control classes in SPSS

| Independent Samples Test |                             |   |       |                              |        |                 |                 |                       |   |         |
|--------------------------|-----------------------------|---|-------|------------------------------|--------|-----------------|-----------------|-----------------------|---|---------|
|                          |                             | Levene's Test for Equality of Variances |       | t-test for Equality of Means |        |                 |                 |                       |   |         |
|                          |                             | F                                       | Sig.  | t                            | df     | Sig. (2-tailed) | Mean Difference | Std. Error Difference | 95% Confidence Interval of the Difference |         |
|                          |                             |   |       |                              |        |                 |                 |                       | Lower                                     | Upper   |
| scores                   | Equal variances assumed     | 3,108                                   | 0,081 | 2,088                        | 87     | 0,040           | 0,52020         | 0,24908               | 0,02513                                   | 1,01528 |
|                          | Equal variances not assumed |   |       | 2,084                        | 82,757 | 0,040           | 0,52020         | 0,24966               | 0,02362                                   | 1,01679 |

## 5. Conclusions

From the above studies, we find that teaching in the direction of predicting and correcting mistakes for students in practical problems on the topic of exponents and logarithms is essential and necessary. We have presented a table showing manifestations of problem-solving and prediction capacity across all levels of education. Also, we have given students examples of teaching in the direction of predicting and correcting mistakes in practical problems on the topic of exponents and logarithmic functions. Finally, the pedagogical experiment evaluates the feasibility and effectiveness of this teaching. We used SPSS software for data processing. However, the article has not mentioned the ability to predict and solve problems in the direction of generalizing, specializing, and finding many solutions to teaching practical problems on the topic of exponents and logarithmic functions. These research directions are looking forward to readers' interest in research.

## Acknowledgments

We would like to thank Ms. Hoang Thi Ngoc for reading and commenting on the final draft of the manuscript.

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