

# Organizing Students of Primary Education Major to Design Situations of Teaching Fractions in the Direction of Connecting to the Real World

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**Abstract** In this article, we first learn about teaching situations and situations of teaching mathematics in combination with the real world, which are related to the professions of teachers in general, primary teachers in particular. Next, we study the content and role of fractions in the subject of mathematics at Vietnam's primary level, thence, we analyze the situations of teaching fractions in combination with the real world. On this basis, we propose a process of organizing students of primary education major to design teaching situations of fractions towards connecting to the real world. To test the validity of this process, we conducted an experiment with the steps of the process for students through professional training activities in classroom. Thereby, to contribute to train the teaching ability for students of primary education major, help them be able to adapt to the development of the mathematics curriculum soon and teach the knowledge of fractions at primary level better in the near future.

**Keywords:** *organize, design, teaching situation, real world, fractions, students of primary education*

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## 1. Introduction

Every day, our children go to school and face a variety of subjects, in which Mathematics, Literature and English are three subjects specially emphasized. In the subject of mathematics, the applicability of mathematics problems is usually limited to illustrations of formulas. Teachers mainly follow the system of exercises in textbooks, workbooks, reference books. Therefore, the expansion of mathematical exercises in the direction of applying in the real world is worthwhile mathematical tasks. Thus, designing situations of teaching mathematics assigned with the real world is a necessary competence of teachers in the current period. Exploiting real-world elements in teaching mathematics well contribute to help students develop the problem solving ability, know how to apply mathematical knowledge into daily life.

In the primary teacher education curriculum at pedagogic universities, it is very important to organize activities of designing situations of teaching for students in order to embed theory into practice. This brings a new learning atmosphere to the lecture hall in the trend of innovating teaching methods at university level, especially for elementary education major which is a specific discipline related to the educational principle of "Learning

with practice". As a result, this contributes to train primary teachers with a steady scientific background and various practical knowledges to meet the increasing demands of teaching profession.

There have been many studies on designing teaching situations, such as Blena Castro and Rodriguez [1], Fandino Pinilla [2], Apostol [3], Suhrit Dey and Roma Dey [4], Strother [5], Nguyen Ba Kim [6], Phan Trong Ngo [7], Dao Tam [8], Duong Huu Tong [9], Pham Thi Thanh Tu [10], Pham Thi Hai Chau [11], Nguyen Thi Kieu [12],... However, there are not many studies on organizing and designing for specific teaching content in general. For example, when teaching fractions, a very abstract mathematical content for children, we need to exploit them more deeply in the direction of strengthening practice for students by using teaching situations that are associated with real-world examples. It is not without reason that Albert Einstein once said: Teaching by example is not "a way of teaching" but "the only way to teach" [13].

In this paper, we focus on the study of organizing students of primary education to design situations of teaching fractions that are linked to the real world. We simultaneously conducted pedagogical experiments to initially confirm the effectiveness and the feasibility of the proposed teaching measures through a specific teaching process. By this process, the teaching ability of primary

education students will be improved, and it will help them teach the knowledge of fractions better and be able to adapt to the development of the mathematics curriculum at primary level soon.

## 2. Content

### 2.1. A Teaching Situation in Combination with the Real World

A situation of teaching mathematics is a situation in which there is devolution of the teacher. This devolution is exactly the process that the teacher includes the content that needs to be passed on to events of the situation and structures of the events to fit the pedagogical logic so that when students resolve them then they will achieve the learning objects. The events of mathematics teaching situations can be taken from the real world or mathematics itself. In each of mathematics teaching situations, there must be mathematical objects (concepts, rules, problems, etc.) that students need to understand, explain and be able to apply into specific situations.

According to our opinion, therefore, a situation of teaching mathematics connected to the real world is a situation whose achieved objective comes from the real world.

In each situation of teaching mathematics connected to the real world, there must involve one real-world problem containing contradictions, obstacles to stimulate students thinking and ask them to judge and propose hypotheses by mobilizing their knowledge and life experience to investigate and solve difficulties that the situation posed. Since then, students acquire new knowledge, form skills, develop themselves and adapt to life.

There are many ways to classify situations of teaching mathematics in terms of characteristics of the subject as well as objectives and different criteria. For instance, it is able to classify typical teaching situations corresponding to their functions such as: forming new knowledge, perfecting and consolidating knowledge, testing and assessing knowledge.

Base on the conditions of deploying in the reality of teaching at pedagogic universities, as well the characteristics of teaching mathematics at primary level, we classify teaching situations connected to the real world into basic forms:

- Teaching situations of forming new knowledge;
- Teaching situations of practicing and training;
- Teaching situations in organizing experiential, extracurricular activities.

### 2.2. Learning about the Content of Fractions in the Mathematics Curriculum at Primary Level in Vietnam

In the primary curriculum of every country, mathematics is of particular importance. In Vietnam, mathematics is a compulsory subject with the four main knowledge areas: Arithmetic, the element of geometry, the element of quantity and word problem solving. Arithmetic which is central knowledge circuit has the biggest volume,

including Arithmetic on the natural numbers, fractions, decimal numbers; the element of Algebra and the element of Statistics [14].

The content of fractions has been officially taught in an explicit and relatively complete way after students get familiar with the unit fractions  $\frac{1}{n}$ , where  $n \leq 10$ , in a

hidden form through the concept "equal parts". In addition, the content of fractions has been integrated in teaching the other knowledge areas of the mathematics subject.

The concept of fraction which is formed at primary level usually goes through two approaches that are derived from the needs of either the real life or the internal mathematics:

+ From the real life needs: Fractions are considered to be a numerical form used to present the number of equal parts that are taken from a given unit.

This activity is expressed by dividing the whole into  $b$  equal parts. Then, take  $a$  parts from those  $b$  parts to obtain the fraction  $\frac{a}{b}$ .

+ From the internal mathematics needs: Fractions are generated by the need for expanding numerical sets [15]. On the set  $\mathbb{N}$  of natural numbers, it is impossible to do the division operation, or in other words, the linear equation in the form of  $b \times x = a$ , where  $b \neq 0$ , has no solution on  $\mathbb{N}$ . Hence, it is necessary to expand the set  $\mathbb{N}$  into the set of fractions so that the linear equation always has one and only one solution  $\frac{a}{b}$ . The fraction  $\frac{a}{b}$  is the correct quotient of dividing a natural number  $a$  by a natural number  $b \neq 0$ .

As an example, we illustrate a plan for forming the concept of fraction presented in the 4<sup>th</sup> grade mathematics textbook [[14], p.106]: Divide a circle into 6 equal parts, coloring 5 parts. We say: *Colored in five sixth of the circle.*

We write:  $\frac{5}{6}$ , read: *five over six*. We call  $\frac{5}{6}$  a fraction.

The fraction  $\frac{5}{6}$  has numerator 5 and denominator 6. The denominator is a natural number that is written under a bar. It indicates that the circle is divided into 6 equal parts. The numerator is also a natural number written above the same bar. It shows that 5 equal parts are already colored.

Through the presentation of the current Vietnamese mathematics textbook as cited above, we can realize that the authors of the textbook have already made the necessary corrections to the previous presentation. We need to specify for students to be able to see those detailed innovations. If the verb "to take" was used in the previous mathematics textbook, then the current textbook use the word "to color" to ask students to perform a specific, intuitive and very familiar action (by ear, by hand, by eye).

In addition, students are equipped with the knowledge on basic properties of fractions; comparing and ordering fractions; addition, subtraction, multiplication and division on fractions and some properties of the four operations. The content of fractions is built from the real world and to solve the real-world problems. Therefore, it is convenient

for teachers to design teaching situations connected to the real world, help students get more excited in learning and improve the ability to apply mathematics knowledge into solving problems in life. The concept of “fraction” is very abstract, which is difficult to complete for some students from primary schools, even to secondary and high schools. However, if applying situations of teaching connected to the real world, then it is possible to help this concept become more specific.

### 2.3. Situations of Teaching the Content of Fractions in the Direction of Connecting to the Real World

#### 2.3.1. Teaching Situations of Forming New Knowledge

According to Nguyen Ba Kim [6], *motivation* is to make students be aware of the significance of activities and their objects. The design of teaching situations connected to the real world to motivate students to discover knowledge helps them be aware of the lesson objectives and make internal motivations promote activities to achieve those objectives.

When teaching the formation of a concept, the construction of a formula, rules, properties of fractions, teachers should exploit the real-world elements related to everyday life around students, the reality of society, the reality of other disciplines to construct motivating situations that ask students have to solve with mathematics knowledge and life experiences. Thereby, they realize knowledge on fractions derived from the needs of the real world and from internal mathematics. However, when designing the real-world situations, lecturers should pose simple problems since life experiences of students are still limited, so they do not deeply understand many problems in the real world. If teachers give situations that are too complicated or far away from everyday life, then students will meet difficulties when solving the situations. According to Nguyen Tien Dung [13], the examples that are specific and easy to understand as well as familiar concepts are exactly the knowledge to which abstract concepts cling.

Through some simple and close situations, teachers can help students see that applications of fractions into life are very clear and this will be useful for them in the future. Teachers should give students much more time to solve situations themselves at class while they observe and be ready to help students when they need. By this way, it is more effective in learning for students.

**Example 1:** Forming the concept of “fraction” by approaching “fractions are the results of the division of two natural numbers with the nonzero divisor”. In this case, the real-world situation to motivate can be: “The teacher has 3 pizzas; she wants to equally divide them to 4 students. Find the way to help the teacher divide the three pizzas and then how many parts of three cakes each student will get?”

**Example 2:** When teaching the comparison of two fractions whose denominators are distinct, the real-world situation to motivate can be as follows: “In the contest of “Who is faster?”, the organizers prepare two students An and Binh two equal circles. After one minute of the

contest, An has colored  $\frac{2}{3}$  of his circle in red, Binh has completed  $\frac{1}{4}$  of his circle in blue. In your opinion, who has colored faster? Since then, you give your comment on which fraction is bigger.”

#### 2.3.2. Teaching Situations of Practicing and Training

Through the activities of praising and training, it is initial to form the concept of fractions, rules for comparing, calculating, consolidating new knowledge, training skills, developing thinking and intelligence for students. These activities give students opportunities to get familiar with how to apply knowledge, skills about fractions to solve problems raised in learning and life. In particular, the situations that teachers have given in teaching practice and train have the contents related to the real world are suitable and effective teaching modes to develop competencies for students, simultaneously appropriate to the new trend of integration and experience in mathematics education.

**Example 3:** Organizing the 4<sup>th</sup> grade students to practice forming a 24-hour schedule. The teacher suggests a plan:  $\frac{5}{12}$  of the total time to learn at school,  $\frac{1}{12}$  to do physical exercises, sing or play chess,  $\frac{1}{12}$  to stay at home,  $\frac{1}{8}$  to do homework,  $\frac{7}{24}$  to relax, eat and sleep.

Of course, we can not expect mathematics education to change immediately in a way that reduces the knowledge of textbooks and increases the number of hours for students to learn skills. However, such situations as above will contribute to advice teachers how to teach students to apply fractions into life.

#### 2.3.3. Teaching Situations in Organizing Experiential, Extracurricular Activities

Experiential and extracurricular activities are types of educational ones conducted in an organized way inside or outside the school to develop and enhance qualities and potentials of students. These activities help students become self-made, cooperatitive spirit, sharing with the people around, support many aspects for the curricular activities to stimulate the process of learning mathematics.

Experimental and extracurricular activities are diverse, integrated knowledge, skills of many subjects, many areas of learning, implemented in different forms such as: Visiting, going picnic; mathematical games, mathematical clubs; mathematical magazines;... Therefore, teaching situations in organizing experimental and extracurricular activities must have the content close to the real world and meet the activity need of students. For example, to deepen the knowledge on fractions, teachers can organize a real-world situation in experiential activity with the topic “Try doing as a farmer” as follows: A vegetable garden has the same 15 plots. The teacher asks students to organize

harvesting  $\frac{1}{5}$  of the number of plots of the garden.

A teaching situation must be a situation in which students can implement an experiential activity in a

specific context. The language of the teacher to express the situation needs to be soft to describe the real-world situation; it should not be rigid as a word problem. For example, teacher students can construct a situation used in the lesson “Find the fraction of a number” as follows: “A teacher organizes learning games for the class 4A with 35 students and asks  $\frac{1}{5}$  of them to participate in the first game,  $\frac{2}{7}$  of them to participate in the second one. Let you arrange yourselves to play so that we can start.”

## 2.4. The Process of Organizing Students to Design Situations of Teaching the Content of Fractions in the Direction of Connecting to the Real World

By solving the teaching situations connected to the real world, students become the subjects of the cognitive and learning processes, acquire knowledge gradually, and develop the ability of adapting to situations in learning as well as in life. However, for mathematical models constructed from the real world, teachers have to restate in an appropriate way by eliminating unnecessary details and data, using the language to express so that students can easily understand, arranging conditions and requirements reasonably [10].

Be aware of that importance in the period of training at pedagogic universities, we propose a process of organizing students of Primary Education major to design situations of teaching fractions in the direction of connecting to the real world as follows:

*Step 1.* Students find out the necessary things to design teaching situations:

- Master firmly the content of fractions  $\frac{2}{8}$  in the mathematics subject at primary level; analyses the content of the curriculum to discover structural characteristics of each lesson according to the development of the knowledge chain on fractions from the 2<sup>nd</sup> grade to the 5<sup>th</sup> grade.

- Define the objective, tasks and requests of the lesson related to fractions.

- Identify the core knowledge on fractions of the lesson.

*Step 2.* Students carry out individual activities to design their own teaching situations connected to the real world:

This step requires students to know how to exploit and apply their prior knowledge and experience to conduct the task; know to use the suitable teaching methods, organizing forms and teaching techniques. It is possible to take real-world situations from real life or from within mathematics subject.

*Step 3.* Organizing to assess the designed situations.

Before implementing these steps, lecturers can divide students into groups so that each group discuss situations to design. Then, discussing the situations together at class.

**Example 4:** Organizing teacher students to design teaching situations connected to the real world in teaching the formation of the concept of fraction.

*Step 1.* Designing real-world situations to organize the teaching of the initial concept about fractions according to

the approach that “Fractions are as the numerical form used to present equal parts taken from a given unit”.

*Step 2.* Students have to answer these questions:

*Question 1.* How many ways to approach the concept of fractions are there?

For this question, students must master 6 ways to approach fractions: Basing on the division; approaching by measurement; basing on the number of parts in a whole; approaching by ratios; basing on numerical rays; approaching by the theory of sets.

*Question 2.* How do the current curricula and textbooks of the primary mathematics subject of Vietnam approach the concept of fractions?

For this question, teacher students need to grasp current Vietnamese mathematics textbooks and introduce primary students to approach fractions basing on “the number of parts in a whole” and the division.

*Question 3.* How many different ways to model fractions according to the approach “the number of parts in a whole”?

Students must specify some more models:

- + The model of area: A circle (a square, a field plot, a garden, a playground, etc.) is divided into 5 equal parts and one colored 4 parts, and then we have the fraction  $\frac{4}{5}$ .

- + The model of sets: There are 5 objects (birds, fish, babies, etc.) drawn in a picture and 4 of them are circled, then we have the fraction  $\frac{4}{5}$ .

**Example 5:** Organizing teacher students to design situations of teaching the addition of two fractions with like denominators.

*Step 1.* Designing real-world situations to organize the teaching of the addition of two fractions with like denominators.

*Step 2.* Organizing students to implement design tasks.

To carry out this, the lecturer can let students implement the following works:

- + Mathematically model the situation through the activities of coloring, cut papers, draw figures, etc.

- + Express the teaching situations connected to the real world: In front of the school yard, there is a rectangular garden. Boy students’ plant rose flowers on  $\frac{3}{8}$  of the

garden and girl students’ plant chrysanthemum flowers on  $\frac{2}{8}$  of the garden. How many parts of the garden have boy

and girl students planted flowers on?

On actually the garden, the teacher specifies for students: The part of garden to plant rose flowers occupies  $\frac{3}{8}$  of the garden, the part of garden to plant rose flowers

occupies  $\frac{2}{8}$  of the garden. Hence, to find the part of

garden for planting both types of flowers, we have to perform the calculation  $\frac{3}{8} + \frac{2}{8}$ . We have  $\frac{3}{8} + \frac{2}{8} = \frac{3+2}{8} = \frac{5}{8}$ .

Thus, the land needed to find is  $\frac{5}{8}$  of the garden. Then, forming the rule of adding two fractions with like

denominators: To add two fractions with like denominators, we add two numerators together and keep the denominator.

*Step 3.* Organizing to assess the situation which students have just designed.

In this activity, the lecturer can let students discuss in groups to review and assess the product they have designed:

+ About the applicability: The designed situation can be used in the formation of the rule of adding two fractions with like denominators.

+ About how to organize:

*Activity 1.* The teacher gives the situation; let students think to solve it by drawing squares and coloring to show the parts of the land for planting flowers:

+ Make two pink squares (the land parts of the garden) for planting rose flowers.

+ Make three yellow squares (the land parts of the garden) for planting chrysanthemum flowers:

As shown in the figure: How many parts of the garden do the land parts for planting both types of flowers occupy?

*Activity 2.* Let students comment, discuss and give their results.

*Activity 3.* Let students give the rule: To add two fractions with like denominators, we add two numerators together and keep the denominator.

## 2.5. Some Experimental Results on the Process of Organizing Students to Design Situations of Teaching the Content of Fractions in the Direction of Connecting to the Real World

We carried out a pedagogic experiment in the process of teaching the course "The method of teaching mathematics at primary school" for the 55<sup>th</sup> course teacher students majoring in Primary Education at Vinh University (Vietnam). Take two groups randomly: a control group and an experimental group, each of them consists of 22 students.

\* For the control group: Carry out teaching the content of fractions by the conventional teaching methods, in which the lecturer did not pay attention to organize teacher students to design teaching situations connected to the real world.

\* For the experimental group: Carry out teaching the content of fractions in which the lecturer organized in 5 periods for students to design teaching situations connected to the real world in terms of the proposed process.

Then both groups constructed and conducted a lesson plan for the content "Fractions and the division of natural numbers" to the 4<sup>th</sup> grade students of the School for pedagogical practices of Vinh University at the same time and conditions.

After the experiment, we marked the lesson plan and attended two periods taught by the representatives of the two groups. Evaluating the results by the method of mathematical statistics helps us to realize that the result of the experimental group is significantly higher than the result of the control group. Specifically, we already calculated and received the result that the average score of

the experimental group is higher than that of the control group ( $\overline{X}_{EXP} = 8.1 > 7.3 = \overline{X}_{CON}$ ) and the standard deviation of the experimental group is lower than that of the control group. For students of the control group, the rate of medium level is 40.9% and the rate of good level is 13.6%, while the respective rates of students of the experimental group are 13.6% and 36.4%.

## 3. Conclusion

With the explanation of theoretic and the teaching measures as mentioned above, we have already instructed and organized students of Primary Education major to create sets of appropriate teaching instruments used to teach students to learn the content of fractions more visually by pictures, drawing boards, papers, interactive boards, images, computers, projectors, fractional games, playground, flower gardens, etc.

In sum, we can affirm in the trend of training students of Primary Education major to develop competencies for learners that the process proposed to organize students of Primary Education major to train the ability to design teaching situations connected to the real world is necessary, effective and feasible. The content of the process is consistent with the cognitive ability and the learning conditions of students and pupils. By this article, we expect to make positive contributions to improve the training quality of Primary Education major at pedagogic universities that train future primary teachers who have the ability to design teaching situations connected to the real world.

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