HELPING STUDENTS DEVELOP AND EXTEND THEIR CAPACITY TO DO PURPOSEFUL MATHEMATICAL WORKS

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The reform curriculum of mathematics at all level from grade 1 to 12 have been tried out in Vietnam. From school year 2006-2007 the new curriculum and textbooks will be implemented in the whole country. The purpose of the reform is to activate the learning mathematics of students. The curriculum tries to lessen the training of basic skills and procedures in mathematics but increases more hands-on activities to help students grasp the mathematics ideas and can apply knowledge in solving real-life problems. The mathematics teachers have learnt the effective teaching strategies by using manipulative materials to teach mathematics in problematic situations. In this article we will present some findings of our research at provincial scale in Hue city of Vietnam. A try-out lesson done by an experienced mathematics teacher will be illustrated. From our research findings and observation of the lesson we will discuss what is the good practice in mathematics education in our economy and how to implement the good practice in our new curriculum.

THE USE OF MANIPULATIVE MATERIALS IN DEVELOPING MATHEMATICAL CONCEPTS

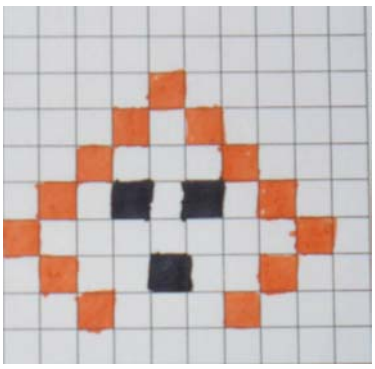
Following the old curriculum and mathematics textbooks, we taught mathematics in a traditional way. A key aim of schools was to prepare workers who were literate about numbers, computational procedures, algorithms and shapes. To ensure the memorization of basic facts, rules, and procedures, schools typically spoon-fed students, encouraging them to depend on authorities like their teachers and textbooks. If students did not know an answer of a problem, they asked the teacher or looked it up in the textbook. This is the reason why our students always need the tuition from their teachers after school. Now the new curriculum requires more than mastery of basic mathematical skills, good algorithms in solving a class of specific problems. In our increasingly complex and rapidly changing economy, the memorization of facts, rules and procedures is not enough. Business, industry, and government increasingly need workers capable of using the power of mathematics to solve new problems.

Traditional mathematics has focused on teaching concepts and skills usually in ways that are often referred to as behaviouristic. The difficulty with this approach is that mathematics becomes defined as the techniques and skills that students learn in a mechanistic way. There is seldom reference to contexts drawn from the world in which we live. Few students ever get to see how mathematics might be used and rightly question its relevance to their world. As mathematics teachers it may be helpful to

think of our role as helping students develop and extend their capacity to do purposeful and worthwhile mathematical work.

The teaching of mathematics is changing. We are challenging the old paradigm of teaching and considering a new paradigm based on theory and research that has clear applications to instruction. The teacher ought to think of teaching in terms of several principal hands-on activities. The new paradigm of teaching is to help students construct their knowledge in an active way while working cooperatively with classmates so that their talents and competencies are developed. The activity 1 below was revised from try out mathematics textbook grade 5 (page 78).

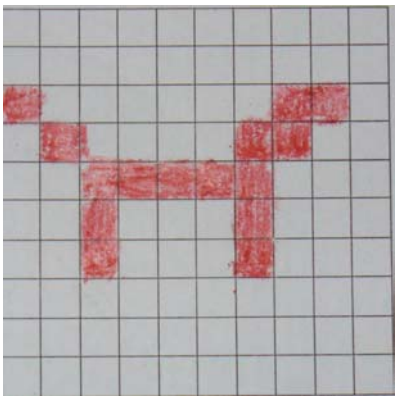
Activity 1. Use Figure 1. Student A shades any number of squares on one of the 10□10 square-grids. Student B answers the questions below the square-grid. Student A checks the answers given by Student B. Each student shades the square-grid twice and answers the questions twice.



No. of squares: _____

Fraction: _____

Percentage: _____



No. of squares: _____

Fraction: _____

Percentage: _____

Figure 1. Some student liked to draw beautiful pictures

Some students liked to draw beautiful pictures such as dogs, houses, robots with the polygon shape and asked their peers to answer the above questions. They realized that the shaded region was not necessary a set of small squares but also any polygon that its area can be found easily. To do this activity most students feel that they were free to raise the questions, and knowledge of mathematics constructed was from their figures not from the teacher. This activity gave a good intuition on the relationship between fractions, decimals and percentages, students actively involved in doing their works.

DEVELOPING MATHEMATICAL CONCEPTS FROM REAL-LIFE CONTEXTS

Traditional mathematics has focused on teaching concepts and skills usually in ways, which are often referred to as behaviouristic. The difficulty with this approach is that mathematics becomes defined as the techniques and skills that students learn in a mechanistic way. There is seldom reference to contexts drawn from the world in which we live. Few students ever get to see how mathematics might be used and rightly question its relevance to their world. As mathematics classroom teachers it may be helpful to think of our role as helping students develop and extend their capacity to do purposeful and worthwhile mathematical work. The critical manifestation of mathematics power in the mathematics investigation lies in the students' abilities to employ mathematical thinking, understanding, tools, techniques and communication skills.

Activity 2. Students in a class are surveyed to find their favourite fruits. The fractions, decimals and percentages of each fruit choice are determined. These percentages are then marked on a 100cm strip of paper, where 1cm length represents 1%. The strip is then bent into the shape of a circle to make a pie chart. In this activity the students work in groups of four, they generate their own data, make graphs and analyses, and present these findings back to the whole class.

These activities are designed to reinforce the general concepts, imagination and concept of conversion from fractions to percentages.

Students record their own data in the table 1:

Fruits	Apple	Banana	Lychee	Mango	Orange	Total
No. of students						

Table 1. The number of students favouring each type of fruits.

Using these data students make a bar chart to compare the number of students favouring each type of fruits. And then students determine and write down the fractions, decimals and percentages of each fruit choice in the table 2.

Fruits	Apple	Banana	Lychee	Mango	Orange
Fractions					
Decimals					
Percentages					

Table 2. The fractions, decimals and percentages of each fruit choice.

The real-life problems are of real relevance to students, because they impinge on their everyday lives. When tackling such problems, students may draw on any knowledge, skills and understanding at their disposal, including those from outside mathematics. Real-life problems are often ill-defined, contain insufficient or redundant information, and may have several alternative solutions. When a problem is obtained, it is put into practice.

In one pilot class of 24 students, the data obtained by students as shown in the table 3.

Trái cây	Táo	Chuối	Vải	Xoài	Cam
Phân số	$\frac{2}{24}$	$\frac{5}{24}$	$\frac{7}{24}$	$\frac{4}{24}$	$\frac{6}{24}$
Số thập phân	0,08	0,21	0,29	0,17	0,25
Tỉ số phần trăm	8 %	21 %	29 %	17 %	25 %

Table 3. The data generated by students in a class of 24 students.

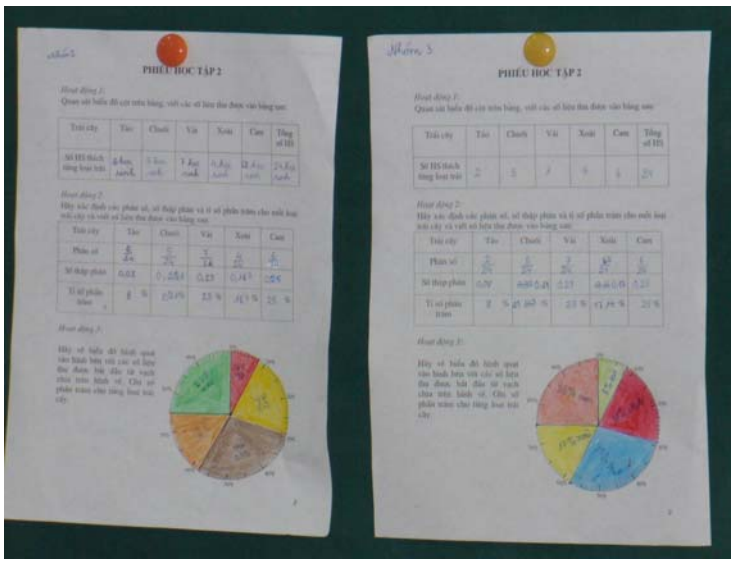
Most of students got the difficulty in deciding which decimals they should use when transfer fractions $\frac{2}{24}=0.083$, $\frac{5}{24}=0.208$, $\frac{7}{24}=0.291$, $\frac{4}{24}=0.166$ to the decimals.

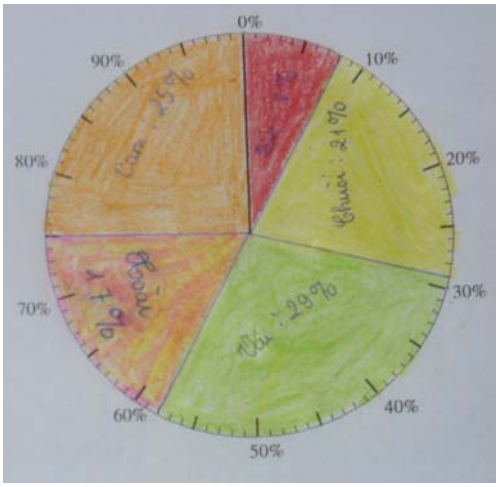
Some students asked why $\frac{4}{24}=2\times\frac{2}{24}=2\times 0.08=0.16$ but the approximate decimal was 0.17. Most of students did not check the condition 8% + 21% + 29% + 17% + 25% = 100%.

These percentages are then marked on a 100cm strip of paper, where 1cm length represents 1%. The strip is then bent into the shape of a circle to make a pie chart.

Students made their own the pie chart from the data generated.

If we totally direct the activity, the problem becomes ours not the students who will subsequently lose interest. How can we expect students to use mathematics outside school if we never give them a chance to make decisions in the classroom? The students have to be given the chance to learn from their own mistakes.





The experience of having worked on a real-life situation may motivate and enable students to perceive the value of techniques when they are introduced. Students may, however, still not able to use the techniques on their own unless they are given further opportunities to apply them in various other real investigative contexts.

USING DYNAMIC MODELS TO MAKE MATHEMATICS INTERESTING

Activity 3.

Work in pair using moving circles.

Instructions:

1) Student A rotates the moving circle to an arbitrary marked position.
2) Student B answers the questions in the figure .
3) Student A checks the answers given by Student B.
4) Repeat (1) to (3) to begin with Student B.

The students are familiar with moving circles in learning fraction as part of a whole. This time they were excited with learning percentage with the same model. Some students liked to rotate with two or three moving circles and asked their peers to answer some questions created by curious students such as what is the fraction of each part of the circle, what is the percentage and how to count them faster.

Fraction:_____Percentage: _____% Fraction:_____Percentage: _____%

Figure 2. Some students liked to rotate with two or three moving circles

The dynamic models really make mathematics interesting. This model can be presented effectively by dynamic software such as Geometer's Sketchpad.

PROBLEM SOLVING AS AN EFFECTIVE TEACHING STRATEGY

The need for problem solving work plays a vital role in our reform mathematics curriculum but how one can use this method depends much on the "teaching styles" of a teacher and the "learning styles" of the students. The students and class-room teachers are not familiar with the problem solving strategies. They still want to teach more algorithmic procedures to students to be sure their students can get high scores in the examination.

Problem 1.

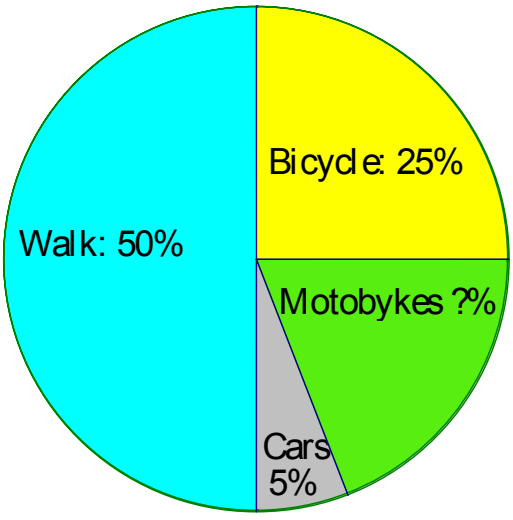
The pie chart on the right shows the means of transportation that 80 students using to go to school. In the chart the percentage of student using motorbikes is missing. Using the chart to find:

Number of students walked: _____

Number of students used bicycles: _____

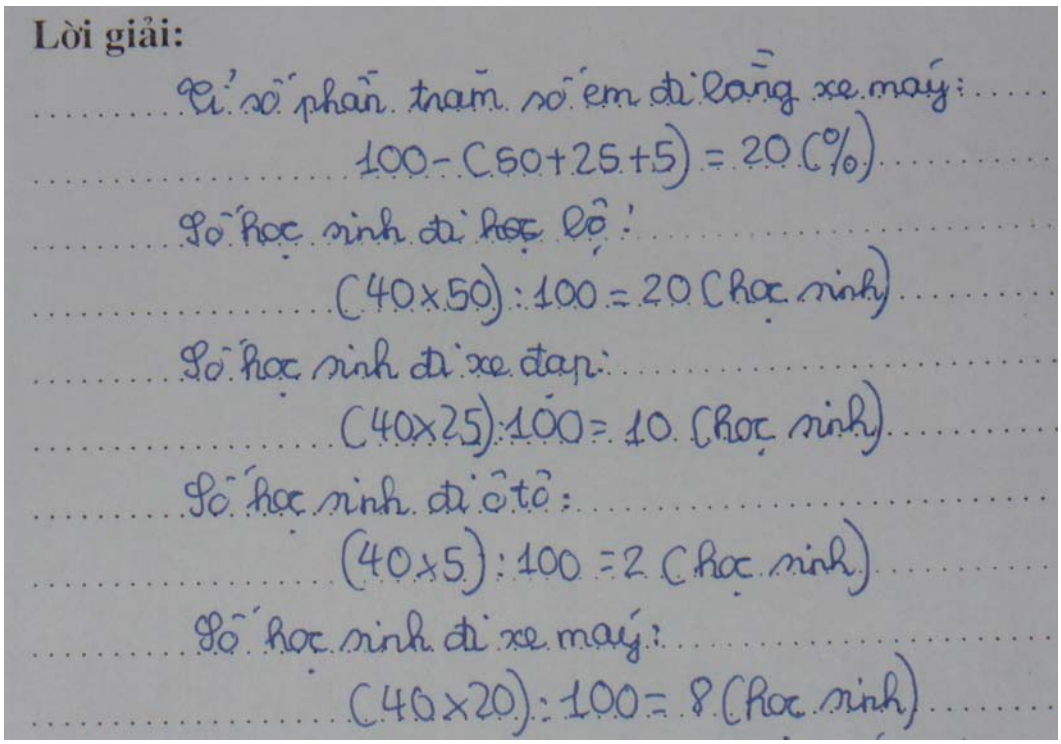
Number of students sent by motorbikes: ___

Number of students sent by cars:_____



The pie chart in problem 1 has a missing number, students felt difficult to find it. They have to guess and check their prediction and then find the method to solve the problem. At the beginning students got stuck because this is a no routine problem. They

exchange the ideas in group of four to find an effective approach to solve the problem. A solution of one group was illustrated below.


Lời giải:

Tỉ số phần trăm số em đi bằng xe máy:

100 - (50 + 25 + 5) = 20 (%)

Số học sinh đi học bộ:

(40 × 50) : 100 = 20 (học sinh)

Số học sinh đi xe đạp:

(40 × 25) : 100 = 10 (học sinh)

Số học sinh đi ô tô:

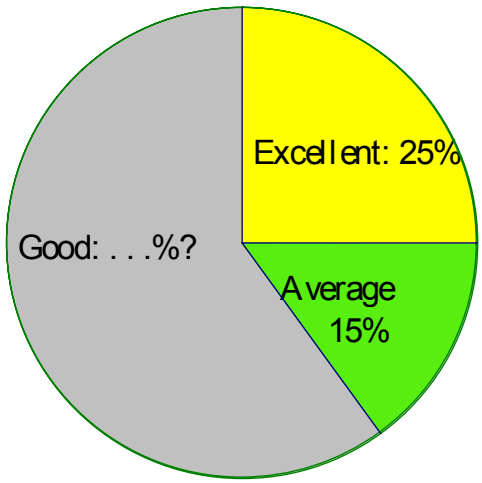
(40 × 5) : 100 = 2 (học sinh)

Số học sinh đi xe máy:

(40 × 20) : 100 = 8 (học sinh)

Problem 2.

The pie chart on the right shows the ranking of the mathematics achievement of grade 5 students in Tran Quoc Toan school. The percentage of good students is missing. If the number of good students is 120. Find the number of students with excellent achievement, average achievement.



In problem 2, students wondered why the total number of grade 5 students was not given. And then another number was missing. When they understand the meaning of percentage as learnt above, they feel confident to solve this problem.

DISCUSSION

- The aim of good practice in teaching mathematics is to help students make sense of their world by equipping them with mathematical skills. These skills include content skills or "what mathematicians know" and process skills or "what

mathematicians do."

- The good practice should balance the content skills and process skills including the problem solving process. These two types of skills are always necessary to students in solving new problems in their lives.
- This emphasis on the processes of mathematics, with problem solving being the core, is evident in our new curriculum initiatives. Some teachers, wary of change and concerned about "jumping on bandwagons" have ignored these processes, and continue to teach only the content of mathematics and algorithmic procedures.
- When the teachers use manipulative materials in teaching mathematics they recognized that their students more active in learning. The students liked to learn mathematics with dynamic or moving models.
- The teachers have to learn how to create new mathematical models with problematic situations and prepare good manipulative materials.
- Students can often generate their own activities and questions. However, it is helpful if we prepare a sheet with a list written out of possible ideas as a resource for students who genuinely cannot see any possibilities for them to reflect on.

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