IMPROVING STUDENT'S UNDERSTANDING ON ADDITION AND SUBTRACTION OF FRACTIONS USING PROBLEM SOLVING APPROACH

HAMZAH BIN SAKIDIN
TAY CHOO CHUAN
Universiti Teknikal Malaysia Melaka

ABSTRACT - The purpose of this study is to improve students' understanding on fraction. The study is based on the final examination result of the Form One students of a secondary school. The finding revealed that students have difficulties on the addition and subtraction concept of fractions. Twenty students were chosen as samples for study. The students chosen were from different classes of Form One to represent the high, average and low ability students.The pre-test were conducted and come up with a problem solving approach to improve the students understanding. Then, the students were given a post test. The test items were analysed by comparing the means of the pre-test and the post-test. There was a marked difference in the means scores of the students in the pre-test and post-test. This means that students learned better, if they were taught through problem solving approach in a cooperative mode of learning.

INTRODUCTION

The main aim of this study is to improve students' understanding on addition and subtraction of fractions using the problem solving approach and working in small groups using the cooperative learning mode. More specifically, this study aimed to find out how effective is the problem solving approach and cooperative learning mode in improving students' understanding of addition and subtraction of fractions as measured by the mean gain between the pretest and posttest.

Fractions and decimals represent a significant extension of children's knowledge about numbers (Curriculum Standard for School Mathematics, CSM, 1989). When students possess a sound understanding of fraction and decimal concepts, they can use this knowledge to describe real-world phenomena and apply it to problems involving measurement, probability, and statistics. An understanding of fractions and decimals broadens students' awareness of the usefulness and power of numbers and extends their knowledge of the number system. Research proves that many students' difficulties in Algebra can be traced back to an incomplete understanding of earlier concepts on fractions. Students who fail to understand the flexible nature of fraction symbols will fail to understand rational numbers at more complex levels (Gray, 1993).

When teaching fractions to students, it should involve activities that are useful in everyday life, that is, fractions that can be easily modeled. Initial work on fractions should draw on students' experience in sharing, such as asking four students to share a candy bar. The concept of unit and its subdivision into equal parts is fundamental to understanding fractions and decimals, whether the quantity to be divided is a rectangular candy bar, a cake or a guava. Students need to use physical materials to explore equivalent fractions and compare fraction.

Classroom activities should provide students the opportunity to work both individually and in small-and large-group arrangements. Working in small groups provides students with opportunities to talk about ideas and listen to their peers, enable teachers to interact more closely with students, takes positive advantage of the social characteristics of the teenage school student and provides opportunities for students to exchange their ideas and hence, develops their ability to communicate and reason.

Learning to solve problems is the principal reason for studying mathematics (CSM Position Paper, 1976). Problem solving is the process by which students experience the power and usefulness of mathematics in the world around them (CSM, 1989). It is also a method of inquiry and applications, interwoven with other mathematical concepts enabling students to see number relationships and applications. Problem situations can establish a "need to know" and foster the motivation for the development of concepts. In developing the problem situations, teachers should emphasize the applications of mathematics to real world problems as well as other settings relevant to the students.

LITERATURE REVIEW

FRACTIONS

Rational numbers were explained by Behr et. al (1993) in at least five ways: part whole, quotient, ratio, operator and measure. The part whole interpretation of rational numbers depends directly on the ability to partition either a continuous quantity or a set of discrete objects into equal sized subparts of sets. As ratio, it conveys a notion of relative magnitude. When two rations are equal they are said to be in proportion to one another. A proportion is simply a statement equating two ratios. Lastly, rational numbers as indicated division usually refers to a part of a single quantity. In the ratio interpretation, the ratio a/b refers to relationship between two quantities. The symbol a/b may also be used to refer to the operation of division $a \div b$.

Rational numbers as defined by Behr, et al have complicated meanings which led to difficulties of learning in the concept of fractions. Gray (1993) observed nine-year old found out that the difficulties children experienced were the transition from whole number arithmetic to the arithmetic fractions. One of his observations was that children counted not by eights, but ones.

The procedure stated above did not aid the children's understanding of fractions both as a process and a product or concept. Kieren (1992) had another way of organizing

children's thinking by introducing children to paper folding, which seemed like from primitive knowing to formalizing. The children developed their fraction language from their experience in folding papers like parts of pieces became eights. He observed that the children's terminology became formal at the same time as their ways of applying their images of the amounts were growing up. The switch from 1/8 to 3/8 came with the change from seeing three countable things called 1/8 to 3/8 to a single amount related to a whole amount.

Mack (1990) defined informal knowledge as applied, real life circumstantial knowledge constructed by an individual student that may be either correct or incorrect and can be drawn upon by the student in response to problems posed in the context of real life situations familiar to him or her. Initially, in her research there was no connection between informal knowledge of fraction concepts and their knowledge of fraction symbols.

However, she commented that with teachers' appropriate interaction students were able to connect their knowledge with formal symbols and procedures, attaching meaning to them. By making clear the connections between symbolic representation and informal knowledge, the interference of role knowledge was overcome.

PROBLEM SOLVING

In problem solving, brainstorming is a procedure in which a discussion group first generated as many solutions as possible while with holding criticism. Despite the short coming of discussion group problem solving, it is probably more effective than individual effort in certain situation for example. Mayer and Salee (1983) suggested that when a solution will commit a group to give course of action, the solution will be better accepted and implemented if it has reached through the process of group discussion.

As to the team size, many teachers find that the most workable learning group size is four. Some cooperative learning educators recommend group of three because of the interesting dynamics this produces (Nan & Graves,1990).

Within these groups, the student learns the basics of solving problems, beginning with the idea that problem solving is not such a difficult skills after all. Meyer and Salee (1983) narrates that a wide variety of activities are used beginning with open question and gradually moving towards questions which have definite solution. Many of these activities are in the form of games to increase student interactions and hypothesis testing within the group.

Furthermore, Meyer and Salee (1983) disclosed that when students are comfortable within their group and have acquired confidence and skill in articulating their ideas, they begin to learn more formal problem solving skills. Clearly, the first skill they need is how to understand a problem; to understand it, they must able to read it. Students acquire the art of reading a problem by writing several problems of their own. As their work progresses, the students begin writing more and more complex stories, testing each other to uncover the essence of each problem. At the same time, through another type of game, students learn the art of organizing information in useful ways.

METHODOLOGY

RESEARCH DESIGN

The main focus of this action research is to improve students' understanding of addition and subtraction of fractions using the problem solving approach and cooperative learning mode. The pretest dealt on addition and subtraction of fractions plus some word problems involving fraction. A week after the pretest a teaching package was given to the students on the same topics and the posttest was given right after the lesson.

THE SAMPLE

The sample of the study consisted of 20 Form 1 students for the academic year 1995-1996 of Sungai Dua Secondary School at Penang, Malaysia. Based on the final term examination, the students were chosen from different classes of Form 1 to represent the high average and low ability students.

INSTRUMENTATION

The instruments used were translated to Bahasa Melayu which is the medium of instruction in school. The instruments used are the following:

3.3.1 Pre-Post Test (Achievement Test)
3.3.2 Questionnaire (for teachers and students)
3.3.3 Interview (Open-ended)

Table 1that follows shows the distribution of items by contents and levels of knowledge.

TABLE 1: Specification of Test Items

Content	Identification	Differentiation	Translation	Total
Addition of Similiar Fraction	1	2,4		3
Addition of Dissimilar Fraction		5,6,10	8	4
Subtraction of Similar Fraction	7	3	11	3
Subtraction of Dissimilar Fraction		12	9	2
TOTAL	**2**	**7**	**3**	**12**

PRE-POST TEST

As shown in the Table 1 there are 12 items and they are equally distributed in four types of contents except for subtraction for dissimilar fractions where there are only two items.

The items were constructed using the multiple-choice type provided with four options for the answer. The reliability of the test items using cronbach alpha was computed using the SPSS for Windows. The coefficient of reliability was 69 and for a teacher-made test, this value is acceptable. All the items have values for corrected item-total correction of 20 and higher which indicates the test is valid in terms of content validity.

QUESTIONNAIRE

There were six items in the questionnaire. The items were to solicit students' attitude towards mathematics and also to elicit their common difficulties encountered in addition and subtraction of similar, dissimilar and mixed number fractions.

INTERVIEW GUIDE

An interview guide was prepared to get information about the teacher's background and the school's strategies and approaches employed to overcome student's difficulties in learning fractions.

FINDINGS

Comparison between the pretest and posttest scores using the mean deviation ratio. A closer look at the posttest scores shows that only item 9 was found to be difficult by the students. The rest of the items were then plotted along the line of less difficult items to very easy items. This plot of scores indicates a considerable increase in the posttest scores of the samples.

TABLE 2: Test Ratio Showing The Pre-Test and Post- Test

Variable	N	Mean	SD	t-value	df	Sig.
Pretest	20	0.5395	0.214	4.08	18	0.001
Posttest	19	.06974	0.191			

Table 2 shows the t-test ratio between the pretest and posttest and the value at the significance level indicates that the difference is highly significant. It means the there is a significant difference between the pretest and posttest at $p<.001$.

The mean deviation ratio, the t-test ratio and the graphical presentation of the scores indicates the teaching package taught to the students using the problem solving approach and the cooperative mode were both effective to teach word problems involving fractions. Likewise, both strategies were also effective in teaching addition and subtraction of fractions.

DISCUSSION

The final term examination of 270 students of Sungai Dua Secondary School revealed that students had difficulty on solving problems involving addition and subtraction of fractions. Based on the item achievement scale, all problems involving fractions were considered difficult. It is further revealed by the item achievement scale that students are better off in multiplication of fractions than in addition and subtraction of fractions.

The purpose of the study was to improve students' understanding of addition and subtraction of fractions through the problem solving approach in a cooperative setting. Specifically this study aimed to measure the extend of effectiveness of problem solving approach in a cooperative setting by comparing the mean scores of the pretest and posttest scores of the students.

The sample of this study was the 20 Form 1 students of Sungai Dua Secondary School, Penang, Malaysia. They were chosen based on their responses on the test items in their final year examination (1996). There were 12 girls and 7 boys. The instruments used in this study were the pretest and posttest to measure the cognitive aspect of the samples, the questionnaire to measure the affective and the interview guide to get information on teacher-selected variables. The reliability of the instrument using Cronbach alpha was computed using SPSS for Windows. The statistical tests that were used were percentage, means, standard deviations, and t-test for dependent samples.

The results from the pretest and posttest confirmed that students performed better in the posttest. This was done through the use of the problem solving approach in a cooperative setting by the researchers. The posttest was conducted after the completion of the enrichment program for the students. It was also observed that students were motivated to learn if they worked in groups. Besides, they felt included because of their special role in the group work. From the interview with the students, it was evident that they preferred to solve problems on fractions by group than working alone. As they say "No big stone is too heavy to carry, if everyone cooperated". According to the students, this kind of activity help them improved their understanding of similar, dissimilar, mixed numbers and especially problem solving.

CONCLUSION

There is a significant difference between the mean scores in the pretest and posttest. From this result, it can be inferred that through the problem solving approach in the cooperative setting, students understood better addition and subtraction of fractions. The great improvement in the posttest can be attributed to the enrichment lesson on fractions in the form of worksheets and activities. Based on the results of the worksheets and activities, the following conclusions can be formulated:

a. Using the problem solving approach in a cooperative setting, the students were motivated to solve problems on fractions. They enjoyed working with peers and teams, not realizing that they are at the same time learning.
b. Some groups were not able to present their solutions to the whole class because of time constraints. Though majority learned there were a few students who really could not solve the problems because of poor mathematics background and lack of motivation to learn.
c. The teaching strategy was able to solve most of the problems identified; however, some students were not cleared about the concept of fraction, so the following tasks should be done in the future:
    i. To solve the problems of a few students who could not solve mathematical word problems, Two Heads Together of cooperative learning should be used to enable the two students discuss and translate work problems on fraction to fraction symbols. High ability student should be paired with low ability student for peer teaching.
    ii. More enjoyable activities such as puzzles, games and creative quizzes will be presented during teaching-learning process for proper motivation of students so that they find mathematics as an interesting subject particularly on fraction.

REFERENCES

Behr, M., Harel, G., Post, T. and Lesh, R. 1993. 'Rational Numbers: Towards A Symantic Analysis – Emphasis On The Operator Construct,' in T.P Conpenter, E. Fennema and T A Romberg (eds), Rational Numbers : An Integration of Research, Lawrence Erlbaum Associates, Hillsdale, NJ 13 – 47.

Graves and Nan. 1990. 'A Part To Play' Latitude Publication, Australia

Gray, E M. 1993. The Trasition From Whole Number To Fraction, paper presented at The

International Study Group On The Rational Numbers of Arithmatics, University of Georgia, Athen GA.

Kieren, T. E. 1992. 'Rational and Fractional Numbers as Mathematical and Personal Knowledge:

Implications for Curriculum and Instruction' Lawrence Erlbaum Associates, Hillsdale, NJ 13 – 47.

Mack, N.K. 1990. 'Learning Fractions with Understanding: Building An Informal Knowledge'

Journal For Research in Math Education.
Meyer, Carol and Salee & Tom . 1993. 'Make It Simpler' (A Practical Guide To Problem Solving In Mathematics), Addison Wesley Publishing Company.