CHAPTER 5

CONCLUSIONS

5.0 Introduction

This study analyzed the computational errors in whole number division of a sample of Form One students. The study identified the error patterns in division computation and the thinking associated with the computational procedures used by the students, thereby hypothesized the possible sources of the errors. The study also analyzed the frequency distribution of the errors among the various achieving groups.

A 48-item test in division computation of whole number adapted from Schonell's instrument (1957), and adjusted according to the KBSR syllabus, was administered to the sample.

The sample comprised 54 students, 25 boys and 29 girls from a suburban secondary school in the West Coast of Sabah. After preliminary analysis of the written tests, eight students were selected for individual interviews to obtain further clarification on the procedures used in their computations.

5.1 Summary and Discussion of the Findings

This study explored the computational errors in division of a sample of Form One students. The study identified error patterns by the students based on their written test and oral interviews. The findings obtained are:

1. Twenty-nine patterns of systematic error in division of whole number were identified. These errors were grouped under four classifications: basic fact errors (2), errors resulting from zero difficulties (10), errors occurring in the use of remainder (8), and errors due to faulty procedures (9).
2. Based on the frequency, the five classifications of errors follow the order as: errors due to zero difficulties (37%), basic fact errors (23%), errors occurring in the use of remainder (18%), errors due to faulty procedure (14%), and random response (6%).
3. The five most common error patterns in division, in the order of decreasing frequencies are: (a) omitting final zero in quotient when zero is not final in the dividend, (b) multiplication fact errors, (c) division fact errors, (d) omitting embedded zero in quotient when zero is not found in the dividend, and (e) using remainder bigger than the divisor.
4. The students, including the high achievers, relied heavily on memorized algorithms and used very little reasoning in their computations. Students who were weak in computation could not recall the division algorithm. They invented erroneous shortcuts that gave them quick answers. They also neglected to check for the reasonableness of their answers.
5. Lack of conceptual understanding of the division process and the procedural understanding involved in the division algorithm were the general cause of the errors in computation. More

specifically, students had difficulty with the following concepts: division process as repeated subtraction (*measurement* model), place value, regrouping, the role of zero as placeholder, and the identity elements involving zero and one. Many of them also could not recall basic multiplication facts.

6. High achievers (grade A group) had no difficulty with basic facts, but they made errors in omitting final and embedded zero in quotient. The most common error types among the grade B group were omitting embedded zero and multiplication fact errors. For grade C group, the most frequent error was omitting final zero in quotient. Grade D group made the most errors in division facts. The low achieving grade E group exhibited errors that were mainly of random responses.
7. Basic fact errors occurred among all students except the grade A group. Errors due to zero difficulties occurred across all achieving groups. These errors were most common among the grade B, C, and D groups. Errors occurring in the use of remainder are also common among the grade B, C, and D groups. Errors due to faulty procedure were most common among the grade D group. Random responses occurred only in the grade E group.

5.2 Implications of the Findings

Computation skills in the four operations form the basis of mathematics in the primary and secondary schools. Teachers need to carry out remedial activities for the students who fail to acquire such basic skills. Consequently, it is essential for every mathematics teacher to acquire the skills in carrying out remedial activities. Diagnosing errors and hypothesizing the causes of the error form the major component of the diagnostic teaching cycle in remedial teaching (Reisman, 1978). Knowledge of error patterns would be useful to the teachers in hypothesizing on the possible sources of the errors. Successful remedial activities treat the errors from their sources rather than treating the symptoms.

The findings of the study indicate that the most common errors in division computation are: failure to recall basic multiplication and division facts, omitting final and embedded zeros in quotients, and using remainder greater than divisor. They accounted for 58% of the errors made by the sample. The findings imply that teachers may have to give more attention to these common errors. Equipped with this knowledge, the teacher would be able to employ instructional strategies that would avoid misconceptions that lead to these errors.

This study also indicates that average and low achieving students fail to master the prerequisite skills in basic facts on multiplication and division. In order to acquire sufficient proficiency in computation, the students need to have the ability to recall basic facts. Mathematics teachers may need to place more emphasis on recalling basic facts. Some teachers had misinterpreted that the KBSR curriculum requires only understanding and no memorizing. In fact, the guidelines in KBSR mathematics recommend that basic facts should be introduced through manipulation with concrete materials to build conceptual understanding of the operations. Thereafter, drill and practice are necessary to commit the basic facts to memory.

Many students make errors due to inadequate understanding of the place value concept that is essential in any computation. Thus, they made the errors of omitting the final and embedded zeros in the quotient. When teaching division algorithm, more emphasis needs to be placed on place value concept and the role of zero as placeholder. It may be a good practice to train the students to align the digits to its correct place value in division algorithm by using squared paper or grid lines.

Low achieving students often lack conceptual understanding of the meaning of the operation. They also encounter difficulty in recalling the many steps involved in the division algorithm. Consequently, they resort to invented shortcuts that lead to errors due to faulty procedure. Teachers may need to use more instructional strategies with learning experience that build a good conceptual understanding of the division process. The results of current findings in mathematics learning indicate that manipulative concrete models help the students to develop conceptual and procedural understanding of the division process. Moreover, in the teaching of algorithm, each step in division algorithms should be meaningfully linked to the concrete models. It is important for the students to see the reasoning behind each step of the algorithm, and not merely applying rote memory of the steps of the algorithm.

In this study, the error in "using remainder greater than the divisor " is common among the students. This error is likely to be caused by lack of understanding of the meaning of the division process as repeated subtraction, as in the *measurement* situation. The use of subtractive algorithm provides a more meaningful link between the meaning of division and the division algorithm. For better conceptual understanding of the division process, the researcher suggests that the subtractive algorithm which relates the steps to the repeated subtraction procedure of the measurement model be introduced, before switching to the distributive algorithm at a later stage. Moreover, the use of subtractive algorithm does not require the bringing down of each digit for the new partial dividend, which is confusing to some students.

The findings of this study indicate that many students rely heavily on memorized algorithm and use little reasoning in their computations. They employ algorithmic thinking rather than reasoning as they perform their computations (Monroe & Clark, 1998). They also neglect to check the reasonableness of their answers. Although some of them do check the steps in their computations, very few students check to see if their answers are reasonable. They may lack the facility to use estimation process to check their answers.

The findings of this study also indicate that an incorrect response of a student may be caused by a combination of several errors. Such errors are not easily discernible from the written response. A teacher may need to use probing questions through individual interview or dialogue to uncover the sources of the errors. Teachers should try to avoid just marking for the correctness of the response, as this does not help a child to overcome his learning difficulty. Instead, teachers may need to delve into the sources of misconception that lead to the learning difficulties.

Most of the errors made by the students display a consistent pattern. These errors should be distinguished from careless errors and random responses. Students who show random response need more remedial activities. They need learning experiences that will help them to develop the meaning of the division process.

Due to the pressure to perform well in the public examinations, Malaysian teachers tend to spend more time on drill and practice in order to help the students to achieve competency in computational skills. They spend considerably less time on manipulative activities that are often necessary for building conceptual understanding. Speed and accuracy in computations are given priority over conceptual and procedural understanding of the basic operations. Very often, the students are told to memorize the steps in the algorithm without understanding the reasoning behind them. Studies have shown that drill and practice do not lead to mathematics achievements (Lo, Wheatley & Smith, 1994). Consequently, teaching mathematics in this technological age should emphasize more on helping students to acquire conceptual understanding of the basic operations before focusing on speed and accuracy in computation.

5.4 Suggestions for Further Research

This study has identified several areas in which further research may be undertaken. These may include the following:

1. The sample of this study is limited to Form One students, further study could include subjects from other age groups such as Standard Five, and Form Four students.
2. This study is restricted to only one suburban school. Further study could include bigger samples from the rural and urban schools for comparison.
3. This study indicates that average and low achieving students write down multiplication tables in order to help them to recall multiplication facts. Further study may be carried out to explore the different ways through which students derive their multiplication facts.
4. This study shows that zero difficulties are the cause of many errors among the students. A more detailed study on zero difficulties in division computation may be conducted.