CHAPTER 1

INTRODUCTION

1.0 Introduction

Mathematics teachers for Form One classes often encounter students entering secondary school with poor foundation in basic computational skills in the four operations of addition, subtraction, multiplication, and division. Computation skill in division is generally considered the most difficult among these four operations. Without proper intervention, these students will continue to encounter learning difficulties in mathematics throughout their secondary school. In the mathematics curriculum for the Malaysian primary schools (*Kurikulum Bersepadu Sekolah Rendah*, KBSR), the scope in division computation covers division of six-digit numbers by any two-digit divisors (Malaysia, 1994a). However, this study focused only on basic division computation that involves one-digit divisors and two-digit divisors of eleven and twelve. Complicated computations that involve other two-digit divisors were not included.

In this technological age, calculators and computers are easily available for complex computation; there is a need to shift the emphasis in teaching arithmetic computation to the understanding of the basic concepts rather than acquiring speed and accuracy in computations. The National Council of Supervisors of Mathematics (1989) suggests that students should gain facility in using the four basic operations in whole

number, but long complicated computations should be done with a calculator or computer. In fact, Reys, Suydam, and Lindquist (1995) further recommends that for division computation of whole number, division with one-digit divisors should be the focus of instruction in school.

The National Council for Teachers of Mathematics [NCTM] (1989), in their Curriculum and Evaluation Standards for School Mathematics, emphasizes the understanding of the meanings of the operations and the development of the operations. In particular, the standards for grade K-4 recommended that the classroom instruction should focus on the development of the meaning of each operation by modelling and discussing a rich variety of problem situations. Students should be able to explain and develop reasonable proficiency with basic facts and algorithm. Furthermore, the students should also be able to use computational techniques appropriately and to determine whether the results of their computations are reasonable.

Students who lack proper understanding of the concept of division operation display numerous errors in division computation. These errors are either systematic errors that show consistent patterns, or random errors with no discernable pattern. In diagnosing errors in mathematics, teachers should distinguish between errors that are random and those that occur more systematically (Driscoll, 1981; Cox, 1975; West, 1971).

1.1 Background of the Study

Mathematics curriculum in Malaysian primary schools emphasizes building and developing understanding of number concepts and basic

skills in computation. On completion of the six years of primary education, students are expected to have acquired the skills in: counting, numbers, place value and the four basic operations (Malaysia, 1983, 1994a, 1994b). As an extension to the primary curriculum, the secondary curriculum reinforces and expands on the use of computational skills in the four operations (Malaysia, 1988).

In Malaysia, all the primary six pupils need to sit for the Primary School Assessment Test (*Ujian Penilaian Sekolah Rendah,* UPSR). The performance of the pupils in the mathematics test has always been the subject of concern for the educators. Awang Had Salleh (1992) remarked that the primary school education is the most critical stage in the system of formal education and a poor foundation in the primary school will result in "cumulative deficiency" in the later stages of learning. Pupils entering Form One with poor foundation in primary school mathematics will have difficulty coping with mathematics at the secondary level. This learning difficulty could be overcome if effort is taken to remedy the learning difficulty at its early stage. Consequently, the Malaysian primary school curriculum (KBSR) places considerable emphasis on the use of remedial activities in teaching. The guideline for implementing KBSR recommends that teachers should identify the weaknesses in learning among students through a series of diagnostic assessments and follow up with remedial activities. Experiencing success through remedial activities will help the students to develop a more positive attitude towards learning mathematics (Malaysia, 1994b).

Lim (1980) made a study on computational errors of primary four pupils. His study revealed that 28% of the pupils exhibited errors in addition, 45% in subtraction, 56% in multiplication, and 70% exhibited errors in division. The findings of his study indicated that division is the most difficult of the four operations. In another study, Suffean Hussin (1986) found that pupils performed poorer in the division open sentences as compared to the multiplication open sentences. Studies in other countries likewise indicated that division is generally considered the most difficult of the computation processes to understand (Downes & Paling, 1968; Reys et al., 1995). The report of the National Assessment of Educational Progress [NAEP] of 1980, on computational skills in division, showed that only about 50% of the 13 year-olds obtained correct answers to the more difficult division questions (McKillip, 1981).

Many students have difficulty in understanding and recalling the complicated procedures involved in division algorithm. It is therefore important for a teacher to understand a child's conception of division process. For remedial work to be effective, a teacher should attempt to identify the patterns of computation errors exhibited by the pupils (Cox, 1975; Driscoll, 1981; Fowler, 1980; West, 1971). It is more effective to treat the errors by its error patterns rather than treating individual errors. Tracing errors to their sources avoids unnecessarily reteaching concepts and procedures that are already known to the pupils, while the actual causes of the errors are not attended to (Fowler, 1980).

Error patterns exhibited by the students can be detected by using purposefully constructed written test. Furthermore, individual interviews

should also be conducted to obtain further clarification on the error patterns displayed.

1.2 Research Questions

This study on computational error in division of whole number attempts to explore the common types of error patterns in division computation among the Form One students. The division test for this study conforms to the scope of the primary mathematics, and involves only division by one-digit divisors and simple two-digit divisors of 11 and 12.

The research questions for this study are:

1. What are the types of computational errors in division made by the Form One students?
2. What is the distribution of error types among the different groups of mathematics achievers?
3. What are the procedures used by the students in division computation?
4. What are the possible sources of computational errors?
5. Are there any differences in the error types exhibited by the different groups of achievers?

1.3 Definition of Terms

The study examines errors made by students in division computation. These errors are categorized using terms as defined below. The definitions of the terms are adapted from those used by Grossnickle

(1936), Roberts (1968), West (1971), Cox (1975) and Engelhardt (1977). These terms were also used in the recent studies by Lim (1980), and Stefanich and Rokusek (1992). Only terms that are appropriate to the Malaysian mathematics curriculum are considered.

1.3.1 Error in division:

Error in division is defined as an incorrect response, or a procedure that produces an incorrect result (Grossnickle, 1939).

1.3.2 Random response:

Pupil attempts to solve a problem in ways that show no discernible pattern or relationship to the given problem (Roberts, 1968).

1.3.3 Careless errors:

These are errors that are not consistently made. The pupils basically know how to perform the correct computation, but due to distraction, boredom, or lapses of attention, make careless errors (Cox. 1975).

1.3.4 Systematic error:

This type of error is detected by looking for consistent pattern in the errors made. Errors that occur at least three out of five times are considered as systematic errors (Cox, 1975). Some examples of systematic errors in division computation used in this study are defined below:

(a) Basic fact errors

A basic fact is the combination of any two one-digit numbers with the answer (Grossnickle & Brueckner, 1959). Basic fact is also referred to as basic combination (Grossnickle, 1936), for example: $3 + 4 = 7$, $15 - 9 = 6$, $12 \div 3 = 4$, $6 \times 5 = 30$. Basic fact errors occur when the pupils give the incorrect basic facts in addition, subtraction, multiplication, and division

(b) Zero errors

The pupil computes problems containing zeros in ways suggesting difficulty with the concept of zero. The zero difficulties include concept of zero as placeholder, and confusion of operational identities involving zero and one (Engelhardt, 1977)

(c) Remainder errors

The pupils make errors in division computation involving the use of remainders. The remainder is obtained by subtracting partial product from partial dividend. Difficulties in remainder include making the correct estimation for quotients, and difficulty in regrouping to obtain the remainder. Remainder errors occur both in remainders within the computation and in final remainder.

(d) Faulty procedure or defective algorithm

The pupils perform computation using a systematic, but erroneous procedure (Engelhardt, 1977). This type of error arises when the pupils fail to recall the algorithmic procedure in the computation and devise

simple erroneous "shortcuts" that give them quick answers (Fowler, 1980; Lankford, 1974).

1.3.5 Achievers:

In this study, the students are grouped into five different achieving groups based on their mathematics performance in the standardized UPSR (Primary School Assessment Test) examination. The mathematics performances of the students are graded into grade A (excellent), B (good), C (average), D (poor), and E (very poor).

1.4 Significance of the Study

Computational skills in the four basic operations of addition, subtraction, multiplication, and division form the basis of the primary school mathematics curriculum. Division computation is the most difficult of the four operations (Lim, 1980; Reys et al., 1995) and remedial teaching is often required. Recognizing error patterns in computation is important in effective remedial teaching. However, limited recent studies (Barr,1983; Cox 1974; Stefanich & Rokusek, 1992) had been conducted on error patterns in division computation after Buswell and John (1926), and Grossnickle (1936, 1939). Cox (1973a, 1973b) focused mainly on diagnosing error pattern in addition and subtraction. Lim's (1980) study in Malaysia was on the computational errors of the primary four students in the four basic operations. The more recent study on error patterns in division computation was conducted by Stefanich and Rokusek (1992) on the fourth-graders. To the knowledge of the researcher, no study had

been done in Malaysia on the computational errors in whole number division of Form One students.

This study was conducted in Sabah as the researcher believes that there is a need for more studies to be carried out on mathematics learning problems of the pupils in East Malaysia, especially in Sabah. At present, most of the research studies concentrate on the schools in West Malaysia.

The findings of this study will provide useful information for the mathematics teachers, in both the primary and secondary schools, on the teaching, development and understanding of the division algorithm. Knowledge of the error patterns and their possible sources will be useful to the teachers in planning instructional strategies to avoid misconceptions that may lead to the errors made by the students.

1.5 Limitation of the Study

This study was carried out on a sample of 54 Form One students in a suburban National Secondary School, in the West Coast of Sabah. The sample in this study consisted only of Bumiputeras (indigenous races) such as Kadazandusun, Murut, Bajau, and Melayu Brunei of Sabah. The sample taken is rather small and localized. It might not be representative of the racial composition of the schools in West Malaysia. Therefore, the findings of the study may not be generalized for all the schools in Malaysia. Nevertheless, the findings will provide an extension in useful knowledge for developing classroom instructions.