

## CHAPTER 1

### INTRODUCTION

#### 1.1 Background of the Study

Communicating in mathematics is one way for students to experience and value mathematics. When students communicate in mathematics, they develop reasoning and problem solving skills. In this way students build their confidence. Furthermore, the use of the language of mathematics becomes natural and meaningful.

According to the New Webster Encyclopedic Dictionary (1970), the verb "communicate" is defined as "to impart to another or others.... something intangible, (such) as intelligence, news, opinions, ... , to share; to participate" and the noun "communication" is "the act of communicating". In mathematics, Shield & Galbraith (1998) refer "communicating in mathematics" to processes such as reflecting on ideas, formulating definitions, reading, and expressing ideas orally and in writing. This implies that mathematics learning is no longer just acquiring facts or being proficient in algorithms. Mathematics learning should involve acquiring abilities such as reasoning and communicating. In fact the National Council of Teachers of Mathematics (NCTM) has endorsed "Mathematics for communication" as the second Standard for the "Curriculum and Evaluation Standards for School Mathematics" (NCTM, 1989). This means that one has to be proficient in expressing mathematical ideas in writing, as well as in understanding written presentations of mathematics.

Further, Siegel and Borasi (1992) comment that the focus in mathematics education is now on the “process” of doing mathematics. This process includes problem-solving strategies, which involve mathematical reasoning and communication.

Communication in the mathematics class involves the use of language. The language used can range from informal to formal styles (Cotton, Cox, Gammon, Goldstein, Monaghan, Morgan, Robin, Watson, Wright and Wilson, 1997). Both these styles of language in either the spoken or written form, including technical mathematical language, are used in the mathematics classroom. The informal style is used to develop students’ understanding while the formal style enables students to express their understanding in a particular mathematical concept.

The importance of communication in mathematics is also reflected in the secondary school mathematics curriculum. In the *Kurrikulum Bersepadu Sekolah Menengah (KBSM)* Mathematics syllabus (1988), one of the objectives is to develop students’ ability to be able to rationalize systematically and critically. Specifically, one aim of Additional Mathematics is “for the student to use mathematics effectively for the purpose of communication” (Ministry of Education, 1988). In addition, the emphasis is further enhanced as an objective of the Mathematics curriculum of the SMART School in *Huraian Sukatan Pelajaran Matematik KBSM Edisi Sekolah BESTARI*, to enable students to communicate and reason mathematically (Ministry of Education, 1998).

Therefore, communicating in Mathematics is an important process in the learning of mathematical concepts as it enables students to experience and value mathematics.

## 1.2 Rationale for the Study

This study intends to explore students' understanding of quadratic equations in Algebra. Algebra is chosen because it is a language of mathematics, which involves symbolism and complex relationships (Everett, 1966; Esty, 1992; Nunn, 1927; Van Dyke & Craine, 1997). Students found this topic difficult and have shown misunderstandings in several concepts in Algebra (Barbeau & Brown, 1997; Stacey & MacGregor, 1997). At the same time, researchers had also identified and classified errors in Algebra (Kaur & Sharon, 1994; Meyerson & McGinty, 1978; Whitcraft, 1980; Zaslavsky, 1997). These errors included those from quadratic equations and functions.

In Malaysia, the researcher and many mathematics teachers find that students are weak in the topic of Algebra. To the knowledge of the researcher, there is no study conducted on students' understanding in Algebra. It is not known whether similar difficulties and errors might be observed in Malaysia. As such, there is a need for a study to explore students' understanding in Algebra.

Students' understanding of concepts and procedures in Algebra can be obtained from writing assignments. Research studies have shown that informal writing assignments, mainly expository journal writing, not only provide meaning but are diagnostic in nature. The factors diagnosed included error patterns,

misconceptions and reasons for students not being able to make particular connections between concepts ( Borasi & Rose, 1989; Bradley, 1990; Drake & Auspaugh, 1994; Mayer & Hillman, 1996; Miller, 1992; Miller & England, 1989).

In written communication, a particular idea would have to be explained in depth in order to ensure that the meaning is delivered. On the other hand, verbal communication does not need much elaboration. This is because non-verbal expressions and interactive dialogue enhance verbal communication. Hence writing, rather than speech, could convey a clearer and more accurate picture of a student's understanding and development of ideas (Dougherty, 1996).

In this study, the focus is on students' written responses as a means of communicating their understanding. Several research studies had been conducted on students' understanding in mathematics from their writing (Drake & Amspaugh, 1994; Miller, 1992; Shield and Galbraith, 1998). Specifically, Dougherty (1996) had used writing in Algebra to infer students' understanding. However, no research of this nature has been conducted in Malaysia.

This research was designed in view of students' difficulties in studying Algebra and the advantage of using writing in inferring students' understanding. The format of the present study follows that of Miller (1992) and Shield and Galbraith (1997), using written tasks to explore students' understanding in mathematics.

### 1.3 Research Questions

Writing in mathematics is important for students and teachers. This study intends to explore students' understanding in Algebra from their written responses.

The written responses of Form Four Science students in Algebra were collected through selected tasks based on quadratic equations. The responses were then analyzed to infer the understanding shown by the students.

The study focuses on the following research questions:

What is students' understanding as shown from their writings on:

- a. quadratic equations?
- b. roots of quadratic equations?
- c. methods of obtaining roots of quadratic equations?

### 1.4 Significance of the Study

Writing in mathematics is believed to be beneficial to both teachers and students (Borasi & Rose, 1989; Clarke, Waywood & Stephens, 1993; Dougherty, 1996; Miller, 1992). Hence, the findings of this study could be used as a diagnostic tool to identify errors and misconceptions that students may have in Algebra. Teachers could employ writing assignments in the classrooms as a daily activity for appropriate instructional strategies to remedy errors and misconceptions immediately after teaching a particular concept.

Writing also improves the thinking and reasoning skills in students and builds students' confidence in mathematics. It is invaluable to educators in Malaysia who constantly strive to improve students' thinking to a higher and more critical level, as well as, build a positive attitude towards mathematics. Furthermore, writing in mathematics could be used as an alternative form of assessment in the mathematics classroom. In this way, mathematics is meaningful as the students can communicate.

The writing assignments were given in the field of Algebra, particularly in quadratic equations, which involves many symbols and conventions that differ from other forms of writing. Hence, this research is significant as it enlightens teachers on students' understanding of quadratic equations.

However, it cannot be denied that there is some concern whether Malaysian students are able to express themselves sufficiently to make writing a useful tool in mathematics assessment. In this consideration, the students were given practices in writing during the mathematics class as training train them to express themselves in mathematics. Expressing oneself in mathematics is important, as it is one of the objectives of the KBSM Additional Mathematics and KBSM Matematik (Sekolah Bestari) curriculum that the student is able to communicate in mathematics. This study can provide some ideas on how to encourage students to express themselves in writing.

## 1. 5 Limitations of the Study

This study assumes that the students' written responses reflect the understanding and skill that they possess. One may argue that the students may possess a better understanding of the task than what has been written. The student may have written only on what they feel is required by the task. This is because they may still not be familiar with writing as their exposure to analytical writing tasks is limited.

Secondly, it is also assumed that the student possesses satisfactory written and verbal language skills in the Malay Language to comprehend and complete both the written tasks and interview. However, it is noted that some students possess better verbal than written skills, and vice-versa. Some students may not possess sufficient communication skills even though they may have the understanding and the mathematical skills involved.

In this study, the student is given unlimited time to complete the written tasks. However, the actual situation showed that a few students had attempted to complete the tasks quickly. As such, the student might have omitted certain components when writing. Nevertheless, these omissions were clarified during the interviews.

In view of the limitations, the researcher had tried to minimize them such that the findings of the study would be able to provide an insight to students' understanding of quadratic equations. The findings would definitely be beneficial to mathematics educators and students.