

## THE PROBLEM WITH WORDS IN TEACHING MATHEMATICS IN A SECOND LANGUAGE

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### ABSTRACT

This paper is a report of a research on how Chinese Malaysian students who have been schooled in a tradition of technical Mathematics responded to mathematical word problems that required language comprehension and appreciation of problem contexts. The challenges faced were investigated, using action research, in a business college context where the students come from a trilingual background. It was found that rewording word problems and allowing code switching in discussions helped students' understanding, and using word problems as starting points and extensions enriched the lessons because it facilitated verbalisation and discussions. The perspective advanced in this article provides cross-cultural insights into the processes of teaching and learning in general. From this perspective, this article may offer insight for professionals in various disciplines.

### INTRODUCTION

Culture is inextricably intertwined with language, and Ellerton and Clements (1991) recognized the significant role that language plays in developing one's mathematical ability. They noted that teachers sometimes mentally divorce Mathematics from language and culture, thinking that the symbolic and notational language of Mathematics is primary and hence that learning Mathematics is hardly influenced by linguistic or socio-cultural factors. In reality, Mathematics teaching and learning involve much interactive communication and dialogue, and many language-based socio-mathematical norms (Cobb and McClain, 1999). Mathematics classes are rich linguistic and social environments worthy of language-based research.

Hofmannova, Novotna, and Moschkovich (2004) advocated the need for Mathematics

educators to consider socio-linguistic theories because learning Mathematics is like learning another language due to its heavy reliance on discipline-specific registers and discourses. The disciplines, here, encompass Mathematics, school Mathematics, and schooling.

The effects and interplay of language in learning Mathematics are even more significant in multilingual environments. Clarkson (2004), for example, reported case studies of teaching Mathematics in various multilingual communities, and suggested the need for more research in this area. There is not just a need for the study of language *per se*, but also the impact of socio-cultural factors, because although Mathematics appears to be culture-free and therefore the school subject least affected by linguistic and cultural considerations, the forms of Mathematics developed in different cultures are inherently and intimately interwoven with the language structures of those cultures.

Ferrari (2004) claimed that, "languages are regarded not as carriers of pre-existing meanings, but as builders of the meanings themselves" (p. 383), so the language used in communicating Mathematics is crucial in the development of mathematical thinking. He suggested that using discussions in the learning of Mathematics may help students to develop linguistic skills that are essential to understand and communicate Mathematics. "This requires a shift of emphasis from 'solutions' to verbal explanations and may involve students' and teachers' beliefs and attitudes towards Mathematics and Mathematics education" (p. 389).

Language use in Mathematics classes has a potential to be discriminatory because it influences the way mathematical skills are learned (Ellerton and Clements, 1991). This is particularly

true with the learning of higher-level mathematical skills such as logical reasoning, proving, and making inferences.

#### **Bi-cultural contexts and word problems**

A study conducted by Yoong, Raman, Fatimah, Lim, and Munirah (1997) on Malaysian primary school children showed how children who have to learn Mathematics in a language that is not their mother tongue face significant difficulty in understanding and solving word problems. Bernardo (1999), in his research on 283 bilingual Filipino students found that performance in word problems improved when the problems were written in the students' mother tongue. Lim (2001), who reviewed the findings of three Malaysian research studies, stressed the importance of mastering a language in order to tackle word problems in Mathematics; suggesting that one's social and cultural beliefs and values influence how one perceives and learns Mathematics and are integral to the language used in problem posing as well as solution processes.

However, some researchers have made suggestions about how to help students bridge gaps in their learning caused by the medium of instruction not being their mother tongue. Lopez-Real (1997), for example, suggested that students be encouraged to reword problems before attempting them. Bernardo (1999) noted that better understanding and performance were obtained when mathematical problems were reworded in order to reduce misinterpretation errors.

Secada (1988) offered a refreshing insight when he suggested that bilingualism is an advantage for learning Mathematics. He claimed that monolingual children might be "unable to free themselves from the semantic constraints of the word problems they were encountering" due to their "lack of dual language and limited flexibility in applying strategies to new problems." Other researchers like Bain and Yu (1980) have found that bilingualism can enhance divergent thinking and problem solving skills.

Studies on students who code switched between English and Chinese (Lin, 1996) and

English and Malay (Martin, 1999) have demonstrated that code switching can help students to learn meaningfully. Perhaps learning Mathematics in more than one language offers the opportunity to acquire a wider range of mathematical genres, which in turn may facilitate transfer between genres.

#### **The Chinese Malaysian trilingual learning experience**

Many Chinese Malaysian students attend Chinese-medium primary schools for 6 years, then Malay-medium secondary schools for a further 5 years, followed by English-medium post-secondary education. This results in students learning Mathematics in three different languages, and difficulties become most evident with word problems in secondary and post-secondary education.

In this paper, we report on some language aspects in a two-and-a-half year action research project where the main research question was to investigate whether Chinese Malaysian post-secondary students who study, in English, Mathematics as an enabling science were able to learn it more meaningfully using word problems. Problems were featured extensively in the curriculum instead of the usual fare of mathematical drills and abstract, "technical" questions. The focus of this paper is language issues that impacted upon this pedagogical change.

Research in this area is important because there has been an increasing shift towards problem solving and problem-based approaches in Mathematics education in many parts of the world (see for example, Pitman, 1989; NCTM, 2000). In the project reported in this paper, students were encouraged to engage in discussion, peer-group activities, and reflection – all of which are Western approaches that require verbalization and the use of language. Such practices are not commonly adopted in the hierarchical and traditional Malaysian educational environment where students are generally encouraged to be silent.

The introduction of Western teaching methods and the use of English language as the