THE SHARING OF MEANING OF MATHEMATICAL WORDS IN A BILINGUAL CLASSROOM : A SEMIOTIC INTERPRETATION

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The teaching and learning of Primary school mathematics in Malta involves substantial use of code-switching between the local language Maltese, and English. Mathematical terms are usually retained in English. A case-study was carried out to explore the various language strategies that a Primary school teacher used in order to share the meaning of such terms with her seven-year-old pupils. The focus of this paper is the word value. *The direct translation of this word from the Maltese* ***tiswa*** *is viewed as a chain of signification and a semiotic model is developed in order to interpret this pedagogic strategy.*

INTRODUCTION

A contemporary popular language form in Malta is one that utilises a fair amount of code-switching between Maltese and English, although the extent to which this happens depends on the speaker and the context. The teaching of Mathematics in local classrooms is also conducted using a mix of the languages, the pattern depending on the teacher's and children's preferences, and also school policy. In a study carried out by Camilleri (1995) in State school secondary classrooms, it was found that across various subjects, the use of code-switching allowed a flexible and 'comfortable' mode of communication. From Camilleri's (*ibid*) research it emerged that a large amount of switching from Maltese to English was a result of the interaction between explanations in Maltese and a written English text. Furthermore, code-switching occurred when subject specific words were used; at times, Maltese equivalents of these words did not exist and when they did, they often did not belong to the academic register.

Similarly, in local Primary mathematics classrooms, one can often recognize English mathematical words, even within stretches of Maltese speech. It is interesting to note that a common local practice is to say the numbers (one, two, three, etc.) in English, even though Maltese equivalents exist and are commonly known. With regards to written texts, Maths books used in local Primary Schools are published in English and all written Mathematics is done in English (for example, whiteboard and copybook work). This implies that teachers need to guide their pupils to read and understand written English words and expressions.

I am interested in exploring how teachers use various language strategies to share the meaning of mathematical words. In attempting to bring together the elements of outward communication and the notion of 'meaning', I have developed a semiotic model and in this paper I use this model to interpret the sharing of the meaning of the word *value*. A Maltese equivalent for this word does exist and is commonly known and used in everyday conversations.

SEMIOTICS AND MATHEMATICS EDUCATION

Semiotics is usually defined as a general philosophical theory dealing with the production of signs and symbols as part of code systems which are used to communicate information (Tobin, 1990). Semiotics includes all signs or signals which are accessible to and can be perceived by our senses. Generally speaking, a sign is something that stands for something else in the sense of 'X represents Y' and mathematical examples include number systems, geometric figures, graphical representations, algebraic and formal notations and natural language (Duval, 2001). I take 'natural language' to include both everyday language and subject specific words which are used together to create a mathematics register which is useful for expressing mathematical notions. Other signs that may be considered include idiosyncratic elements such as personal and collective metaphors, informal diagrams and gestures (Sáenz-Ludlow, 2001).

Steinbring (1997) has developed a semiotic triangle to interpret mathematical knowledge as follows:

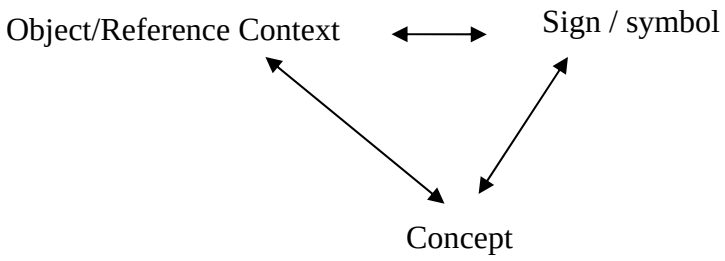

Figure 1. Steinbring's (1997) epistemological triangle

According to Steinbring (1997), meanings of mathematical concepts emerge in the interplay between a sign/symbol and reference contexts or object domains, the latter usually being known in at least some basic aspect. As an example from Primary mathematics, the author offers sets of three apples or balls as a reference context, the symbol '3' as a sign and 'elementary number concept' as the third component of the triad (Steinbring, 2002). Another example gives the respective elements as: a unit square with a diagonal, $\sqrt{2}$, and 'aspect of the concept of real numbers' (Steinbring, 1997).

In my study, I chose to view mathematical vocabulary as spoken symbols or signs. Mercer (2000a) suggests that one way of helping learners in the classroom to make sense of technical words is by introducing them in dialogues that help to make meanings clear and he discusses "how words gather meanings from 'the company they keep' - that is, from the influence of the meanings of other words which are used with them" (Mercer, 2000b, p.67). 'Clarity' from a semiotic point of view may be considered to be appropriate links with other signs or words that are already familiar to the learner. Of course, words 'keep company' with many other words and the teacher may wish to draw attention to particular ones by stressing them, changing

intonation or indicating their 'importance' in some way or another. As the new words themselves become familiar, they may then be used to support new learning in a continuous chain of signification.

In my adaptation of Steinbring's model, I take 'symbol' to be a mathematical word and 'concept' to be a meaning for that word. As part of what I view as a reference context, I incorporate the element of 'familiar words' as shown in Figure 2:

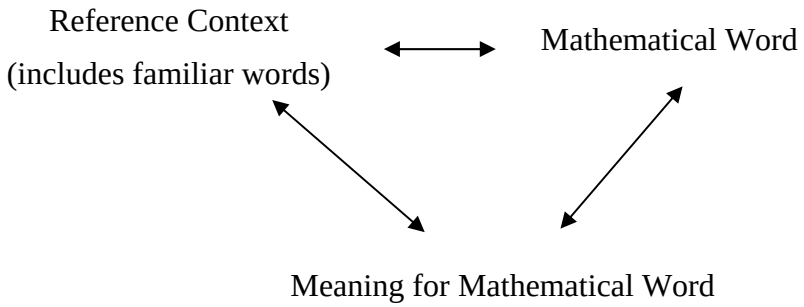

Figure 2. Epistemological Triangle for a Mathematical Word

The inclusion of 'familiar words' takes into account (a) the assumption on my part that words are a constituting factor of the reference context; (b) the notion that words gather meaning by way of *other* words that they are associated with; (c) the semiotic view of chains of signification.

DIRECT TRANSLATION AS SEMIOTIC CHAINING

In my observations of a Year Three classroom, the teacher Angela used the strategy of direct translation for mathematical terms which she considered to be the 'new' and 'key' terms for the week's topic *Money and Shopping*. In this paper I will focus on the strategies she used to focus on the word *value*.

Angela started off the lesson by conducting a discussion in Maltese with her seven-year-old pupils. She asked them to identify the seven Maltese coins (e.g. the one cent coin, the two cents coin and so on), and as they did so, she drew images of the coins on the whiteboard. The discussion then turned to the value of the coins, with both teacher and children using the Maltese word '**tiswa'** (value, what it's worth) when referring to the denomination of the coin.

Interpreting this discussion using the semiotic model presented above, we can say that the sign in focus at this point was the spoken symbol **tiswa**. The reference context was the set of coins together with the familiar (Maltese) words for 'bigger/smaller number', 'buy more/less'. The association of the word **tiswa** with these expressions helped to establish its meaning (or perhaps to reinforce it, since most of the children appeared to be already familiar with it). Diagrammatically:

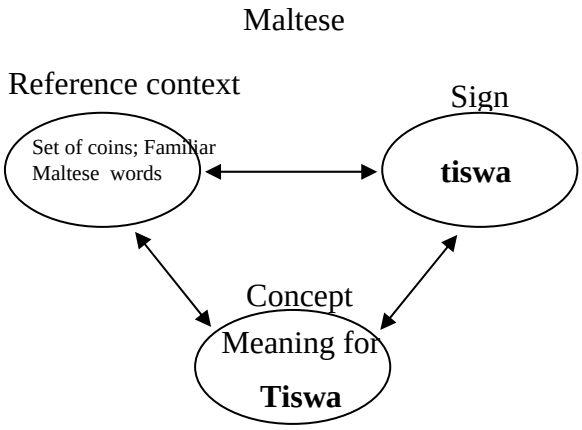

Figure 3. A meaning for **Tiswa**

The next step was to introduce the English word *value* which the children would shortly meet in its written form. Angela started up the same discussion again, asking the same questions ("Which are the Maltese coins?" and so on), *but this time in English*. Thus she 'went over the same ground' so to speak in a different language. Aspects of the context reference were retained, that is the same coins were refered to, and the familiar words were the English 'bigger/smaller' etc. The word *value* was used instead of **tiswa** and Angela drew attention to the association she wished the children to make by calling **tiswa** the 'magic word'. It appeared to me that an actual meaning of *value* was carried over from the previous Maltese discussion: all that remained was to 're-name' the notion in English.

The following excerpt illustrates the part of the discussion from the point when Angela switched to English. Since the conversation included both Maltese and English, I have translated the Maltese parts, but indicate their presence by using a **bold** font. The Maltese original for *value* was **tiswa;** 'T' indicates the teacher speaking, Ps pupils in chorus:

T: I'm going to ask you some questions and then we're going to write them down. How many Maltese coins are there? How many?
B: Seven.
T: Very good. There are seven Maltese coins. Which coin has the smallest value? What does value mean? **If I ask you** 'which has the smallest value?'
P: **Size**
T: **Is it size that I mean?**
Ps: **No!**
T: **The** …
K: Number
T: Number, alright. **So I'm asking for which** coin? **What's the word in Maltese?** Which coin has the smallest value?
F: **Its value [kemm tiswa]**
T: **Its value [kemm tiswa], good. Which has the least value? [[liema tiswa l-inqas?]**
F: one cent

(T*eacher repeats above conversation as she write the question "Which coin has the smallest value" on the whiteboard and children give answer again*).

T: **What is that word that Fiona said, the magic word?** Which coin has the smallest value? **What am I asking here**?
D: **What its value is [kemm tiswa].**

T: **Well done. Then which one has most value? [Mela liema wahda tiswa l-iktar]** Which coin now has the largest value? What am I asking you? (*hands go up*). Gordon?

G: **The most**; the one pound.

A semiotic representation for the word *value* in this instance is shown below:

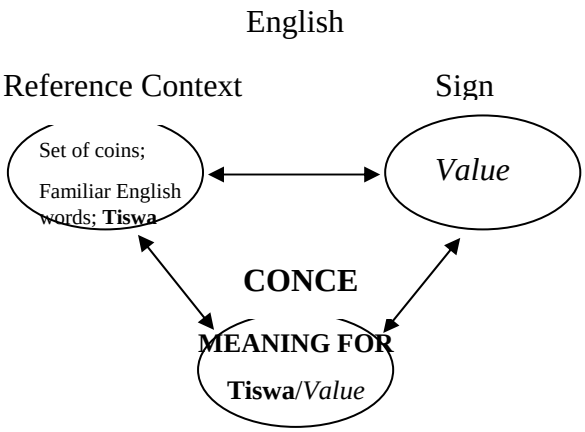

Figure 4. *Value* as a translation for **tiswa**

DISCUSSION

In the Maltese mathematics classroom I observed, the teacher used the words **tiswa** and *value* in a dialogue in which their meaning became evident. For **tiswa**, chains of signification were the result of using familiar Maltese words and expressions such as 'bigger/smaller', 'buy more/less'. Once a meaning for this word was established, the 'role' of the word **tiswa** appeared to change. It now formed part of a reference context that stood in relation to the new word *value*. This reference context included the same images of coins, and a ‘re-play’ of the discussion in English. This pedagogical strategy may be illustrated as shown in Figure 5: the super-imposition of the planes may be interpreted as a semiotic chain across the languages, the link being formed by way of the word **tiswa**, its meaning and the elements of the reference context that are kept constant.

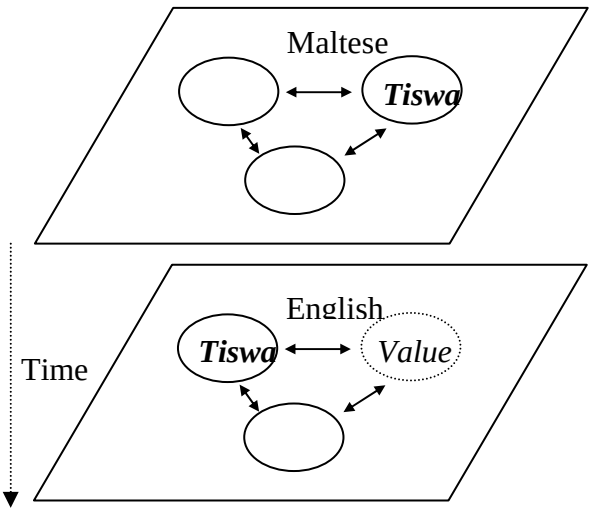

Figure 5. Semiotic Chaining across languages

This pedagogical strategy appeared to be a powerful one and was also used by the teacher to introduce the words *cost* and *change*. Indeed, the strategy may be used in cases when the Maltese equivalent for a word is familiar to the children, possibly from their everyday experiences as in the case of 'Money' vocabulary.

It would be interesting to explore what alternative language strategies a teacher might employ in situations where direct translation is not possible. In such cases it remains to be seen how the semiotic model presented in this paper may be used or adapted to support the interpretation of these language strategies.

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