USING METAPHOR ANALYSIS TO EXPLORE ADULTS' IMAGES OF MATHEMATICS

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This paper discusses the possible use of metaphor analysis in exploring adults' images of mathematics. Based on reviews of past literature and the author's own experience of using this kind of analysis in one of the image study, the potential advantages and problems encountered during the study are discussed.

What is a metaphor?

Metaphors are pervasive in our daily life. We use metaphors to conceptualise, to represent and to communicate many of our thoughts and actions (Lakoff and Johnson, 1980). According to Lakoff and Johnson (1980), a metaphor is a mental construction that helps us to structure our experience and to develop our imagination and reasoning. Moreover, according to Johnson (1987) metaphors are constructed through an 'embodied schema' or an 'image schema'. An embodied schema is defined as "structures of an activity by which we organize our experience in ways that we can comprehend. They are primary means by which we construct or constitute order and not mere passive receptacles into which experience is poured" (Johnson, 1987, pp.29-30). This means we construct metaphors to link our bodily experience of something to our more abstract thinking, and to "give shape, structure, and meaning to our imagination" (Sfard, 1994, p.47). This suggests that in fact, the whole conceptual system of how we think and act may be fundamentally metaphorical in nature. In brief, metaphors are something that constructed by our minds that help us to present something in terms of something else. For example, Sfard (1996) proposes that two metaphors for mathematics learning as acquisition and participation metaphors.

Reviews on the use of metaphors

Reviews on past related literature have shown that the use of metaphor in scientific thinking (e.g. Ortony, 1979, Martins & Ogborn, 1997) and as an analysis tool for mathematical thinking (Pimm, 1981, 1987) has been recognised for some time. Recently, there is an increasing number of study using metaphor to explore teachers' thinking (e.g. Cooney, et al., 1985; Munby, 1986; Clandinin's, 1986; Bullough, 1991) and mathematicians' experience of understanding mathematics (Sfard, 1994). For example, Munby (1986) studied some teachers' use of metaphors in their descriptions of their work, and he concludes that "given the powerful link between metaphor and construction of reality" (p.206), the use of metaphors prove to be a promising alternative in exploring teachers' thinking.

Likewise, Clandinin's (1986) study used metaphors such as 'classroom as home' and 'language as the key' to conceptualise teachers' personal practical knowledge and their classroom practice. In another study, metaphors such as 'teaching as parenting'; 'teacher as butterfly' and 'teacher as chameleon' are used to explore preservice teachers' personal teaching experience (see Bullough, 1991).

In fact, the use of metaphors to describe images of mathematics or learning mathematics is also not rare. Kelly and Oldham (1992) studied the images of mathematics and mathematics education of a group of primary school teachers and student teachers. They found that the metaphor best fitted the overall picture in their sample's image of mathematics and mathematics education was 'a racecourse round which students and teachers had to gallop, generally jumping hurdles (problem solving) on the way'. Likewise, Buerk (1982) noted the metaphors presented by a group of able women who avoid mathematics. These included the following:

Mathematics does make me think of a stainless steel wall-hard, cold, smooth, offering no handhold, all it does is glint back at

me. Edge up to it, put your nose against it, it doesn't give anything back, you can't put a dent in it, it doesn't take your shape, it doesn't have any smell, all it does is make your nose cold. I like the shine of it - it does look smart, intelligent in any icy way. But I resent its cold impenetrability, its supercilious glare. (p.19)

In addition, Sfard (1996) proposes that "mathematics education research seems to be caught in between two metaphors," which he calls them as '*Acquisition Metaphor* and *Participation Metaphor*" (p. 399). According to Sfard (1996), learning-as Acquisition Metaphor has been deeply entrenched in our thinking about learning mathematics. For example, we uses titles such as "Acquisition of mathematical concepts and processes, Building up mathematics,…" (p.400) for many major publications in mathematics education. It is also commonly quoted that "the teacher may help the student to attain her goal by *delivering, conveying, facilitating, mediating* etc." (p.400). All these expressions suggest that mathematics is viewed as an accumulated commodity and thus learning mathematics is equated with acquisition of this commodity. However, recently there has been a shift in the vision of learning mathematics where the metaphor of 'learning-as-participation' has become more apparent. Unlike the acquisition metaphor, learning as participation metaphor stresses the importance of learner as becoming a participant, rather than as acquisition of something. Nevertheless, Sfard (1996) concludes that there is no clear-cut preference from one metaphor to another, but more important, 'the acquisition and participation metaphor, when combined together, run a good chance of gratifying all our needs without perpetuating the drawbacks of each one of them" (p.409).

An example of a study which uses metaphor analysis

In a study to explore the images of mathematics of a sample of adults of the UK public (see Lim, 1999), I chose to use metaphor analysis as one of my methods to analyse the data. This is in view with the plausibility of associating metaphors with image (as discussed in the review above). Defining image as a mental construct, Rogers (1992) argued that

throughout history, philosophers and mathematicians have been involved in the ontological questions about the status, 'reality' and existence of mental images. Whichever philosophical standpoint we take, we have to admit two fundamental aspects of this debate: first, we are aware of the power of the human mind to construct mental images; and secondly, our abilities to manipulate these images and use them to inspire creative thought, and many different forms of communication" (p.49).

Therefore, I would expect that some people might use metaphors to describe their images. This is also because it is

this human desire to make stories about the world in our attempts to come to terms with the physical and metaphysical phenomena we encounter daily has led to a vast fund of metaphor; of manipulating our images to enable us to come to terms in some way with the world we live in. (Rogers, 1992, p.50)

Thus, in the study, I argued that it is plausible to conceptualised image as metaphor and to expect some of the respondents to express their images of mathematics in terms of metaphors. Here I describe briefly how I carried the study and the problems encountered as a result of this kind of analysis.

The study used a short questionnaire and a followed-up interview to collect data. The questionnaire consisted of two open-ended questions and 9 structured questions. The open-ended questions (Question 2) asked for participants' images of mathematics and learning mathematics in the form of descriptions, and metaphors or analogies. Table 1 shows the open-ended questions asked with examples given.

Initially I hesitated as to whether I should give an example for each of these open-ended questions, as I understand that any example given might bias the responses obtained. However, during piloting, I was asked for an example of an image by a number of respondents. Thus, I decided to give an example of metaphor to act as a trigger as well as to clarify the question. I acknowledge that whatever type of example that I give (such as positive or negative image) might influence the type of answer that I obtain. So I chose to give an example of an image in the form of metaphor, and which was neutral with regard to positive or negative images of mathematics.

What did I get?

As expected, the two open-ended questions elicited a wide range and variety of responses. Some responses expressed views or proposition such as mathematics is "interesting but difficult " (R329) or "a lot of things that I will not never use" (R059). Others were given in metaphor forms such as mathematics is "like playing with my children, never tiresome" (R526) and learning mathematics is "learning to walk, we've all got to " (R009). In the study, 27% of the respondents expressed their images of mathematics in the forms of metaphors, while 66% of them gave their images of learning mathematics in metaphoric terms. It was exciting to find the variety and diversity of these metaphors, besides the commonness that they shared. However, the rich variety and diversity of metaphors have also given rise to problem of multiple interpretations.

First of all, I sought to find a common theme that emerged from the data. I found although some responses were given in metaphoric forms, they share some commonness and can be classify into some main categories. Three common categories of metaphors emerged from the data. These were:

a. Mathematics as a journey
b. Mathematics as a skill
c. Mathematics as a game or puzzle

The analysis of the study shows that the metaphor of mathematics-as-journey seems to be most commonly expressed by the respondents. Some examples are:

Mathematics is a

challenging journey - rewarded by arrival at your destination (R255).

Learning mathematics is like

an easy stroll on a windy day (R034)

running uphill - difficult but you get there (R376)

Implicitly, the journey metaphor highlighted the close relationship between images of mathematics and images of learning mathematics. For many, viewing mathematics as a challenging journey elicits the experiences or the process of learning mathematics. For some people, the experience of learning mathematics might be like a struggle in a journey such as, "walking through mud" (R155) or "an uphill struggle" (R417). These metaphors indirectly indicate the difficulty and frustration that were experienced by these respondents, especially those reporting a dislike in learning mathematics in school. Some of them felt that learning mathematics is like "being stuck in a bus queue" (R268).

In contrast, particularly those who reported a liking of mathematics viewed these journeys as explorations or discoveries. For them, learning mathematics is like

exploring - there is always something new to know (R331) or

being an explorer-finding new paths and worlds (R364)

For these people, mathematics is a journey to discover new things, new knowledge and new insights. These results suggest that it was the joy of discovering new understanding in mathematics that attracted them to get interested in mathematics. Even though many of them also found learning mathematics a difficult journey like,

a journey through a dark tunnel with a light at the end (R139) or

walking through sand - hard work but put in effort, you'll get there (R136)

Therefore, there is this sense of achievement and satisfaction that encourage these people to work hard and to strive for solution. Implicitly these metaphors indicate that there is a definite solution for each mathematics problem. Learning mathematics is "a journey through a dark tunnel with a light at the end" (R139) and there is a destination for you "to get there" (R133, text-

unit 13).

It is interesting to read that some undergraduate students and tutors in Allen and Shiu's (1997) study also gave similar metaphors that reflect mathematics as a journey. Allen and Shiu's (1997) categorised these responses under one of their four categories: "struggle leading to success". Two very similar responses from the tutors are: learning mathematics is like

climbing a hill: - hard work where you follow the path you're on - and then the joy and satisfaction of being at the top (T3)

climbing a hill. The higher you get the clearer the view of surrounding countryside - as you can see more the links and layout and connections become more obvious. (T18). (p.10)

In short, 'mathematics as a journey' metaphor indicates that mathematics learning is a difficult process that needs a lot of effort and time. However, there are two possible extreme outcomes: either you reach the destination (obtain the solution) and feel happy and satisfied, or the opposite, fail to solve the problem and feel disappointed and frustrated.

Mathematics as a skill was the next commonly expressed metaphor. Closely linked to a utilitarian view of mathematics, some images of mathematics portray mathematics as an important and necessary skill for daily life and work. Mathematics is

an essential basic skill for society (R092).

Similarly, learning mathematics is like:

learning to walk, we've all got to (R009).

Once again, the skill metaphors reflect the view that mathematics is a skill that is not always easy to learn, just like

learning a musical instrument, some are easier and others are extremely hard (R542).

Nevertheless, at least nine respondents were attracted to learning mathematics because to them, learning mathematics is acquiring a skill, like "riding a bike - once learnt never forgotten" (R123).

There were some respondents who viewed mathematics as a set of skills that is hierarchical, like " brick laying - each brick is the foundation for the next block" (R081).

Others believed that mathematics learning is a skill that needs

a. memorisation such as "learning law: rules and cases to remember in total" (R485) or
b. needing a lot of practice: "learning to ride a bike - takes plenty of practice" (R520).

Likewise, the skill metaphor for mathematics suggests that learning it could be a skill that develops more easily for some people, like

playing the stock exchange - once you get the hang of it, it's ok (R469),

or gets more difficult for others, just like

riding a bike, simple enough until you come to a mountain (R066).

In summary, 'mathematics as a skill' metaphor suggests that mathematics is viewed in terms of its utilitarian value, while learning mathematics viewed as a skill is seem to be hierarchical, needing memorisation and lots of practice; difficult to be mastered by some but easy for others.

The third category of metaphor was viewing mathematics as a game or puzzle. This seems to be closely related to the problem solving views. Examples are mathematics is "a brain teaser - a puzzle to be solved" (R388) and learning mathematics becomes

finding your way through the maze (R174); or

playing chess - absorbing and challenging (R220).

Viewing mathematics as a game or a puzzle to be solved reflects the fact that mathematics learning is fun and challenging for some people. Mathematics is

fun when everything works out but remains a challenge (R470)

or learning mathematics is like playing

a jigsaw puzzle - slow but relaxing- it makes your mind work (R389)

What are the problems?

The above quoted three commonly expressed metaphors – as a journey, as a skill and as a game or puzzle – were rather clear-cut. However, there were also a lot of responses that were opened up to various possible interpretations. For example, learning mathematics is like "playing with my children never tiresome" (R526) or "like going to sleep" (R003). Should we interpret these metaphors as daily life experiences that are enjoyable and not enjoyable respectively? Can we argue that these words 'never tiresome' indicate 'enjoyable' while 'going to sleep" indicate 'boring and thus not enjoyable'? However, as one of my colleagues pointed out that to her, 'going to sleep' is an enjoyable experience especially when you are feeling tired. This raises problems concerning the validity of our interpretation and data analysis.

In brief, I face at least three problems while I was trying to analyse the responses. These problems include:

(i): it may opens to too many possible interpretations;

(ii) some responses are too ambiguous and abstract to be interpreted; and

(iii) one metaphor may be interpreted differently by different researchers.

For example, in the study, one response to the question on the image of mathematics was given as 'maths is a snail shell in the garden' (R117). It was too ambiguous. "A snail shell" may be taken as unused rubbish in the garden and thus mathematics is equated to useless in daily life? One could also argue that "a snail shell" may be interpreted as something that is commonly found in the garden and therefore mathematics is something essential in daily life? It opens up to too many possible interpretations and it was not possible to get further confirmation because the respondent did not agree to be interviewed in the second stage of this study. As it is too difficult to interpret what exactly the metaphor is implying. Therefore, for this type of response, the best way is to disregard it.

On the other hand, another response given was '"peaches and cream - solid basic sweet effect ' (R544) which is equally ambiguous as the previous one. However, it was possible to reconfirm and clarify its meaning with the respondent because he agreed to take up the follow-up interview in the second stage of the study. At first, I coded it in the category of 'beauty of mathematics'. During the interview, we have the following conversation:

I: You mentioned that mathematics is 'peaches and cream - solid basic sweet effect', could you please explain what you meant by this metaphor?

R544: Yes, It seems to me that people that don't like it, see it as a bit frightening and horrific, they got a hang up because in the past, they always failed to come out with a right answer. If you got a fairly open-ended mind with regard to things like maths and science, then you won't ended seeing it as necessary having to come out with a concrete conclusion. So, that aspect of it I don't find any of it frightening. In the same way that if you use the metaphor like peaches and cream as oppose to hmm... something like fish and chips, you actually like fish and chips because it is better taste that you get with vinegar and stuff like that. You see the difference? That is how I will make the comparison. I suspect that people who don't like it, hmm, would like much vinegar

on their fish and chip. Ha! Ha! [laughter]

Therefore, after the interview, I have recorded his response to the category of 'enjoyable'. The possibility of misinterpretation like the above shows the importance of reconfirmation with the respondent whenever it is possible.

Conclusion

The rich variety of images in the form of metaphors, and other verbal representations have illustrated the possible use of metaphors analysis, as a mean to gain a better insight and understanding into people's conceptions, views, feelings, and their experiences related to mathematics education. However, the wide range in variety also opens up the problem of multiple interpretations. Therefore, effort such as reconfirmation with the respondents may be a way to overcome these problems.

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