

## **Teachers' Beliefs and Practice: The Chicken or the Egg?**

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The relationship between beliefs and practice is often discussed in research. On the one hand it is perceived that one's beliefs will influence the instructional practice in the classroom. On the other hand professional development focuses on practice, encouraging the reflective practitioner who is prepared to reorganise beliefs as a result of practice. Is this a case of "the chicken and the egg" or does one of the ingredients in this complex recipe carry greater weighting than the other?

This paper explores the relationship between beliefs and practice as perceived by primary classroom teachers implementing a new curriculum document in mathematics. The teachers shared the viewpoint that practice was the ingredient which carried greater weighting. They perceived their beliefs as shifting or being reorganised as a result of practice. They acknowledged, however, that for shifts to take place they did hold one over-riding belief: the belief that educational practice was not fixed and that children's performance could suggest new approaches and ways forward.

Curriculum change is not new to teachers. Over recent years they have come to expect change as an integral component of their profession. In the area of mathematics New Zealand teachers were presented with a new document for implementation in 1992. "Mathematics in the New Zealand Curriculum" (Ministry of Education 1992) emphasises such aspects as:

- posing problems within meaningful contexts
- the use of a variety of approaches
- the use of calculators from Level One upward
- mental calculation
- a variety of assessment methods
- the development of positive attitudes and confidence

The curriculum states that "as new experiences cause students to refine their existing knowledge and ideas, so they construct their new knowledge (p.12)". Mayers and Britt (1995) describe the theory that argues for this view of learning as constructivism and highlight possible implications for the teacher in the classroom.

As the curriculum was introduced into New Zealand school teachers were asked to reflect upon their current practices in teaching mathematics. Many were already using the advocated approaches but others were placed in a position of addressing change. While many of these latter teachers are making shifts in their teaching as they implement the curriculum, others have interpreted written statements in such a way that supports their current practices. In this way they have made little or no change in their approaches or content coverage.

If we accept the curriculum as promoting a constructivist approach to mathematics (Mayers & Britt, 1995) then we must also recognise the possible fear of the unknown faced by some teachers. They do not necessarily understand what is meant by the term "constructivism" and fear that they will not be able to cater for children in their classes pursuing a range of different ideas or approaches. This fear can be caused by a belief that their own mathematics knowledge is insufficient to meet a wider range of demands, or by a desire to retain control over the teaching situation and direction of the lesson.

As part of a longitudinal study exploring the effects of curriculum change in mathematics (Ellis, Pfannkuch, Barton & Thomas, 1994), three primary school teachers were interviewed about their classroom programmes in this curriculum area. Although the focus question was: "What are teachers' classroom practices, and what conditions and teacher beliefs drive these practices?" the teachers interviewed were also asked to present

their viewpoints on the relationship between their beliefs and practices and how they worked with other teachers in their school who perhaps held different beliefs or followed different practices. The purpose of the interviews was to clarify direction and content of possible questionnaires to be circulated to primary teachers as part of a larger study.

## **Beliefs and Practice**

### ***What are Some of the Beliefs?***

Southwell (1993, p.293) describes a belief as "an idea which, when held, determines the way the individual acts" and acknowledges "there is some evidence to believe that the beliefs which a teacher holds about mathematics affects the way in which mathematics is taught". Van Zoest, Jones and Thornton (1994) see teacher beliefs as belonging to three main categories: "the teacher's view or conception of the nature of mathematics, the teacher's model or view of the nature of mathematics teaching, and the teacher's model or view of the process of learning mathematics". While the survey they have used in their research includes elements related to all three of these categories, other research often places greater emphasis on only one or two of them.

Mayers (1994) expresses the opinion that it is teachers' beliefs about mathematics, rather than mathematics teaching, that have a stronger influence on practice. Frank (1990), however, places emphasis not only on beliefs about mathematics, but also about mathematics learning. She outlines a set of twelve beliefs as identified in a study by Kogelmann and Warren in 1978. Described as "math myths" they are (Frank, 1990, p.11):

some people have a math mind and some don't; math requires logic, not intuition; you must always know how you got the answer; math requires a good memory; there is a best way to do a math problem; math is done by working intensely until the problem is solved; men are better in math than women; it's always important to get the answer exactly right; mathematicians do problems quickly in their heads; there is a magic key to doing math; math is not creative; and it is bad to count on your fingers.

Frank goes on to state that teachers need to ask themselves which of these myths they hold as beliefs and are conveyed in their classroom practice.

### ***Beliefs Influencing Practice?***

At a time of curriculum change the possible impact of beliefs being conveyed into the classroom becomes a key issue for consideration. Much has been written about the influence of teacher beliefs on instructional practice (Thompson, 1992) with relationships between held beliefs and classroom practice being explored.

Examples where beliefs influence practice are described by Southwell and Khamis (1992) who identify similar maths myths to those listed by Frank (1990). They report that teachers who view mathematics as a set of facts and procedures tend to focus on number aspects as they implement any new curriculum in mathematics. They also note that the belief that there is only "one right answer" is strongly opposed to an open-ended problem solving approach in the mathematics classroom, rather the teacher holding this belief is more likely to demonstrate "correct" methods for children to follow.

Howard (1992) highlights curriculum changes which require greater use of calculators and computers in the mathematics classroom. He points out that such changes require many teachers to challenge their beliefs about the importance of learning basic facts and completing pencil and paper computations. This set of beliefs is also viewed as an issue which is often confronted in public forums addressing parental concerns about children's education.

While there is continued discussion on the ways in which beliefs influence practice, studies related to teacher development models focus on ways in which practice can allow a reorganisation of beliefs.

### ***The Reflective Practitioner - Practice Influencing Beliefs?***

Malone (1995) supports a reform-minded approach to teacher development which is based on the assumption that if provided with an alternative model teachers may see possibilities for their own practice. The critical factor in this approach is seen to be the need to evaluate and reorganise one's beliefs.

Bush and Kincer (1993, p.323) identify expert teachers as being "more efficient, analytical, flexible, and knowledgeable in their teaching" and support the notion of the reflective practitioner in the classroom. Reflection is seen as a major factor in recognising and perhaps changing one's set of beliefs (Southwell, 1993; Clarke, 1993 and Thompson, 1984). As a sound technique for improving the quality of teaching, reflection should therefore not only focus on the process undertaken by oneself as the teacher but also consider the impact of teaching on the learner.

Studies have been carried out to gauge student-teacher performance following a structured teaching programme which was designed to present a successful model of teaching not necessarily in line with the groups previously held beliefs (Van Zoest, Jones & Thornton, 1994; Mayers, 1994). Findings indicated that exposure to and reflection on changed practice lead to a change in beliefs by the sample groups. It was noted, however, that espoused beliefs were not always immediately in harmony with practice suggesting that time is needed for beliefs to be transferred back into practice.

Clarke (1993) highlights the possibility that teachers may also espouse beliefs that are not in line with actual practice. While some of the factors which inhibit practice may be unavoidable, reflective practice is seen as beneficial in assisting the practitioner to recognise those factors over which they have greater control and therefore potential areas of change.

### ***The Chicken or the Egg?***

Thompson (1992) describes the relationship between beliefs and practices as very complex with many factors contributing to its development. Beliefs are viewed as relating not only to a teacher's previous experience but also to their views of control in the teaching process. Beliefs may also be general across a range of curriculum areas rather than being specific to the teaching of mathematics. As beliefs may or may not be consciously held Thompson expresses the need for teachers to face their beliefs.

Thompson has not stated whether it is beliefs which influence practice, or practice which influences beliefs, but such statements as those above tend to suggest a focus on the former relationship. Sullivan (1987), however, notes that student teachers own personal experiences of learning mathematics are known to be the most significant influence on their beliefs about mathematics teaching (cited in Mayers, 1994). While this suggests the relationship in which practice greatly influences beliefs, the example focuses on practice in the form of prior learning rather than teaching.

Other research suggests a more reciprocal or circular relationship between beliefs and practice with each influencing the other. Wood, Cobb and Yackel (cited in Bush & Kincer, 1993, p.323) state that their current work with teachers is based on the assumption that "beliefs and practice are dialectically related ... beliefs are expressed in practice, and problems or surprises encountered in practice give rise to opportunities to reorganise beliefs".

### ***Why do we need to identify the relationship?***

Recognition of teacher beliefs is seen as a key factor in teacher education at both pre-service and in-service levels. Southwell (1993, p.293) suggests that:

If prospective teachers hold certain beliefs about mathematics that mitigate against them teaching mathematics with enthusiasm and real understanding then it is the responsibility of the institution preparing these students for their teaching role to break the cycle which has developed.

Thompson (1984, p.106) expresses a similar need for teacher inservice stating:  
 If teachers' characteristic patterns of behaviour are indeed a function of their views, beliefs and preferences ... then any attempt to improve the quality of mathematics teaching must begin with an understanding of the conceptions held by teachers and how these relate to their instructional practice.

Both these statements emphasise the need to establish sets of beliefs which promote effective classroom learning and teaching. This raises the question, however, about how best to establish these beliefs. Do teacher educators focus on the beliefs themselves which can then be transferred to practice, or do they focus on the practice which will influence the beliefs?

### Perspectives from Classroom Teachers

The aim of this study was to ascertain perspectives from primary classroom teachers about beliefs and practice as related to their classroom teaching. The data gathered from this study could be used to assist the preparation of questionnaires gathering baseline data as part of the Mathematics Curriculum Change Longitudinal Investigation (Ellis et al, 1994). This latter study aims to identify and understand changes in the New Zealand mathematics curriculum with one area of focus being teacher perceptions.

#### *The Sample Group*

Three teachers from Auckland primary schools were interviewed about their classroom practice in mathematics and their opinions about beliefs and practice in relation to their mathematics teaching. The three teachers represent a range of schools which reflects a cross-section of socio-economic areas of Auckland. All three teachers have been teaching for more than fifteen years and are now in senior teaching positions in their schools. Two of the teachers teach in junior classrooms (children 5-7 years of age) and one teaches in the senior part of the primary school (children 8-10 years of age).

#### *Changing Beliefs*

While the teachers agreed that they may have come to the teaching profession with a previously-held set of beliefs, they felt these had changed over a period of time. Initially this was seen to be the result of pre-service and in-service instruction and support but an important factor to be taken in to account was that of the confidence gained by positive experiences in teaching. It was on the theme of length of teaching experience, however, where two teachers interviewed highlighted different perspectives. While Teacher N felt that his teaching practice was more open to change

*"... now that I am more experienced as a classroom teacher and feel confident that I can build on the ideas the children present ..."*

Teacher P pointed out that

*"... some of the teachers who have been teaching for a long time do not want to put the effort into changing approaches which have worked for them in the past and really need to see the new ideas working before taking them on board."*

An underlying principle identified by all three teachers was that you needed to work at being open in your approach. The following statement by Teacher P was indicative:

*"...if you do not allow practice to influence belief then you stagnate as you don't try anything new."*

#### *Facing Challenges*

Given that the curriculum document outlined content to be covered as well as suggesting possible learning experiences and approaches to present the ideas to children,

the three teachers interviewed felt that their beliefs were not the issue. They saw aspects of the suggested practice as sometimes challenging previously held beliefs but necessary in order to realign their beliefs with the demands of the curriculum. The focus of their discussion therefore related to how these challenges were faced.

Teacher D stated:

*"...with some of the new ideas I like to work with the other teacher at my (class) level. We sit down together and plan out how we will cover the objectives...."*

Teacher P pointed out:

*"... coming to Dip. Math. Ed. classes and being involved in maths organisations has given me a lot of people to sound ideas out with. I wasn't really confident about maths but now I know that I just need a bit of time to work it out."*

This notion of a support network with school colleagues, professional development or involvement in professional organisations was a continuing theme. Teacher N said:

*"... the school is really important. You need to know that you have their support. As a staff we have worked together through the issues relating to the new curriculum and we know we have the backing of each other and the principal too. One of the issues we had to face was allowing the children to use calculators and we had parents coming down to school worried that their children wouldn't learn how to add etc. We had talked this all through together so we knew the right (indicating quotation marks with his hands) things to say and we also knew that they would get the same feedback from others as well."*

Teacher P also identified the potential of a school network and discussed the process within her school for parent meetings to go over some of the changes in the various curriculum documents. In this way parents have the opportunity to voice their concerns while being presented with a clear rationale for school decisions that are being implemented.

### ***Influencing Others***

Each of the three teachers was asked to move beyond their own classroom and identify any beliefs they perceived to be held by other staff members, particularly those beliefs which appeared to influence curriculum implementation. Within this discussion the teachers identified strategies they had put in place to affect change.

The structure and jargon of the curriculum document was seen to be a valuable asset in providing the opportunity to address needs in other classrooms within the school. Each teacher made reference to approaches by other staff members made to them either in their role as a senior staff member or because of their supposed knowledge of mathematics education. Concerns they identified as being expressed by other staff included:

- difficulties in maintaining control over what was happening if children were left to explore an idea for themselves;
- confusion resulting from a document which they perceived as vague and lacking in direction;
- difficulties in identifying what mathematics (strands) had been covered within a particular unit of work, (this was often related to assessment issues);
- lack of knowledge about some of the content or jargon used (e.g. stem and leaf graphs)
- fear of the words (e.g. "Why do we do algebra in the juniors now?").

The follow-up actions to these approaches were seen as an important factor in modelling practice which could influence a change in beliefs.

Teacher P pointed out:

*"... it is really important to have the right resource material available. If you leave the old textbooks around then they will be used. I try to show the teachers the new resources ... I always make sure that the first time I suggest they try something for themselves that it is one of those activities that is a sure-fire success. ..."*

Teacher D reiterated the notion that planning together tended to overcome most of the problems, while Teacher N again highlighted the need for a school approach, saying:

*"... we didn't get involved in the contracts that were happening so as a staff we committed our meeting times to addressing the new syllabus ... we would bring to each meeting those things we didn't understand or just wanted ideas for and everyone pooled their knowledge ... it worked really well - even the more traditional ones on the staff started to try some of the ideas because we would be talking with great enthusiasm about what we had tried in our class ..."*

He went on to describe a scenario where one teacher in the school was opposed to the use of calculators and the children were "used" to influence a change of belief:

*"... didn't want them in his room and refused to let the children use them at all. There are four of us in the syndicate so we decided to cross-group for a unit of work and the rest of us used calculators as much as possible. The children would go back to ...'s room and during Social Studies or something they would keep asking if they could go next door to borrow the calculators. I suppose it could have backfired but he could hear them saying things like it will be about so-much and he realised that they were still thinking for themselves even with the calculator. He is still thinking it through but he lets them use them a lot more than before..."*

## Discussion

### *The main focus - beliefs or practice?*

The initial purpose of the interviews was to explore further the ways in which teachers' beliefs influence their classroom practice. Although it was expected that teachers would focus on such aspects as the use of calculators and the learning of number facts this did not prove to be the case. It soon became apparent that the focus of each teacher's discussion became the practice itself. This could be partly explained by their statements about how they saw the curriculum change affecting their classroom practice, as each teacher highlighted a change in teaching approach rather than changes in content.

The focus of these teachers was clearly on how their mathematics teaching was influencing their beliefs. This differs from much of the literature in two ways. Firstly, the emphasis is on their beliefs about mathematics teaching rather than mathematics itself as suggested by Mayers (1994). Secondly, they clearly defined the practice as influencing beliefs rather than the inverse scenario described by many (Frank, 1990; Howard, 1992; Southwell and Khamis, 1993).

While the teachers were open to change and believed that they could learn from their classroom experiences or practice, they did acknowledge that there may be aspects of their teaching which have been influenced by beliefs that they are unaware they hold. This would support the suggestion that teachers need to be made aware of possible beliefs in order to evaluate and reorganise these beliefs (Clarke, 1993; Frank, 1990; Malone, 1995).

### *The Teachers' Beliefs*

In discussing aspects of the maths myths suggested by Frank (1990) or Southwell and Khamis (1992), the teachers shared the opinion that professional development for teachers both within their own school support structures and from external providers was

addressing many of these issues. They agreed that the introduction of a new curriculum had resulted in increased dialogue among staff which, together with sharing of practical experiences, had produced changes in both practice and accompanying beliefs.

Confidence was seen as a key factor in allowing a teacher to focus on their practice and to try out new ideas without fear. While Southwell (1993) would like to see institutions responsible for teacher education taking a lead in breaking possible belief and practice cycles, it becomes apparent that it is only possible to lay a foundation at this stage and that as teachers build their own experiences, so too will they have the confidence to question more openly their beliefs and practice. In this way teachers will adopt a strengthening role as reflective practitioners (Bush and Kincer, 1993).

### ***The Author's Viewpoint - In Summary***

Although they were presented with the notion that their beliefs about mathematics and mathematics teaching were likely to influence their practice, the teachers interviewed tended to reject this idea. Rather, they saw effective practice as influencing beliefs and attitudes within their classrooms. They agreed, however, that in this relationship they held an underlying belief which was that:

*"education was not so closely defined that you could not learn new ideas and approaches from the children you taught."*

*Teacher N*

In this they identified a need for teachers to be open enough to allow their beliefs to be challenged, or confirmed in some instances.

It appears difficult to completely separate one's beliefs and practice, indeed, it may be questioned whether there is any reason for a separation. The complex relationship between beliefs and practice is confirmed in both the literature and the sample of interviews with classroom teachers. If the set of beliefs held by a teacher has been influenced by some form of practice in the past, then research should be focusing more on the practices which give rise to the beliefs than on the beliefs themselves. Is it possible that the focus of a research question on beliefs influencing practice can in reality result in a report which disregards or underestimates the inverse relationship?

If pre-service and in-service approaches are to be effective in promoting practice which supports the new curriculum it is critical to clarify the relationship between beliefs and practice. If one element of this relationship is found to be of greater influence than the other, then professional development work could be focused in that direction. The teachers interviewed suggested that their teaching experience and confidence in their ability to control the teaching situation influenced the extent to which they were prepared to try new ideas and approaches during their teaching career. If this is accepted then in-school professional development will need to recognise and cater for individual needs, providing appropriate guidance and support relative to the individual staff members involved.

The small sample of interviews reported in this paper suggests that the focus of future research should be on practice. It is recognised that a larger sample is required before such conclusions can be confirmed. If beliefs are accepted as greatly influencing practice, then any facilitated pre-service or in-service work would then reflect the beliefs of the person in the facilitation role. Similarly approaches and questions forming a further study in this area will reflect the beliefs of the researcher - a real chicken and egg problem to ponder.

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