MATHEMATICAL BELIEFS OF TRAINEE TEACHERS DURING THE FIRST YEAR OF HIGHER EDUCATION

Ray Huntley

Anglia Polytechnic University

Prior learning experiences help trainee teachers develop beliefs about the nature of mathematics and its teaching and learning, which shape the nature of their training experience. Using ethnographic methods a cohort of trainees in one institution were surveyed about mathematical beliefs. Results indicate evidence of both change and stability in beliefs, and that stated intentions for teaching mathematics are challenged by school demands to meet national criteria for pupil performance.

INTRODUCTION

How do trainee teachers view the teaching and learning of mathematics? All trainees pass at GCSE level, whilst some achieve 'A' level or work where mathematical ability is requisite. Mathematical competence and enthusiasm levels are varied, and broad mathematical backgrounds affect trainees' development. I believe initial teacher training is interpreted through mathematical beliefs and outcomes for teachers are a function of beliefs and training.

RESEARCH QUESTIONS

- What are the factors that affect trainee teachers' mathematical beliefs?
- Do trainees' mathematical beliefs change during the first year of training?
- How do trainees' mathematical beliefs affect their teaching style and choice of pupils' learning activities?

LITERATURE

Trainee teachers set out with well-developed personal beliefs about learning and teaching (Joram & Gabriele, 1998). Alteration in beliefs during training was considered by Kagan (1992), in which she claims a lack of change in pre-existing beliefs, and that university courses are largely irrelevant in supplying adequate procedural knowledge for teaching mathematics. Teachers teaching the way they were taught was confirmed by, for example Bramald, Hardman & Leat (1995):

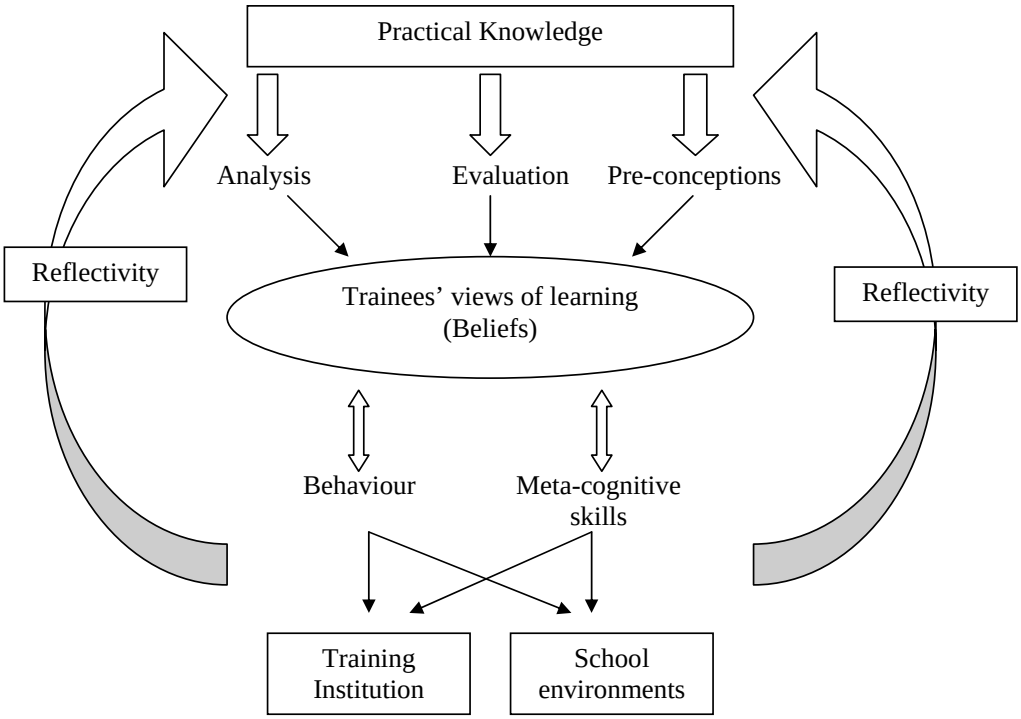
> '…student teachers have definite ideas about teaching and learning when they start out in their training, which have developed from their own educational experience and which shape their perceptions of teaching and developing practice.' (p.23)

Furinghetti & Pehkonen (2002) argued that teachers' beliefs about mathematics are deeply rooted and peripheral changes such as curriculum or teaching materials cannot influence them.

Jones, Henderson & Cooney (1986) showed that a gap exists between expressed beliefs and classroom practices. The following definitions help to establish the boundaries of the concept of beliefs:

'Beliefs are mental constructs representing the codification of people's experiences and understandings as beliefs.' Schoenfeld (1998, p.19)

'…the visual representations, mental pictures, the impressions, and the experiences associated with the concept name.' (Vinner, 1991, p.61)



The diagram identifies beliefs as a core training element, but the strength of existing beliefs force trainees' views to act as a gatekeeper to any change that might occur in training. The return linkages represent reflectivity, and I suggest these are not naturally occurring, but in new trainees need to be instilled. This happens in 'Professional Studies' modules, but may appear in sessions such as mathematics.

DATA COLLECTION AND SAMPLING METHODS

Records of experience were gathered from individuals through questionnaires. This was effective in gathering broad evidence from the research group from which emerging themes regarding teaching approaches were sought. The questionnaire was issued to 93 trainees in year one of a BA programme. A return rate of 61 out of 93 trainees was achieved, giving confidence in using the questionnaire outcomes to make generalisations about beliefs of the cohort.

QUESTIONS USED IN THE QUESTIONNAIRE

1. Do you find mathematics enjoyable?
2. Which aspects of mathematics do you find most difficult?

3. Which aspects of mathematics do you find easiest?
4. What or who were the main influences on your views about mathematics?
5. How would you describe the nature of mathematics?
6. What, in your view, are the essential elements of mathematics?
7. Do you think mathematics is to be 'created' or 'out there' to be discovered?
8. What value, if any, does mathematics have?
9. What is the value of learning and teaching mathematics in school, in your opinion?
10. What was your experience of learning mathematics?
11. How do you think children learn mathematics?
12. What do you think are the needs of learners of mathematics?
13. What is your view of the teacher's role in mathematics lessons?
14. What teaching approach will you adopt when teaching mathematics?

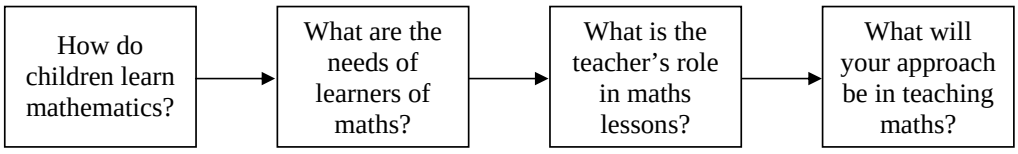
The sequence was chosen to allow responses to feelings about engaging with mathematics, exploration of views about the nature of mathematics and finally views about how mathematics should be learned and taught. Data was categorised in terms of 'intended teaching style', incorporating features of trainees' backgrounds which may lead them to adopt a particular view about mathematics teaching and learning.

ANALYSIS OF RESPONSES

Question four considered the main influences on trainees' mathematical beliefs with a positive or negative influence being detailed. The balance of positive to negative was approximately 80% to 17%, with 3% neutral. Common influences were teachers, both good and bad, but distinguished by phase. Many trainees regard their teachers at school as positive influences. Most responses are person related, such as teachers, lecturers, family members, followed by a variety of situation factors, such as 'sitting next to someone I got on with'. The negative influences were single occurrences, and included: 'in top set but felt out of my depth', 'switched off…the teachers didn't help', 'just worked through a book', 'told I wasn't very good', 'hated the teaching methods', 'scary secondary school teacher', 'low expectations because I was a girl' and 'lost interest at secondary school'.

FROM LEARNING TO TEACHING

Questions 11-14 were designed to develop a train of thought, represented in the flowchart below:



The questions were set in this way to determine any tangible link in the views of the cohort, between the learning experience for pupils and the teaching approach adopted. The responses to question 11 were typified by three themes; 'practical application', 'discovery' and 'participation'. These suggest that respondents feel the most effective way to learn mathematics is to 'do it', and not to be 'told it'. Learners' needs in question 12 are described as being 'different approaches and teaching points', 'relation to the real world' and 'understanding the methods'. The first of these recognises teachers' roles in providing varied opportunities for learners to assimilate knowledge, skills and understanding. This was echoed in the responses to question 13, where many of the cohort regarded 'enthusiasm' and 'making it fun' as key elements, followed by 'giving strategies and methods'. This indicated a necessity to provide knowledge, skills and understanding, but around the notion of making learning enjoyable. This was reinforced in responses to question 14, where many reported their intended approach as being one of 'fun', closely followed by the need to make lessons practical. It was encouraging from the point of view of a mathematics educator that so many trainees felt they would, and indeed should, teach this way.

INTERVIEW OF SAMPLE GROUP

To redress any assumptions made when analysing returns, a sample group were interviewed, selected following a categorisation of teaching approaches during analysis of the questionnaire, and consisted of four trainees, interviewed before and after their period of school experience.

Sample Group		
Name	**Gender**	**Age group**
Alison	Female	23-27
Becky	Female	18-22
Elizabeth	Female	33-37
Robert	Male	38-42

INTERVIEW OUTCOMES ON QUESTIONS 11-14

Alison in question 11 shows awareness of the variety of methods children use to calculate. She described how children in one class gave different methods to the same problem, and then reflected on the teacher use of a variety of methods, allowing the children to work with the methods they find easiest. From questions 12 and 13, Alison thought children need a sound understanding of 'basics', presented in a variety of fun ways, and that the teacher's role is to provide strategies. This suggests she will teach in a fun way, using various strategies and resources, and use formative assessment to check learning.

Becky refers to learning as 'building on prior knowledge, consolidating skills and moving on', but there is no suggestion of whether a single strategy is used, or a variety. She suggests a key feature of learning and teaching mathematics is the teacher's subject knowledge, and use of appropriate resources and differentiated activities to enable learners to progress at their own rates. Becky also aims for her teaching to be enthusiastic.

Elizabeth admitted she wasn't sure how children learn mathematics. She wondered whether they learn from everyday experiences, suggesting a limited teacher's role. She feels the teacher's role is to guide children from one stage of understanding to the next, but also points out that learning mathematics should be made fun, implying the teacher has a role in this.

Robert insists children should not learn by rote, and that they should be given problems to solve, relevant to their experiences. In this way they will develop confidence with the known before facing the unknown. He responded with the need for learning collaboratively, but without defining this, and amongst the variety of styles and strategies he advocates, he includes the notion of mathematics being fun.

SUMMARY OF INTERVIEW RESPONSES

It is clear there is a view that mathematics should be a fun learning experience, and that the role of teacher is to enable that to happen through enthusiasm, sound subject knowledge and support for individuals. Regardless of background, the trainees all wanted something positive for the children they would teach. Those who enjoyed mathematics at school wanted to pass it on, whilst those who had less enjoyable experiences wanted to ensure that any pupils they teach would not suffer in the same way. Overall, the responses suggest that the trainees' beliefs about learning and teaching mathematics are built firmly on the prior experiences they had as pupils.

RECOMMENDATIONS

The findings suggest further research should focus on how other institutions consider trainees' beliefs, and whether they make any attempt to influence them during training. The study could be replicated across a broader selection of universities and trainees at different stages of their training programme to determine to what extent beliefs may change.

In addition to the impact of trainee beliefs, there is a supplementary issue regarding choice of pupil learning activities. These are crucial in allowing pupils to grasp intended concepts and engage in learning at the level intended by the teacher. In mathematics, the choice of examples is a critical in a pupil's perception of the concepts. In analysing the examples, Watson and Mason (2001) write:

'It has long been acknowledged that people learn mathematics principally through engagement with examples, rather than through formal definitions and techniques. Indeed, it is only through the examples that definitions have any meaning…' (p.379)

Further work is necessary around how trainees' beliefs affect their choice of activities, and the conclusion is that such research is essential in understanding this relationship further.

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