

# Does Student Success Motivate Teachers to Sustain Reform-Oriented Pedagogy?

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This paper investigates one outcome of teacher professional development, student success, which appears to be an effective mechanism to motivate and sustain teacher change for teachers implementing reform-oriented teaching approaches. The reform-oriented pedagogy is inquiry-based and aims to encourage student mathematical thinking in order to increase student achievement in numeracy. It is this outcome of increased student achievement and student enthusiasm for the new teaching approaches that motivated teachers in this reported study to sustain changes to their teaching.

## Introduction

As a result of reform-oriented mathematics being introduced into pre-service and in-service professional development programs throughout the last decade researchers are currently exploring the extent to which teachers have incorporated aspects of these reforms into their classroom practice (Anderson & Bobis, 2005; Cady, Meier, & Lubinski, 2006). This paper reports on one aspect of a similar study that explored the extent to which eight primary school teachers incorporated the mathematical reforms introduced in the New Zealand Numeracy Development Project [NDP] in-service professional development. The study concluded that while, overall, the teachers perceived the NDP program reforms as worthwhile and important, their self-reports indicated the intense nature of the personal content knowledge to be learned and incorporated into classroom practice was challenging. For most of the teachers the reform-oriented, inquiry-based teaching approaches took an extended time of ongoing support to internalise and consolidate (Cheeseman, 2006). However, all but one of the teachers reported their student responses to the new teaching approaches as positive and a key motivator for them to continue with the NDP reforms. This paper focuses on this aspect of teacher incorporation of mathematical reforms when motivated by positive student responses to the reform-orientated teaching approaches.

## Background

Reform-oriented mathematics has evolved in western countries because of international concerns about student underachievement in mathematics. The resulting critique led many educators to argue that achievement standards could not improve unless mathematics was taught differently so as to engage more effectively all groups of learners (Duit & Confrey, 1996; Fennema & Franke, 1992). Skemp (1986) claimed that most teachers taught in an instrumental manner, whereby the mathematical procedure was given to the students, rather than in a relational manner, where the students were actively involved in seeking a solution path. Duit and Confrey (1996) concluded that rote learned “procedural knowledge becomes an effective mathematical tool only within the framework of conceptual understanding” (p. 83).

The critique of procedural mathematics pedagogy by researchers led to a growing acceptance within the reform movement of an alternative view of learning mathematics based on Constructivist theories. Cobb et al. (1991) saw the constructivist view of mathematics learning as inquiry-based, “a process in which students reorganise their conceptual activity to resolve situations that they find problematic”, rather than “a process of internalising carefully packaged knowledge” (p. 5). Such mathematical reforms required a major shift in pedagogy from teaching approaches that focused on a procedural approach to a teacher-facilitation approach focusing on student thinking and reasoning (Stein & Strutchens, 2001).

New Zealand teachers were assisted to accommodate these reform-oriented teaching approaches by participating in the government-initiated NDP in-service professional development program. To be eligible to participate in the NDP program teachers were required to enrol as part of a whole school or syndicate based initiative. The nature of the professional development was long-term and school-based in order to create a community of learners encompassing the management team, teaching staff and the students. The reform approaches included an inquiry-based strategy-teaching model, whereby teachers facilitated student learning through problem-solving. This was to involve higher-order thinking, the use of apparatus, and the

encouragement of student explanation and justification of strategies (Higgins, 2004). Importantly, discussions of alternative mathematical strategies served as a model for new learning to occur for the students, and often for the teacher as well (Steffe & D'Ambrosio, 1996). Teachers found by asking students to express their mathematical thinking they, too, encountered problem-solving strategies that were new to them, thereby creating an opportunity for reciprocal learning for both students and teacher.

The NDP strategy-teaching approaches followed the constructivist view that places students central to the teaching and learning process (Hughes, 2002). The teachers in this wider study found the complex nature of the reforms (e.g., coming to terms with understanding multiple strategies and moving away from procedural-based algorithms) led to huge shifts in their content knowledge and teaching approaches. They struggled to accommodate the range of these reform-teaching approaches without ongoing support (Cheeseman, 2006). Similar teacher reports were identified in the nation-wide government evaluations of the NDP (Young-Loveridge, 2004). Other studies investigating teacher change in relation to curriculum and professional development initiatives reported teachers' difficulties accommodating the reforms (Anderson & Bobis, 2005; Cady, Meier, & Ljubinsky, 2006; Stigler & Heibert, 1997). These studies found that teachers accommodated some aspects of the reform pedagogy but not others. This report suggests that teachers in this study were more inclined to accommodate pedagogical practice that created positive responses from their students resulting in increased student achievement in or enthusiasm towards mathematics.

## Methodology

The study used an interpretive approach to investigate the perceptions of a small sample of teachers who participated in the in-service professional development of NDP. The mode of enquiry was in the form of forty-five to sixty minute face-to-face interviews. The in-depth nature of the interviews provided an effective method to collect quality data from the participants, eight teachers, who shared self-reports (Davidson & Tolich, 2003) regarding the extent to which they had incorporated the mathematical reforms introduced in the NDP program. Semi-structured, open-ended interview questions were formulated as a guide for the researcher to follow. The main intention of the researcher was actively to listen so that the interview was shaped by the participant's voice. Davidson and Tolich (2003) describe the participants' layers of understandings as a rich texture of experience and see the use of good quality questions as a key "to get people talking along the thematic lines of the research" (p. 148). They suggested prompting to be used only "to bring out the main points of what they have to say" (p. 148). Probing was used spontaneously on numerous occasions during the interviews to seek clarification, or to encourage the participants to elaborate their ideas. The quotations from the participants included, verbatim, in this paper were derived from two general interview questions: "What aspects of the project helped you most? How and why?"; and, "How has your developing understanding from participating in the project changed your teaching practice?" Some prompts were used with these questions where the researcher thought it necessary to probe further.

The teachers were selected from four urban primary schools, two teachers from each school. The schools were chosen because they were centrally located and their teachers had been involved in the program for a minimum of two years. The researcher was responsible for the selection of two of the participants. The principals of the respective schools selected the remaining six teachers. The teachers selected covered the range of age groups taught, from five-year olds in the junior school to ten-year olds at the senior level of the school. Seven of the teachers were in their second year of using the new reform teaching approaches with the exception of one teacher who was still participating in the formal NDP program. Although the small sample of teachers involved in this interpretive study made generalisation problematic, the in-depth responses from the interviews provided valuable information about the centrality of the students' responses to teachers' learning and valuing of the reform teaching approaches.

## Findings

Seven out of eight teachers, without prompting referred to student success and student enthusiasm as key motivators to sustaining the changes they had made to their classroom practice as a result of participating in NDP. The new inquiry-based teaching approaches involved working with students in small groups to allow for interaction between the teacher and students, and interaction among students. The teachers reported that listening to students explain and share their mathematical thinking was a major shift in pedagogy and equally, a shift in learning styles for their students. The teachers noted the teaching approach involved both teaching

and formative assessment providing information on their students' achievement and teaching needs. Their excitement about their student achievement is reflected in their comments.

- Robyn: On reflection I can see how valuable the program has been; seeing the progress the kids have made and the stages they have moved on to. So it [personal time given to project] was worth it! ... I've really enjoyed teaching the program and I can see how [well] my kids have responded to it. I really like the strategies based way and I can see how it will provide a really good grounding for those more advanced concepts further down the track.
- Sandra: I think you actually do see kids' lights going on and they actually make those connections, and I think they might have done that in the past but I wouldn't probably have noticed it. But now you know what you're looking for to make the jump and that's quite exciting.
- Claire: The NDP program provides a chronological building of skills and strategies which gives the children confidence because 99% of them actually experience success before they are asked to take on a more difficult concept.

Teachers' enthusiasm was further supported when they saw that student achievement in their class was evident in school and class assessment statistics.

- Amanda: Our [school wide] statistics show that the children have improved in numeracy over the last couple of years [since undertaking the professional development].
- Ruth: Most of them [children in class] have jumped tremendously. One that's most dramatic ... she didn't have very good basic maths knowledge at all at the beginning of the year and I tested her on Form A [countable numbers]. She had no idea about proportions and ratios, and now she does and is on Test B [part-whole strategies] – for somebody like her that's a huge jump.

The students' positive responses to and their engagement in the new teaching approaches was another positive aspect identified by two of the teachers.

- Ruth: Some of them [children] while we were teaching fractions and decimals were very reluctant at first but once they realised that there was quite a bit of fun involved [referring to less paper and pencil work and increased use of apparatus], you could see they were actually enjoying it. Quite often I would have them sitting down during morning tea still carrying on and I would say, "Don't you want to go now? Can we pack up please?"
- Sandra: I guess what we're doing is we're asking kids to explain their thinking which we've never done before. We just asked for a result but now they have to justify what they've done, and say why and it's accepted. They know that people are listening, and the kids are sparking off [each other] and it's totally different, isn't it?

The teachers also spoke about how the students' enthusiasm towards the teaching approaches had helped them sustain the content and pedagogical changes they had made.

- Claire: It's changed my attitude – I love maths now. I really like it – the kids say, "Oh can we have some more time?" And they don't want to get off the mat. It's [NDP] very effective. The children absolutely love it. The first thing every morning they say, "Can we have maths now?"
- Amanda: The children get excited at the number properties [abstract] stage – everyone bursting to say how they got it [strategy used]. They are getting immediate feedback and they feel so proud! ... I'd never go back to just teaching algorithms without teaching children [a range of] mental strategies ... it's really doing them a disservice. I just see it as so good, encouraging the children to think. I am sold on it [NDP teaching approaches].
- Janet: The children loved the numeracy games! They like the number, the challenge, the practice activities, and because the children explain their thinking it's [NDP teaching approaches provide] very visible achievement!
- Sarah: The children love it [maths] because they share their thinking and they, particularly the boys, love

the materials and games ... I love it because I think that you are much more aware of what you want the children to know and where to take them next – you are not actually giving them the information, you are trying to get it out of them.

The eighth teacher was less enthusiastic about the professional development program and felt her students were not showing such positive signs of achievement or excitement about the new teaching approaches.

Helen: I think I keep kids in holding patterns a bit long because this is my first year. I think when you are learning yourself; the kids have to go on a holding pattern while you read the brochure [booklet] and keep working at what you are going to do.

Helen was the only teacher in the group of participants who was in her first year of the program and she felt her teaching was taking a backwards step before she was able to move the students forward. Her comments could be due to a number of reasons: she was less trustful of the program; she needed to know more theory behind the inquiry-based teaching approaches and or she had older students (10 year olds) who were already highly successful learners of mathematics. Her reservations were further illustrated by her comments about the program and reference to her students' progress.

Helen: I'm not sure about that theory and I would like to know what the theory is. When you start something you really don't know where you are going so you don't know what it is that you are learning [the big picture]. E.g. why we are doing this style? What the benefit is? That it is not just a fad that will come in and disappear and the kids will be a year worse off.

Helen's concern that her students may be "worse off" evolved from her professional development switch to inquiry-based teaching from the procedural-based teaching of algorithms that was expected of the students when they progressed to the intermediate school (11-12 year olds) the following year.

## Discussion

The notion of student enthusiasm and increased achievement resulting from the teachers' inquiry-based teaching approaches was a common thread in seven of the eight teachers' self-reports. The firsthand experience of incorporating aspects of the professional development (e.g., eliciting student strategies and the increased use of numeracy games) in their classroom with their students allowed the teachers to see the immediate success the program had in engaging their students' learning. Student success and engagement in the inquiry-based teaching approaches appeared to be an important factor to maintain the teachers' shift in pedagogy and beliefs as illustrated in Amanda's comment, "I'd never go back to just teaching algorithms ... it's doing them [the children] a disservice". Research on teacher change reports teachers' beliefs and attitudes affect the quality of engagement in professional development and suggest "the most significant changes in teaching attitudes come after they begin using a new practice successfully and see changes in student learning" (Guskey, 1985, p. 1). This outcome was reflected in the teachers' reported enthusiasm using the new teaching approaches and motivated them to continue with the changes they had made as a result of participating in NDP. Guskey (2002) considers the positive impact of professional development on student learning as reflected in teachers' new learning directly benefiting students in any way as an effective evaluation of quality teacher professional course work.

The school-based, in-class situation of the in-service professional development whereby teachers worked directly with their own students allowed for the possibility of reciprocal learning or "teacher reflexivity". Steffe and D'Ambrosio (1996) described "teacher reflexivity" as how student mathematical development contributes to teacher development. Active listening to student strategies can add to the range of teacher's strategies. Reflexivity also extends to teachers using their students' mathematical thinking to inform their planning and teaching (Simon, 1995; Steffe & D'Ambrosio, 1996). The teachers' discussion about student achievement, although not referred to directly, implied they were indeed using their student responses to inform their planning. Some teachers made mention elsewhere in the study of increasing their own mental agility after listening to a range of student strategies. These were important shifts in teaching approaches made by the teachers after listening to their students' mathematical thinking and observing the students' enthusiasm when sharing their strategies. The teachers' willingness to try out the new strategy-teaching approaches with their students is supported in the professional development literature that regards teachers who are risk takers and demonstrate improving their own mathematical knowledge are more likely to motivate students and to foster

their learning (Barth, 2001; Fullan & Hargreaves, 1996; Steffe & D'Ambrosio, 1996). The teacher comments demonstrate they were able to motivate their students mathematically and that their student responses in turn motivated them to sustain teacher change.

Indeed, increased student achievement in and enthusiasm for numeracy was a significant motivation for seven of the eight teachers to continue to use the new inquiry-based teaching approaches promoted by the NDP professional development program. The eighth teacher used the approaches while participating in the program but was less convinced of the value of them. Her less favourable attitude to the new teaching-approaches appeared to be influenced by her students' bored disposition to the strategies introduced and it seemed less doubtful that she would sustain the new learning over time. Cobb et al. (1991) describe the change in teacher beliefs, knowledge and practice as a result of participation in professional development as reflexive in nature. They consider that "it is essential that teachers have reason and motivation to want to reorganise their pedagogical practice, which can only occur if teachers come to view aspects of their current practice as problematic" (p. 8). Helen believed moving away from her current practice (the procedural-based teaching of algorithms) was not beneficial for her students in terms of mathematical expectations at intermediate school and therefore did not see her current practice as problematic. Concern about her students' achievement appeared to influence her beliefs about and acceptance of the strategy-teaching approaches.

The literature on teacher change reports new knowledge and pedagogical experiences are filtered through the teachers' belief system and then interpreted in the teachers' own way (Fennema & Franke, 1992; Stigler & Heibert, 1997). For seven of the teachers, student enthusiasm for the new teaching approaches and achievement as a consequence of these practices led to their feeling successful regarding the changes to classroom practice. This mirrors the professional development literature on teacher change (Barth, 2001; Fullan & Hargreaves, 1996; Higgins, 2004). For one teacher the student responses to the new teaching approaches were not influential in motivating her to change her beliefs dramatically or commit to incorporating the reforms over the long term.

Although this study had a limited sample of participants, seven of these eight teachers were motivated to continue the initiatives presented in the NDP reforms. This motivation was generated by the students' enthusiastic responses to the teaching approaches and their visible increase in achievement, thus providing an effective mechanism to sustain teacher change. The richness of the teachers' voices in recognising the importance of student achievement and enthusiasm as central to successful professional development makes worthwhile academic commentary.

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