Students' Views about Mathematics Learning: A Case Study of One School Involved in the Great Expectations Project

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This paper reports on the responses of students attending a school that was involved in the study of students' perceptions and dispositions towards learning mathematics and also in the Great Expectations project, a Teaching Learning and Research Initiative designed to raise teachers' expectations of achievement. Twenty-seven year 5–6 students at City School were asked to comment on their views about communicating their mathematical thinking and strategies with peers and teachers. City students regarded the communication of mathematical thinking and strategies as extremely important for their learning and were very articulate in explaining the reasons for their views. Further information gathered from the school helped to explain why City students were so aware of the importance of mathematical communication. For some years, the school had been working towards developing assessment practices that put student learning at the centre of its teaching. As part of this process, students were expected to communicate with their teachers about their learning goals and reflect on how well these were met. The school's emphasis on strengthening teacher–student relationships and encouraging self-responsibility in students seems to have played a major role in helping students appreciate the importance of reciprocal communication in mathematics learning.

There has been increasing concern over recent years about disparities in students' achievement and what can be done to address the learning needs of students more effectively. Analysis of the major sources of variance in students' achievement has identified teachers as the single biggest factor (apart from students themselves) in explaining the variance in achievement among learners (Alton-Lee, 2003; Hattie, 2002). According to the meta-analyses of Hattie, teachers account for about a third of the variance in students' achievement, whereas other factors such as home, school, and peer group explain no more than 5–10 percent each of the differences in achievement among students. The growing recognition of the importance of teachers has led to considerable research on what it is that teachers do that can make the difference for their students. However, a problem with research such as this can be that studies are done in isolation from one another, even though there is often great potential for making links between related studies.

The Teaching Learning and Research Initiative (TLRI), a recent initiative by the government, was designed to fund research projects involving partnerships between teachers and education research experts. The goal of the TLRI was "to find out what works in terms of lifting student achievement, and then to apply those lessons in the real world so students do actually enjoy the benefits" (Mallard, 2003). One of the first projects to be funded through the TLRI was Great Expectations (GE), a project directed by Dr Mary Hill that focused on "enhancing learning and strengthening teaching in primary schools with diverse student populations through action research". The GE project involved teacher researchers from six schools in the Waikato/Auckland region investigating how teaching and learning can be systematically improved, and how expectations are implicated in this (Hill & Robertson, 2004a, 2004b). Each of the six schools chose a different area of particular concern to its teachers, including information and computer technology, literacy, numeracy, teacher professional development, and assessment.

The director of the GE project was approached by me to see whether she would be interested in the possibility of linking the GE project with the Numeracy Development Project (NDP)

evaluation research. She was enthusiastic about the way that this could enhance both studies and invited me to present a proposal to teachers in the GE project. City School was one of two local schools invited to participate in the study of perceptions and dispositions towards mathematics learning. The students from City School had been very articulate about their mathematics learning and about the importance of communicating with others about mathematical thinking and strategies. Further information was gathered from the school in order to understand better how City students had come to have such views and insights into their mathematics learning. The research question that guided this particular study was:

> How is one school's involvement in an initiative designed to raise teachers' expectations of achievement related to students' perceptions and dispositions towards learning mathematics?

Method

Participants

The participants in this study consisted of 27 year 5 and 6 students (15 boys and 12 girls) in three classes at City School, an urban school of about 400 pupils serving a medium socio-economic status community (decile 5). Nineteen of the students were Pākehā/European, three were Māori, four were Asian, and one was of Pasifika ancestry. The students were selected by their teachers from a range of stages on the New Zealand Number Framework. The Principal and Deputy Principal were key informants for the second part of the study, which explored the reasons for students' views.

Procedure

Students were interviewed individually in a quiet place away from the classroom. They were told that the interviewer was interested in finding out more about "how kids learn maths and how their teachers can help them" and "what kids themselves think about learning maths". Students were asked to comment on a range of topics, including the importance of working out problems mentally, of getting answers correct, and whether they thought there was only one way or several different ways of working out an answer. They were then asked the following questions and the reasons for their responses:

> Do you think it is important for you to know how other people get their answers?
> Is it important for you to be able to explain to other people how you worked out your answer?

Interviews were transcribed for later analysis. Once the interviews were complete, the school was asked to identify each student's current stage on the Number Framework used as part of the NDP assessment. This information was used to categorise students as *high* (at stage 6: Advanced Additive Part–Whole or above), *middle* (at stage 5: Early Additive Part–Whole), or *low* (at stage 4: Advanced Counting or below).

Results

As Young-Loveridge, Taylor, and Hawera's paper (p. 97 in this compendium) has shown, 21 out of 27 City students thought that it was important to know how other people worked out the answers to their mathematics problems. The remaining six were equally divided between disagreeing with the idea that knowing how others solve problems is important (three), and being unsure about what they thought (three). When the students were asked about the importance of explaining their own solution strategies to others, the level of agreement was also

high (20 out of 27). Only two students seemed sure that explaining their thinking to others was not important, and the remaining five were unsure. When the students were asked to explain the reasons for their initial responses, City students gave very detailed answers. Their responses were organised into four major sections, as detailed below.

1. Knowing others' strategies is important

The responses of students from City School were notable, not just because more of them thought that knowing about others' strategies was important, but also because they were very articulate about their reasons for holding particular views. They tended to refer to multiple advantages of knowing about other students' strategies and were able to elaborate about classroom learning processes:

> Because it might help you in working out your ways, because you might be working out a really difficult way but you're not knowing it, and then somebody else shares something with the class, and then it would be really good because you would then find out that you might be able to use that way. (C1, girl, middle)

> Because it can help you grow and develop because if you are always just doing your way and never seeing anybody else's way of doing it … Sometimes when you are stuck, other people's ways can help you, 'cause one time … my way didn't work for it, and then I just sat there and thought about some other people's way and one person's way helped me solve that problem. (C2, boy, high)

> Because other people may have different ways and you can learn off them and you maybe get better and better. (C18, boy, low)

> It could help your learning by getting better, if they can show you how they got to work it out. Sometimes you can get very confused about what other people say, but it's good to hear their learning because sometimes it's most likely to help your learning as well. (C19, girl, low).

2. Knowing others' strategies is <u>not</u> important

Only three students from City School were clearly of the view that knowing about other people's solution strategies was not important. Two of them, assessed by their teachers as being low in mathematics (that is, at Stage 4 Advanced Counting), referred to privacy issues:

> Because it's their own business how they do it … It's not important for me because I know my own way to work things out. (C15, boy, low)

> Because it's their way they do it, you don't have to, 'cause it's really none of your business. (C26, girl, low)

3. Explaining one's strategies to others is important

The majority of students from City School thought that explaining their thinking was important and gave detailed explanations of their reasons for responding positively to the question. For example:

> Because it's good that I know how I worked out the answer first of all, and it's good 'cause I like sharing my ideas with other people and my point of view of how I can work it out, and so if I say my way and another person tells their way and their way's a bit easier, I can just try it their way, and then you get lots of different ways by telling your one, then other people go "I've got a simpler way of doing that", so it helps you to learn. (C2, boy, high)

> It's helping my learning as well, so it's good to share what your side of the story is. (C19, girl, low)

> Because sometimes people ask you how you did it, so you've got to know how you did it, so before you take their answer, you say the answer, you think about how you did it. (C20, boy, high)

4. Explaining one's strategies to others is <u>not</u> important

The two students who did not think it was important to explain their strategies to others talked about the importance of individuality as their reason:

> Because they could have their own way to work it out. (C15, boy, low)

City Students' Perceptions of the Numeracy Project

Although the interviewer had not set out to ask explicitly about students' experiences of the NDP, several students spontaneously referred to the project. A decision was made then to ask students to comment on: "What do you think about this ANP [Advanced Numeracy Project] programme you've been doing in maths?" Unlike same-age peers in a previous study (Young-Loveridge & Taylor, in press), City students were aware that they had been "doing" the NDP and were happy to comment.

> We've done ANP and that was fun because the best part I liked about it was that we could, we learnt more and that we had enough time to do what we wanted … We got to use blocks, we had heaps of maths games about it and we still play them now. (C15, boy, low)

> It has made a big difference … It's shown me easy ways to work things out and it's helped me to remember things and it's shown me some patterns and things. (C16, girl, high)

> I know about this ANP thing … I think it's good in some ways, but sometimes it can be a bit tricky and hard to understand, but in a good way, it's alright to learn. (C19, girl, low)

> It teaches you different strategies to answer a question and easier ways. (Asked if she thought it was better than the way she was doing before?) Yes and no, because there are some parts that sort of, don't exactly, they're just sort of lengthening the questions and yeah, it's quite good. (C21, girl, high)

> I think it's easier to learn things than with the old maths because I think more people are generally happy with that because it's sort of just fun and also it's got lots of good ways to work it out, like doubling up. (C23, boy, high)

> I think it's different and it makes your brain think a bit more about the equation rather than just doing it one way, it makes you think a bit more about it which is good I think, because you should really know a few ways to work it out or something like that. (C24, girl, middle)

> It helps way better. Way more … Well it actually tells you the questions and makes sense and so gives you a little bit of detail and doesn't really tell you much about it, you can really use it to help you. (C26, boy, middle)

> Well, it gets you learning and it shows you different ways of how you can add stuff. (C27, girl, low)

> I think it's cool because we get to use equipment and it makes maths easier. (C28, girl, middle)

The School's Perspective

Further information provided by the school helped us to make sense of the ideas that students shared with us. This information included discussions with the Principal and Deputy Principal about what they have been trying to achieve in their school and writing by the DP on aspects of the school's practices as part of her Masters thesis. Both stressed that they were speaking not as individuals but on behalf of the whole management team, which had spent considerable time brainstorming ideas as part of developing school policy and practice. The management team had previously been involved in a Ministry contract that focused on assessment and learning.

According to City staff, it is the culture and climate of the school that is its distinctive feature. They believe that "teachers feel supported in the school". They commented on the pride staff feel about their relationships with students: "We are keen to communicate with students openly and honestly." … "Students know the school listens to them – they trust us." They talked about both staff and students having an ethos of self-responsibility in the school, with the management team providing a model to all members of the school community. They remarked on the importance of having strong leadership within the school and about the fact that the school is a "non-judgemental environment" where staff can reflect on their practices honestly, with a view to addressing any problems as part of an ongoing process of improvement. They commented on the importance of distinguishing between responding to students' learning needs and delivering the curriculum. They made it clear that students' learning needs have a very high priority at City School. There was also discussion about the focus on the behaviour management of students, and the way that this has an impact on classroom learning. Previously, a more punitive model had been used, with negative consequences for unacceptable behaviour. A conscious decision had been made to take a more positive approach to behaviour, emphasising virtues, values, and overall social development, with the goal of fostering self-regulation of behaviour in students. This was described by City staff as a "solution-oriented focus".

Another important practice at City School was the use of "learning logs" (a book in which comments about a student's learning were recorded) as a way to get students to think about their learning. The students were helped to write about their "learning intentions" in the learning log, and later to select pieces of work to include in the learning log that showed how well they had met their learning intentions. Staff described the way that the students had to "talk about their learning and relate it back to their learning intentions".

A deliberate decision seems to have been made at City School to try to reduce the power imbalance in the relationships between teachers and students. As Cullingford (1995) has pointed out, "the difficulty for children is that schools automatically put all the power into the hands of teachers" (p. 2). Some schools, however, are moving away from having teachers hold an authoritarian role over their students towards building more collaborative relationships in which goals are negotiated with students. The emergence of the learning logs seems to have played an important role in this shift towards more democratic relationships with students. According to City staff:

> What the learning logs have sparked for us really is the importance of the teacher–student relationship and the power that teachers have traditionally held over students, and the ways we've been breaking that down, working on that, anyway. [We] think that's probably why you've had the sort of feedback from our students that you did.

It appeared that City School's involvement in the NDP had come at an opportune time (teachers at years 5 and 6 participated in 2004, and those at years 1–4 the previous year). The teachers had already established a climate within the school in which students were expected to converse with their teachers and with other students about many aspects of their learning, and this was happening across the whole curriculum. The idea of discussing ways of thinking and strategies for solving problems in mathematics was not new to teachers at City School, in contrast to many other teachers participating in the NDP. These kinds of conversations with students were already part of accepted practice in the school across all areas of the school curriculum. City staff spoke about the way that the philosophy behind the NDP fitted very well with what was already happening at City School in curriculum areas apart from mathematics.

> ANP and ENP have had a huge influence, and our staff love it, they just love it … It fits in with the way we work with kids.

An Independent Perspective on the School

A report from the Education Review Office (ERO), based on a review conducted just after we interviewed the students, was made available to the school earlier this year. The ERO report is useful here because it provides an independent view of the school that corroborates the perspectives of City staff as well as the students' views on what is happening in their school. Because it is a written report, it provides a permanent record of the practices evident at City School at the time of the review. The following excerpts from the ERO report helps to capture the character of City School. The ERO report commented on the learner-centred approach to student assessment, including the role of self-responsibility by students:

> A comprehensive range of assessment practices is well used to identify needs, monitor progress and report on achievement of individuals and groups of students. These practices involve teachers using a variety of standardised and diagnostic testing tools to accurately determine individual learning needs and inform planning; teachers making wide use of aspects of formative assessment to monitor learning and provide feedback to students; learning logs for all students which highlight learning intentions and reflect the use of self, peer and teacher and parent feedback; analysis of achievement information at syndicate level that is effectively used to develop annual action plans to target learning needs; and procedures through which parents are well informed about learning progress and achievement levels of their children.
>
> A feature of the school is the emphasis on student achievement and strategies to improve learning for all students. Teachers are setting challenging benchmarks for student achievement in literacy and numeracy … Students are achieving well and school benchmarks have been raised to recognise this achievement and progress.
>
> A central focus of school operations is strengthening students' ability to learn and achieve. An emphasis on the 4R's of resourcefulness, resilience, reflection and relationships encourages students to be actively involved in the learning process. Students take responsibility for their own learning and supporting the learning of others.

Quality teaching was also referred to in the report:

> High quality teaching is evident school wide with several examples of outstanding practice. Teachers are hard working, committed and plan and organise programme information by an analysis of relevant student achievement data and current best practice. Teachers are encouraged to be reflective practitioners, and to focus on teaching to the learning needs of individual students. Effective professional learning opportunities and a rigorous performance management system support teachers to continually improve teaching practice.
>
> Planning, classroom organisation and the effective use of a variety of teaching strategies are informed by relevant student achievement data and current best practice and research. Appropriate and effective grouping based on the identified needs of students is evident particularly in literacy and numeracy.

The report also commented on the overall climate within the school and the importance of relationships between students and their teachers.

> A positive climate prevails across the school, with warm, constructive interactions between and among teachers and students. An effective behaviour management system based on courtesy, consideration, co-operation and common sense underpins relationships throughout the school. Students are well taught in stimulating, well-resourced classrooms and demonstrate high levels of on-task behaviour.
>
> The school's focus on the 4 C's of courtesy, consideration, co-operation and common sense underpin positive relationships between teachers and students. Students are actively engaged in learning.

Discussion

The comments of the Principal and Deputy Principal, as well as statements made in the report by ERO, all help to put the responses of City students into a wider context. It quickly became clear from discussions that staff at City School had been working over many years to shape its philosophy and practice and to ensure that student learning was its central focus. Threading through the comments of City students and their teachers was a clear commitment to democratic decision-making processes within the school. City students were expected to show initiative and responsibility in relation to their own learning. Students tended to see their teachers in a "mentor" role, as sources of help and assistance who could be consulted whenever the need arose, rather than as authorities who disseminate knowledge (Blumenfeld et al., 1997; Nuthall, 1997). There was a strong sense of agency evident for both teachers and students, and this was accompanied by feelings of ownership about the learning, particularly for students. Being members of several professional learning communities committed to improving students' learning and raising achievement (for example, school, GE team) has probably further enhanced the professional learning of City staff (Camburn, Rowan, & Taylor, 2003; Copland, 2003; Little et al., 2003).

Ideally, it would have been good to make links between what happened in classrooms and improvements on the Number Framework, as assessed by the diagnostic interview. Unfortunately, changes in staffing meant that a decision was made not to gather final assessment data from two of the year 5–6 classes. The result was that there was complete data from only half of the initial cohort, and it did not make sense to proceed with the quantitative analysis.

Further insight into the way City School "does things" could have been gained by doing classroom observations as well as having conversations with the students. This would have allowed the interviewer to talk to the students about specific activities and events that had happened within the classroom mathematics programme and to explore the students' perspectives on those activities and events, as well as asking about the "general". It might also have been valuable to talk to younger students (that is, years 3–4) about their views.

Some might argue that City School is atypical, and hence the findings cannot be generalised to other New Zealand schools. However, City School provides a powerful and telling example of just what can be achieved in a school when the conditions are favourable and staff are committed to changing their practices in order to improve learning. What is clear from this account of City School is that bringing about change in how schools teach mathematics is a hugely complex and challenging issue. Consideration needs to be given not just to what happens in the classroom during a mathematics session, but also to the wider perspective of the school as a whole, including the overall climate and practices of the school (Hiebert et al., 1997).

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