

Improving the Effectiveness of Mathematics Teaching through Active Reflection

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A small study of active reflection was undertaken with 21 primary students in a Prep and Year 1 classroom. To provide feedback from the students on their views about their personal learning and ways they could be better supported to learn mathematics a simple survey was supplemented by one-to-one interviews. Students' perceptions of their learning of mathematics, their identification of the mathematics they were learning; and what they felt would better cater for their learning needs. Ongoing reflections by students and the teacher throughout the year provided further data for consideration. The findings show that young students are self-aware, they understand what they are learning and they have ideas about ways their teacher could support their learning. These findings fed into the teacher-reflection process and professional learning, which in turn led to some changes in classroom practice.

Introduction

To improve my practice as a teacher, I became involved in a Teacher-Led Research project. This research was underpinned by the *evidence-based professional learning cycle* (Timperley, 2008) where teachers measured the impact of their professional learning on their practice. My aim was to inquire more deeply into my practice in an attempt to understand how to improve student learning. This paper reports the results of an aspect of the work that we were doing as a school community involving active reflection, based on feedback from our students.

My research question was: What do I need to do differently in my teaching practice to address the perceived needs of my students in mathematics? In the words of Hattie (2012), "my role, as a teacher, is to evaluate the effect I have on my students ... it is to understand this impact, and it is to act on this knowing and understanding" (p. 19). This requires gathering "defensible and dependable evidence from many sources" (p. 19). The evidence gathered included results of a survey, interviews and classroom observations.

Background

Reflective teacher practice is a topic that has long been explored by researchers (Shulman, 1986; Shulman, 1999). It is suggested that teachers learn "via disciplined critical reflections of their own practice" (Shulman & Shulman, 2004, p. 258). Shulman pointed out the importance of learning from our experiences and suggests that "critical analysis of one's own practice and critical examination of how well students have responded are central elements of any teaching model" and "at the heart of that learning is the process of critical reflection" (Shulman & Shulman, 2004, p. 263-264). Accomplished teachers are capable of learning from their own and others experiences through active reflection according to Shulman.

Absolum also used the term 'active reflection' and suggested that this applies to the teacher, to the student, and to both taking time together "to think, review and enhance the learning process" (2006, p. 23). Through a learning-focused relationship with students "the student focuses on what has to happen *now* that will best help me learn?" and "the teacher

focuses on what do I need to do *now* to best help this student learn?” (Absolum, 2006, p. 28) Teachers are, as a profession, very reflective considering whether their students are learning as well as they could and what adjustments they might make to their teaching to support the learning even further (Absolum, 2006). Teachers constantly make decisions based on reflection about class management, activities and resources and their students. A major OECD study points out that, “individuals who are reflective also follow up such thought processes with practice or action” (OECD, 2005, as cited in Absolum, p. 143).

Through reviewing and reflecting, problems can be identified and something can be done to resolve the situation. If teachers are to establish a firm foundation for improved student outcomes, they need to “integrate their knowledge about the curriculum, and about how to teach it effectively and how to assess whether students have learned it” (Timperley, 2008, p. 11). Teachers can then respond constructively to what the evidence is telling them and make the necessary changes to their practice, and as they “take more responsibility, and as they discover that their new professional knowledge and practice are having a positive impact on their students, they begin to feel more effective as teachers” (Timperley, p. 9, 2008).

My purpose in collecting the data reported here was to consider ways in which I could further support students learning of mathematics, thereby becoming more effective. I was able to do this through my own reflection on the teaching and learning process, the adjustments I made, and how I taught my students “to use reflective strategies to strengthen their own capacity to learn” (Absolum, 2006, p. 143).

Methodology

Three data sources were collected and examined for this research: an initial student survey determined student needs, feelings and beliefs about their learning in mathematics, a five minute video of a semi-structured student interview with a subgroup of 7 students, and regular daily student reflections following mathematics lessons. The daily reflections were continued throughout the year. These daily comments by the students enabled me to reflect on the teaching and learning in my classroom and to consider what I needed to do to better support the learning and what adjustments I needed to make to suit individual needs.

Survey Design

Data collection began with a survey to gauge how students felt about learning mathematics. It was administered early in the school year to one class of Prep/Year 1 students, 11 students in their first year at school (Prep) and 10 students in their second year at school (Year 1). There were 10 male and 11 female students. The purpose of the survey was to establish how students felt about their learning in mathematics; whether they could identify the mathematics they were learning and whether they felt I, as their teacher, could better cater for their learning needs. The survey was designed to be easy for younger students to interpret and quick to complete. I read each question aloud, students completed a Likert scale by colouring one of four faces ranging from smiley to sad (see Table 1). A scale of four options was chosen to prevent students who were unsure selecting the middle option as a default.

Video Interviews

The week following the survey, seven students were selected as a subgroup, representing a range of mathematical thinking and experiences across the year levels, for

video interview, to elaborate their written responses. Survey questions were revisited and additional questions were included during semi-structured interviews. Examples of additional questions were, ‘Do you feel like you can extend yourself’ and ‘What do you do when you have tried something and it doesn’t really work?’

Table 1
Collated survey results (n= 21)









Class Survey				
Colour the face that shows how you feel.				
1. How do you feel about learning mathematics?	15	3	0	3
2. Do you always know what you are learning?	9	8	2	2
3. Do you know when you are successful?	10	6	4	1
4. Does your teacher help you to learn?	14	4	1	2
5. How do you feel when something is difficult?	8	4	2	7
6. How do you feel in our classroom?	17	2	0	2

Table 2
Interview group results (n = 7)

Distribution of responses of subgroup of students.				
Colour the face that shows how you feel.				
1. How do you feel about learning mathematics?	4	2	0	1
2. Do you always know what you are learning?	3	3	1	0
3. Do you know when you are successful?	5	2	0	0
4. Does your teacher help you to learn?	4	2	1	0
5. How do you feel when something is difficult?	2	2	1	2
6. How do you feel in our classroom?	4	2	0	1

Student Reflections

Classroom-based student observation data were videorecorded two to three times weekly throughout the year, during or at the conclusion of the mathematics lesson, as students reflected on their learning. In total 120 videos were collected. These videos were viewed, some were transcribed and all were analysed to determine patterns and similarities. This provided valuable feedback and evidence that facilitated my reflection and gave me direction on how I could better cater for student learning needs. Students were deliberately introduced to and provided with a variety of prompts to support this. Some examples of prompts included:

- What am I most pleased with in my learning today?
- What did I find tricky and why? What did I do about it?
- Where do I need to go next with my learning?
- How could the teacher have helped you more?

Findings

Survey responses and elaborated interview responses gave a sense of students’ perceptions about learning mathematics and insight into individual students’ feelings and

attitudes at the beginning of the school year, while classroom observations of student reflections provided feedback that assisted my reflection and continued throughout the year.

As evidenced in Table 1 most students surveyed enjoyed learning mathematics. The three students who were unhappy were often provided with extra support in the mathematics classroom. Seventeen (80%) students felt that they knew what they were learning and when they had achieved success. Eighteen students (85%) felt that the teacher helped them to learn. Nine (43%) students felt neutral or sad when they encountered difficulty. It is interesting to note that 4 (19%) students felt neutral when they encountered difficulties and 8 (38%) felt positive. Results from the subgroup of students are presented in Table 2 for comparison. The summary shows similar distribution patterns to the whole class results.

Analysis of the interviews provided insights as the students elaborated their survey responses. It became clear that the seven students in the subgroup had a sense of where they saw their learning in mathematics going and how I as their teacher could help them. For example, Ben said, "You could help me learn higher numbers and then I could try and plus them." Nina suggested, "Maybe you could just tell me what the whole thing was again because sometimes I forget." All seven students agreed that they knew what they were learning by referring to the whiteboard or being a good listener. Literature supports (Clarke, Cheeseman, Gervasoni, Gronn, Horne, McDonough, & Rowley, 2002) the idea that if a teacher has a clear focus and if the children understand the purpose of the lesson it is likely to lead to a better understanding and better learning outcomes.

All of the subgroup of students knew that it was important to learn mathematics and felt happy that they could extend themselves through prompts offered. For example, Zena said, "If we are choosing numbers, sometimes we choose an easier number, or a bigger number to challenge ourselves." Four of the seven students preferred to work with a partner and all students expressed the need to persist when things get tough. Some of their comments included, "I just try again" or "I just have a go of doing it" or "I try my own way." One student's responses are highlighted below.

The Story of Eric

Eric (aged 6 years) was selected for interview as one of a subgroup. He began the year with reluctance and had difficulty settling into the school routine. The fact that he was very nervous and hesitant when sharing his thoughts with the class, made his story even more interesting. Eric had a limited understanding of number and could not count past 13. However, during his interview Eric expressed a liking for mathematics, particularly learning how to count and working with a partner. He felt that his learning was progressing well because he listened a lot and knew what I was saying. Eric knew that if he had "done a lot of work" he was successful. He knew that you need to learn mathematics because "if you don't learn maths you won't be smart" and he thought that I could help him more by telling him what to do when he "got the stuff mixed up." When asked, "What do you do when you have tried something and it doesn't really work?" He replied, "I look at the page what (sic) I've done and it hasn't really like been all done. I fix it up and try and remember what we did." In other words Eric would try to evaluate his thinking by interpreting what he had done, review it and then think back to what was expected of him, and try and complete the task. This reflection process demonstrates some interesting thinking for a young student and was one of the many pieces of evidence that I reflected on.

The third source of evidence were the daily reflections by the students based on how they saw their learning in mathematics was progressing and how they felt their learning could be improved. On each occasion students responded to one of the reflective question prompts. This daily feedback led me to act to better support my students. One question I used weekly is, “*How could the teacher have helped you more?*” This is the underpinning question of the project.

As I reflected on the student’s comments some interesting patterns and similarities arose and seven themes emerged from the data. These elements contributed to and continued to inform decisions I made as to how to be a more effective teacher. Each theme will be discussed in the section that follows.

Provide a Variety of Prompts, Models, Materials and Supports. Feedback suggested that several students were lacking in confidence and needed support, not only when writing numbers or words when recording their findings, but also with skills. Nathan wanted help working out how much his numbers made altogether and Nina wanted help counting, “not by ones but by a quicker number.” These types of messages informed my future planning and practice. A variety of support was implemented through coaching, scaffolding, guiding and providing a range of mathematical models and tools.

Use a Variety of Assessment Tools. The difficulty that some students found with recording their mathematical thinking in writing indicated that alternate means of capturing evidence of mathematical growth and achievement were necessary, especially for students in the early years of school. As Eric expressed in his way, “If you are writing the words and if you can’t remember, it’s about holding it and if you are writing the number and you can’t really write it, it’s hard because you are doing two things at the same time.” Therefore in addition to students written work samples, assessment evidence was captured on video where students demonstrated their skills. Formal assessments such as the Mathematics Online Interviews were also used. Each of these provided powerful evidence and gave a very clear picture of mathematical knowledge and growth.

Maintain High Expectations of Students. Some students expressed the need for more of a challenge and needed to be provided with further opportunities that allowed them to “gather, discover and create mathematical knowledge and skills” (Siemon, Beswick, Brady, Clark, Faragher & Warren, 2011, p. 14). Ben desperately wanted to work with bigger numbers and Eric wanted to learn “to count to numbers like the grade sixes count up to, like one thousand.” These responses reinforced the fact that high expectations for all students, even those who experience difficulty, are important.

Choose Quality Tasks that Challenge and Allow for Differentiation. It was obvious that “for worthwhile learning in mathematics, students need mathematically appropriate, engaging and challenging tasks” (Roche, Clarke, Sullivan, & Cheeseman, 2013, p. 32) that encourage students to think deeply and problem solve. Eric suggested he would have liked to work with more three-digit numbers and not just two-digit numbers in subtraction. This comment reinforces the importance of choosing mathematical learning experiences, which can be differentiated, and “specifically plan to support students who need it and challenge those who are ready” (Sullivan, 2011, p. 27).

Encourage Persistence. According to Roche and Clarke (2014) the term ‘persistence’ can be described as “actions that include concentrating, applying themselves, believing that they can succeed, and making an effort to learn” (p. 3). Responses from these students indicated they were willing to persist. They demonstrated this in several ways. When Ben

was faced with a struggle he commented that instead of asking for help “I tried to make the idea different and tried my own way.” Encouraging persistence, promoting effort and allowing students to persist help them to see it as valued. A further example of this was demonstrated when Eric admitted to continuing to work, “While you said we had to come to the floor,” because he desperately wanted to solve the problem.

Provide Clear Instructions, Highlighting the Focus and Expectations. Feedback from Zena suggested that I “could explain the work better” and Nina thought I could “say it two times so we know and we don’t do the wrong thing.” Keeping in mind that I purposefully “hold back from telling them everything” (McDonough, 2003, p. 34) and “setting up tasks with a certain amount of uncertainty in how they have to go about the task is a way to make them engage mindfully and bring their sense making to the activity” (Askew, 2012, p. 108). As a result of this feedback emphasis has been placed on more specific and engaging whole class introductions with interactions between the teacher and the whole class.

Create a Learning-Focused Relationship with Students. Fundamental to this project was the notion of a learning-focused relationship where “both the student and the teacher know that by working together the quality of student learning will be much better and the standard of achievement much higher” (Absolum, 2006, p. 28). I established a relationship with these students “based on openness, honesty and mutual respect” (Absolum, 2006, p. 142). Reflecting and acting on student responses in an environment where students felt supported in their learning emphasised that learning was valued in this classroom. Jack pointed out, “At the start of the year I was pretty scared to do it, but the more you do it the better you get,” which indicates his increased confidence over the period of the project. Terri summed it up by saying, “You have to co-operate and work together.”

Discussion

This study demonstrates how active reflection by the teacher can enhance the learning process of students and teachers. While there are limitations of sample size and scope in these data, I would argue that it is possible to learn from the findings. Another constraint of the study may be that student interpretation differed to an adult view. However, the reflective processes and the student responses provided a starting point for me to reflect and act. As the teacher it was my responsibility to make changes to my practice in the light of the students’ feedback and decide what I could do better. I was also challenged to discover any unproductive beliefs that I might hold in relation to effective conditions for learning.

Survey results at the beginning of the year indicated that 85% of students enjoyed learning mathematics, however 15% felt less positive and 10% of students felt unhappy in the classroom. This was one aspect that I attempted to change through careful planning, assessment and preparation of resources to support those students who needed it. Interestingly 15% of students felt I needed to do more to help them learn. This then led me to investigate student opinions in more depth.

Through semi-structured interviews students were encouraged to elaborate further on this, as well as other aspects. Several students suggested they would like their learning extended and could give examples of what it was they would like to be able to do, for example, learn how to count to 100 or learn how to count by 3s. Surprisingly when presented with a challenge they claimed they were not discouraged and were able to express several ways of over-coming this. Responses such as these provided direction and

increased my awareness of how and what I needed to do to adapt to provide opportunities for these students to feel challenged, but at the same time supported. By offering enabling and extending prompts and posing tasks that created a challenge I was able to support those experiencing difficulty and extend those that needed it. One of my students, Eric shared the fact that he wanted to learn to count to 100 and through support such as this he was able to count past 100 by the end of the year, with confidence.

Reflecting on my practice prompted me to make small changes to practice, and observe resulting improvements in student outcomes. “When this happens, teachers come to expect more of their students—that they will learn more quickly or deeply than they had previously believed possible” (Timperley, p.18). Eric’s story is evidence of this. Following the initial interview there was a dramatic improvement in Eric’s confidence and his willingness to reflect and clearly articulate his feelings and achievements. He confidently self-assessed his work and was extremely motivated to achieve his goals. He could express where he needed to go next with his learning and was always eager to contribute to the class plenary, and frequently selected his own reflection question. His increased confidence and enthusiasm when he reflected on his learning was inspiring and rewarding to see. By the end of the year he had been assessed as operating six months above expected level. He could confidently count by 2s, and 5s and 1s and 10s past 100. He could read, record and order two and three digit numbers. As a result of attending to student feedback, careful consideration went into planning appropriate tasks and scaffolds such as labelled photos of classroom resources and displays of key words and numbers were used to support students like Eric to facilitate their effective learning.

Evidence was provided on how the teacher could cater better for student needs through opportunities for students to reflect on this and further learning became evident. Initially this took time to establish in the classroom. While I acknowledge that there is a concern that this is my classroom and these are my students, nevertheless the feedback that I received is worthwhile and substantially influenced my planning and reviewing of mathematics lessons. Students as young as six can reflect on their own thinking when asked to do so with familiar material (Schraw & Moshman, 1995).

The messages I received from my students as they reflected actively on their learning are important in relation to promoting effective teaching and learning. It is important that reflection by both the teacher and the student happen over the course of each lesson: whether at the beginning, throughout the lesson or at the conclusion. Some obvious frustrations that were experienced by some of the students in relation to recording, feeling suitably challenged, and obtaining clear instructions were highlighted, and as a result I made adjustments to my planning and teaching, responding to their feedback.

Through active reflection I was able to consider the successfulness of the lesson in terms of student engagement, appropriate challenge, strategies used by the students, and intended learning. I examined my practice in light of listening to my students.

While there is a need for teachers to impart information ... and while teachers do and should know more than students, there is a major need for teachers also to listen to the students’ learning. This listening can come from listening to their questions, their ideas, their struggles, their strategies of learning, their successes, their interactions with peers, their outputs, and their views about the teaching. (Hattie, 2012, p. 163)

Reflective questions can often reveal the complexity of what is happening in the classroom and give students the opportunity to be heard. Responses the children provided enabled me to see “learning through the eyes of students” (Hattie, p. 14) and make necessary adjustments to facilitate effective teaching in mathematics.

Conclusion

This present study sought to investigate ways in which active reflection could be used to create the opportunity for improved teacher practice in mathematics. Daily reflection enabled me to promote and sustain the conditions to further support student learning. Throughout this study I adapted my teaching practice taking into consideration ways in which I could support students who struggled with understanding what was expected of them, who had difficulty recording their findings, and who needed help or extension. These improvements resulted from feedback and reflections from students. I have incorporated these elements into my practice and will continue to incorporate them into my planning. Being actively reflective empowered students to see the value of reflecting and the impact it has on improving the teaching and learning in their classroom. Thinking about the concluding remarks for this paper made me aware that not only has my practice changed as a result of active reflection, and the students have seen the value of active reflection, but in addition I realise that the habit of mind involved in active reflection has caused a change in the way I think about teaching and learning. Constantly in the back of my mind every decision I make is now based on the question: How could I be more effective?

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