

Using Student Data for Teacher Reflection

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Abstract

Current models of teacher reflection focus on teachers and their actions. Although useful to effect practical changes in teacher pedagogy, teacher-focused reflection does not necessarily support transformative change in which teachers challenge implicit intentions and move toward an emancipatory educational system. A practitioner-based research project conducted in a non-academic secondary mathematics classroom pointed toward the possibility of a learning-focused approach to teacher reflection by using the voices of students. Student data in the form of interactive writings, portfolios, and narrative interviews, framed within a pedagogical relationship, affected the evolution of a teacher's practice. Narrative inquiry amplified the voices of disenfranchised students and demonstrated a growing metacognitive awareness. Van Manen's (1977) reflective framework provides support for the use of student data to move teachers toward higher forms of teacher reflection. This article suggests that by listening to and learning from their students, teachers can transform their practice in significant and effective ways.

Introduction

Beekeepers are an opinionated lot, each sure that his methods, and his methods alone, are the proper ones. When I first began keeping bees, the diversity of passionately held opinion bewildered me, but now that I have hives in locations scattered over a thousand-square-mile area I think I understand it. ... I have learned that I must treat the bees in one yard quite differently from the way I do those even thirty miles away. The thing to do, I have discovered, is to learn from the bees themselves.

(Hubbell as cited in Ayers, 1992, p. 151)

A beekeeping metaphor might not be central to many educators' understanding of reflection, but it does contain some relevant elements. Many of our images of teacher reflection have been formed by readings and personal experience. As a result of the personal nature of those images, educators, whether classroom teachers or educational researchers, are sure that the method they use is the most appropriate. However, each teacher and each classroom is unique and teachers must develop strategies for reflection that are meaningful to the particularities of their practice.

Hubbell (as cited in Ayers, 1992) addressed these particularities in an important way – to learn from the bees themselves. I propose that by listening to and learning from the students in a classroom, teachers can enhance their reflective practice. Teacher reflection is an integral element in teacher development and teaching effectiveness. Reagan, Case, and Brubacher (2000) noted that “much of the daily work of the classroom teacher actually involves making judgements and decisions” (p. 19), which requires thoughtful deliberation and purposeful action to support student learning. Therefore, a focus on teacher reflection has been recognized as an important element to enable effective decision-making and improve teaching and learning in the classroom.

Although definitions of and methods for teacher reflection vary, some commonalities exist. Norlander-Case, Reagan, and Case (1999) described Dewey’s conception of reflection as analytically reflecting on an educational problem, and using rational thought to resolve the problem. Schön (1983) argued for the inclusion of teacher reflection as a professional action because professional knowledge (constructed through research and disseminated through publication) is not sufficient to guide teachers in coping with the complexities and uncertainties of practice. Schön’s (1983) description of reflection-in-action was a process of making sense of educational phenomena so that those understandings turn into something the teacher “surfaces, criticizes, restructures, and embodies in further action” (p. 50). In both cases, focusing on an educational phenomenon leads to making sense of the teacher’s thoughts and subsequent actions.

Other researchers (i.e., Cochran-Smith & Lytle, 1999; Mills, 2000; Noffke, 1995) have noted the interplay of reflection, inquiry, and action where teacher reflection was used as a foundational element for research in the classroom. Specifically, action research has become a research methodology used by teachers to rigorously inquire into their own practices. Action research is identified as a process where teachers “collect evidence and make decisions about their own knowledge, performance, beliefs, and effects in order to understand and improve them” (Gay & Airasian, 2000, p. 593). A teacher’s self-critical awareness often occurs as he/she attempts to understand his/her practice retrospectively (using teacher reflection as data) while looking forward to a more effective practice (Carr & Kemmis, 1986). Recording reflections on teaching is “an ongoing attempt by teachers to systematically reflect on their practice by constructing a narrative that honors the unique and powerful voice of the teachers’ language” (Mills, 2000, p. 63). This teacher-focused reflection provides opportunities for teachers to collect data that focuses on their actions and beliefs in order to impact their practice.

Teachers also engage in reflection on a daily basis without a formal research framing – a more informal approach of teacher-focused reflection that intends to inform daily practice. One form of teacher-focused reflection is reflection about teacher actions in the classroom, instructional strategies, or decision-making through the use of journals or logs (Artzt & Armour-Thomas, 2002; Reagan, Case, & Brubacher, 2000; Zeichner & Liston, 1996). Students’ thoughts and motivations remain unsolicited, as the focus remains on the acts of the teacher. Another form of teacher-focused reflection involves students in that teachers pose questions about their instructional strategies to their students (Henderson, 1992; McCaslin & Good, 1996; Parker, 1997). These examples of reflective models maintain a focus on teachers and teacher actions rather than student learning. This form of reflection results in changes to the practical and immediate. Changes in classroom processes prompted by informal teacher reflection can often be

seen on a technical level, making an evolution of teacher beliefs challenging. To inform and change teacher beliefs and practices, indeed to sponsor teacher growth and development, a teacher-focused approach to teacher reflection can be augmented through the use of student data.

In this article, I recommend that in order to inform and change teacher beliefs and practices, we need to consider a learning-focused approach to teacher reflection. In learning-focused reflection, data collected from students about their own learning is used by teachers to reflect on the effectiveness of their teaching. The focus draws student learning into direct view as the object of reflection to inform teaching practice and beliefs. While limited examples of learning-focused reflection have been presented in the literature, teachers did report that the use of student data informed their practices and prompted changes in their teaching (Buchanan, 1993; Cook-Sather, 2006; Whitin, 1993). The inclusion of student data encourages teachers to reflect in more meaningful ways, with the aim of transforming practice and beliefs. The data from this study provides an exemplar of how student data can support meaningful learning-focused teacher reflection. Specifically, the following questions are addressed: a) How can a shift toward teachers' use of student data be viewed as learning-focused reflection? b) How can learning-focused reflection transform teachers' practice and beliefs?

Theoretical Framework

Studies in teacher reflection often lead to the construction of new theoretical frames for understanding and developing teacher reflection. Existing theoretical frames can also be used to ascertain the effectiveness of a specific approach to teacher reflection. Van Manen (1977) created a hierarchical frame that explicated three levels of teacher reflection. This model can be used to notice shifts toward more effective and transformative forms of teacher reflection and is used to substantiate the analysis and interpretation of the data presented. In addition, this model supports the process of using student data to encourage teacher reflection. Listening to the voices of students within the form of student data is most effective within a relational pedagogic framing. This pedagogical approach encourages a caring teaching environment to enable opportunities for teachers and students to be in conversation with each other about the learning process.

Van Manen's Model

At the first level of reflection, teachers engage in practical reflection. Teachers focus on technical aspects of teaching, such as classroom management or selecting and implementing specific instructional strategies. Practical reflection seeks to describe the educational phenomena and it exemplifies a teacher-focused approach to reflection. Zeichner and Liston (1996) described a technical approach to reflection as ineffective because teachers locate the problems within the students rather than questioning their own beliefs and assumptions.

As teachers engage in interpretive reflection, they move towards a second level of reflection. In interpretive reflection, teachers focus on analyzing the meaning of experiences in the classroom and the interpersonal nature of teaching and learning. Interpretive reflection seeks to understand the educational phenomena. This level is consonant with Schön's (1983) conceptualization of

reflection. Valli (1990) recognized that “reflection becomes a necessary condition for the caring relation and community” (p. 44). It is within the analysis of the meaning of experiences that a teacher can come to understand the relational aspect of teaching and learning. As well, reciprocity of reflection needs to occur, in that a caring relation is completed when students respond to the listening and caring for that a teacher enacts when in relation with her/his students. Noticing and cultivating caring relations occurs within the interpretive reflective level, valuing the interpersonal nature of teaching and learning.

The third level of reflection in van Manen’s model, critical reflection, focused on political and ethical issues in the classroom and striving for emancipation from oppressive forms of authority. Critical reflection seeks to disturb and change the underlying assumptions affecting the educational phenomena. Parker (1997) extended this notion of critical reflection when he stated that “reflective teaching is emancipatory. It is concerned to *improve* practice rather than *collect* knowledge and to foster the rationality and autonomy of the teachers and the taught within a setting of democratic and liberal values” (p. 31). The notion of critical reflection is consonant with Freire’s (2000) conception of praxis, where reflection and action are intertwined in order to transform interactions within a domain.

Listening to Students

The context in which meaningful, learning-focused reflection occurs needs to encourage the voice (Baxter Magolda, 1992) of each student in the classroom. Encouraging students to give voice to their learning requires a classroom that fosters risk-taking and provides a nurturing environment. Noddings’ (1984) philosophy of teaching is characterized by a caring relationship – a relational way of being with learners which invites them to enter into conversation with their teacher. Pedagogic seeing and listening demonstrates a caring ethic of teaching, respecting the complexity of the learner, of the teacher, and of their interactions. Van Manen (1986) attempted to describe what characterizes a teacher who really sees and listens to each individual child through vignettes. He understood that this “pedagogic thoughtfulness is sustained by a certain kind of seeing, of listening, of responding” (p. 12). In being receptive of another, there is a desire and necessity to see a student in multiple ways – as a learner, as a student, as an individual, as a human being. The knowledge gained from each of these facets of the relationship meld together to create a view of a learner that is full and complete. When a teacher draws on this intricate knowledge of an individual, to really listen, the learner can experience pedagogic listening.

The pedagogical relationship of teacher-with-learner is formed and reformed continually through a series of negotiations between both individuals. The verbal dialogue of a teacher with a learner in the context of classroom discourse or one-on-one, teacher observations of a learner, and the ongoing assessment of learning are all methods essential for teachers to construct a pedagogical awareness of a learner. Further, teachers can encourage students to write with them about content, their thinking, and their learning. It is in the writing between teacher and learner that an important facet of the relationship, of a personal and interpersonal nature, can be given time to grow and affect the pedagogic relationship (Mason & McFeetors, 2002). These data offer important contributions to encourage learning-focused teacher reflection which can move beyond the practical towards transforming teacher beliefs and practices.

Method

The data presented in this article was derived from a larger study that explored the ways in which students came to be successful in a Grade 10 Consumer Mathematics class that I was teaching. Through ongoing inquiry in my classroom, I had come to see two factors that fostered students' success: teaching as a relational and caring act (Noddings, 1984; van Manen, 1986), and a curriculum that provides opportunities to understand mathematical concepts (Manitoba Education, Training and Youth [METY], 2002).

Participants and Context

Situated within a Canadian suburban high school, the class involved in this research study was composed of 22 students with a range of abilities, motivations, and work ethics. Consumer Mathematics is a non-academic course that invites learners not intending to study post-secondary pure or applied mathematics to think and communicate mathematically through engagement in financial/consumer topics and skills/concepts used in daily life (METY, 2002). Most students who select Consumer Mathematics are students who have not succeeded in mathematics classes in the past, and who believe the course is accessible and will suffice as a mandatory mathematics credit. Approximately half of the students in this study had previously attempted and failed a Grade 10 mathematics course, while the remainder were in their first high school mathematics course after marginal success in Grade 9 mathematics.

Eleven students participated in the study on a voluntary basis. The research processes, such as the types of data collected and the relational nature of my pedagogy, were already part of the teaching and learning processes in the classroom. Because of the inseparability of research and classroom practices, all students in the class participated in all aspects of the research processes. In supporting the explication of learning-focused reflection, the voice of one participant, Karl, is amplified. Karl's example, among the other data participants, is useful in demonstrating learning-focused reflection because his particular success shares commonalities with the success of many of his classmates. The case study of one participant provides the opportunity for a thick description of one students' voice that can serve to transform practice and beliefs.

As I enacted Noddings' (1986) philosophy of caring within an educative context, I endeavoured to listen closely to the students in the classroom. The pedagogical relationship formed with each learner was informed by listening in multiple ways (such as classroom observations, individual conversations, written classroom artefacts) and built within a community of belonging (Craig, 1995; Romano, 2000). Practically, the instruction in the class was composed of exploring mathematical and consumer situations. These learning outcomes were addressed through inquiry (Borasi, 1992; Flewelling & Higginson, 2000) and discovery activities, as well as teacher-led instruction. Balanced and success-based assessment strategies were used (such as projects, small tests, and portfolios), which encouraged students to reflect on mathematics content and mathematical processes as well as their own learning.

Data Collection

Narrative inquiry, where narratives are constructed in order to interpret the lived experiences of individuals, provided the framework for this research study. Interpreting narratives is an ongoing process throughout the inquiry as the inquirer draws out themes from the data; these reconstructions, which are often supported by previously established theoretical models, are shared with the participants in order to confirm interpretations (Clandinin, 1986). Thus, this framework was consonant with my quest because of its reflective nature in telling and retelling the stories individuals are living. This provided the basis for both teacher and students to be thoughtful about teaching, learning, and their interactions with others. The relational nature of narrative inquiry provided a framing to make sense of the teaching and learning in the classroom, with the explicit purpose of “enhancing personal and social growth” (Clandinin & Connelly, 2000, p. 85). A retrospective look at my experiences as teacher through self-study (Conle, 2000) has provided an opportunity to document and analyze my growth as an educator.

The method of data collection respected the complexity and interdependence of the teacher and students in the classroom. Throughout the course, I authored daily field notes – a chronology of the class and personal reflections. These notes served to record specific interactions each day and tell the story of the teacher. The rest of the data collection occurred in three similar cycles over the duration of the Consumer Mathematics course. Within each cycle, students authored numerous data pieces in the form of interactive writings and portfolios. At the culmination of each data collection cycle, I authored a narrative of success for each student, which was the focus of a subsequent one-on-one interview.

Students authored interactive writing (Mason & McFeetors, 2002) entries in their mathematics journals or as test reflections. They responded to prompts that encouraged them to explore issues of the nature of mathematics, goal setting and studying strategies, and mathematical thinking in their mathematics journals, while test reflections explored issues of test preparation and mathematical thinking. For each of the pieces of interactive writing, I wrote replies to the students interacting with the students and their ideas. Students submitted eighteen interactive writings over the five-month semester course.

At the end of each unit of study, students created portfolios that were used to assess their learning. Each of the five portfolios submitted contained a test and five additional items of the student’s choice. These items were used to demonstrate the learning or growth that had occurred during the unit. The students communicated their observations of learning through three-sentence reflections for each portfolio item. At the end of each portfolio, students wrote an overview reflection which described their learning as a process. The students also assembled a final portfolio that invited them to notice and celebrate specific instances of learning success and more long-term learning progress over the entire course.

The teacher-student conversations were one-on-one informal interviews that were recorded and transcribed. Three conversations took place over the semester, one at the end of each cycle of data collection. The conversations focused on a narrative of success that I authored about each participant. I constructed the narratives by interpreting data collected previously, pointing toward the student’s success and the process by which I noticed their success. The narrative explicated a

student's success through the use of a general theme and pointed towards specific examples from classroom events, journals, and portfolios. In the conversations, students described these successful moments, found other examples of success, and confirmed the validity of the theme for their story of success.

Data Interpretation

In narrative inquiry, analysis and interpretation of data are conducted both while the study is in process as well as at the conclusion of data collection (Clandinin & Connelly, 2000). Interim data interpretation occurred while narratives of student success were constructed for each cycle of data collection. A particular theme of success was drawn from the data for each student, through synthesis of their lived experiences. The thematic interpretation was confirmed with each student during the interview, with clarifications made as the student pointed to specific moments of successful learning. In the case of Karl, his particular theme of success focused on his growing metacognitive awareness – being able to say things about his thinking and learning.

In stepping out of the research context after the all data was collected, a theme across student narratives was deduced with the support of six theoretical frameworks (Baxter Magolda, 1992; Belenky, Clinchy, Goldberger, & Tarule, 1986; Chickering & Reisser, 1993; Dudley-Marling & Searle, 1995; Romagnano, 1994; Weiner, 1972). The successes of the students were held up against the frameworks for the intention of drawing meaning from the experiences. Through categorization of commonalities and coding of the data, themes were drawn from the narratives holistically – a phenomenological approach to data interpretation (van Manen, 1990). Common themes emerged across the narratives, which were generalizable across cases (McFeetors, 2006).

In addition to narrative thematic text analysis of student success narratives, interpretation of the teacher's narrative also occurred at the end of the study. Through field notes, I documented my learning and growth in using a learning-focused reflection strategy that was informed through student data. In order to analyze the effectiveness of this form of reflection, I utilized van Manen's (1977) three-level model of teacher reflection: the model provided a framework with which I could come to understand my growth as a teacher as I listened to the emergent voices of my students. Coming to understand the experiences of students through their words prompted to consider the effectiveness of my pedagogy and sponsored the evolution of my beliefs and intentions. Thus, the following results are presented with respect to these three-levels.

Results and Discussion

In analyzing data from the study, one of the themes of student success that emerged was their development of metacognitive awareness (Schoenfeld, 1987). In the final narratives, the success of nine of the eleven students was connected strongly to metacognition. It was an element of the learning that I had consciously cultivated by encouraging students to be metacognitive in their interactive writings, and I modelled metacognitive thinking in my interactions with the students. The aim was to have students explicitly consider their thinking and learning.

The following excerpt is taken from the third narrative I authored about Karl's success. This narrative was selected because it represents the capstone theme of his success. Several elements of learning and being a student had changed for Karl over the semester including his ability to think about his thinking and learning and to describe it to his teacher. Consider the practical elements that could have contributed to the change in metacognition, the value of the endeavour, and the context in which it occurred (an educative system that implemented a mathematics course for disenfranchised students).

Karl's Goals for Math Class

The main character in stories, Karl, often goes through some sort of change during the telling of the story. Sometimes they are big changes and other times they are smaller changes, but either way changes are significant. This is your story about being successful in Consumer Math class. As the main character in this story, I'm not sure if you have changed or if the way you tell me things has changed over the semester. I would like to think more about that with your help.

...

When you described the difference between journal and activity questions and textbook questions, you talked about interesting and boring questions. You also mentioned that boring questions are difficult to answer quickly, because you are bored. But what I liked best was that you mentioned that interesting questions are questions where you *think*, and those are also the questions that help you learn new. But, as I thought more about what you said about thinking, I began to see that it wasn't necessarily an either-or. Instead, you were beginning to talk about the *quality of your thinking* and *your thinking about different things*. And it wasn't just *thinking about math* that you were doing, but *thinking about your own thinking and learning*.

I noticed the idea of *thinking about your thinking* when you talked about journals 8 and 9. You even mentioned that journals are a place where you "explained my thinking, of how I think of the answers." That first part is about *math thinking*. But when you made that statement, you were *thinking about your thinking*. You noticed that journal 9 made you go back and see if you "could remember what I was doing at the time I did the cell phone activity." You also mentioned that you're good at answering journal questions. I wonder if you believe you're good at the *math thinking* or the *thinking about your thinking*. Another example of *thinking about your thinking* is when you told me that explaining questions helps you "put my thoughts into order." It made me wonder if *thinking about your thinking* is something that you do on your own in math class.

Talking about your learning and success in math class is a very challenging thing, Karl. I think you've been improving at doing that over the semester, though. I noticed in our second conversation that you talked about many *different kinds of learning*. A good example is when you made a distinction between remembering and learning new. We looked at those ideas in both conversations. In the first

conversation, you used specific *examples* to try to make distinctions between reviewing and learning new. But by the second conversation, you could say that remembering was “trying to think of what I did in past years. And learning is going through new stuff and trying to learn it.” Instead of making it an either-or situation, like in our first conversation, you used *ideas* to describe remembering and learning new – and struggled with the idea that they both involve thinking. In your final portfolio overview, you chose to use the different ideas of learning new and remembering to *tell me about your learning* over the semester.

I have noticed that good marks are important to you still, but I have also seen a difference in the way you talked about your goals for math class. Is that how the main character of this story of success in math class has changed – in his goals for himself in math class, in his thinking or in his describing of thinking? It made me wonder, Karl, if you are getting *proficient at thinking about your thinking and learning in math class*. And if you are getting proficient, is that some thing that will help you succeed in math class next year and in other classes?

In considering this narrative, which relates several moments of Karl’s metacognition, questions of how Karl came to make metacognitive statements could be posed. What aspects of the classroom milieu and the teaching and learning in the classroom prompted those types of statements? To be sure, part of the results came from a focus on metacognitive awareness, but it was also developed and refined as a result of my reflection over the semester as I listened to Karl and his classmates. Karl’s growth can be used as an example of how, through the use of his data, my practice was informed and transformed through practical, interpretive, and critical reflection.

Practical Reflection

When teachers engage in practical reflection, they ask questions of themselves that are characterized by how they might improve educational situations in the classroom through technical means. Van Manen (1977) described this level of reflection as a “preoccupation with techniques, controls, and with means-ends criteria of efficiency and effectiveness” (p. 209). Although I had developed a frame for students to become metacognitive through interactive writings and portfolios, as I began to read the students writing, questions emerged of how to sponsor meaningful reflections. Consider Karl’s first portfolio overview reflection:

My overview of this unit was that it was useful to help me in my future job/jobs. This unite [sic] was not very difficult for me to do because I studded [sic] it every day. I think that overall I did good on this unite [sic] my test scores were up there and I did well on all other assignments to.

Although I had verbally communicated instructions for a half to one page reflection about their learning, I found that Karl’s reflection was not adequate to demonstrate thoughtfulness about his learning and learning about mathematics.

As I thought about Karl’s writing, I noticed that it was a report on the unit rather than an exploration of his thinking and learning during the unit. My thoughts turned to how I could

encourage Karl, and his classmates, to explore and express what they were thinking and learning during the unit. I considered questions of: When should students write their overview reflection? How should I provide guidelines for the reflections and what prompts should I use? How should I frame my comments when I return the portfolios? As I thought about each of these questions, I formulated resolutions that I believed would support teaching about how to assemble portfolios and write reflections. These questions and their resolutions illustrated what van Manen (1977) referred to as technical skills, “trainable techniques, procedures, or ways of accomplishing things” (p. 211). Prompted by Karl’s data, I made decisions to scaffold more meaningful portfolio reflections by allocating time in class for writing the reflections, handing out more detailed written instructions, and providing a clear description of expectations.

When the students were ready to create their next unit portfolio, I implemented some of the ideas that I had considered in my reflection. I provided specific starting places for the overview reflection. For the second portfolio, Karl wrote in his overview reflection:

All in all, I’d say I had greatly improved in trig since last year. From mediocre marks to very nice marks in the 80s and 90s. I learnt and reviewed all of the things from the last cupple [sic] of years as well as learning new things.

So in summery [sic], I learnt many new things, reviewed older things and remembered many older things and had a blast with getting good marks.

Although this reflection was similar in length to Karl’s first overview reflection, he had demonstrated an evolution in his thoughtfulness. In his individual reflections, Karl had taken the opportunity to make distinctions among ‘learning new’, ‘reviewing’, and ‘remembering’ by using specific examples and statements to illuminate his thinking. From the final statement in Karl’s overview, I was able to discern that thinking about his learning was something that was within Karl’s grasp, something that I could scaffold through my practice. I was finding methods to “gain more effective control over practical activities” (van Manen, 1977, p. 207). Using Karl’s first portfolio overview had given me an opportunity to think about what I could do specifically in my instruction to improve the implementation of unit portfolios.

In a classroom situation, engaging in reflection of a practical nature is important for a teacher to improve technical aspects of teaching and learning. Student data can inform the types of questions teachers should be asking and guide teachers in generating effective pedagogical solutions. However, even though questions of a practical nature are important to consider, van Manen (1977) asserts that teachers must move beyond practical reflection to consider other questions of meaning and significance.

Interpretive Reflection

Teachers engage in interpretive reflection when they ask themselves what purpose or value is inherent in specific teaching and learning activities. Characteristics central to interpretive reflection are: “interpersonal communication, ... analy[sis] and clarif[ication of] meanings, perceptions, assumptions, prejudgements, and presuppositions” (van Manen, 1977, p. 213-214) with the purpose of understanding educational phenomena. In terms of teaching metacognitive

skills to Karl, I considered several questions: What effect does interactive writing have on the interpersonal nature of teaching and learning? Of what value is metacognitive thought for students' growth and development? What does it mean to have students engage in the act of becoming metacognitively aware? These questions depict a desire to make sense of students' emerging sense of metacognition.

In the second interview, Karl described some of his thoughts about the interactive writing. Although he felt it was a way for me to fill time and he questioned the role of language arts in mathematics class, he also took the opportunity to describe the importance of my replies to his journal responses as "just the fact that you have read [the interactive writing] and have a response is enough for me". Karl's words caused me to consider, afterwards, the value of interactive writing as a way to actualize a caring relationship, highlighting the importance of relational teaching, and they confirmed my intentions of forging a teacher-with-student relationship with Karl and each of his classmates.

Karl clarified his interpersonal statement when he described my reply as: "Sometimes you have questions in there, and that also gets me thinking. ... I just think it over in my mind". Karl was developing metacognitive awareness within the pedagogical relationship we formed. Our continual communication affected his understanding of his thinking and learning and demonstrated to me the importance of listening to Karl as a way to affect his learning. Karl expressed metacognition in simple ways, such as including reasoning as a mathematical way he was thinking when he wrote: "It demonstrates how much I remembered from last year. This demonstrates my, reasoning ability in that I reasoned with myself as to what I should do". This nascent metacognition, of Karl and his classmates, was tentative as I came to realize in interviews when the students struggled to notice these statements in a critical way. Developing metacognitive awareness was more difficult than I had first perceived.

Using Karl's writing to inform my thinking, I began to challenge my assumptions about the goal of interactive writing in my classroom. Although my primary intention for interactive writing was to cultivate a teacher-with-student relationship, by listening to and reflecting on Karl's data my intentions evolved to include modelling and encouraging students' development in metacognition. I was challenged to expand the purpose of interactive writing as Karl communicated that thinking about his learning would help him succeed in other courses. My evolving intentions led me to deliberately author interactive writing prompts that would invite students to think about their thinking and explicitly model metacognitive thinking when I wrote replies. I began to value interactive writing as a process for teaching metacognition.

In addition to practical reflection, interpretive reflection informs teacher practice and beliefs in a more thoughtful manner. Exploring issues of meaning and professional assumptions provides opportunities for teachers to question their beliefs, notice the implications of their beliefs, and then either transform or maintain those beliefs as they listen to their students. Van Manen (1977) emphasized that "coming to an understanding is a sense-making and an interpretive enterprise" (p. 220). Interpersonal aspects of teaching, along with sense-making of teaching, occurs as teachers focus on the learning of their students to inform their practice in rich and meaningful ways.

Critical Reflection

Critical reflection focuses on questions of why within the broader socio-political context of schooling (Goodlad, 1984; Lortie, 1975). Reflection at a critical level attempts to uncover and address how schooling affects the teaching and learning within a single classroom. Van Manen (1977) characterized critical reflection as genuine self-understanding, emancipatory learning, and makes a strong connection to Freire's sense of critical consciousness (Freire, 2000). Teaching students to become metacognitive and listening to their early attempts to notice and articulate their thinking and learning provided an opportunity for me to reflect on the institution of schooling, the traditional role of mathematics, and my role in these structural entities.

During the course, students were beginning to make metacognitive statements that required significant amounts of teacher scaffolding through the use of prompts and routines. To be thoughtful and articulate about their thinking and learning was a challenge for the students. This became clear through two different kinds of interactions with Karl. The first was in his reflective writings for portfolios and in his interactive writings. Although he occasionally indicated some good thinking, most of his writing identified good thinking without describing why it was good thinking. For example, in a test reflection he stated, "It was good thinking because it worked and I got full marks for the question." The importance of the marks-based language, rather than thinking- or learning-based language, demonstrated Karl's inculcation in a schooling system that valued product and performance over process. The second indication of Karl's difficulty in thinking metacognitively was in the final interview. The narrative provided space for Karl to find examples, other than in the story, of when he had written about his thinking or learning. As he flipped through his portfolios in the interview, he could not identify moments of his own metacognition.

As I thought about the scaffolding I provided and the direct manner in which I identified statements of metacognition to Karl, it became clear that metacognitive thought was not a process that he, and his classmates, assimilated into their learning strategies, at least not explicitly nor readily. Karl's experience is an illustrative example of the difficulties all his classmates encountered in developing and noticing metacognition in themselves as learners. Listening to the students in the interviews and re-reading their reflective writings caused me to consider why metacognition was so difficult for these students to engage in and subsequently to notice. I began to wonder what previous school experiences these students had that would make noticing and talking about their thinking and learning a laborious process for them, a process that was inconsistent at best.

As I thought about Karl's statements and actions, I began to consider the systemic reasons why metacognition was so difficult for these students. Was it that the students had become silent (Belenky, Clinchy, Goldberger, & Tarule, 1986) through events either in school in general or in mathematics class in particular? It could have been a process of losing voice through educative moments that disenfranchised them and placed them in a position of powerlessness over their own thinking and learning. Was it that they did not have opportunities in previous grades to develop metacognitive skills? It could have been an important learning process that had not been taught to them, and rather than becoming learners they only had experiences of being students. Both of these questions led me to a critique of educative institutions and their role in the nominal

development of learners. I questioned the control students had been subjected to through asymmetrical power relationships with authority in their classrooms. It also led me to consider student motivations for selecting Consumer Mathematics. Perhaps some of the students had selected Consumer Mathematics because of their lack of learning skills, fostered by their previous schooling, rather than their positioning with mathematics or decisions about career and life goals. These possibilities strongly impact on not only metacognitive development, but on all teaching and learning activities within the course.

Answers to these critical questions have been difficult for me to formulate, although they have caused me to consider my practice and develop an emancipatory stance in the classroom. I began to view the role of metacognition, not only for the cognitive benefits of deliberative learning of mathematics, but as a means by which students could develop voice and become learners. My conceptualization of learners includes individuals who have control over their own learning, which necessitates an understanding of how they learn so that they can cause it to occur in any educative situation. Although I recognized the limitation of teaching metacognition to students in Grade 10 with little or no previous experience, there was also a positive sense of possibilities for these students to be emancipated through their continued development of metacognitive awareness throughout high school. I began to view student engagement in metacognitive discourse as a way in which students can develop voice (McFeetors, 2006). In this way, my beliefs about the importance of incorporating metacognitive elements and my deliberate efforts to enable student voice in Consumer Mathematics evolved: I came to believe that students were empowered and became authorities of their own learning (enacting a role as an authority) as they regulated their own learning to be positioned to succeed not only in mathematics class but in all of their courses.

Critical reflection broadens the stance of the teacher within the educational system. Awareness of socio-political factors affecting classroom practice only come into view as teachers ask questions of school-wide influence. It is through this questioning stance that teachers can “achieve a deepening awareness both of the sociocultural reality that shapes their lives and of their capacity to transform that reality” (van Manen, 1977, p. 222). The teaching and learning within a classroom is not confined to that community, but is affected by broader issues. This critical reflective stance can be developed as teachers’ reflections focus on student learning, rather than on themselves and their pedagogical actions within the school.

Conclusion

I could have approached my reflection on teaching metacognition by focusing solely on my thoughts and actions as a teacher. I believe this approach would have limited the transformative nature of my learning. Through the use of narratives supported by student data, I was able to listen to Karl and consider the effects of my pedagogy on his learning. This directly challenged my practices and my beliefs about teaching metacognition to Grade 10 mathematics students. There were technical elements that improved as I listened to Karl, such as the scaffolding of interactive writings and portfolios and the kind and quality of feedback I provided for each student. Karl gave me insight into the nature and importance of the relational philosophy of teaching that I enacted in my classroom and caused me to make sense of what it means to foster

students' metacognitive growth and development. I also grappled with the context within the educational system and was able to recognize and develop an emancipatory stance in my teaching. Not only did these reflections, using Karl's thinking and learning, inform my practice, but they also transformed my beliefs about teaching and learning.

Deliberate use of van Manen's three-level hierarchical model of teacher reflection supports teacher engagement in a transformative reflection that informs practice in a way that encourages critical action. The model provides a balanced and comprehensive approach, which encourages more than technical reflection. Instead of reflection for efficient techniques and teacher control, transformative reflection impacts teaching, learning, and beliefs about teaching in significant and ongoing ways. In a teacher-focused approach to reflection, practical reflection is attainable; however, to engage in interpretive and critical reflection, there is a necessary movement towards a learning-focused approach. To be learning-focused in teacher reflection means to have the thinking and learning of students central to informing the reflection.

This article articulates and demonstrates an essential approach to the study and improvement of teaching. Not only should teaching be the focus of reflection but student thinking and learning should be integrated into reflection to enable inquiry for transformative pedagogy. In order for teacher reflection to be effective, it must be able to inform the teacher about the teaching and learning practices occurring in her/his classroom in an attempt to transform those practices. The use of student data is a way in which teachers can listen, make sense of, and situate their reflection. Consonant with Hubbell's experience of beekeeping, in order to transform teaching practices, teachers must learn from the students themselves.

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