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METAPHORS AND ANALOGIES IN TRANSITION

Beginning Teachers' Lived Experiences

1. CONNECTING WITH METAPHORS AND ANALOGIES

Typically beginning teachers sever their ties with university-based teacher educators upon graduation. As Howey and Zimpher (in Feiman-Nemser, 2001) noted: "Nowhere is the absence of a seamless continuum in teacher education more evident than in the early years of teaching" (p. 1037). Similarly, Feiman-Nemser (2001) observed: "There is no connective tissue holding things together within or across the different phases of learning to teach" (p. 1049). The need to maintain a partnership, within the context of a professional learning continuum, uniting initial teacher training, induction and continuing professional development was also recognised by beginning teachers. In a survey of 696 beginning teachers in Australia (Department of Education, Science & Training – DEST, 2002), 61.6% of respondents "believed Education faculties should play a continuing role in the professional development of their graduates, through involvement in induction" (p. 17). In this chapter we explore the potential power of sustaining conversations between university-based teacher educators and their recent graduates during the beginning years of their teaching careers by sharing and discussing the stories of three beginning teachers about their use of metaphors and analogies in science teaching.

1.1 Metaphors for Science Teaching

Teaching metaphors like the *teacher as provocateur* (Prawat, 1996), were used by Steve (first listed author) in his pre-service science education programs to help students imagine what teaching might be like from a social constructivist perspective. As well, some students (e.g., Marianne – the fourth listed author) were encouraged to develop a range of personally relevant teaching metaphors that might assist them teach in ways that were consistent with their beliefs. This practice was

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based in part on Steve's previous research with practicing teachers who deliberately changed their pedagogy to accord more closely with their understanding of constructivism. In one case study (Ritchie, 1994), the teacher called Bernice created the metaphor of *teacher as travel agent*. This metaphor proved to be a successful reflective tool for initiating and sustaining change in Bernice's classroom, even on topics that were considered outside of her field of expertise. Of course, several other researchers found personally created teaching metaphors helpful in conceptualising and enacting a wider range of pedagogical practices for experienced teachers (Nichols, Tippins, & Wieseman, 1997; Thomas & McRobbie, 1999; Tobin & Tippins, 1996). In pre-service teacher education, Bullough and Stokes (1994) and Volkmann and Anderson (1998) were strong advocates for student teachers to develop metaphors for teaching. For example, Volkmann and Anderson (1998) argued that metaphors taught in pre-service programs had the potential to clarify meaning in the complex and challenging first-year that awaited graduating chemistry teachers.

During her pre-service science education programs with Steve, Marianne developed a strong interest in personal teaching metaphors to guide her teaching practice. Three personally relevant metaphors that Marianne developed in her first year of teacher preparation were: *teacher as founding club leader*, *teacher as talent show coordinator*, and *teacher as toolbox*. Each metaphor created an image of a specific environment and the role she might play in that context. For example, as a talent show coordinator / teacher, Marianne recognised the need to set the general focus or theme for the show (or unit of work) before negotiating suitable acts or performances (i.e., activities and investigations) with her students. In this way, students learned science as they practised and performed their acts. Marianne's interest in metaphorical thinking extended to her second and final year of teacher preparation where analogies for learning scientific concepts became a topic in the curriculum.

1.2 Analogies in Science Teaching

Science metaphors and analogies can be effective tools to help students develop understanding of important concepts, especially those that are abstract or difficult to experience directly (e.g., Dagher, 1995; see also, Chapters 2, 3, 5, 6, & 7). Analogies can provide a conceptual bridge between existing and targeted knowledge (Glynn, 1994), as well as evoke emotion, interest and creative insight (Duit, 1991, Gilbert, 1989). Visual metaphorical images portrayed in some cartoons also might help to support the relational connections between vehicle or analog and target (Cameron, 2002). However, inappropriate use of analogies can lead to the formation of alternative conceptions when teachers do not intervene (Duit, 1991; Glynn, 1994). For example, in Yerrick, Doster, Nugent, Parke, and Crawley's study (2003) of pre-service teachers use of physics analogies within groups during inquiry projects, students demonstrated a strong tendency to overgeneralise analogies and map irrelevant features from the analogy to the target concept. Also, the students

"engaged in the generation of their own analogies that emerged first as personal theories, many of which were poor conceptual matches for the target concept" (p. 458). In similar inquiry contexts, Yerrick et al. (2003) recommended that frequent questions and guidance from the teacher might be effective in averting reinforcement of alternative conceptions. In the stories below, we show how three beginning teachers interacted with and guided their students as analogies were introduced and critiqued.

2. STORYTELLING

Connelly and Clandinin (1994) argued that stories are central to teacher education because the telling and writing, retelling and rewriting of stories can lead to awakenings and to transformations in the practice of the teacher-storytellers. Telling stories of their use of analogies in this chapter serves a pedagogical purpose for the three teacher-participants. Through their narrative interactions with each other and Steve, the teachers constructed more sophisticated ways of acting, believing, perceiving, and evaluating classroom actions (Rex, Murnen, Hobbs, & McEachen, 2002). As Connelly and Clandinin (1994) argued, sustaining conversations with theory, research, different classroom conditions and contexts, it is possible for the teachers to create more mindful retellings of their stories. Such ongoing conversations involve a similar reflexive process advocated by Fenstermacher and Richardson (1993) who claimed that:

> Practical reasoning is improved by helping the … teacher frame increasingly more sophisticated and well grounded practical arguments, thereby enhancing the teacher's ability to think more deeply and powerfully about his (sic) action. (p. 104)

With the goal of sustaining professional conversations with his former students, Steve invited each of the three teacher-participants to write a brief account of their use of metaphors and analogies during their first year of teaching. These stories were edited by Steve and returned to each storyteller for checking. All three stories were then shared between the participants for further discussion and reflection. In this way, we hoped to establish a mini-learning community that provided a connection between the pre-service and teacher induction phases of teacher learning because:

> Novices need opportunities to talk with others about their teaching, to analyze their students' work, to examine problems, and to consider alternative explanations and actions. If novices learn to talk about specific practices in specific terms, if they ask for clarification, share uncertainties, and request help, they will be developing skills and dispositions that are critical in the ongoing improvement of teaching. (Feiman-Nemser, 2001, p. 1030)

Before discussing the perceived benefits of this process from our experience, edited versions of the original stories are re-presented.

3. BEGINNING TEACHERS' STORIES

In this section three second-year teachers each tell a personal story about their transition from pre-service teacher education to first-year teaching. Each story

focuses on the use of metaphors and analogies in science teaching. All three teachers graduated from the same science education class taught by Steve at James Cook University. While Alberto (i.e., the second listed author) teaches in the same city as Steve, Heidi (i.e., the third listed author) and Marianne moved interstate where they coincidentally teach at the same school.

3.1 Alberto's Story

I have become conscious of several metaphors that characterize my teaching. These change depending on the class and conceptual difficulty of the work. Walking from my Year 11 Chemistry class to my Year 8 Science class I purposefully change my demeanour. It hurts to admit this, but I have to be a bit of a mongrel with my Year 8s otherwise they get out of control. So from *teacher as provocateur* in Year 11 where I increasingly invite students to critique the effectiveness of particular analogies to help explain difficult concepts, I become *teacher as police officer* in Year 8. I also use the *teacher as Steve Irwin* (you know, the Croc Man) metaphor in Year 11 when I use interactive historical vignettes or perform entertaining demonstrations. Even though students appear to like being entertained, I have come to the conclusion that my Steve Irwin metaphor can be counter productive if overused. Generally, I have found that as my understanding of metaphors for teaching grows it helps me to analyse and adjust my practice. This is especially evident in relation to the application of the *teacher as provocateur* metaphor when used with science analogies.

I first heard of the *teacher as provocateur* metaphor at university in discussions about teaching from a constructivist perspective. But my first observation of a teacher's use of analogies in Chemistry left me unconvinced of the merits of analogies. I remember observing a series of Chemistry lessons by my supervising teacher who seemed fond of using analogies. I came away thinking "what a mess". Her students pulled the analogies apart. I told myself I would avoid using analogies in my classroom at all costs because I was afraid of falling foul of a similar fate.

In my first year of teaching I was allocated two Chemistry classes. Concerned that students did not understand the concepts adequately, I turned to analogies in frustration. My first reference to a common textbook analogy was successful. This encouraged me to go further.

I invented an analogical model (see also Chapters 5 & 6) to help explain the structure of atoms following the "Rutherford gold leaf experiment". I first questioned the students about what they remembered about the structure of the atom. From these interactions, the question "how do we know this?" begged an answer. I continued:

> Imagine that we throw a sheet over our overhead projector. Now suppose we stand at the back of the room and fire an air rifle at the covered projector. If the air rifle pellet pierces the sheet and encounters empty space, it will pass straight through to the other side and leave a hole in the wall. If the pellet hits the solid form of the projector behind the sheet, it bounces straight back without hitting the wall. We fire many pellets at the

> sheet. In the end we have a series of holes where the pellets encountered little resistance and a pattern shape of the projector on the wall where the pellets did not penetrate.

At this point the students were silent. I was concerned that I had confused them. I asked: "What will we see on the wall after we finish shooting?" "The shape of the projector, its outline", some replied. I asked, "Will this shape be an exact copy of the projector?" "No", they replied. "How is it different?" I retorted. "It's the outline only, it's not 3D", they answered. More questions and answers followed:

"What information about the projector doesn't it give us?"

"Colour, what's it made of".

"So how is this information helpful?"

"It gives us an idea of what it looks like".

Now that I was convinced that the class recognized the limitations of this model, I discussed the Rutherford experiment in more detail.

My use of analogies has increased. I now use them whenever we come across a novel or abstract concept for which there is no physical way to describe it. Sometimes students cheer, clap or just smile widely when they first get it (i.e., understand the concept). I realise that these analogies provide a metalanguage with which we can talk about Chemistry before identifying the Chemistry concepts. For me, analogies have been one useful tool to help students' understanding.

3.2 Heidi's Story

"Are we doing a prac today Miss?" is often the first thing students say to me as they enter the science classroom. Practicals are popular with students, let's face it, "hands-on" is more fun than writing notes and listening. However, we all know that life teaching science cannot be all about practicals. I try to use alternative teaching strategies when students need to learn prescribed concepts. One strategy I have used that draws upon metaphorical representation is to select appropriately relevant and humorous cartoons to illustrate science concepts. I sometimes even invite my students to construct their own cartoons to illustrate their understanding of ideas for the benefit of fellow students.

I first tried out humour in my practical teaching in my Year 11 Biology classes. The allocated topic was concerned with the relationships between organisms. Rather than preparing an overhead transparency with the required definitions I searched through one of my Gary Larson cartoon books where I found a selection of single frame cartoons that illustrated predation, symbiotic relationships, mutualism, and so forth. I organised six cartoons onto overheads and proceeded with, what I felt was, a unique lesson. I placed the overhead up and asked the students to view the cartoon and tell me what they thought it was about. From this introduction I asked the students to work in groups to come up with a cartoon to illustrate the relationship they were given in a package I had prepared, and then present it to the class. Each package included: information on an organism's relationships, paper, and an overhead pen and transparency. The students took on the challenge and resulted in some interesting cartoons. A few weeks later, when we had a mini quiz, the students

knew the vocabulary and some even drew little cartoons to help answer some of the questions. I felt that the lesson had been a success.

In my first year of teaching I was required to teach the Big Bang theory in my Year 8 Science class. I assigned a particular astronomical event to each student before inviting the class to take up relative positions around the room to form a time line. I then showed a video, which explained the events. I was disappointed to find that the majority of students could only remember events at the beginning and end of the sequence on the end-of-topic quiz, even after they had copied the sequence in their notebooks. I returned to the topic a week later with a different approach. I asked the students to look at the events they had written down. We watched the video again. Then, working in pairs, I asked the students to draw the events, in sequence, as a multiple frame cartoon; that is, to represent their understanding in the form of metaphorical images (cf. Cameron, 2002). Some looked excited while others looked concerned. Using crossed out watches to show that there was no time at the beginning and cute characters representing matter and anti-matter the students produced some creative pieces that represented the sequence accurately. When it came to the formal unit test, 26 of the 30 students were awarded 5 to 6 out of 6 for the Big Bang question. I feel this was a positive and encouraging result. I concluded that the variety of teaching strategies used for the topic had helped the students retain the information and understand this theory.

I have learned that cartoon humour, for me, can be a device to motivate students and aid them with their learning. It also shows them that science is all around them, even when they do not realise it!

3.3 Marianne's Story

The use of analogies and metaphors had interested me since pre-service teaching where I completed projects on developing personally constructed teaching metaphors (e.g., *teacher as talent show coordinator*) and analogies to help student understanding of the cell using "The general model of analogy teaching" (GMAT; Zeitoun, in Dagher, 1997). I was eager to implement and reflect on the use of analogies in the classroom in my first year of teaching. Despite this goal, the realities of day-to-day teaching overwhelmed me for the first term. Also, the out-of-class responsibilities of a teacher began to mount, including attending numerous meetings, induction, paper work for student reporting, excursions and experiments, and "actively participating in the life of the school". An additional difficulty was adapting to the school science program. The units were broader than what I had previously encountered and there was no set text for students. In the hands of experienced teachers this allowed the unit to be shaped to the class' needs and interests using their vast wealth of personal knowledge and resources. However, for a first year teacher used to structure and organisation it was like being placed at the wheel of a cruise boat, knowing where the ship is destined but having only a vague idea on how to sail there. I spent most of the first term just "treading water" and it was not till the first break that I had a chance to relax and reflect. My interest in

investigating analogies in the classroom had paled in importance considering all the other demands of a new teacher. Nevertheless, I was able to encourage students to develop analogies in the classroom with mixed results.

Student generated analogies can be a powerful aid to teachers in the classroom. Although there are well known pitfalls with such analogies (see also Chapter 5), as I have experienced personally this year, they can also provide feedback on students' understanding of the prescribed concepts as well as providing an extremely effective tool in helping other students learn. I have learned that analogies lose effectiveness if students have limited familiarity with the analog, and it is a good idea to appraise student analogies before whole class discussion.

A student generated one successful analogy following my whole class discussion of the function of a neurone. The student had not started the diagram I had requested to be drawn and when prompted he explained he had been thinking and that a neurone was a lot like a power cord. He suggested that the axon was like the wire inside and the myelin was like the insulation on a power cord. Other students listening agreed and started expanding the analogy further by including dendrites and synapses. This developed into a class discussion on the analogy and how far you could take it. Students took the core idea and applied it while also realising its limits, namely, there was no corresponding cell body in a power cord so they started discussing computer networks and cabling. The discussion did require me to guide it back when ideas were getting confused or ridiculous and also to field questions including: "If myelin breaks down is it dangerous like if insulation is damaged on a power cord?" leading to discussion on diseases. In the end the class had a good understanding of the parts and function of the neurone, and demonstrated this on their overall achievement for this section of the exam.

4. DISCUSSION

The stories shared between the three beginning teachers became reflective devices to help each teacher reinforce or modify his/her teaching practices. Marianne was encouraged to continue her use of analogies in science teaching and, following the readings of each other's stories, Alberto has subsequently introduced pre- and post-testing to gauge students' understanding through analogies. Furthermore, Alberto declared: "the idea of getting the students to write their own analogy had occurred to me previously but it was not until I read Heidi's story that I was prompted to use it, in part because of the obvious benefits she had with student generated cartoons."

4.1 Making Connections with Students

A common thread between the three stories was the teachers' recognition that the metaphors and analogies created common ground between teacher and student, especially in relation to shared language (or images) linking analog and target concepts. In Marianne's story, the students actively used the language associated with power cords (analog) to explore the function of nerve tissue. Alberto added the

following account of his more recent experience teaching stoichiometry through analogy, largely inspired by his interactions within our learning community:

> Reading Heidi and Marianne's stories reminded me of what good teaching involves. For instance, I found analogies useful in helping me to create a third space where students and I could discuss chemical concepts through a shared vocabulary. Heidi found this space with her cartoons, and I quote "…the students knew the vocabulary…" From reading Heidi's story I was also reminded that it is possible to assess students' understanding of a concept as a guide for further teaching. More specifically, in one of my chemistry classes I chose to start the instruction using an analogy (i.e., ham sandwich – B_2H which represents 1 slice of ham for 2 slices of bread) rather than with the chemical concepts, and then bring in the chemistry once students had gained confidence with the analogy. Two weeks after having used the analogy for the first time, I asked students to provide me with examples of their own analogies. After reading the analogies they had written I noticed that two students still did not understand one of the basic concepts pertaining to chemical equations. Using their analogies I was able to approach them individually and discuss the problem. What this in turn allowed for was that the students were able to self-correct once I pointed out there was a problem. The use of the analogy allowed us to share a common language where I was confident the student would understand me and be able to show their understanding. One of the students was able to self-correct and then provide an explanation of why what he/she had written was incorrect.

4.2 Monitoring Analogies

Alberto's account draws attention to another significant shared experience between the teachers, namely, the need to monitor students' use of analogies. All three teachers wisely checked student-generated analogies or extensions before whole class discussion so as to avoid the creation of alternative conceptions. Their supporting roles for student conceptual development was reinforced by Yerrick et al., (2003) who concluded:

> Our study is a reminder that teachers serve an important role in classrooms by guiding and scaffolding ways in which knowledge, particularly analogies, gets shaped, refuted, and promoted. Exemplary curricula alone are no substitute for the teacher's role as the primary driver for rules of discourse in collaborative settings. This kind of classroom interaction stands in sharp relief to the kinds of talking science that are found in more conventionally managed classrooms. (p. 460)

4.3 Learning Together

Heidi and Marianne were fortunate enough to start their teaching careers at the same school. Working together and sharing their stories of successes and failures meant that they could also learn together. As Marianne noted: "I have benefited from continued contact with Heidi as both underwent our first year of teaching. Watching Heidi's enthusiasm and success with humour and cartoons has inspired me to add this as an additional teaching strategy to my *toolbox*. Cartoons were a simple step for classes used to analogies, and it certainly added a motivational factor." Heidi also recognised the value of networking with Marianne and Alberto.

> Marianne and I continuously bounce ideas off one another and discuss what has worked and not worked in our classrooms. This has been extremely helpful in its own, not only for better teaching and better learning, but for personal development… Alberto and I had discussed his trials and successes with his analogies in the classroom, and I remember how he was pleased with the outcome his "ham sandwich" analogy had produced.

Finally, despite the obvious challenges and constraints experienced by beginning teachers, each teacher participated actively in our discussions and various iterations of this chapter. Marianne identified several impediments to realising her ideal image of teaching in her first year. Alberto's story appeared to come along at the right time because it encouraged Marianne to reflect on her own teaching practices with the view to refining her teaching metaphors. As she admitted: "Overall my personal metaphors are changing and refining to fit my increasing experience and teaching environment. But in addition, I am becoming more confident in my ability to shape slowly both my teaching and the school culture by still aiming at idealistic teacher metaphors." Alberto, Heidi and Marianne's contributions here not only show the value that each teacher placed on maintaining our community, but also that the process of writing and sharing their stories provided a motivational incentive to contribute worthwhile accounts for each other's learning and possibly the readers of this chapter.

5. CONCLUSIONS

Teacher educators recognise that the ongoing study and improvement of one's teaching is difficult to accomplish alone (Feiman-Nemser, 2001). In this study, three beginning teachers – former classmates – shared their stories with each other and reacted to their colleagues' accounts in ways that helped each to become more reflective and implement new ideas about science analogies in their own classrooms. Steve was their professional development broker in this case. He created the learning community by inviting each of the teachers to participate in this project – the incentive was to write about the experience for the purposes of this book. Even though each teacher was busy, he/she wrote his/her story and reacted to each other's accounts with some significant shared learning outcomes, as illustrated by Alberto's concluding comment:

> I believe that in order to change my teaching to improve student outcomes, I must remain flexible like a supple, well-stretched muscle. Reading the other teachers' personal accounts was like a warm up – the stretching exercises to help me reflect on and modify my practice. The personal narratives have been particularly helpful to me in identifying good practice. The shared experiences of other teachers furthers my experience without having to be in their situation. I think of this as a way of shortcutting my development to achieve my teaching goals.

From Steve's perspective (and possibly for other teacher educators), sustaining conversations with his former students has not only reinforced his appreciation of the constraints that beginning teachers face, but also it has helped him to re-conceptualise aspects of his pre-service programs. Not only is it important to discuss the role of metaphor and analogy in science teaching from the vast research

literature base available, but also it is important to share the real-life stories of beginning teachers committed to better student learning outcomes. The latter strategy will now be added to subsequent programs taught by Steve. The deconstructed stories/dilemmas of experienced teachers' use of analogies presented in Wallace and Louden (2002) will now be supplemented by the stories told by Alberto, Heidi and Marianne, for discussion/deconstruction by Steve's pre-service teachers. These stories hopefully will resonate with current student teachers as well as inspire them to persevere – sometimes against the odds – and create exciting new learning opportunities for their future students.

As Government departments around the world consider the increasing demands for better induction programs for beginning teachers (e.g., DEST, 2002), one principle for effective induction stands out from our experience in this project – "Induction programs should be negotiated on the basis of individual needs and goals, rather than standardised content, and should recognise that teachers' needs change over time" (DEST, 2002, p. 114). Because our ongoing discussions extended our previous work together at university, our agenda was negotiated on the basis of individual and collective needs and goals. We shared an interest in metaphor and analogy, and through this interest we sustained further conversations about the three teachers' lived experiences applying metaphorical thinking in class over the course of their first year as science teachers.

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