

Conceptual Article

Collaboration in Teaching about Science Teaching

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Abstract

Collaboration in teaching about science teaching plays a vital role in enhancing both teacher professional development and student learning outcomes. Collaborative practices encourage educators to share knowledge, teaching strategies, and reflective insights that promote innovative approaches to science instruction. Through teamwork, co-planning, peer observation, and joint problem-solving, teachers create a supportive environment that fosters creativity, critical thinking, and deeper understanding of scientific concepts. This process not only strengthens pedagogical skills but also builds a sense of community and shared responsibility among educators. Furthermore, collaboration enables the integration of interdisciplinary perspectives, the effective use of technology, and the design of engaging, inquiry-based learning experiences. Ultimately, collaborative teaching contributes to developing students' curiosity, scientific literacy, and problem-solving abilities, while ensuring continuous improvement in teaching practices.

Keywords: *Collaboration, Science Teaching, Teacher Professional Development, Co-Teaching, Inquiry-Based Learning, Reflective Practice, Interdisciplinary Approach, Student Engagement.*

Background

When the authors decided to teach their General Science curriculum units together they also decided to research their teaching of methods for science through a critical self-study model.

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The General Science curriculum units they were to teach together formed part of the final year of study for Bachelor of Education students as well as for the one year Post Graduate Diploma of Education students at Monash University in Clayton, Australia.

Rebecca was new to teacher education (working part time at the university and teaching at high school) while Stephen had to years' experience in teacher education (having spent 13 years teaching in secondary schools). Hence they shared a some natural synergies in their learning of science teaching that could be beneficial to their practice

There were a number of reasons they had for sharing and researching their practice. First of all in articulating his practice to Rebecca, Stephen thought it would help Rebecca understand both the thinking behind his practice and the difference between the pedagogy of teaching and the pedagogy of teacher education . As outlined in the literature, teacher education is often conducted by ex-teachers without formal training in teacher education and it seems to be expected that good teachers will make good teacher educators because the 'teaching' in teacher education is the same as the teaching in schools. Korthagen, Loughran and Lunenberg noted that ' ... the complex interplay of skills, knowledge, and attitudes that comprise the expertise of teaching about teaching... [Offers insights into and] foreshadows the issues, questions and concerns that are important in the research agenda for teacher educators and teacher education... ' (p.110). Cochran-Smith contends that it is valuable for teacher educators to make public the important issues they grapple with in their teaching, and by doing, they can assist other teacher educators to reflect on their own practice in new ways. These views clearly influenced their approach to and thinking about their teaching of methods for science.

Second of all by articulating his practice and his thinking about his practice, Stephen considered that researching that aspect of practice might help him to better understand what he did and why he did it and therefore further develop his knowledge of his pedagogy of teacher education. Through this process, Stephen would then have multiple opportunities to 'unpack' that which is often tacit knowledge and articulate it in forms that influenced his practice as a teacher educator. By sharing in the planning of classes and debriefing after each class, this would also offer opportunities for Rebecca to question Stephen's teacher education classroom practice and further elucidate the pedagogical reasoning underpinning his teaching of teachers. In so doing, Rebecca would be able to question what she saw as critical incidents and inquire into the how and why of the pedagogic actions as they appeared to her 'in the moment'. Kosnik

identified such critical incidents as 'events that [she] considered [helped to] raise broad, sustained issues' (p. 69). Loughran and Berry summed up well the type of thinking behind about the value of sharing their practice:

... we believe that the ability to be explicit about what one is doing and why, is enhanced through systematically inquiring into learning through experience (self-study) so that the relationship between knowing and doing might be more accessible. Importantly though, learning from the experience of "being explicit" requires a sensitivity to the ongoing tensions associated with balancing pre-service teachers' perceived needs and concerns and their teacher educator's beliefs about what they need to know and be able to do. (p.194)

Third of all through the process of sharing discussing and debriefing the classroom events, Stephen would be introducing Rebecca (as a beginning teacher educator) to the ideas underpinning a pedagogy of teacher education in a supportive and reflective way rather than the more 'sink or swim' approach that so often happens in teacher education programs. This mentoring and support through team teaching should not be underestimated for as Rosean and Wilson observed, as teachers become teacher educators they often struggle to maintain a teacher education focus. Teachers new to teacher education typically are comfortable in articulating their problems in the school classroom and reflecting on their practices there, but when they move into teacher education they do not ponder about teaching in the same way. Therefore, this project based around collaboration and research in their teaching of science education together offered powerful ways of assisting in the transition from teacher to teacher educator.

The intention of this research paper then is to add to the professional wisdom of teacher educators more generally in ways commensurate with Cochran-Smith's expectations for scholarship in teacher education.

Theoretical Perspective

In their initial discussions about teaching together the authors shared their views about that which they valued in building a pedagogy of teacher education in an attempt to understand how they would each teach. They held similar views to those which Hoban identified four conceptions of teaching; craft knowledge, labour knowledge, professional knowledge and art knowledge but modified these to three views of teacher knowledge (craft knowledge, science

(professional) knowledge and art knowledge) for working with their pre-service teachers. Craft knowledge of teaching included the skills accrued over time while labour knowledge included the lesson plans that teachers implemented. In modifying Hoban's conceptions, they combined these two views of craft and labour knowledge and called this craft knowledge. Such craft knowledge is often the focus of the teaching practicum where pre-service teachers are 'apprenticed' for several weeks to learn the craft from an experienced teacher. Hoban contends that such a view of teaching is a 'behaviourist view of teaching'.

The art knowledge of teaching includes the personal input by the teacher as an artist might do. Teachers have a talent and their personal judgements about how and when strategies are used are to be valued. The science view of teacher knowledge implies that teaching can be influenced and improved by the research (or scientific knowledge) conducted of and by teachers. The authors agreed that while their pre-service teachers' immediate needs might often be focused on the craft knowledge of teaching, as teacher educators they should offer opportunities for their pre-service teachers to investigate and reflect on the science and art knowledge of teaching. One way they chose to do this was to implement the practice of 'being explicit' when teaching. That is they decided to share explicitly why they were teaching the way they were teaching and what their thinking was behind the approaches they used. In this way they would be modelling the decision making processes that teachers make when considering their content, the class and the context by which they taught. As teacher educators, they wanted to teach in a way that modelled teaching practices for their pre-service teachers based on reflection. Kosnik contended in her study that teacher educators should participate in the same reflective practices that they asked their pre-service teachers to participate in.

That does not however mean that such an approach is simple or easy to do, for as Berry noted, "Even though I have identified that articulating my thinking about teaching during the act of teaching is an important goal of my teaching, I have also found that this is not an easy goal' to 'live' as a teacher educator. I am not always consciously aware of my actions, in action, nor am I able to readily articulate my pedagogical reasoning on the spot. Usually, there is a multitude of thoughts running through my head as I teach. How do I know which of these is useful at any particular time to select to highlight for my students." (p. 2). Recognizing and responding to the problem in teaching would certainly be a demanding activity and one way of ensuring that their pedagogical reasoning could be available to their pre-service teachers was

to ensure that they made their model (adapted from Hoban, 2004) explicit to the pre-service teachers in their classes.

Linking to cases: Research and practice come together

In the first week after the pre-service teachers complete their teaching practicum in schools, a normal program feature is for Science Method lecturers to interview their pre-service teachers about their practicum experience. The purpose of this is two-fold, first of all to see what they have done in preparing for classes, making lesson plans, recording their observations of classes and making reflections about their own teaching. Second of all to support their introduction to teaching, to listen to their stories about their successes, to be understanding of their concerns and to offer advice and assistance where needed. In a meeting with a group of their pre-service teachers for a focus group interview about the practicum debrief one pre-service teacher commented that the students were not as enthusiastic as she had expected with an activity she had planned. She said that she expected that rather than doing book work, she thought the opportunity to go out outside of the classroom would be a motivation for her students. When this was not the case, she was surprised and asked the group at the interview why they thought the students were not excited by doing something different.

Considering this situation and following their reflections on their learning from the interviews the authors decided that pre-service teachers should read and discuss several of the cases from Looking into Practice. They considered the cases to be a way for the pre-service teachers to relate their practicum work to the writings about practice done by other teachers. In this way they might then make the connection that reading other teachers' cases could offer one way of gaining knowledge about teaching.

These cases were written by teachers involved in a teacher research project in which they investigated and reported on one aspect of their science teaching. One particular case documented how a teacher taught a class on electricity using a role play. Her students were not enthused by the idea of the role play, which was unexpected for the teacher. However, they become highly motivated when the teacher mentioned that the role play included lollies/sweets. Some days later when the teacher questioned the students about the activity, few could remember what the role play was about except that they had eaten lollies/ sweets. The case raised many issues about teaching and learning including:

- ♦ Students are not always enthused by 'doing activities beyond' the normal classroom convention;
- ♦ Lollies/sweets are a great motivator for younger students;
- ♦ Students do not remember what you expect them to remember; and,
- ♦ The need to build strong episodic links between the rewards (lollies/ sweets) and the content being explored.

Over the next week the authors examined the cases in more detail and chose several cases each that they would use with their pre-service teachers. The purpose being to use cases in such a way that the pre-service teachers could make links between craft knowledge (the focus of their practicum) and the science knowledge (the main focus of their university study). It was hoped that the teaching and learning issues identified would emerge from the pre-service teachers' small group discussions and they would then more easily connect these issues to similar experiences they had had while on practicum.

Methodology of Critical Reflection

As the above makes clear, this study is based on a model of collaborative inquiry. Deppeler notes that "Inquiry that is systematic, self-reflective and informed by evidence can be an effective tool for critically examining issues and influencing teachers' beliefs and learning about their practices" (p. 73). The authors felt that critical inquiry into their practice would give them the opportunity to systematically identify the issues that arose in their classes. As Berry observed., without having each other in the room, there is so much that has happened that would have been missed and therefore never examined. Deppeler also cites (Bray et al., 2000, p. 6) which states that "collaborative inquiry is a process consisting of repeated episodes of reflection and action through which a group of peers strives to answer a question of importance to them." The authors decided to share their planning of classes, though not necessarily teach the same content. An example of this was the choice of content for the first lesson. The purpose of the lesson was to show that new teachers needed to deconstruct their formal science knowledge and to then reconstruct that knowledge in ways that might be more suitable for secondary students in schools. Stephen chose states of matter for his class to discuss and work with, while Rebecca chose cells. Part of Rebecca's reason for doing this was to ensure that she did not just rely on Stephen's ideas or responses for her teaching, but to make sure that her lessons were authentic and reflective of her beliefs about teaching and learning. So while the

classes had the same purpose, the content and context were flexible, each chose the content based on the background of the pre-service teachers, the confidence the pre-service teachers they had with the material and decisions made by each of the authors about the make-up of their own classes.

Of great importance was their pre-service teachers' learning and the way these students of teaching might make the transition from students to teachers. As teacher educators, the authors were conscious that their pre service teachers would be watching the way they taught in an attempt to identify what they were doing in order to keep the class flowing smoothly. It soon became apparent to that this needed to be far more explicit to the pre-service teachers as they were rarely able to "put themselves in the shoes" of the teacher whilst still being students. This led the authors to become very conscious of the way they modelled their teaching and tried to make explicit what they were doing and why.

Putman and Borke (1997) suggest that 'student teachers may have preconceptions that differ significantly from the views of learning and teaching that teacher educators wish to develop.' (p.1227) They go on to say that this could affect the new concepts of teaching and learning that the teacher educators are trying to describe as pre-service teachers will try to fit these new concepts around their current views. Having said that, Lunenberg (2007) also notes that such affects are usually "diluted" by the initial confrontation with actual teaching practice.

Lunenberg (2007) used a definition of modelling from Gallimore and Tharp (1982) which stated that modelling by teacher educators is the practice of intentionally displaying certain teaching behaviours with the aim of promoting pre-service teachers' professional learning. Both methodologically and practically, the authors have approached this study in ways that attempt to model what they believe is good teaching practice combined with explicitly explaining their pedagogical reasoning as a way of capturing and portraying the data that would comprise both their teaching of teaching and their students learning about teaching:

Collecting Data

Researching practice is more systematic than just reflecting on one's practice. The authors set out to record, analyse and critique their practice an attempt to better understand each other's teaching and their developing pedagogy of teacher education. To do so required each to keep a professional Journal of their teaching in which they would each write field notes when

observing the other teach and during their debriefing sessions. The data collected from such field based observation therefore formed the basis of the data sets for this paper.

Results

The data from this study (based on the field notes/journal entries) is analysed and presented in a systematic manner based on a presentation of the use of the cases and the reactions and responses to that work with the pre-service teachers. Presentation therefore follows in a chronological manner offering the Teaching and Learning perspectives followed by the learning through the subsequent debrief of each.

Teaching using Cases 1

In my class pre-service teachers worked in table groups of 4 reading the case and 'unpacking' the teaching issues they saw in it. I was surprised that the pre-service teachers could see the teaching and learning issues and could discuss them in quite sophisticated ways. Would they use lollies? They discussed both alternatives and the class was split over whether the lollies were useful or a distraction. But only one student made a link to her practice. She had used the role play and took the class through how it worked. I asked the class what 'model of electricity' was the teacher from the case using? The discussion was useful I thought and we concluded that the model was simplistic but useful and practical for the age group of the students. (Keast, journal - week 5: K class review)

View of using cases 1

In my journal the first thing I have written after watching Stephen teach his class is, "Why can't they link it? They have just spent 5 weeks in schools and have been given what I thought was a great stimulus for discussion about their experiences on teaching rounds and yet they do not seem to link this teacher's story to their own experiences out on rounds." I could see that the case had many identifiable moments that I thought would send the pre-service teachers into a flurry of "that happened to me on rounds," or "I saw that happen in this class that I observed." And yet, all they came up with was whether or not they would use this activity in their teaching and if they think it was a good idea or not. There was no mention of what the teacher from the case may have thought or felt and no relationship made to what they did or saw on their teaching rounds. (Cooper, journal - week 5: K class observation)

Stephen did not explicitly ask the pre-service teachers to link their comments to their teaching but he did put two questions on the board. One was about the science being taught

and the other was about using the teaching procedure. The pre-service teachers gave very superficial answers that indicated that they felt they didn't have any knowledge of any value to offer to the discussion. When Stephen asked the pre-service teachers to "tell me more" most of the time they couldn't articulate any further than they already had and just repeated themselves. They couldn't see where Stephen was going with this, but really wanted to have a go anyway. The discussion was never stilted and the pre-service teachers seemed quite satisfied with the lesson but it left me thinking; "Did they not have the language or experience to discuss teaching at this level? They just didn't see what I thought they would see in the case." (Cooper, journal - week 5: K class observation)

Stephen's class spent a lot of time talking about risk taking. His pre-service teachers quickly identified that when a class was going badly that the teacher needed to make an 'in the moment' decision to either keep going or make a change. The pre-service teachers could see that in many situations there was a great need for change but that making that change involved a great amount of risk and therefore, most of the pre-service teachers said that they would not deviate from their plan even if they could see that a change was required. They viewed risk taking as necessary but something you did not easily do as a beginning teacher and certainly not as a pre-service teacher. Some of this seemed to be born out of a fear of losing control of the class and some of it seemed to be the influence of the supervisors they had had on their practicum. (Cooper, journal - week 5: K class observation)

Two great comments that were made by pre-service teachers from Stephen's class were: "Teacher's really meant it when they said they were disappointed in you." And "I wasn't expecting to have Year 12's who weren't interested." As soon as I heard these comments I immediately thought that they would make great starting points for cases themselves. Stephen and I are very keen to get the pre-service teachers to write cases themselves, but at this stage I'm not sure that they understand the point of them. I also don't believe that they value the opportunity to talk about their teaching this way. Maybe this is something that you only start to value once you have been teaching for a while and you realise that this opportunity is so rare. (Cooper, journal - week 5: K class observation)

Debrief 1

I went to lunch for our usual debrief quite dejected. The class _had not gone at all how I had planned it. The case did not invite the pre-service teachers to talk about their own practice.

It was as though the teaching of another teacher was too isolated from them for them to engage with it. They could see the issues, they could make decisions about whether they would do it exactly the same or not use lollies. They identified how they might make stronger links to the electricity concepts during the role play itself. But all this was in isolation to the links to their own practice. I questioned Rebecca. "Was it obvious to you what I was trying to do?" She agreed, it was plain for her and she expected them to make the link. "How can I make their teaching more explicit in terms of shared practice?" I felt the class was not as effective as it could have been and I grappled with Rebecca's help to understand how I could have made it better. But a larger question started to loom over me, "what would I do next week?" (Keast, journal - week 5: Lunch debrief)

This episode was not what we expected and the discussion at the debriefing was energetic and engaging as we grappled with what had happened.

Debrief 1

During our debrief Stephen commented that he was trying to create an "ah- ha moment" for his pre-service teachers with respect to the link between the work we do with them at university and the experiences on their teaching round. I wondered if there was a midpoint somewhere between without spelling it out for them as the "ah-ha moment" but have since decided that this would be an almost impossible judgement to make as it could be different for every student in the room. When Stephen told me what he had planned I thought it was perfectly clear to me and that he did not need to do any more than just introduce the cases and let it all unfold. We talked about many possibilities for why the pre-service teachers had not jumped at this opportunity to explore their teaching which included; not understanding the task, us not making the task explicit and the pre-service teachers not being able to view themselves as teachers whilst being in a class as students. (Cooper, journal - week 5: Lunch debrief)

In planning this lesson, Stephen shared with Rebecca not only his plans for the lesson but his pedagogical reasoning. By doing this, he hoped it would help Rebecca understand the difference between teaching in school and teaching in a teacher education program, addressing the concerns identified by Korthagen, Loughran and Lunenberg that expert teachers are called into be teacher educators. During their debrief reflection, the discussion focused on the pedagogical reasoning of the teacher educator as much as what occurred. In this lesson, Stephen expected his preservice teachers to make connections between their own classroom teaching

experience and the issues that unfolded in discussions of the cases. While the students readily identified the issues, they made no connection back to their own teaching experiences. After the lesson Stephen grappled with why the preservice teachers could not 'see' that reviewing another teacher's teaching practice clearly related to their own teaching experience.

Rebecca, like Stephen, could not understand why the preservice teachers did not make the expected links. The authors considered several reasons for this, including Lunnenberg et al, (1997) idea that the teaching round (craft knowledge) can diminish the impact of ideas discussed at university (science knowledge). This teaching experience was meant to address this by providing an experience of science knowledge through discussion of craft knowledge and encourage preservice teachers to note that discussions of practice were useful in better understanding their own practice. Of course this all relied on preservice teachers identifying issues raised in the case discussion with their own practice.

In searching for reasons the preservice teachers did not make links, Rebecca thought this may have to do with the students' lack of language or did not yet have the classroom experience to articulate their thinking. Observing a teacher educator in practice gave Rebecca opportunities to reflect on his practice and through this understand better the pedagogy of teacher education. As an experienced teacher Rebecca had developed her own pedagogy of teaching but as a new teacher educator she was still coming to understand the pedagogy of teacher education.

In the discussion about the teaching episode, it became clear that Stephen's intention not to make this explicit but rather expected it to be an 'ah-ha' moment revealed his pedagogical reasoning. Only by being in the room and later sharing the discussion of what took place, was it possible for Rebecca to see what Stephen valued in his teaching. She too valued students making 'ah-ha' type connections in their work, but wondered if she could encourage this by making a small change to the teaching. In this way she was reflecting on her teaching of teachers and changing her teaching based on that reflection. In this way she was coming to understand and implement her own pedagogy of teaching teachers. One aspect of teacher education pedagogy different from the pedagogy of teaching is looking at ways to engage the preservice teachers in understanding teaching. While observing the class, Rebecca looks ahead at the possibility of having preservice teachers write and discuss cases written by preservice

teachers rather than cases written by teachers. She wonders whether cases written by preservice teachers would be more engaging for preservice teachers than cases written by teachers. Following the debrief, Rebecca taught her class the same unit of work. The following illustrates how that unfolded.

Teaching Using Cases 2

After our debrief over lunch I decided that I would try to balance precariously on the continuum of telling them exactly what we wanted and achieving the "ah- ha moment." I decided to add an extra question to my list of focus questions which was, "how does this link to your experience?" I thought this was a way of saying what did you see on your teaching rounds that links to this case, without really saying it. The pre-service teachers very quickly made links to using concepts maps and computers in their teaching. I was concerned that the pre-service teachers would focus on the teaching and miss the science and this is exactly what happened. The science content was a minor aspect in the case, but I did feel that the teaching strategies and the issues raised in this case would allow the pre-service teachers a way in. The discussion was lively and many pre-service teachers had stories about how they had used computers successfully, or not, as the case may be. (Cooper, journal - week 5: R class review)

View of using Cases 2

So we went off to Rebecca's class that afternoon with mixed feelings of expectation. While we plan together, we do not always teach the same. Teaching is very personal and we share plans but often the content or context will vary. Rebecca for example chose a different case to start with, Planning for Semantic Maps .

In my field notes I wrote, "Would Rebecca make this explicit (the link between craft knowledge and science knowledge), given our conversation over lunch about my class?" Clearly Rebecca saw the purpose of using Cases and the links I was trying to make for the pre-service teachers even though they could not. Yes, Rebecca included the question "how does this link to your experience?" as the last question in her list of questions she put up on the board to guide their unpacking of the case. I wondered at the time if they would make a link to this given it was the last point in a list of questions. As the pre-service teachers began discussing the case they linked straight away to their practicum teaching experience. Why was this so obvious to her class and not mine?

During Rebecca's teaching I had an "ah-ha" moment where I realised that pre-service teachers were able to engage in her class because the content and context had provided a way in for them to discuss what they had done both in the university classroom and their teaching at schools. The difference between the two classes was Rebecca's way into the discussion. I realised it related to both the context and content of the Case. The pre-service teachers related to the content of this case - cell chemistry (her first development task in class at the beginning of semester was on cells) and the context - both concepts maps (semantic maps) and using the computer room. Compared to my content - electricity, and my context - role plays. Only one student in my class had taught electricity while out in schools and she had also used something similar to the role play. With an unfamiliar content my pre-service teachers found it difficult to relate to their own teaching experience. Few had tried role plays in their science teaching. Similarly with unfamiliar teaching context the pre-service teachers found it difficult to relate their teaching experience to the problematic nature of role plays. It was clear that having a case where the pre-service teachers were familiar with the content or context allowed them to connect and engage in the discussion about the case that included their own experience of teaching.

As Rebecca's pre-service teachers read their second case I asked Rebecca to join me in the preparation room. I said I had an insight and related to her the idea of content and context. She agreed that this could have been the key that we had been searching for over lunch and we agreed to discuss it after the class during our debrief. When we returned to the classroom the pre-service teachers seemed a little subdued but: Rebecca pushed on and I continued to take notes. Later I left the room for several minutes. (Keast, journal - week 5: R class observation)

Further teaching using Cases 2

The class was going along quite nicely and I had just set the pre-service teachers another case to read when Stephen motioned to me to join him the prep room which is behind the classroom. We disappeared for a moment to discuss what Stephen had observed during the first half of my class and returned to a very quiet group of pre-service teachers. A few moments later, Stephen had to leave the room. The second the door closed the questions started.

"Are you alright?"

"Are you in trouble? Did you do something wrong?"

"Are ;We in trouble, did we say something we shouldn't have?" "The lessons been going really well, why would she be in trouble?"

They thought I had been pulled aside and disciplined for my poor teaching!

I reassured them that everything was fine and reminded them that Stephen and I were working together on a research project and that he and I were just discussing the differences between the way he and I had approached something. I made it very clear that he was there to watch me and the way I fought. They laughed, slightly relieved but still slightly unsure. Upon Stephen's return there was still some awkwardness about so I decided to turn their attention back to the task at hand and we ploughed on.

My pre-service teachers clearly hold the view that it doesn't matter what you do during the lesson you must complete every lesson by having your students write down what they've done in class so that they don't forget. We have spent a great deal of time discussing the power of episodes in learning and we are all in agreement that this is a great way to learn. But, in the eyes of my pre-service teachers it will only work if they make notes about it as well. What I find so fascinating about this view is that I haven't asked them to take notes once during our classes this year. Many of the pre-service teachers do it anyway, but I think this is more an indication of the teaching they have been exposed to at university, rather than anything else. I think this will be a constant debate between us. (Cooper, journal - week 5: class review)

Debrief 2

The authors began their debrief by considering, "What were our expectations and were they reasonable?" Rebecca's class had made the link between craft knowledge and science knowledge rather well and on their own that Stephen had wanted for his class. It seemed to work better for Rebecca than Stephen, because she used a different case that included a content and context the pre-service teachers more readily identified with and she gave a question on the board to direct them to make such link. "Did the Case make a difference?" The case Rebecca chose first was more about the how of teaching than the science taught. Rebecca was concerned that teaching was easier to discuss and that the pre-service teachers were engaged but not to the depth she thought they would be. Their discussion was clearly focused on the use of the concept maps and computers rather than what the teacher was doing or thinking. They were engaged by the content but did not see the task as other teachers' stories of teaching that could guide their reflection on their own teaching and what they might do in a similar situation.

Rather they talked about using concept maps and other issues that occurred in their teaching from this, or about computers or about teaching cells. A significant question for Stephen and Rebecca from all of this was, "What are they expecting from us?" So while the preservice teachers in Rebecca's class did relate issues from the case to what they experienced on teaching rounds, they did not discuss this from pedagogy perspective as hoped. Other questions emerged, "How are their needs and concerns different from what we want them to learn about?" and "how can we bridge these differences effectively?" and "can cases be a vehicle for this?"

The pre-service teachers appeared to view the case lessons and the issues they brought up much more superficially than Stephen and Rebecca expected. In one case they saw it as one teacher making an error, talking with a colleague who they all viewed as a superior and fixing it up for next time - rather than viewing this as an example of teacher growth and a teacher using a familiar strategy at the beginning of a unit rather than at the end and in so doing realising that using it at the beginning meant her pre-service teachers needed more support. An interesting issue here was that the pre-service teachers viewed teacher talk as always from expert to novice. That the teacher had made a mistake and the discussion with an 'expert' had fixed it up. Rather than, we saw the case as a teacher trying something new, it did not work as planned. She discussed it with a colleague and together they talked their way to a better understanding of using such a technique. Each had learnt something about using this strategy in their teaching and in this way their pedagogical understanding had improved.

Another purpose for using cases was for the pre-service teachers to see why teachers would write and read cases. That it was an opportunity to share ones practice, share the complex natures of teaching, and to build professional wisdom and tacit knowledge. But we had little feedback that this was the case. What we found was that our pre-service teachers could not move beyond the science knowledge (the model used), the content (talking about cells) and note taking as the method of learning by students. Rebecca spent a great deal of time Trying to move her pre-service teachers to see that there were other ways of knowing and learning. But her pre-service teachers kept coming back to, "yes but then I would get them to take notes". It was like note taking was the ultimate way for all students to learn. Several of my pre-service teachers had worked in difficult schools and little note taking was done by the students as they had quite poor literacy standards. They offered several different ways to help

students learn. But in Rebecca's class the dominant view strongly held by most was that they learnt best by note taking and it gave you something to refer to.. Therefore students must have the same view. In a way this paralleled the views that Rebecca and Stephen were trying to teach, but they did not see at the time. Teacher educators need to realise that learning happens over time and strongly entrenched views of what learning is are not be changed easily. Conceptual change in science with pupils takes time, effort and seeing a reason for change, so conceptual change in our pre-service teachers will be the same. To change their conceptions about what is good science teaching will _not happen in one discussion but needs to be revisited many times over each semester before it is to occur, if at all.

But the issue that shocked us more was the way the pre-service teachers viewed our roles as teacher educators. When they went to the preparation room, the class viewed this as Stephen, older expert disciplining Rebecca in a role of student 'teacher educator'. It was clearly what they had experienced and related to from their teaching round! Rather than two educators collaborating on an issue, the preservice teachers observed Stephen supervising Rebecca on what she had done wrong! The pre-service teachers clearly had the perception that there were and are 'right ways' to teach. Even though Stephen and Rebecca questioned this in each lesson and have told them several times that they are partners in a research project they still view their roles as supervisor and student. (Field notes - week 5: recording of post class discussion)

But an issue for both classes was the problem of the pre-service teachers engaging with the issues that teachers raised in their cases. I wrote during the class that pre-service teachers were focusing on the trees not the forest. In Rebecca's class, like mine, they viewed the teaching in simplistic terms, as the teacher doing the right thing or wrong thing, not that teaching itself is problematic. That teachers make 'in the moment' decisions that can lead them down different paths, often away from what they had planned but in response their student's needs. Such divergence often led to activities that were untried and required significant risk by the teacher but was seen as necessary. The student teachers did not see this in the same way. Several made comment that they would not have the confidence to take such a risk in their own teaching to change direction. Rebecca had the opportunity after observing Stephen's class to change her teaching to address the concerns of linking craft knowledge to science knowledge. While the preservice teachers did make such links, new issues emerged for Rebecca as she came to learn about the pedagogy of teacher education. She expected her preservice teachers to engage in

discussion about the pedagogy of teaching rather than the mechanics of teaching. This was significantly different from her teaching in school, in that Rebecca was trying to make her preservice teachers come to understand the pedagogy of teaching, and in so doing she was learning about the pedagogy of teacher education. As Cochran-Smith (2005) observed, by sharing the issues the authors each grappled with in their teaching of teachers, helped the other to better to understand their own teaching.

Post Briefings

After the briefings Stephen and Rebecca both wrote their journals and shared them with each other. They were puzzled by what they should do next. They considered conducting an interview about Stephen's teaching of in the last lesson. It was their intention to share their purposes for the class with the pre-service teachers. To make the links between craft knowledge and science knowledge explicit and to clarify the broader issues in the cases ask them for their comments. But also it would demonstrate that experienced teachers (and teacher educators) plan lessons with purpose and good intentions only to find that do not work as they had planned. Many of the pre-service teachers had experienced this during their teaching rounds and this would give them an insight into both Stephen and Rebecca's planning and delivery. Stephen and Rebecca also wanted to show that they too grappled with the best way for their learners to learn and gave much thought to how they planned their teaching and why they did it the way they did. Another purpose was to make their reflection on their practice explicit as a form of modelling the practice. To demonstrate that they were willing to change what they had planned to teach and how it could be taught to meet the needs of the pre-service teachers. The plan was that pre-service teachers would then discuss what makes a good case and they would start planning to write a case of their own teaching experience from the last teaching practicum. This would be quite risky for them as they would be telling their pre-service teachers that they felt that their lesson with them was not as effective as they had hoped. That Stephen thought he had not taught well. Sharing both his failures and his successes, they both knew was valuable, but to talk explicitly about a failure seemed to be placing his professional reputation on the line. As Loughran noted in a similar situation he thought that sharing his thinking aloud could be viewed by his pre-service teachers as indecisive. Stephen had Rebecca had observed what Loughran had in his study, that pre-service teachers had a strong belief that there was one 'correct' way of teaching in each situation and experienced teachers like Stephen knew how to

do it correctly. Revealing to them that you had a failure could risk their faith in your ability as a teacher.

Teaching about Teaching Cases

So the lesson began, I gave a run-down of what we would be doing and set up two chairs at the front of the room for an interview. Rebecca asked what my purpose for last week's class was. I gave my purpose, focusing on the linking between practice and research. The reading was supposed to help them see that they could learn about teaching and improve their thinking about their teaching by reading and analysing another teachers practice. Well, the pre-service teachers readily expressed that they had done that in their in groups. The only problem was they thought that talking about their own experience was like talking off topic. So they ensured . not to bring this into the larger group discussion but kept it to their small groups. They were trying hard to meet what they thought my expectations were. They asked why did I not make it more explicit? Why did I not just tell them to make the link? I explained that I was hoping for them to have an 'ah-ha moment'. That I thought something they discovered would have a stronger episode than something I told them. Rebecca said that in her teaching if she told students she thought that had an impact value of 2 out of ten, but if they discovered it, it had an impact value of 8-9. out of ten. So we had both deliberately chosen in my class to avoid felling them. (Keast, journal - week 6: K class review)

During this lesson we decided to share our teaching experience as a case with Stephen's class. Basically, we sat in front of Stephen's class and told them that the lesson last week didn't really go to plan and that their responses were not what we had expected. The pre-service teachers in our classes appear to hold a view that there is a right way and wrong way to teach things and there is some expectation that Stephen and I have got it right. Well, we decided to take a big risk, more of risk for Stephen than for me, and tell the pre-service teachers that on this occasion it had not gone to plan.

I asked Stephen what his purpose had been for his lesson and he explained it to the class along with what he saw as the teaching and learning issues in the lure of the lolly case. We explained that we wanted the pre-service teachers to have an "a-ha moment" and make a connection between what they had done on practicum and what we do with them at university. We then asked the pre-service teachers why they hadn't discussed any of their teaching rounds experience. They said a couple of things:

- ♦ They were talked out and had been discussing their rounds all week so they were over it.
- ♦ They thought that talking about their rounds would be considered off topic!
- ♦ They wanted to know why Stephen hadn't made it explicit to them that he had wanted them to make links to their teaching rounds. He explained the idea of an "a-ha moment", but I'm not convinced that they really understood what he meant nor did they grasp power of it as a teaching tool.

Stephen set his class to work on planning to write their own case and I moved around the room assisting students. One of them asked me to come over to their table. She said that she felt she knew why last week hadn't gone so well. She felt that Stephen had set up the girl who demonstrated the role play to fail, to prove that the science model in the case was no good and that our interview today was self-serving and in no way could it be viewed as Stephen taking a risk or opening up his practice to scrutiny. I asked another student what she thought about this and she said that she could see the first student's point. I went to another table and asked what they thought and they said they too could see the point. I was stunned! Clearly they didn't know Stephen and they had no idea what he was about or what he believed about teaching. I just couldn't believe that they thought this way. The pre-service teachers expressly asked me not to tell Stephen about this. But in a way one of the pre-service teachers made it very obvious by sitting with her back to us, which I noted earlier but decided not to mention whilst the interview was happening.

My lesson was in the afternoon and I started by talking about what had happened in our class last week and what had happened in Stephen's class and then about what Stephen and I had done that morning. News had travelled fast! The pre-service teachers had heard already, so we discussed the differences between the discussions that had taken place in each class when the cases had been introduced. My pre-service teachers were interested in what had happened but were not particularly taken with it so I moved on with the rest of my class. What this showed me is that they haven't yet understood how personal teaching is and how scary it can be to open up your classroom for other people (let alone the students themselves) to comment on. We talked about super engaging lessons where you planned things like role play and how often you used them and once again we debated the value of these types of lessons vs notes!

When I told them that my Year 11 Physics class had only written notes twice for the entire semester I think they thought I was lying.

We discussed what made a good case and teased out some of their ideas for cases. We talked about why teachers read and wrote cases but I still feel that their thoughts on this are a little superficial. Perhaps they haven't taught enough to appreciate the value of monitoring your own learning about teaching and tracking the experiences you have and thus monitoring your own growth as a teacher. (Cooper, journal - week 6: class observation)

Debrief after Teaching about Teaching Cases - Rebecca

Rebecca made the decision to tell Stephen what the preservice teachers had told her during the class. Stephen's immediate response was "Why didn't you tell me during the class and we could have unpacked it?"

I knew that was true, but I also knew how nervous some of the pre-service teachers were about having said this, so we decided just to let it go. My feeling is that the pre-service teachers who spoke to me, spoke because they wanted Stephen to know what they thought without making it public knowledge. Stephen of course was shocked, just as I would have been, and he decided that he would speak privately to the pre-service, teacher, who had demonstrated the role play and see how she felt.

What this showed me, is that something that was so obvious to me, like Stephen's beliefs about teaching and learning, were not obvious at all to the preservice teachers and that it is also important for the preservice teachers to understand who you are as a person in order to understand how you react in the classroom. I thought that Stephen had done a great job on several occasions of articulating his beliefs about good teaching and good learning. He has talked about how he came to these understandings and about why he believes it is important for teachers to have an understanding of their beliefs. Maybe all of this is useless in isolation from an understanding of the person who thinks it. Having only met with the preservice teachers a handful of times, and not having had the opportunity to visit any of his preservice teachers while they were on their practicum, Stephen has had very little opportunity to build a relationship with this class. They couldn't identify with any clarity his intention in his actions and therefore did not take full advantage of the great opportunity presented to them when Stephen openly discussed his planning and teaching. (Cooper, journal - week 6: Lunch debrief)

Even though both Stephen and Rebecca made their intentions and purposes explicit to their students, the preservice teachers heard and interpreted what was said in a very different way to what was intended. Stephen was trying to make explicit to his preservice teachers his pedagogical reasoning so that they may reason about their teaching in similar ways. It was important for Stephen to model the practice he expected of his preservice teachers.

While Stephen thought he was taking a big risk revealing his 'failure' to his preservice teachers, they did not see it as a risk or a failure. They could not understand why they were not told to make the links. Stephen and Rebecca reflected that in many ways early in the year, the preservice teachers were still seeing teaching as telling. The other surprise for the authors, was that preservice teachers wanted to meet the teachers expectation, 'doing the right thing', was high on their learning agenda. While it was the authors' intention to engage the preservice teachers in discussions and understanding of pedagogy of teaching secondary students, the preservice teachers expected more craft knowledge.

What was revealing for Stephen, was the idea that the preservice teachers had thought that he had singled out a preservice teacher to repeat the activity in the case so that she would be seen as a failure. Stephen would never have that intention for his preservice teachers, and he articulated his beliefs, but maybe the preservice teachers were not ready to hear them.

The two most important things to come out of this study for the authors, were understanding their own beliefs and their pedagogical purposes for working the way they did, and coming to better understand the pedagogy of teacher education. Reflecting with Rebecca over these critical incidents, and articulating his intentions both verbally to Rebecca and written in a journal made Stephen more aware of the beliefs and values he had of teaching and learning. He came to understand why he wanted the preservice teachers to make 'ah-ha' moments, but he also realised that at times he needs to assist them to make the links. As a beginning teacher educator, Rebecca gained valuable insights to the pedagogical reasoning of an established teacher educator and learnt rapidly about the difference between teaching school students and teaching preservice teachers.

Conclusion

The authors learnt several things about their pre-service teachers;

1. They have set beliefs they bring to the course about what constitutes good teaching and learning,

2. They see all roles that involve two teachers as one with expert knowledge and one as the novice - learning,
 3. They have expectations about what we do, what the course ,has to offer and what they are getting out of it,
 4. Their reluctance to move beyond their comfort zone rn their teaching practice.
- We begin by discussing these in detail.

The pre-service teachers came to the unit with their own beliefs about teaching science and what constitutes good teaching and learning in science. This agreed with Putnam and Borko who suggested that pre-service teachers have different views of teaching .than teacher educators. Stephen and Rebecca believe as teacher educators, part of their role is to encourage pre-service teachers to question their beliefs and consider other beliefs about teaching and learning. One example of this has been the pre-service teachers beliefs that for their students to learn in the classroom they must write something down into their workbooks. Rebecca had discussed this with her class several times, but her pre-service teachers cannot remove themselves from they are used to doing during their recent studies or in the work place. Even though she had not asked her pre-service teachers to take notes during her classes, and they can observe that she is modelling good teaching practice they still want their students to take notes as the main method of learning. Fo1 Stephen, his pre-service teachers' discussions about the role plays focused on a lack by the teacher. to have the pupils write down what they had observed. The pre-service teachers had not conceived that the activities they conduct in classrooms could be stand-alone learning, experiences for their pupils. Lunenberg et al. contend that process of learning is more important than the content of the message taught to pre-service teachers. What is apparent is that conceptual change such as the one Rebecca and Stephen encourage in their pre-service teachers, takes time, effort and a reason for change. One off episodes no matter how powerful or linked to their experience is not enough. Such issues need to be visited again and again. This is one issue that Stephen and Rebecca wanted to continue to discuss and explore over the course of the year.

Introducing collaborative roles rather than the expert-novice role has been another conception the pre-service teachers have struggled with. In schools they are treated for the most part as novice learners needing expert guidance. Supervising teachers have the role of expert, but more importantly they are expected to know all the correct answers. Two episodes

emerged that reinforced this for Stephen and Rebecca. The first was in the discussion of the first case discussed Rebecca's class, where the pre-service teachers inferred that the discussion between two teachers was led by an expert. Stephen and Rebecca saw this exchange as a collaborative discussion, where one teacher was exploring her practice with the support of another. It was the critical questioning of the second that prompted the teacher to reconsider her teaching and her expectations. She was able to work through the poor experience and rethink how she would have to use that strategy next time with more support because it was being done at the beginning of the unit rather than the end. The pre-service teachers viewed this as an expert outsider giving advice and wisdom to a novice struggling with her practice. Their roles in school were superimposed on to the roles within the cases that were discussed. Rather than seeing the 'science knowledge of teaching' in the form of cases informing their practice they were viewing the cases as examples of 'craft knowledge' where they could learn techniques from an expert. This was made clear to Rebecca and Stephen when they discussed Stephen's 'ah-ha' moment in Rebecca's class. Rather than the pre-service teachers observing Stephen and Rebecca sharing their practice, they observed a novice being reprimanded by an expert!

The pre-service teachers had expectations of what the course would offer. Fullan identified these expectations and Stephen and Rebecca conferred with them for their students. Though Stephen and Rebecca, were explicit in letting pre-service teachers know their purposes within each individual class and the course as a whole, the pre-service teachers could not yet 'hear' what they were being told. When Stephen and Rebecca shared Stephen's perceptions of his poor class they were quick to say that they had all learnt something from the class and had not seen it as poor learning experience for them. They were quick to let Stephen and Rebecca know that they had met their expectations. They were expecting more 'tips and tricks' that they could use in the classroom rather than discussions and investigations of different types of learning that can occur in a science classroom. They were focused on the craft knowledge as Fullan had suggested and were not seeing the science knowledge as being capable of informing their practice. They were focused on the 'craft knowledge' of how to do it, rather than explore the 'science knowledge' of why it might be done differently for different classes and different student groups. Even if teacher educators create strong episodes of learning, pre-service

teachers' conceptions of good science teaching and learning are hard to change. This reinforces the difficulty of conceptual change.

The pre-service teachers could recognise in the cases that it was important for experienced teachers to take risks at times based on 'in the moment' decisions and change their lesson plans to suit the needs of their students. However, they thought that it was too risky for them to try. A well planned lesson plan needed to be followed and the risks for them of following tangents could end in disaster. The disaster they feared appeared to be two fold, classroom management and to content details they would not know. Classroom management in the first semester is a biggest issue that the pre-service teachers raise: Before the first practicum round, it is the one issue most often in tutorials consistently across the course. How will they be able to handle issues associated with misbehaving teenagers? It is not surprising then that this is a concern for them in terms of changing from their lesson plan. However, Stephen and Rebecca believe that this is the only time when they will have an extra person in the room, where if something did go horribly wrong they would be able to seek assistance. For this reason alone it is a better time to try something risky than next year when they are alone in the classroom. The issue of content raises different concerns. Pre-service teachers are concerned that students may ask them questions they cannot answer and as a result they will lose respect in the eyes of the students. Stephen and Rebecca have reiterated that there are times when students ask experienced teachers questions that are difficult or they call } not answer. Learning to cope with this situation is another part of becoming a teacher.

Stephen and Rebecca learnt several things about their own practice as teacher educator. As noted by Cochran-Smith (2005) focusing on critical incidents where the authors grappled with their practice as teacher educator proved rewarding in articulating for each their understanding of the pedagogy of teacher education. Both authors valued the opportunity to critically reflect on each other's practice and recognised the value of teaching together as recognised by Rosean and Wilson . The experience so far for Stephen has been extremely enlightening. Articulating his practice to Rebecca has made him more focused on what he is teaching and why. It also that revealed that the style of lessons that Rebecca and he taught could often be confronting for their pre-service teachers. Such confrontation, when made explicit was useful for the pre-service teachers to reconsider their beliefs about good science teaching and learning. This only worked when there were high levels of trust and respect

between lecturer and learner. Missing practicum visits during the year had lessened the opportunity for Stephen to build the relationship he normally did with his students and had it made it more difficult to critically question the pre-service teachers about their beliefs without it appearing personal.

We have been reframing our teaching to encourage our students to engage in issues of teaching and learning rather than meeting what they see as our expectations. We would not have seen such an insight if we had not had a critical friend in the class, had not had the debrief and had we not been prepared to change our teaching in response to our students' learning needs. Seeing teaching teachers as problematic allows us to recognise the difficult nature of such teaching and investigate issues that not only illuminate the complexity of the task but offer new insights into the ways we frame that teaching.

Rosaen and Wilson had identified the struggle that teachers had moving from teaching students to teaching teachers. In their study, teachers were used to being reflective and problematising their practice with student classrooms but struggled to transfer this to teacher education. By sharing her practice with Stephen, and listening to him explain his teaching of teachers, Rebecca more quickly recognised the difference between the pedagogy of teaching and pedagogy of teaching teachers. While she continues to learn about teaching teachers, as Stephen does, she is asking questions about her pre-service teachers learning. Rebecca believes that this had come about because of the conversations she had with Stephen about his teaching approach and why. It is their plan to investigate the differences Rebecca sees between teaching students 4 days a week and teaching teachers the other day.

Loughran suggested that pre-service teachers need to have a teaching experience that goes beyond classroom control before they can appreciate the value of reflective practice. The same could be said about the use of cases. Most of the pre-service teachers here had no more than 5 weeks experience in a classroom and therefore, may not have experienced a class where classroom management was not the main focus for them during the lesson. The cases that we offered as stimulus for discussion all dealt with issues beyond classroom control. While it was possible for our pre-service teachers to think about what this would be like, they may not have experienced it first hand, making it difficult for them to connect with beyond a superficial level. By offering these cases, Stephen and Rebecca were attempting to give them a context that is common and therefore a way of discussing possible problems that may arise in the classroom,

but as they did not know how it felt to be in that situation they could not comment in a profound way. Rebecca and Stephen now recognise that their pre-service teachers were still judging the teaching presented in the cases as 'good' or 'bad' rather than 'problematic'. They have realised that pre-service teachers have considerable tension between adopting the view that teaching is problematic and needing to pass practicum and doing a 'good job' in school to pass the course! As teacher educators, Rebecca and Stephen learned that recognising these issues and managing the tensions between practice (craft knowledge) and theory (science knowledge) are integral elements of understanding the pedagogy of teacher education.

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