

Promoting higher levels of reflective writing in student journals

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(Received 17 October 2007; final version received 3 October 2008)

This paper traces the development over several years of an initiative involving student journals that was introduced into a tertiary science education course for pre-service teachers to promote enhanced learning of how to teach science. Very soon after introducing the journals into course work the lecturer began engaging in ‘unplanned’ informal reflection (reflection-in-action and reflection-on-action) when she witnessed the shallow, often trivial nature of her students’ reflective writing and the lack of pedagogical insights they were gaining from the exercise. Motivated by her own ongoing scholarship the lecturer introduced purposeful coaching of reflective skills into her pedagogy to scaffold students’ learning and promote more useful reflection. The impact of these interventions on students’ reflective capabilities and learning were investigated using a formal action research cycle. Findings indicate that student teachers’ reflective skills improved and resulted in deeper and more focused thinking about how to teach science for learning

Keywords: levels of reflective writing; pedagogical content knowledge; reflective tools; student journals; targeted teaching strategies for reflective writing

Introduction

Reflective practice is widely advocated as an important attribute to promote, develop and foster in participants of teacher education programmes (Bain, Ballantyne, Packer, & Mills, 1999). Thinking about one’s experiences is believed to enhance professional learning and growth by helping student teachers to develop an educational philosophy that will guide and improve their teaching practice in classrooms (Loughran & Corrigan, 1995; Moon, 1999; Shireen, Desouza, & Czerniak, 2003, Wallace & Loudon, 2000). This paper relates to a post-graduate course in science education that I began teaching in early 2005 at the University of Waikato and to a teaching and learning initiative that when first introduced and trialled was nominally and loosely based on reflective practice. The course caters for students with science degrees who are seeking entry into the teaching profession, and contributes towards a one-year programme in secondary teacher training. Graduates of this programme serve an internship for a further two years in schools before becoming fully certificated secondary teachers.

My teaching and learning initiative in its original form involved the use of student reflective journals as a means of providing feedback about teaching and learning in workshops and communicating to me their classroom experiences when students were away from University on teaching practice in schools. In these accounts of classroom

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teaching and learning, I discovered the students' comments tended to be descriptive and lacked depth of thought, but their comments (or lack of comments) frequently hinted at aspects of the course content that could be added or modified to improve the students' teaching practice. I consequently used this information to help design the workshop sessions and tasks for the remainder of the course.

Despite the sketchy nature of these early student journals I was encouraged by insights I was gaining from my own professional and academic learning to continue their use in the course. There is strong evidence in the research literature that a more structured approach to the teaching of reflective writing that intentionally targets and scaffolds student learning of the skills, especially in activities that promote greater understanding of learning how to learn in a given discipline area (Moore, 2005), can result in higher quality thinking about teaching and learning (Bain, Mills, Ballantyne, & Packer, 2002; Moon, 1999). The coaching of student teachers in how to reflect and the use of content or situations for reflection that have pertinence for their professional learning in a given field have become guiding principles for me in the design of my pedagogical strategies for this course. Since 2006 I have introduced certain measures into my teaching to strengthen students' reflective skills and the quality of their reflections and from 2007 I engaged in planned action research to investigate the impact of these interventions on student learning. Thus the initiative has evolved into a more focused and determined attempt on my part to instil in student teachers an awareness of their own learning through reflection and a means by which they can monitor and further their own learning. The findings to date suggest that the strategies introduced in this initiative, particularly focused coaching and practice of these skills in workshop activities prior to journal-keeping, are proving to be successful in promoting deeper levels of student reflective thinking and greater awareness of what teaching science might involve.

The first phase of the initiative

This largely informal developmental phase took place over the first three years of the course as I familiarised myself with the learning needs of the student teachers and identified various problems. It was a time of drawing ideas from my previous teaching and learning experience, including my recent academic research, to synthesise and trial new pedagogical approaches and strategies for solving identified problems like students' inability to reflect deeply. The phase was characterized by experimentation of the 'trial and error' type.

In my secondary teaching career I had experienced reflective thinking as a purposeful teaching and learning strategy in workshop situations during my participation in research projects such as the Learning in Science (Teacher Change) Project (Bell & Gilbert, 1996). Fellow teachers and I were being introduced to constructivist approaches to teaching and learning (Osborne & Freyberg, 1985) and we were asked to reflect on our experiences in journals while trialling innovations in our classrooms. As I thought back on my own experiences with journal keeping I was conscious that this exercise in itself did not contribute hugely to my professional learning, although I did gain insights into teaching and learning from the workshop discussions with other participants. In the research project there was no guidance, that I can recollect, about how to structure our reflective writing and little imperative on us to produce these journals at any stage – our verbal reflections in the workshops seemed to carry more weight with the researchers. I realized that in order to encourage my students to

engage in purposeful and regular reflection, some measures and guidelines needed to be provided for journal keeping and recognition given to the worth of their reflections. My initial support for students involved a reflective tool I termed the ‘Shulman framework’.

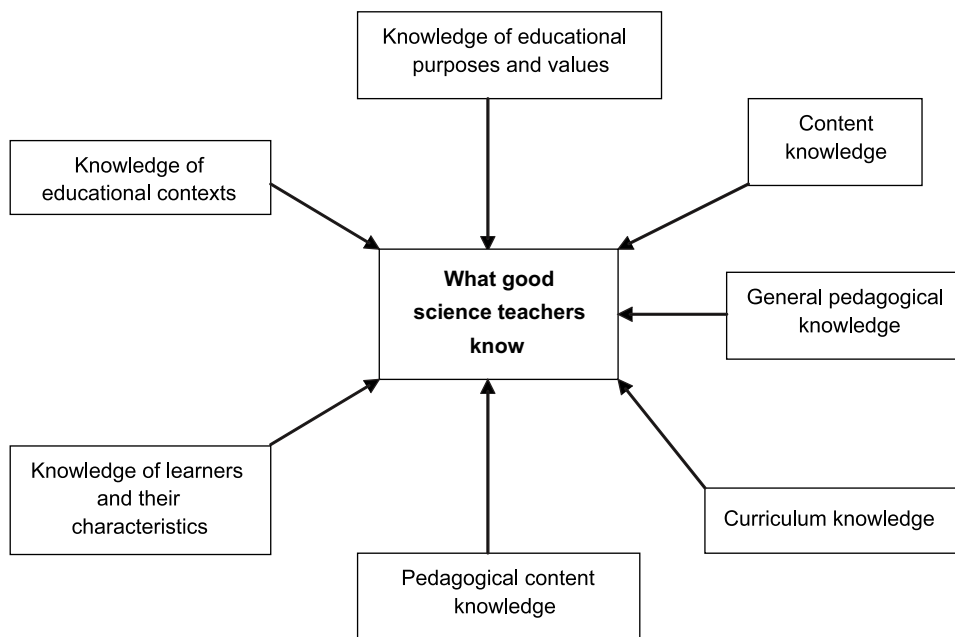
In my reading of the literature associated with teachers’ professional learning I had encountered a paper by Shulman (1987) on the nature of the knowledge base required by good (effective) teachers. His paper was informed by philosophy, psychology and a growing body of knowledge gained from case studies of the practice of young and experienced teachers. In seeking to promote teaching that emphasises comprehension and reasoning, transformation and reflection, Shulman (1987) observed that good teachers utilise a complex knowledge base gained from a range of sources or ‘domains of scholarship and experience’ for understanding (p. 5). To deal with the complexity of the knowledge base good teachers draw upon Shulman proposed a number of categories. These categories include:

- Content knowledge;
- General pedagogical knowledge, with special reference to those broad principles and strategies of classroom management and organisation that appear to transcend subject matter;
- Curriculum knowledge, with particular grasp of the materials and programs that serve as ‘tools of the trade’ for teachers;
- Pedagogical content knowledge, that special amalgam of content and pedagogy that is uniquely the province of teachers, their special form of professional understanding;
- Knowledge of learners and their characteristics;
- Knowledge of educational contexts, ranging from workings of the group or classroom, the governance and financing of school districts, to the character of communities and cultures; and
- Knowledge of educational ends, purposes, and values, and their philosophical and historical grounds. (p. 8)

Acquiring this knowledge base of experienced teachers requires the novice teachers taking my pre-service course to begin a journey of discovery into the practice of teaching. This view of their learning is closely linked to the concept of situated cognition (Brown, Collins, & Duguid, 1989; Hennessey, 1993), which recognises that ways of knowing differ from one community of practice to another and that learning is a process of enculturation into the ways of thinking of members of that community. On this journey they would be progressively learning and filling their ‘baskets’ of knowledge as defined above from sources such as discipline scholarship, educational materials and structures, formal educational scholarship and the wisdom of practice (Shulman, 1987) (see Figure 1).

I decided to introduce Shulman’s classification system as a framework for reflection (see Figure 1) through a scenario based task early in the course (see Figure 2).

This activity was designed to raise students’ awareness of the diverse knowledge sources teachers draw on when engaged in their profession and to give them some sense of where their learning journey was taking them. During a follow-up discussion various aspects of the task were examined and expanded upon in turn, using contributions from my teaching experience, and then related to appropriate categories of Shulman’s framework. I felt optimistic that the framework had merit as a reflective



Note: After Shulman (1987).

Figure 1. Shulman's Framework.

tool because students could use it to monitor their personal knowledge and skill growth and comment on this growth in their reflective writing. Thus the students were asked to begin recording their progress in relation to any or all of Shulman's knowledge categories in journals and to note the circumstances under which this progress was or was not occurring. Their writing was to be assessed so there was some requirement on them to regularly write in their journals. I looked forward to reading students' assessment of their progress after they returned from their teaching experiences in schools.

Where are we going in this course?

- Imagine the scenario: You have just arrived at your first teaching position and learned that as the first topic of the teaching and learning programme, for the Year 10 Science class you have been assigned, you are required to teach the topic 'Chemical Reactions'.
- In pairs discuss and record what steps you imagine you'll have to take in order to begin teaching this topic e.g. What will you need to do? How will you go about tackling this task? What information will you need? Resources? (what, how, when, where, why etc).
- Share findings with another pair and summarise key points for whole-class report back.

Figure 2. Teaching scenario task.

In this first experiment with journal writing the end results fell far short of my hopes and expectations in many respects. The students' records of their experiences actually provided little information about the knowledge gains they were making and very few students linked these experiences to Shulman's framework. They appeared to 'forget' to use this reflective tool. I was disappointed that students' reflections were generally low level with the emphasis on descriptive rather than evaluative thinking.

So, in the following two years of the course I continued to experiment with my reflective journals initiative by attempting to make more overt reference to Shulman's framework in workshops when appropriate and in the assessment criteria for their journals (see Appendix 1) to 'remind' students of its role in their reflection. This more pro-active approach brought some success as student comments began to focus on the effectiveness of workshop and classroom activities for learning rather than descriptive detail, but they rarely related their experiences to Shulman's framework and the growth of their knowledge bases. There were exceptions. One student, Jennifer (all names are pseudonyms), who had been a research scientist in her previous career, related her experiences to Shulman's framework with deep understanding. Under the heading 'Pedagogical content knowledge' Jennifer wrote:

Discussions on the nature of science (in workshops) highlighted discrepancies between what I as a research scientist did and what students learn at school. I can see that *classroom teaching* of science in a procedural manner where the teacher states this is the question, this is the path to the answer and this is the answer you should (have) got will give a false perception. [Though it is taught this way for (1) getting results to prove a theory/concept; (2) time constraints so must get work done, no side tracks; (3) making sure all students have same experience and meet learning objectives for assessment purposes].

BUT science research is not like that. The question comes before the concept (based on observation and why it is like that) and many questions are needed in order to define the problem because often one knows a lot of information just not how it relates (until one asks the questions that show this). Then comes trialling different methods/ease of answering a/some question(s) to define the problem more exactly [during which process one discovers other question(s) that need thinking about]. Experiments seldom give straightforward results, they always raise other issues (more questions). It is the questions that drives science knowledge and discovery, not the solutions. How does this relate to teaching science in a classroom?

Jennifer's contribution was indicative of the type of critical thinking that many writers in reflection believe is most effective for learning how to teach (Coble & Koballa, 1996; Shireen et al., 2003; Wallace & Loudon, 2000). Her level of reflection demonstrated not only insight into the 'authentic scientific inquiry' versus 'school science' dilemma but also a willingness to explore and reason through this complex issue (Bain et al., 1999), one that in fact worries many eminent science educators (Atkin & Black, 2003; Hodson, 1996; Hofstein & Lunetta, 2003). Rather than a description of events or impressions, Jennifer's reflection involves 'a form of mental processing with a purpose and/or anticipated outcome that is applied to relatively complex or unstructured ideas for which there is not an obvious solution' (Moon, 1999, p. 23). Schon (1987), in his earlier work on reflection, was interested in the thinking that professionals engage in when confronted with practical problems that are unique and not in the 'textbook'. He coined the phrases 'reflection-in-action' for actions where teachers draw on tacit knowledge to solve immediate problems and 'reflection-on-action' for retrospective thinking about problems after the event. In both instances he

believed that practitioners learn and change practice from reflection on real life, in situ problems that are out of the ordinary and not straightforward. As Bain et al. (1999) noted in their study of student teachers' reflectivity during field experience placements, mature students like Jennifer, who had been a scientist in her previous career, are able to recognise such situations more readily than their younger, less experienced peers.

In hindsight I could see that my expectations for the student teachers' reflective writing were unrealistic, given the broad guidelines I had provided. Further exploration of the literature on journal writing made me aware that reflection was a far more complex and multifaceted activity than I had first thought (e.g. Dart, Boulton-Lewis, Brownlee, & McCrindle, 1998; Hatton & Smith, 1995). I had only scratched the surface in relation to my own understanding of the nature of reflection and devising pedagogies for acquiring reflective capabilities. For example, as I began to appreciate subtleties like differences between the 'focus' of reflection (the nature of the event, observation or issue being reported) and the 'level' of reflection (the degree to which the student has worked with the subject of reflection and the level of analysis/reflection reached (Bain et al., 1999), I realized that my students had had little/no experience of what good reflective writing actually looked like or practice in doing it. My ability to detect and discriminate quality in reflective writing also needed honing. I had also overestimated their understanding of the ideas that underpin the Shulman framework and therefore their ability to relate these concepts to their classroom and school experiences as novice teachers. Despite the sketchy nature of these early student journals I was heartened to read authors like Bain et al. (2002), who, in support of journal use in pre-service teacher education, report that many researchers and theorists maintain that reflective skills can be taught and learned despite early difficulties. In not scaffolding the reflective process sufficiently for students I had made assumptions that they could think and write reflectively, when in fact these skills need to be acquired through the use of targeted teaching strategies and practice.

The second phase of this initiative

In this phase, based on insights gained from the research literature, my own academic research and my earlier trial and error approach in the course, I decided to engage in formal action research to investigate ways to improve the student journals. The research monitored the impact of more focused interventions on the quality of the student teachers' reflective writing and the development of their pedagogical content knowledge (PCK). The following interventions were included:

- The exposure to learning experiences that provides the 'raw material' for reflection, that is, experiences that deliberately challenge their existing ideas about science and teaching science. The pedagogical intent on my part is to extend their thinking, enhance their understanding of Shulman's framework with emphasis on the PCK concept (van Dijk & Kattmann, 2007) and further develop their PCK in science. Examples include: post-box activities to share ideas from professional readings; group problem solving, such as fair testing that involves providing feedback and feedforward comments to peers on their performance; and designing CoRes (Content Representations) and PaPeRs (Pedagogical and Professional Practice Repertoires) for teaching specific topics (Loughran, Berry, & Mullhall, 2006).

- the allocation of set periods of time (about 10 minutes) for reflective writing in each of the workshops after students engage in activities designed to increase their PCK in science. This time to practise focused reflective writing is strongly recommended by Moon (1999). On other occasions students were required to do short pieces of reflection as professional tasks between workshops.
- the retention of Shulman's framework as a reflective tool, but emphasising that students critically assess their own learning experiences in relation to their developing PCK and apply that experience when creating learning opportunities for their students. I have modelled this strategy on that used by Moore (2005) who had encouraged her trainee teachers in mathematics to use reflective journals to learn how to learn mathematics with marked success.
- the explicit sharing of the nature of skills to be learned (Clarke, 2001) through the use of exemplars that illustrate good reflective journal writing, as suggested by Moon (1999). I used examples of student writing from previous years (see Jennifer's previous example) that exemplified certain aspects of learning to teach science along with pieces of writing from current students that best showed evidence of reasoning and reconstructing (Bain et al., 1999).
- the focus on feedback that relates to exemplars to improve journal writing and the appreciation that 'feedback focusing on the reflective writing process – giving guidelines and a suggested framework for moving into higher levels of cognitive activity – is both more effective and more easily generalised than feedback focusing on the *teaching issues* raised by teachers' (Bain et al., 2002, p. 193).

Methods

Informed by my academic reading for my doctorate and more latterly for formulating a proposal for an education research bid, I chose to use an action research design known as *practical action research* as outlined by Cresswell (2005). The methodology comprises a general spiral of generic steps that lets me pursue solutions to my identified problems in collaboration with other researchers or mentors and to enter the spiral at any point appropriate to my particular action research project. The research questions were concerned with:

- the impact of the interventions on the quality of students' reflective thinking and writing and their learning of how to teach science; and
- student teachers' perceptions of the effectiveness of the interventions in helping them to reflect and learn how to teach science.

Data collecting methods were qualitative and included: participant observation in workshops; examination of artefacts such as samples of student teachers' reflective writing, the contents of their reflective journals and my planning notes for the course; and interviews with participants (done with 6 of the 16 participants by a professional colleague using a semi-structured schedule of questions that I provided).

Data coding and analysis

Reflective writing and journal entries were coded in terms of students' reference to their own learning and development of PCK (learning how to teach science). Analysis involved determining the level of thinking (Bain et al., 1999) students engaged in

when they gauged the impact of the event, issue or observation on their own understanding of the PCK concept and the development of their PCK in science. The focus in the coding for the interviews was on instances that revealed the student teachers' perceptions of how well the teaching strategies I used helped them to learn how to reflect and how their reflective capabilities were developing, and the impact of reflection on their learning how to teach science. In the analysis I was looking for those strategies students believed were most effective for teaching them how to write reflectively in a manner that enhanced their learning of how to teach science.

Findings

Students' reflective writing capabilities, and their development of the PCK concept and their own PCK, showed most growth in the episodes of 'compulsory' reflective writing that occurred in the early workshops and professional tasks. The focused nature of the reflective tasks on content that challenged preconceived ideas, the regular sharing of exemplars and feedback that prompted further thinking appeared to help students increase the sophistication of their reflections and their insights into the teaching of science.

Content that challenges pre-conceived ideas

The following reflective writing task was given in the first workshop after a post-box activity that required students to comment on statements related to the Nature of Science: 'On the piece of paper reflect on the effectiveness of the post-box technique in terms of changing the way you conceptualise the nature of science – then do a pair and share'.

Here are two pieces of reflective writing that exhibit aspects of relating and reasoning that are higher levels of reflection:

I felt that the post-box technique is a very useful tool for opening up my way of thinking about science. During the process I was more aware of my views and able to discuss and listen to others' point of views. In some cases I was able to 'see' things in a different way such as the statement of science is an unbiased, value free activity. The way I saw this statement was quite different from others as many saw this as value of life etc. ... It was helpful to see different views and I felt overall was very effective. (Mary)

I have long believed that science is an objective discipline that is independent from commercial interests or biased human purpose – 'value free'. The post-box technique reveals that science does have the side that is value-driven, though the overwhelming majority is for the humanitarian purpose. As for the technique itself, it provides a channel for open discussion and collection of view-points that allows some ideas that I never thought before. It is a very good and helpful method. (Jack)

The use of exemplars

The pieces of writing above were used as exemplars (with the authors' permission) in the follow-up session. In the interviews students commented on the value of such exemplars for learning what's involved in reflective writing:

Yes, I think hearing other pieces of reflective writing and seeing what was expected, and having a few more goes and practice at it probably helped me a lot. (Nora)

Yeah I found it hard initially until I probably heard some other people's writing and then I was able to go ... 'Okay that's what they are after. I need to think a bit deeper, not just skim the surface'. (Carol)

Written feedback and feedforward comments

With other students' reflective writing (on the same task) I used feedback to focus the student's thinking more on the required cognitive task, i.e. the extent to which the post-box technique affected their personal learning:

I thought that the post-box technique was a useful way to challenge existing ideas, particularly as there were many people who had very different ideas about some of the concepts. Surprisingly, since we are scientists and, theoretically, probably from the same 'school of thought' e.g. the NZ school. I was, of course, reassured when others thought like me, and assured, but respectful when others had ideas that seemed absurd to me. Valuable all the same to hear other points of view. (Vanessa)

My written feedback comment was: 'Did *your* understanding about the Nature of Science change in any way, or was your understanding unchanged?'

Those students who were interviewed generally expressed appreciation of the feedback and feedforward, often commenting how my questioning form of feedback prompted them to think:

Yeah, and she made some comments on some of the reflective writing that I've done. She'd written some comments like, 'Do you think it would be useful?' or ... you know, tried to tease ... tried to get me to just take that next step into how I would apply that in my own practice, which is really kind of the goal of the reflective writing, in the end. So I guess when I started off I wasn't really thinking about that, I was just talking about the experience rather than how are you going to use that experience to build for next time ... so ... yeah the feedforward was quite good ... not for that particular piece of writing, but for the next time. (Nora)

I thought that, 'This is what I think I learnt from that, but I'm not really sure' ... because I didn't spend a lot of time reading the professional task. And when she came back and she wrote a few questions there, 'Could you think of the ...? Could you ...?' That made me ... Oh yeah, this is what I could get out of that' ... you know, things that I didn't see. (Elaine)

Levels of reflective writing

An example of another reflective writing task early in the course related to a professional task I had given the students prior to the workshop. They had been required to write a 250–500-word statement that highlighted some of the key ideas that Shulman raises when he talks of teaching as involving 'processes of pedagogical reasoning and action' in his paper 'Knowledge and teaching: Foundations of the new reform' (1987). These prepared statements were shared and discussed in groups during the workshop to prioritise key ideas emerging from the paper for presentation to the whole class. After the presentations they were asked to address the following question in 10 minutes of personal reflective writing: 'Has your understanding of teaching changed after reading Shulman's paper and completing the class exercise?'

Some reflections now begin to reveal the highest levels of reflective thinking (Bain et al., 1999) as students reason through their preconceptions and internalise the personal significance of their learning:

I taught in two very different schools in the past. The school's pedagogy was lecturing and the other school was facilitating. Thinking back on my idea of teaching of teaching in these two opposite ways I wish I could have read Shulman's article about pedagogy all those years ago to just break the way I should have taught open to me. Although I probably had these ideas in my head I only used comprehension, instruction and evaluation of the students' learning parts. Transformation was never really planned and I do see that this could be of big value to the success of teaching as it gets you to think about the 'how to teach', the students etc. Further, I never really reflected on my teaching other than 'Did the students understand or not?' In the future I will spend much more time on evaluating my own performance and reflection of how and what I taught and also on how and what the students learned through my teaching. (Elaine)

The discussion our group of four had about the importance of comprehension or transformation as higher importance was of great interest as we came to agree in depth knowledge and enthusiasm for your topic will award greater learning opportunities than a well planned lesson on subjects the teacher is not so passionate about. (Tom)

I also realized that teaching is much, much more than what happens in the classroom. The comprehension, transformation, evaluation and reflection is probably going to take up more time than the actual instruction part, at least in the first couple of years of teaching. However I think it is important to never stop transforming, evaluating and reflecting to keep improving one's teaching skills. (Mary)

In following reflective sessions more students were able to think metacognitively about various learning activities they engaged in. Concept mapping, for example, was a new experience for some and proved quite challenging:

I must admit I hadn't come across this style of learning before ... I initially started writing down the main and sub-topics of the paper and then tried to organize them, it was only when I was semi-happy that I then tried to construct links between them. This aspect I not only found difficult but it made me go back and re-read areas of the paper to identify appropriate links. It was this that made me fully understand what the paper was about and so consider concept mapping as a useful learning tool. (Shirley)

I also found that the student teachers were approaching the set reflective writing tasks with more ease and confidence and tended to write longer pieces of reflection in the given time slots. Their reflections were also more focused on what they had learned from the activity in relation to learning how to teach science. Here a student teacher reflects on a reading about science teachers sharing their PCK of the topic 'Chemical reactions':

Something that came to mind while reading this paper was that teaching is like any other skilled task. The more you do and learn from experience, the greater your ability to see what else could have been done better. This for me encapsulates PCK. Every teacher brings with them varying levels of prior knowledge and experience and will therefore notice different areas which need work or could have been done better. (Georgina)

Independent journal writing

Once students left the workshop situation and began 'freelance' reflective writing in their journals while on teaching practice I noticed an overall inclination to lapse back into lower levels of reflection, especially those students whose reflective skills had remained relatively unsophisticated during the coaching sessions. However, all students continued to provide instances of reflection that revealed deeper appreciation

and understanding of how to teach science than I had seen from student teachers in previous years of the course. The reflections tended to be more infrequent but of higher quality and often focused on revelations that had been triggered by some event. For example, after realising she has taught a concept incorrectly Jill comments:

I corrected this the next day by my associate teacher's advice, because if I had left it the students would have been left with a misconception about electrical currents that would have made them less receptive to the correct idea when they come across it in the next year. To prevent this I need to do more background knowledge preparation with my lessons.

One student teacher was notable for the sheer volume of reflective writing that he produced while on practicum. His writing often reflected quite deep-seated insecurities about his teaching abilities but also very perceptive thinking about actions he could (and did) take to improve his practice. After a lesson, Vance writes:

The whole lesson was basically lecturing with a didactic approach and I had talked too much. I could do more activities, such as quick-fire/pop test, testing the prior knowledge, letting students try and then allowing them to come up with conclusions, letting them think, e.g. CO and CO₂, why are they called monoxide and dioxide respectively ... I should seek for students' ideas more often, and the teacher stay out of it.

The value of practising reflective writing skills

A clear finding from student teachers that were interviewed after the course was the value of practicing the skills in the programme. Elaine, in her interview, explains:

- E: Well, just from the start, I'd never reflected in my life. So the first one was shocking that I gave back to her. I don't know what I wrote in that thing, but just ... her doing it over and over again and any time she taught us something, or a new strategy or something she asked us to reflect on that. And that really got me thinking because I never thought that way. I never reflected on anything.
- Interviewer: So it was the repetition?
- E: Repetition ... yeah, of doing all kinds of different strategies that she taught us and then asking us to think and reflect on how that worked for us ... so yeah, that's ...
- Interviewer: So just over and over again?
- E: Yeah.

Conclusion

This initiative has been based primarily on the application of well-known theories and strategies to develop student teachers' reflective skills for enhanced professional learning through reflection (Schon, 1987; Shulman, 1987). I have drawn heavily on the findings and suggestions of a range of researchers in the field of reflective journals to improve student learning in my course and many of my findings mirror the positive outcomes reported by these experienced workers in the field (Bain et al., 1999; Moon, 1999; Moore, 2005). However, what I believe is significant about this study is the positive impact the practice of pre-teaching these skills, and the manner in which they are taught, is having on students' reflective capabilities. These skills are introduced and nurtured before students are required to keep their own reflective journals and

before they are given the independence to reflect on those issues and events they consider significant. The acquisition of these skills was achieved by providing focused opportunities within the early portion of the programme for students to experience and practise the skills as they learned how to teach science. This targeted teaching included the use of timetabled slots solely for reflective writing early in the programme, exemplars of reflective writing, reflective frameworks and regular written feedback and feedforward comments from myself about their writing.

The use of action research (Cresswell, 2005) is giving me a clear sense of direction and purpose in my own professional growth. With this focus comes the confidence that each modification I make to my teaching approach is likely to have positive outcomes for my students because my decisions are guided by evidence-based reasoning specific to our teaching and learning situation and targeted at our identified needs. Next year in the course I intend sharing more exemplars with students that illustrate varying levels of reflectivity (Bain et al., 1999) and ensuring my feedback and feedforward comments extend students reflective thinking in ways that encourage them to take actions to refine their PCK. The initiative has been time-consuming but gratifying when I see students' successes in their learning. Moon, (1999) who has worked for a long time in the field of reflection, comments:

In the preparation of this book, a number of situations have become evident where journals have been introduced without much forethought. This can work. It is almost in the nature of journal writing to be experimental – but some thought may mean that the exercise is more likely to be sustained, with a more substantial and satisfying outcome. However, while forethought is important, it is unlikely that a journal will be 'right' the first year. Journal writing evolves with the experiences of the learners and the teaching staff (p. 98).

These thoughts certainly reflect my experiences with student journals, and I look forward with anticipation to another phase of action research next year and even better results for my students!

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APPENDIX 1. Assignment One: development of a science teaching portfolio and professional tasks

The section below relates to the instructions for the reflections journal that is part of the requirements for Assignment One

As a key component of your portfolio I want you to keep a **reflections journal**. This is an ongoing record of your thoughts as you reflect on the progress you are making and the areas you need to further develop. Use the Shulman framework as a basis for your reflections, and ask yourself questions like:

- What knowledge/understandings have I gained from the various learning experiences occurring during this course, including practicum?
- What's going well?
- What areas do I need to do more work on/gain more experience of?
- What can I do to improve my capabilities in these areas?

I suggest you use a **small notebook** for this purpose.

The journal was assessed using the following criteria

Each aspect will be graded as follows:

No evidence of development	0
Evidence of some development	1
Evidence of sound, appropriate development	2
Evidence of high quality, insightful development	3

Criterion 1: Provides details of knowledge and understandings gained from practicum experiences, with reference to the Shulman framework.

Grade	0	1	2	3
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Criterion 2: Describes areas of strengths in teaching with instances of successful teaching and learning.

Grade	0	1	2	3
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Criterion 3: Describes areas of teaching practice that need strengthening, with reasons.

Grade.	0	1	2	3
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Criterion 4: Discusses possible strategies for further development and improvement of teaching capabilities.

Grade	0	1	2	3
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