Using reflective practice in a Mathematics class

Mandy Lee - Embury Institute for Teacher Education, Durban, South Africa

ABSTRACT

This article reports on a reflective writing assignment that was carried out with second year General Mathematics undergraduate Bachelor of Education Foundation phase students at a Private Higher Education Institution for Teacher Education in Kwazulu-Natal. In an attempt to get students to develop a better understanding of the mathematical process, a reflective writing assignment was implemented over a period of 6 weeks, which included affective, content and process entries. The intention was to get the students to link the journal entries to the subject content that was covered during lectures, reflect on what they had learned and how they could implement this knowledge practically. The students would then be in a position to identify any gaps in their knowledge, which they could address before being assessed under examination conditions. Contrary to expectations, the students found the assignment to be an extremely difficult task and disliked completing it. They found it very time consuming and could not always see any value in reflective writing in a Mathematics module. In this article the insight and experiences gained from the assignment will be presented from both the lecturer’s perspective and the students’ feedback.

INTRODUCTION

This article tracks the implementation of a reflective journal assignment with a group of approximately seventy undergraduate pre-service teachers at a private higher education institution. The purpose of implementing a reflective journal assignment was primarily to encourage students to adopt a deep approach to learning to engage with the lecture content and coursework. Students were provided with journal prompts that linked to the content covered during lectures. The intention was to supplement mediated learning (Laurillard, cited in Hinett, 2002) by helping the student make connections between the theory and the constructs that they had learned formally during the lecture. Furthermore, some of the journal prompts developed un-mediated learning in that students were given examples of an incorrect response or solution and asked to unpack where the learner had made a mistake. In essence they were tasked with deconstructing the fictitious learners’ thought process and considering the implications of each step in the calculation process to identify where the learner had erred. They then had to state how they would explain this error to the learners and what possible teaching strategies they could use. Thus, in answering a prompt question in their reflective journals, the students were given the opportunity to draw on the past (their lectures and any prior knowledge that they have of the topic) and the present (their textbook and whatever other resources they had at hand) and to direct themselves into a better understanding of the topic (Hinett: 2002). This article begins with a brief discussion of how the use of reflective practices as a pedagogical tool is understood in the literature. The methodology of this study is then briefly presented before the main issues arising out of feedback from the students are discussed.
WHAT IS REFLECTIVE PRACTICE?

The expectation, by the lecturer, was that students would become more aware of their existing knowledge, identify the shortfalls therein, and thus identify their strengths and weaknesses through the process of reflective writing. In completing the assignment the students were compelled to think about what they had learned and understood during their lectures. This required them to determine the links between their newly acquired knowledge and their existing knowledge and what impact this had on their current understanding. Furthermore, they became more aware of their progress and the development of their ideas as they interacted with different mathematical concepts. The difficulties that they encountered during the learning and the strategies they acquired and developed to overcome these difficulties were all part of the reflective process. Reflective writing, as a means of reviewing and consolidating their learning, allowed them to evaluate their performance and progress which enabled them to plan their studies. By promoting a deep approach to learning, the intention was to increase their confidence in their ability which would result in a more positive attitude to Mathematics and critical thinking skills.

The concept of ‘reflective practice’ has been variously ascribed in the literature but probably the most well known early proponent of its use as an educational approach was Donald Schön (1983). Reflective practice involves thoughtfully considering one’s own experiences in applying knowledge to practice. Numerous approaches and tasks have been developed to encourage teachers and students to engage in reflective practice. Many of these involve reflective writing in the form of autobiographical narratives.

A great many research papers and conference papers make claims about how reflective practice enhances learning. Moon (2004) suggests that reflection can lead to deeper learning as students use metacognitive practices to engage with their learning in ways which achieve more complex and integrated knowledge structures. Hinett (2002) likewise indicates that reflection can improve the quality and depth of student learning by developing students’ capacity to evaluate their learning and make judgements regarding the way forward. She furthers states that it is not just a process of looking back. It is in fact a transformational process that encourages critical thinking and deep learning through inquiry. Reflection is the process that gets us from just experiencing an activity to understanding it. Thus the intention of the intervention reported in this paper was to supplement mediated learning (Laurillard, cited in Hinett: 2002) by helping the student to make connections between the theory and the constructs that they had learned formally during the lecture.

The value of reflection as a pedagogical approach rests on the assumption that knowledge construction is a social practice. Learning is thus understood to be undertaken in particular socio-cultural ways. This constructivist understanding is based largely on the work of what has become known as the New Literacy Studies (NLS; see for example, Barton, 1994; Gee, 1996; Street, 1995; 1996). Learning, and thereby knowledge construction, is understood to be an ideological activity and one which is greatly influenced by the norms and conventions of the student’s prior schooling and other environments and by the norms and expectations of the discipline in which such learning occurs.

While Mathematics might be understood to be an autonomous, apolitical and neutral set of skills, premises and functions requiring a generic approach to learning by students of the discipline, researchers within the NLS approach would argue that this is not the case. Mathematics, like all other disciplines, would instead be seen to be not as a unitary immutable set of facts but rather as differing across time and place and determined largely by the values of those who construct it. The norms and conventions of Mathematics are regarded as social constructs and not presumed to emerge naturally. Despite this emphasis in NLS on the specificity and shifting nature of social, cultural and political contexts, there would still be a realist acknowledgement of the universal truth claims made in Mathematics. A particular mathematical formula, for example, need not be understood in relativistic terms as only having meaning within its socio-
cultural, historical context. However, NLS theorists would understand that the ways in which the formula is developed, learned, or spoken about, or represented, or used would indeed be determined by, or greatly influenced by, the norms and conventions of the user.

This understanding of Mathematics as a set of socially constructed practices has a far-reaching impact on our understandings of how it is taught and used. It becomes far more important for the teacher to understand her students’ personal contexts. It becomes far more important for the students to be made aware of the cultural and other norms and conventions at play in Mathematics. These norms and conventions are no longer understood as common sense and neutral but are instead understood to be political and less accessible to some students than to others. The need to make the peculiar norms and conventions underpinning Mathematics as a discipline explicit to students thus becomes a crucial part of teaching.

The link between reflective practices and this social constructivist understanding of learning in general and Mathematics learning in particular is clear. Claims that reflective practices allow students to consider common sense assumptions and beliefs embodied in their own experiences (Bell, 2002) and then make connections to the present situations and expectations (Dantas-Whitney, 2002) mean that using reflective practices in teaching is one way of helping students to acquire the norms and conventions expected of them within the discipline of Mathematics.

Understanding Mathematics (and all other disciplines) as being constructed by sets of socio-cultural practices means understanding that such practices are underpinned by specific sets of epistemological and ontological premises. Reflective practices are seen as one way of making beliefs, values and attitudes explicit (Ruddock et al, 2000; Leshem and Trafford, 2006).

**METHODOLOGY**

The assignment took place over a four week period, with students having to complete three reflective journal entries per week comprising an affective, a content and a process entry. The journal prompts related directly to the work undertaken during lectures the previous week. There was also a lecture on different theories of reflection which provided the opportunity to discuss with the students the benefits of this kind of assessment and how it relates to the outcomes of the module and curriculum. The theories of reflection discussed were structured debriefing, based on Kolb’s experiential leaning cycle (Gibbs, 1998), levels in the development of teacher reflection from teaching practice (Watton, Collings and Moon, 2001) and Bloom’s taxonomy (1956).

The students were given the opportunity to examine the assignment before the lecture in which reflective writing was discussed in order to identify beforehand if they had any difficulties with the language and the prompts.

Students received feedback on their reflective work for the first two weeks before they were required to submit their next entry to enable them to reflect on the feedback that they received and make the necessary changes. They also received written and verbal feedback which they could take into consideration before completing their next journal entry.

A qualitative approach to collecting data about the students’ experiences was implemented with students being required to complete a questionnaire anonymously on completion of the assignment, regarding different aspects of reflective writing. The purpose thereof was two-fold. Firstly, to get feedback regarding the reflective task with the type of questions designed to ascertain if indeed a deep approach to learning
had transpired. Secondly, to ascertain if the students’ perception of this task was that it had encouraged a deep approach to learning.

The questionnaire comprised of 11 statements that students were required to rate on a Likert scale from 1 to 5 to ascertain the extent to which they agreed or disagreed with the statements relating to reflective practice. Space was provided for additional comments after each statement to allow students to elaborate on or justify their rating.

**FINDINGS**

Feedback received from both the assignment and questionnaires was mostly positive with a number of themes emerging. Reflective writing forced students to review their work which had the dual result of identifying what concepts had or had not been understood, clarifying what was learned in lectures and therefore resulting, in a number of cases, in a deeper understanding of the content.

**Reflection as a means of encouraging independent learning and motivation**

By working through the journal prompts, students learned to think independently, thus their dependency upon the lecturer was decreased. Through a process of transformational learning (Mezirow, cited in Di Biase, 1998: 9) students were expected to discuss their thinking processes and identify areas of difficulty, if any, and what steps they took to overcome these. In addition to being given suggestions as to what other resources might help them understand and integrate the new knowledge with their existing knowledge, the students were encouraged to help one another. The students, in trying to identify errors in a calculation answered by a fictitious learner, had to reflect on how a learner might have gone about trying to solve the problem; identify what their thought processes had been; and what difficulties the learner might have encountered. Once students ascertained that there were content areas with which they were experiencing difficulty, they had to make a decision to either seek help or to do nothing, which would then impact on their test and examination results. Thus students were encouraged to take ownership of their own learning, which is an important part of being independent and having to make choices.

The reflective comments in the journals indicated that in many cases students were gaining confidence and expressed a sense of achievement when they were able to arrive at the correct solution. A few students indicated pleasure at the improvement in their marks and that they had found it motivating, which encouraged them to be accountable for their own learning. Many students had positive comments with regard to the individual goal setting prompt in which they were required to set goals for themselves. Cheung argues that ‘the use of individual goal setting prompt accompanied with appropriate feedback and teacher support is crucial in building effective motivational approaches and self regulatory learning strategies in enhancing academic success’ (2004: 7). She concludes by citing Dembo that students who set goals for themselves and develop plans to achieve these goals are in fact taking responsibility for their own lives.

Therefore within this context of Mathematics, reflective practice became a suitable tool for developing independent thought, critical thinking and in some cases, as a motivational tool as depicted by the following comments

... made me analyse a lot more and (reflective practice) encouraged me to think about what I had learnt and not just accept that I know it (Anonymous student comments, MAT 202 Assignment, 2008).

**Reflective practice as a means of communication**

Students were very positive about the example in which they were required to identify the error and explain the correct process. Firstly, because it helped them to understand the difficulties learners might encounter.
Secondly, it gave them practice at explaining which they felt was good experience for teaching practice. They also identified the fact that although they had the knowledge and understanding of a particular concept they often had difficulty actually explaining the concepts and the mathematical processes involved. However, most students acknowledged that they had benefited from these types of journal prompts as they were finding it progressively easier to express themselves using mathematical terminology.

From an affective perspective, reflective writing provided students with an outlet for expressing their fear, frustration, and so forth as it had compelled them to become more honest with themselves. In agreement with Moon (2006), I found that reflective practice, and especially reflective writing, as a form of self-evaluation develops personal development and self-empowerment. In addition, reflective writing gives the lecturer in the role of a mentor, insight into specific issues and difficulties that the student might be experiencing. Furthermore, the reflective writing skills that the students learned by participating in this assignment, are skills that they will be able to apply throughout their teaching career.

**Reflection as a tool to encourage a deep approach to learning**

Some students acknowledged that they were now more aware of their own affective strengths and weakness and commented on how this impacted on their work, with regards to lack of confidence and belief in their ability. In some cases this had a motivating effect as they had identified the issues and could now move forward, but for others this was de-motivating as they were already investing a great deal of effort into understanding and learning Mathematics. Moon (cited in Hinett 2002: 3) states that when students move beyond passive assimilation of knowledge to enquiry, thereby promoting independent thought, and they are given a voice in the form of reflective practice their self-confidence and awareness increase. It is at this stage, she believes that they have developed a deep approach to learning. Of particular interest for me to note was that a few students indicated that they did not enjoy Mathematics and were therefore happy with a surface approach to learning. Therefore in future assignments motivating learners to the extent that they understand the value in completing the assignment and are willing to undertake the various tasks, will need to be an area of focus for the lecturer to address. However, I suggest that the locus of control and intrinsic and extrinsic motivation will also be factors influencing the approach to learning that individual students will adopt.

**Reflection as a form of assessment and as an attitudinal measure**

Some students felt that they should not be marked on reflective thought and therefore it should not be used as an assessment tool. A number of students had found the assignment stressful since it was structured differently to work in class and, therefore, they had found it difficult to transfer their lecture knowledge to a more practical and reflective scenario. At the conclusion of the assignment tasks, a number of students were still of the opinion that this type of assignment was more suitable to English and hence held no value for them as students of Mathematics. Assessment of the journal entries indicated that a number of students had done particularly good work and were able to identify and link the concepts in the prompts to the lecture content. This allowed the lecturer to identify whether or not the students had understood a particular section.

Through negotiated assessment the students had had an input on establishing the assessment criteria. The fact that not every journal entry was marked, in spite of this being negotiated, was viewed in a very negative light and many students found it de-motivating. Hence, the assessment strategy needs to be reviewed. Marking is a problem, it is very time consuming and lecturers usually do not have the time to provide constructive feedback, which is essential. In addition, many students go to a great deal of trouble and one does not have the time to mark every aspect of their work. Peer assessment and review (Moon, 2006) is an alternative to consider as a possible solution.
Furthermore, students cited other module commitments and assignments, which had resulted in them feeling under pressure, stressed and battling to cope. Time constraints also meant that there was no flexibility in the length of time in which they had to complete the entries. Students felt that they could have done better had they had more time, given that this was still a fairly new approach to assessment in Mathematics for them, and one in which they were still coming to grips. Negative feedback that filtered through was the fact that they did not gain as much because they were rushed and some were of the opinion that reflecting on work was not relevant to a Mathematics module. These issues in all probability gave rise to the students’ opinion that this was a difficult assignment to undertake and why some did not enjoy completing it. Thus further consideration needs to be given to the number of prompts and the time framework within which to complete the tasks, when structuring this type of assignment for future use, to alleviate these problems.

CONCLUSION

This assignment design, as an attempt to encourage students to adopt a deep approach to learning to engage with the lecture content and course work can be considered to have been a success, in spite of some negative feedback from students. The negative criticism can be used to improve on the assignment and for future attempts to draw on, in addition to incorporating other reflective practice strategies. As Watson (2001: 1) writes: ‘Reflection can happen through writing, speaking, listening, reading, drawing, acting, and any other way you can imagine.’ Furthermore the number of entries that were included in the assignment could have detracted from its value. Nevertheless, the final outcome showed there was an overall improvement in students’ reflective practice and writing skills, which, as pre-service teachers and later as fully fledged teachers, they will be able to put to good use.

REFERENCES


