



The use of reflective journals in a first year mathematics unit

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Abstract: For many years society at large has proudly commented that 'maths was my worst subject at school'. This statement is then usually followed by some explanation of why this was so, for example, 'numbers scare me' or 'I just freeze when doing a test'. Anecdotal evidence suggests that more and more students are entering university with this mind set and this attitude may be part of the reason why fewer students are attempting higher levels of mathematics at school. In 2008 our institution decided to introduce a new unit that was specifically designed to help students develop strategies to lessen the effects of maths anxiety and test phobia. This report details the introduction of a reflective journal as part of the assessment in a mathematics unit. Students were required to make journal entries every two weeks. These entries required students to reflect on their current examination preparation practices and to put strategies in place to lessen the effects of maths anxiety. Preliminary findings indicate that although students found this exercise helpful, it did not necessarily improve their mathematics marks. However, even if the student's feelings towards mathematics improve, we will have gained. A positive attitude towards mathematics, by those who love it and are successful at it, as well as by those who struggle with mathematics, can only be of benefit.

Introduction

The use of reflective journals as part of the assessment of a unit has been the subject of several research reports (Farrell 2007; Lanigan 2007; McGuinness 2007). In these reports, students are required to reflect on their learning of the content presented in the unit. These studies found that students who engaged with the reflective journal activity not only experienced a deeper understanding of the content, but experienced a greater awareness of their own style of learning, and acquired more self confidence as well as a positive change in attitude. It is well known that the discipline of mathematics does not inspire confidence in many students, nor do some students have a positive attitude towards it. Factors influencing students' attitudes concerning mathematics and their performance in this discipline include whether or not they suffer from mathematics anxiety and test phobia. Also related to students' learning is an awareness of their learning style. As Vincent and Ross (2001, p.5) state 'Students benefit by using knowledge about their particular learning style to better manage their learning'. Thus a knowledge of one's own learning style and the associated learning strategies that complement that style is critical, if one is to develop valuable learning strategies.

Mathematics anxiety and the methods suggested to try to lessen its effects on students has been the subject of many books, web sites and educational articles in recent years. The effects of mathematics anxiety on students include many avoiding mathematics courses altogether (Sheffield and Hunt 2007), and their performance being directly affected by mathematics anxiety (Sheffield and Hunt 2007; Hembree 1990, cited in Sheffield and Hunt; Scarpello 2007; Gresham 2007; Ruffins 2007; Metje, Frank and Croft 2007). Mathematics anxiety, if left unchecked in students, could severely impact on their career opportunities as their ability to undertake study in many fields in tertiary education will be drastically reduced.

At our institution, anecdotal evidence gathered over several sessions indicated that some students described or attributed their poor past performance in mathematics, to mathematics anxiety and/or test phobia. Not surprisingly, these students had little or no mathematics background but they were enrolling in courses that required a certain level of competency in mathematics, for example, Business and Science courses. The figures for students who completed high school mathematics the year before attempting our business statistics unit were worrying. Most of these students had not taken advanced mathematics at high school; the largest group were those who studied elementary mathematics. Only 63% of those who studied elementary mathematics at high school and who

attempted all compulsory components of the statistics unit, passed; the most common grade was a fail and only 29% were awarded a grade better than a pass.

In 2008, a remedial mathematics unit was implemented that sought to address the effects of mathematics anxiety and test phobia and to inform students of their particular learning styles through the use of a reflective journal. This unit required students to review their attitude towards mathematics by identifying if they suffered from mathematical anxiety and to examine their learning styles, to determine if these were in conflict with each other. To record their 'mathematical journey of discovery', students were required to maintain a reflective journal, which detailed their progress in overcoming mathematics anxiety/test phobia, and developing successful learning strategies that were compatible with their learning style. With the first delivery of the unit over it was possible to look at one measure of success: the attitude of the students at the end of semester. It is not possible yet to determine whether or not this unit has enhanced the mathematics performance of these students in the first year mathematics units as they have not yet undertaken these.

Methodology

One hundred first-year students entering a Business course in 2008 were identified as not having the basic mathematical skills needed for this course and were enrolled in a remedial mathematics unit. As part of the assessment procedures of this unit, students were required to keep a reflective journal which explored their feelings about and attitudes towards mathematics, at the beginning, during and end of the session. The reflective journal was a compulsory assessment item; if answers were not submitted to all questions then a fail grade was given. The reflective journal questions were posted each fortnight and paralleled the assessment procedures closely. After students had participated in a tutorial group discussion on these questions, they had two weeks to complete the questions. Students' answers were not marked, but tutors did respond to some students' responses, seeking elaboration on a particular aspect, or offering general feedback. At the end of the session, students were required to complete a 'final reflection' which consisted of an 800-1000 word description of their 'mathematical journey'. This was compulsory and marks contributing 30% to the final mark were awarded. To assist with the final reflection students were asked to address nine points. Marks were awarded for thoughtfully addressing these points and for supporting their statements with quotes from their journal.

The aim of this paper is to assess one measure of success for this unit: whether there has been a change in students' attitudes to mathematics and whether they have greater awareness of their learning styles and what they need to do to best prepare for tests and examinations. The students' journal entries were used to assess this.

The reflective journal questions and student responses

The reflective journal questions required students to address three issues:

- How to identify mathematics anxiety and then implement strategies to try to lessen its effects.
- Identify and then implement test preparation strategies according to their learning type.
- How to study mathematics effectively.

The first week elicited responses from students about their past experiences with mathematics and current feelings towards mathematics. Typical responses (paraphrased) to these questions were:

'Maths is annoying and bewildering.'

'Why do we study mathematics when it has no applications in the real-world.'



‘I hate mathematics but it always seems to be there.’

‘I liked it in early high school, but had a bad teacher, stopped working and now get angry and frustrated.’

‘I was too embarrassed to ask questions – others would think I was dumb.’

‘I got angry and embarrassed when I couldn’t do the questions.’

Over the next few weeks, students were asked to access a number of articles, to determine what type of learner they were, and also to establish if they were sufferers of mathematical anxiety. These articles listed strategies to use when learning mathematics, according to learning styles, and also suggested behaviours designed to minimise the effects of mathematics anxiety. These strategies were then to be implemented when preparing for the first written class test.

Responses to the question ‘How do you think you will go in Class Test 1?’ were generally positive:

‘I am putting the strategies that suit my learning style in place, so I hope to do well.’

However for some students, this optimistic attitude was short-lived when the results for the first class test were known. Reasons cited for poor performance included little or no preparation because of poor time management skills, or ineffectual preparation methods that were based on past behaviour. Mathematics anxiety was cited as a major factor contributing to some students’ poor performance, although it was recognised that the effect of insufficient preparation was understood to heighten the anxiety experienced.

‘The questions were easy but I was still anxious. I knew I should have studied more.’

Students’ preparation for Class Test 2 was affected by the results obtained in Class Test 1. Some students did realise that to learn mathematics effectively requires active participation in the learning process, such as attending and contributing to lectures and tutorials, reviewing the lecture material before the next lecture, and working in study groups. Sufferers of test phobia in particular, recognised the need for continual revision of the material to raise the level of confidence before entering the examination room. However, one student who felt confident about his performance in class test 1, as he felt that his study strategies would result in a ‘good’ mark, was somewhat less confident about the approaching Class Test 2, because of his result in Class Test 1. Anxiety on entering the examination room was cited as the cause of his poor performance and he did not indicate that he intended to employ any strategies to try to overcome this.

Towards the end of the session, some students did indicate that their attitudes towards mathematics were changing and could identify why they had experienced problems in the past:

‘My problem was not preparing properly. The maths itself is not all that hard.’

‘I need to do lots of practice before exams. I need only to put my mind to it. I can understand it and actually feel comfortable doing maths.’

Could mathematics anxiety or test phobia be an excuse for laziness or dislike of mathematics? The journal entries neither confirm nor deny this. In the first journal entry some of students who answered questions about their feelings and experiences of mathematics used words like ‘phobia’, ‘scared’, ‘anxious’ ‘unsettling’, ‘panic’, ‘nervous’. Some of these, and many others used other negative words

in this part of the journal including ‘dislike’ and ‘hate’. Some also admitted that they had never worked at mathematics, or not for some years. We can conclude that almost all students had some anxiety, dislike or disinterest, and that some at least had not put in much work in the past.

Was it successful?

To answer this question, one has to ask, ‘What does success mean?’ Traditionally ‘success’ has been measured in terms of ‘passing’ or ‘failing’ a series of written examinations. Hence, based on the results of both class tests, the use of the reflective journal did not achieve this aim. However, if a more diverse meaning is taken, one that involves heightening students’ awareness of the rigors associated with attempting study at university, then the reflective journal exercise has been ‘successful’.

For most students, this was the first experience writing a journal in mathematics. The articles students were asked to review generally proved both popular and helpful. Students also found the requirement to make a journal entry every two weeks kept them ‘on track’ throughout the session. All of the students rated their experience with the reflective journal as being ‘good’ or ‘satisfactory’.

At the end of the session, students wrote a ‘final reflection’ that described their ‘mathematical journey’ throughout the session. In most cases, students did recognise the reasons for their past poor performance in mathematics, and did make a serious effort to address these as the session progressed. Some students identified difficulties other than mathematics anxiety and test phobia, for example, poor time management skills and adjusting to the independent learning style that characterises study at university. Techniques to manage these concerns will be included in the next offering of this unit.

Some students realised that they were not prepared for university study, or that they would have to work much harder if they were to succeed. In the final reflection students commented on their feelings towards mathematics at the start of semester (as recorded in their journal) and at the end. Table 1 records the change in students’ feelings towards mathematics and shows that there were more positive feelings and fewer negative ones at the end of the semester.

Table 1. Attitudes to mathematics before and after

	All negative	Some positive, some negative	All positive	Unclear
Start of semester	45%	40%	7%	7%
End of semester	5%	40%	55%	0%

Note that a positive comment need not mean that the student liked mathematics, in fact very few went from disliking to liking mathematics:

‘My maths skills are not good, but I’ve improved and am inspired to do more practice.’

‘I still hate maths, but can now handle maths anxiety and put my feelings aside and do it!’

‘I know I need more study time.’

‘I still don’t like maths, but I’m now more positive and confident, and my marks are better.’

Another aspect in which the journal was successful was that even if students did not implement their strategies to improve their performance in mathematics during the semester, they indicated that they knew what they had to do to succeed.



This was the first offering of the unit and the reflective journal activity, so it is yet to be determined how this impacts on the success or otherwise on students' performance when they attempt their first compulsory mathematics unit.

Conclusion

More and more students are enrolling in university courses that require a level of competence in mathematics. However, just as many students are taking lower level mathematics courses at secondary school, or avoiding mathematics altogether because of their attitude towards mathematics. As noted by Metji, Frank and Croft, 'It is these students who struggle at university as they suddenly realise how important mathematics is for their chosen degree programme' (2007, p.81). In this study, reflective journals were used so that students could critically examine their attitudes towards mathematics, what factors contributed to these, and how these attitudes impacted on their past performance. Throughout the session, students were exposed to different learning styles and strategies intended to facilitate the effective understanding of basic mathematical concepts and to lessen the effects of any mathematics anxiety and/or test phobia experienced. Overwhelmingly, students found this a positive experience, as it highlighted the probable causes of their dislike of mathematics and provided the means to address these. The vast majority of the cohort engaged with this activity and realized that to have any likelihood of successfully completing a business course at university, competency in mathematics, in conjunction with strategic and efficient learning strategies must be achieved. This realization came about through careful consideration of current practices, modification of these if necessary, and observing immediately the effects of any changes in study habits made.

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