Concise paper

Maths with Attitude: an encouragement based approach

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ABSTRACT

This paper describes the Christchurch Polytechnic Institute of Technology (CPIT) approach to the teaching of an introductory, level 2 (where level 5 is equivalent to stage 1 university), mathematics course. It describes what has been done to address maths anxiety and poor attitudes to mathematics. An analysis of Maths Anxiety Scores (MAS) and Maths Self-Concept (MSC) scores is presented and compared with achievement. The results of interviews with students who have completed this course are also presented.

1. INTRODUCTION

The level 2 Maths for Computing course is a compulsory component of the national Certificate in Computing (level 3) qualification as taught at CPIT. Prior to the national certificate a similar course was taught as part of a local certificate. In developing this course the emphasis was on topics that would relate to Business and Computing. The students were usually mature students with minimal mathematics background, a poor attitude to mathematics and an anxiety about their ability to learn mathematics and/or do a mathematics test, often because of previous negative mathematics experiences.

Even at an introductory level computing tutors expect students to have basic mathematical skills and understanding, e.g. in developing spreadsheet formulae, using binary and ASCII and using business graphs appropriately. At a higher level it is recognised that knowledge of discrete mathematics and its application to ICT is important for all ICT students (ACM/IEEE Computing Curricula: Computer science guidelines, 2001; ACM/IEEE Computing Curricula: Software engineering Draft Guidelines, 2004). Hence it is important that students are encouraged to see mathematics, not as a stand alone body of knowledge, but as a tool to be used and applied in many IT contexts (Gasson, 2004).

Students with a poor attitude to maths or with a maths anxiety are nothing new. There are many studies that report on this at primary, high school and university level (Doepken, Lawsky, & Padwa, ; Pajares & Urdan, 1996; Wilkins & Ma, 2003). Maths anxiety and maths self-concept scales have been developed and used to show maths anxiety and maths self-concept are strongly correlated with achievement (Gourgey, 1982; Norwood, 1994; Perry, 2004; Townsend, Moore, Tuck, & Wilton, 1998). However as Townsend & Wilton point out, not much has been done on interventions that can improve maths self-concept and/or maths anxiety (Townsend & Wilton, 2003). Townsend & Wilton used co-operative learning activities as part of the delivery of a university statistics course and showed that maths attitudes could be improved. Perry indicates that maths anxiety is usually a result of previous negative experiences and suggests solutions that encourage students to ask questions, think positively and remember any positive experiences (Perry, 2004). Schwartz further suggests: that students need to realise that the process is more important than the answer, teachers should always review the basics before moving to more complex problems, that students be counselled on taking tests and support systems are provided for students (Schwartz, 1999). As Funkhouser states many educationalists emphasise the importance of active student involvement in learning. He compared the use of Computer augmented geometry instruction and a traditional approach with secondary school students and noted better achievement but similar attitudes (Funkhouser, 2003).

2. THE CPIT APPROACH

In 1999 CPIT offered no national Certificate in Computing; however CPIT did offer a level 3, Introduction to Computing certificate program.

This local certificate contained a compulsory maths course entitled Maths for Business and Computing. The students for that first course were mostly mature women. That first course was the ultimate in student-centred learning. The first session was used to share their previous maths experiences, their attitudes to maths, and their expectations for the course. A range of possible topics, related to business and to computing, was listed on the white board. The students voted, anonymously, for their choice of nine topics and the top nine topics became the course. It was also decided to use open-book tests and, where possible, to create a related spreadsheet for the topic. The topics included: GST/ markup/ discount, depreciation, bar codes and check digits, binary/hex/ASCII, business graphs, budgets, wages/salary and simple equations.

Together the tutor and the class learnt a lot. Together they developed some spreadsheets. Often the learning went well beyond level 2. And in every session the "where" and the "why" was discussed. Where are percentages used?, why are percentages used?, why learn about binary?, why do businesses use graphs?

The course evaluations indicated that this was a positive learning experience for all. To hear students say "The maths course was the best course I did" was music to the ears of a maths teacher.

The philosophy of this first course has continued. The course has matured, a booklet of notes and exercises has been produced and spreadsheet exercises refined. The emphasis on why has continued. The application to business and computing problems has continued. The use of open-book tests and a discussion of previous maths experiences and attitudes to maths have continued.

The teaching philosophy adopted for this course is one of encouraging students and an effort is made to overcome their maths phobia with open-book tests, an applied focus and the use of spreadsheet exercises.

For the 18 week course, 5 sessions were scheduled for a computer lab. As from semester 2, 2004 this course is now taught as an 8 week module at 4 hours per week (2 hours in a classroom, 2 hours in a computer lab).

2.1 Does This Approach Work?

The positive student response to the first course was most heartening. It was also a rewarding experience for the tutor. Student evaluations of subsequent classes have been just as positive although there are still students who drop out or attend irregularly and there are students who fail. Student evaluations indicated that most enjoyed the course and they often expressed surprise that they had been able to pass a maths course. In order to determine whether this approach changes student attitudes to mathematics, standard questionnaires were administered before and after the course, and some students were interviewed after the course.

3. METHODOLOGY

Students were asked to complete a questionnaire at the start of the course and a similar questionnaire at the end of the course. The questionnaire comprised the items from the Betz MAS (Pajares & Urdan, 1996)and the Marsh SDQIII (Gourgey, 1982)

The questionnaire was administered and collated independently of the tutor. A comparison was made with course results.

Because of an end-of-course administration hiccup very few students completed the post-course questionnaire, so an effort was made to interview students who had completed the course and gather their comments on attitudinal changes (if any) and what had caused this.

4. RESULTS

The semester 2, 2004 class was a small group of 11 students. All 11 completed the pre-test Maths Anxiety Score (MAS) and Maths Self-Concept (MSC) questionnaires. One student gained a cross-credit for this course and one dropped out before the first test. Neither student is included in the results. One student with a MAS of 44 and a MSC of 32 dropped out after the first test. The pre-test Maths Anxiety scores ranged from 20 to 44 with an average of 30. For this test the minimum possible score is 10 and the maximum is 50. A high score indicates a high level of maths anxiety. The Maths Self-Concept scores ranged from 32 to 112 with an average of 86. For this test the minimum possible score is 27 and maximum is 135. A high score on this test indicates a positive attitude to mathematics.

Only 4 students completed the post-course

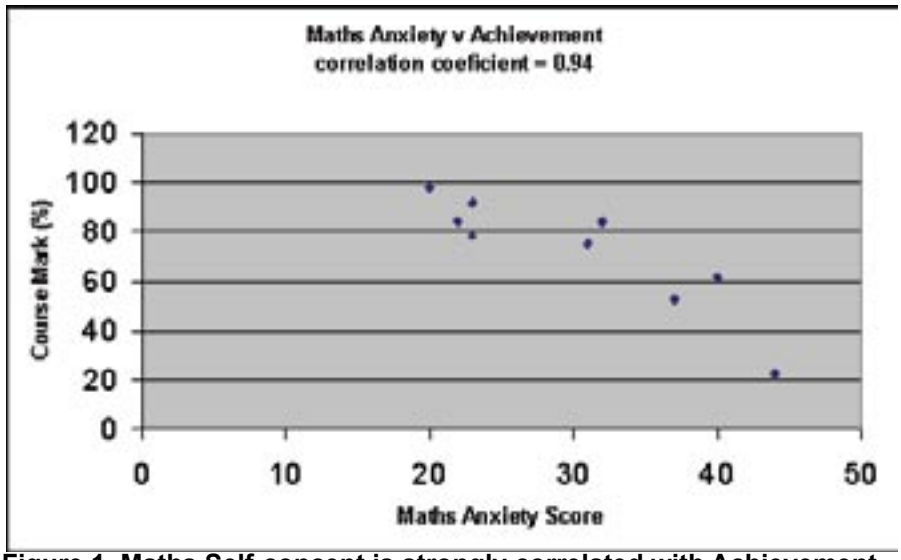

Figure 1. Maths Self-concept is strongly correlated with Achievement.

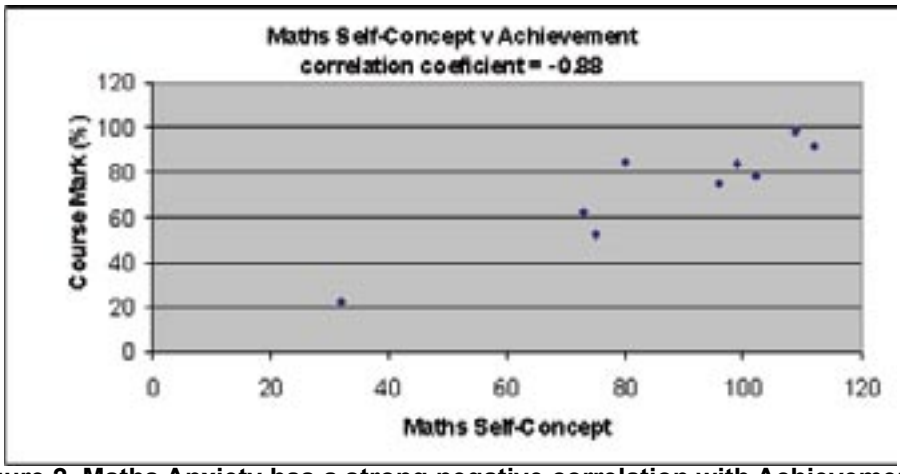

Figure 2. Maths Anxiety has a strong negative correlation with Achievement.

questionnaire with the following results. For at least one student there has been a significant improvement in attitudes to mathematics.

4.1 Interview Responses

Q1. Did your attitude to maths change as a result of this course? In what way?

I'm more scared now - maths has changed a lot since I did it at school.

Before "I was given up for lost" - now I feel really cool about maths

I'm not so afraid - I do understand it now

I was amazed that I could learn maths

It has made me enjoy it more

It was taught in an everyday manner

It was the course I learnt the most from last semester

After a 9 year break from maths it bolstered my maths confidence

Q2. What things helped your learning?

Peer support x 2, Teaching at my level, Using spreadsheets, Patience when I don't understand x 2, Step by step instructions, Teacher encouragement - saying "you can do it", Simplified concepts, Relevant topics, Also learnt the why - the reasoning behind it, Seemed like it could come in useful, Related to what we were learning in other subjects, Problems related to the real-world x 3, Went at the right pace

Q3. What things were not helpful?

None x 3, Other students (negative) attitudes

Q4. How would you rank the following methods for improving attitudes to maths: Table 2.

5. CONCLUSIONS

The research indicates that important factors in changing attitudes to maths are:

* recognising maths anxiety
* using real-world problems
* use of computers
* group work

Table 1: Before and After scores

Before			After	
Maths Anxiety	**Maths Self-Concept**		**Maths Anxiety**	**Maths Self-Concept**
20	109		20	108
23	109		22	109
31	96		25	110
37	75		33	76

* encouragement

This research supports the findings of others that maths anxiety and maths self-concept are strongly correlated with achievement although it is worth noting that this correlation is with the pre-course MAS and MSC scores. No meaningful conclusions can be made from the limited number of students who completed both the pre and post questionnaires. It is reasonable to assume that students with low maths anxiety and high maths self-concept prior to the course will have similar scores after the course. If we are looking for a change in attitudes we should look at students who start with high MAS and/or low MSC. The student comments reflect a positive attitude to the course and support the findings of Perry that MAS is often linked to previous negative maths experiences and that it is important to teach the why as much as the how (Perry, 2004). Swartz observes that MAS is often most evident in test situations and that talking about test taking can help overcome this fear (Schwartz, 1999). The use of open book tests on this course is primarily to reduce this fear of tests that some students have. It is worth noting that although "Talking about maths attitudes and maths anxiety" has an average ranking of 3.6 it was ranked 1 and 2 by two of the five students interviewed. These two students both started with a high MAS.

Additional data is being collected from the level 2 Maths for Computing students and from stage 1 degree students. The research will focus on the students with a high MAS or low MSC.

For the students that were interviewed the indications are that the teaching and learning methods used for this level 2 Maths for Computing course at CPIT can make a difference to attitudes to maths and help overcome maths anxiety.

Table 2: Ranking methods

Method	Average ranking
Using computers/spreadsheets/websites	2
Using problems based on real-world situations	2
Using a problem solving approach with minimal lectures	3.4
Talking about maths attitudes and maths anxiety	3.6
Group work	4.6
Let the student decide how many exercises they need to do	6.6

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