UNDERLYING FACTORS AFFECTING MATHEMATICS ANXIETY IN SCHOOL CHILDREN

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ABSTRACT

This presentation reports on a study that investigated mathematics anxiety among school children. Public perception has always seen mathematics as difficult and many students seem to suffer from high levels of anxiety with the subject. Changes to both the methodology of teaching mathematics and the content taught have had limited success in altering this perception or anxiety level. One reason for this limited success may be that underlying factors outside of the classroom environment have not been seriously taken into account. These factors could include parental support, the physical environment, health issues and the advent of technology. This study investigated some of these underlying factors using questionnaires. Queensland students in Years 3, 7 and 8 were investigated along with parents and teachers of Years 3 and 7 students. Correlation tests were utilised, data wERE cross-related between the various groups and areas showing promise of being statistically significant were noted for future follow-up action. The main findings showed that underlying factors contributing to students' anxiety included: parents' own anxieties and the impact of these on their children; home issues including nutrition and tiredness; school transition matters; teacher attitudes and some technology issues. Differences due to the sex of students were also revealed. Areas needing further study ARe highlighted and recommendations to rectify the problems identified will be made for each stakeholder group.

INTRODUCTION

Anxiety towards the study of mathematics is prevalent among many school children, often caused by a range of situations both physical and emotional in the home and at school (Spagnolo, 2005; West & Varlaam, 1991; Hadfield, 1990; Jayaratne, 1987; Guppy, McMaster & Higham, 1983; Lazarus, 1966). Teaching methodology, content and relevance have all been the subject of on-going research in the context of mathematics anxiety, resulting in continual change in pedagogy, not always for the better (Mitchell & Gilson, 1997; Halpern, 1992; Weissglass, 1991; Reuman, 1989; Papert, 1980).

This study investigated possible other factors which could have been causing an underlying anxiety about mathematics, preventing the pedagogical changes from having the expected impact within the classroom. These included: 'Home-based' areas such as parental support, the physical environment at home, travel to school and health issues, and 'Other' areas such as a primary school teacher's ability to teach mathematics well and the introduction and use of technology in the classroom. A thorough study of the literature on these and related topics was carried out, and research questions were framed (as listed in the discussion section) in order to provide the focus required for the study.

METHODOLOGY

The initial data collection administered questionnaires to 160 Queensland students, mainly in Years 3 and 7, from both State and private schools in a regional centre and the State capital. Questionnaires were also given independently to their parents and teachers and the results of the parental responses directly linked back to their own children's responses. Ethical issues concerning working with children existed which needed to be considered carefully. Questionnaires previously developed were examined but none fitted the parameters required, so new ones were developed and checked for validity. The second survey was on technological issues only and was administered to 180 Years 7 & 8 students in one P-12 private school:

Analysis was undertaken using the SPSS statistical program. Correlation tests were utilized to investigate possible linkages between the data items. The purpose of this study was to investigate whether correlations existed and whether such correlations helped provided evidence of causation between the two linked items because of the general concern that such related factors may be exerting an influence on students. That some of the causations might be "spurious" is fully acknowledged and cross referencing was used wherever possible to minimise this likelihood. The Spearman's Rho test uses the ranking of response and not the continuity of the data and hence was the appropriate statistical device to utilise for the initial questionnaire data, whilst the Pearson correlation test best fitted the data from the second questionnaire.

RESULTS AND INTERPRETATIONS

Summary descriptive statistics were first developed from the data so that the overall balance between the different items could be established. The following graphs show the balance between schools and sexes for the data from the first questionnaire.

Figure 1: Year 3

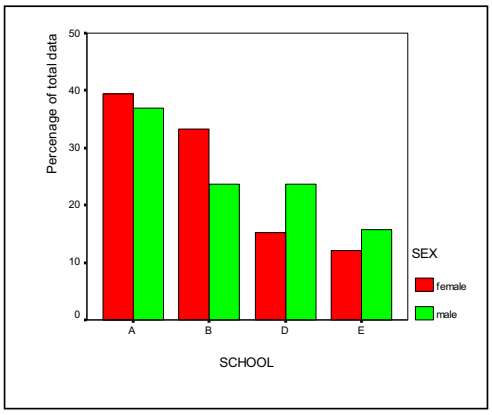
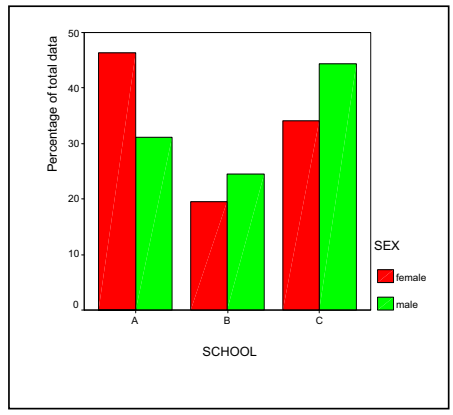


Figure 2: Year 7



Overall, the balance was considered acceptable for the purposes of this research. The following graphs demonstrate that the parental response rate was very good and it allowed their data to be compared to their own children's' data.

Figure 3: Year 3

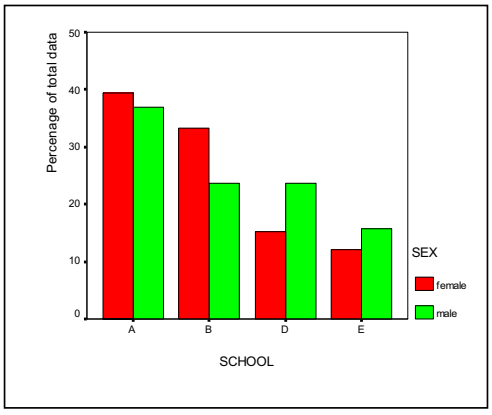
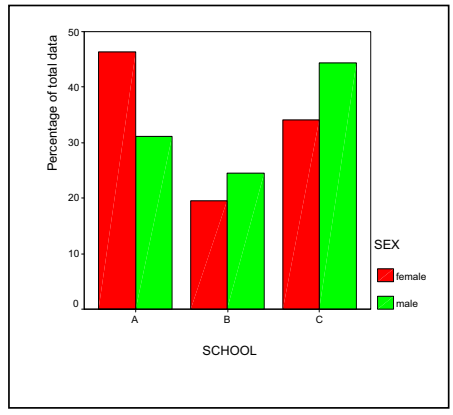


Figure 4: Year 7



Year 7 responses

The first two correlations carried out were between data items where strong correlation was expected in order to help confirm that reliable data was being collected, as shown in Figure 5. These were also checked using Chi-Square tests (see Figure 6) to confirm that the item choices offered showed clear differences and were not likely to be just random variations. Both gave positive results. They compared parents and their own children's responses to what the children had for breakfast, shown below, and to comments on liking maths. As only correlations flagged as of significance (with positive Chi-Square test results) are being reported upon, the actual figures have been omitted for the remainder of the data.

Figure 5: Correlation result

Correlation Coefficient **0.502(**)**
Sig. (2-tailed) N7386**
Correlation is significant at the **0.01** level (2-tailed).
Correlation between student and parental responses in Year 7 about Breakfast using Spearman's Rho test

Figure 6: Chi-Square test

Chi-Square (a,b)	92.753	70.558
Sig.	0.000	0.000

(a) 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 18.3.
(b) 0 cells (.0%) have expected frequencies less than 5. The minimum expected cell frequency is 21.5.

The following relationships were found: If parents had anxiety about mathematics themselves, they generally have told their children about it. Anxious parents often had children who resisted attending school. Children who failed to have breakfast showed tiredness symptoms and this affected their level of work. Living a long way from school affected work levels for girls. Liking maths in Year 7 engenders a positive belief that Year 8 mathematics will not be difficult. If students are nutrition conscious, then they tend to be consistent in their eating habits by having both breakfast and lunch. Having lunch was linked both to liking maths and to showing work to their parents, which was also directly linked to liking maths.

Most showed linkages for both boys and girls, but differences of correlation level were often apparent. Some differences of opinion existed between parents and students on the issue of student tiredness where agreement was expected. Overall, home factors are clearly linked to school in various ways and hence some parents may not be providing the home environment that is needed for their children to be positive about their schooling.

Year 3 responses

For Year 3 students, some linkages similar to those from Year 7 were found, but the need to keep the language of the questionnaires much more simple limited the range of responses. Never the less, various correlations were clearly shown. Parents believe there is a direct link for their boys between liking maths and wanting to go to school although the boys themselves don't show this link. For girls the students say that there is a link but their parents don't clearly indicate it. Travelling long distances to school caused tiredness. Anxious parents often had children who resisted attending school. Eating healthily was linked to not wanting to attend school and liking maths. Also, students who liked maths reported that their best friends liked maths too and almost all felt that maths was their teacher's favourite subject.

Nutrition is clearly a key area even at this age and there were differences in responses from boys and girls. There were also differences between parent and student responses on student tiredness which reinforce again that home environment issues are important.

Year 8 responses

Due to operational difficulties, there were only a limited number of responses from Year 8 students. Despite this, some results were apparent. Parents of Year 8 students who reported suffering from anxiety with maths themselves tended to tell their children about it. This correlation had high significance and reinforces the Year 3 and Year 7 results on this issue. It also provides a level of validity to the Year 8 data, despite low number of responses, as parental responses were similar for parents of all year levels. Tiredness was linked to school attendance and liking maths linked to showing work to parents. Again, both of these reinforce the need to investigate the effect of home issues more thoroughly.

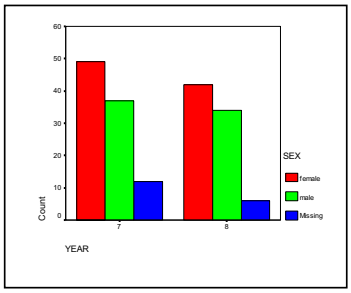
Teacher responses

Responses from teachers suggested the following relationships: Female teachers had a higher rate than male teachers of disliking mathematics as a subject. For those with difficulties in their own school time, females outnumber males three to one. Teachers who dislike teaching mathematics at school had difficulty themselves at school. From the teacher's intellectual perspective, maths was a very positive part of the curriculum but it was linked to a "lack of confidence in teaching maths". Ten to thirty percent of their students had, in their opinion, anxiety problems. Half said that physical factors were affecting their students and just over a third felt that parents were contributing to the problems. Overall, these results confirmed the findings of studies in the literature on mathematics anxiety that showed that many teachers are maths anxious themselves, and they reinforced the responses from students and parents demonstrated earlier.

Technology questionnaire results

Figure 7 shows that there was a reasonable balance between year levels and sexes. The following results were found: Liking maths correlated with good results in maths except for Year 8 boys, which raises a question about why these boys are not achieving well despite liking the subject. Anxiety before a maths test correlated strongly with anxiety before any test, which suggests that using maths as an indicator of academic attitudes and problems, as this study set out to do, is justified. Students said that they found using a calculator easy and understood all the symbols, but in practice this is not true. Girls linked understanding the calculator to a positive view of it use. 50% of girls, but only 30% of boys, liked using one. Nearly 20% of both sexes ticked a box showing a definite dislike. There was a distinct reduction in those liking maths on transition to Year 8. Many Year 7 students said that they were anxious before tests, but Year 8 students were not. Seventy percent of Year 8 students said that they couldn't use a calculator's functions well. These last results indicate some worrying aspects, including attitude changes and a lack of concern over basic issues on entry to high school.

Figure 7: Student responses, by year and gender



DISCUSSION

This study set out to examine factors which had little exposure in relation to their effect on student anxiety levels among mathematics students previously. These included:

- parent and student interactions on a number of issues, such as opinions about mathematics and about going to school
- health and location issues and their relationship to problems at school
- the general living conditions in which the students find themselves

This study has assumed that, as mathematics anxiety seems to be the most commonly expressed subject-specific anxiety and hence could be used as a general guide to school behaviour patterns, these other factors should correlate with it to some extent. Surveying both parents and their children was felt to increase the likelihood that responses in affective areas would provide genuine results.

Answers to the research questions

1. What are the underlying factors that affect the anxiety level of primary and middle school students towards the study of mathematics?

'Home-based' issues are clearly part of the problem facing students, affecting their school experience. First, parents who had anxieties with maths at school themselves generally told their own children about them and this seemed to affect some of their children by promoting anxiety. Second, the common sense idea that tiredness correlates with a lack of breakfast seems relevant here. Nutrition is clearly a key issue, relating directly to classroom performance. That some parents are not reading their children's health issues well, nor their feelings on various school issues, directly links what happens in the home to school performance. Third, Year 3 students who liked mathematics reported that their best friend liked mathematics too, and finally the overwhelming majority of Year 3 students felt that their teacher liked mathematics - this contradicts the results of the teacher survey undertaken. Both of these link pedagogical practice to student feelings about maths.

Two major items relate to 'Other' issues, as defined in the introduction. First, a lack of technological expertise seems to exust in conjunction with a worrying increase in disinterest and an increasing dislike of mathematics as children progress to high school. Hence, improving students' feelings towards mathematics could help the overall move from primary to high school. Second, the data confirmed that many teachers themselves felt maths anxious, although it was encouraging that Year 3 students had not picked up on this. Never the less, it could be adding to the stress levels of teachers themselves, with unknown consequences.

2. Are there any differences between the responses of urban and rural students or between the sexes?

This question examined at two related factors to see if they were affecting the primary issue. Urban and rural differences unfortunately lacked enough data to make valid comment, but differences in the responses relating to the two sexes were apparent. First, there were clear differences between the less positive responses shown by parents with respect to their girls and with respect to their boys, indicating that maths stereotyping is still

happening. Second, boys who liked mathematics said that they showed their school work to their parents, whereas girls did not do so. Girls indicated a higher level of anxiety about high school compared to boys, and there were differences between how parents perceived school work for boys as compared with girls. Finally, there was a positive correlation between those who like mathematics and those who achieved good results in the subject – except that boys in Year 8 did not show this correlation.

3. What actions might be taken by stakeholders (teachers, parents, students, school administrators and university lecturers) to rectify any problems uncovered?

Relevant to the research question, the following implications for teaching and learning can be made: Friendship groupings in Year 3 should be made part of group work arrangements because they promote positive attitudes among students towards their mathematics learning. Teachers of Year 3 needs to give the appearance that they like mathematics even if they do not, as it is a strategy that seems to be very effective with this age group. As boys and girls respond to situations differently, teachers should actively plan for these differences of approach. To improve competence in the use of a calculator, teachers need to introduce innovative and interesting ways of using the calculator so that its functions are utilised effectively in a wide variety of situations (not just in maths), bearing in mind that it may include teaching girls separately with different stimulus material. Assessment must follow much more closely what is actually taught, using a wider range of techniques. Teachers need to use encouragement in the classroom, especially of girls. Making mathematics enjoyable without losing its rigour may be the key to success at this level. Teachers' telling children to do something and not mirroring the actions themselves is usually counter productive.

In addition, the following implications for stakeholders can be made. The stereotyping of mathematics with males seems to be creating problems for many children from an early age and girls are expressing more anxiety than boys - parents need to offer greater encouragement to their girls. Providing healthy and nutritious food is essential for children to get the most out of their educational opportunities – many parents are failing here. Significant numbers of children seem to suffer from tiredness and many parents are not aware of this enough to take effective action. With potentially large numbers of primary teachers, especially females, indicating a dislike of teaching mathematics, school administrators need to allocate time to discuss and to deal with the issue. Some teachers may be failing to recognise anxiety for what it is – is this a lack in their training? More innovative mathematics programmes at Year 8 level in particular are needed – time and money has to be provided. Better school to home communication is needed. University lecturers need to not only recognise that the problem of mathematics anxiety exists in many of their students but need to take effective steps to remediate the anxiety. Finally, Universities need to rethink their priorities within teacher training.

The wider significance of this research project

Previous studies carried out on maths anxiety issues in the USA reported that College and older students responded in similar ways (as did boys and girls) to questions about maths anxiety issues. Unfortunately, studies of teacher trainees reporting on their own experiences at school contradicted some of these findings, the early primary aged students had not been included, most of the home/school issues had not been researched in depth, if at all, and current technology issues had not been directly linked to mathematics problems. These four factors meant that the earlier research may have been more student specific than had been previously understood.

For Australian school children on the other hand, some differences were reported by different age groups on a variety of issues. Some major differences between the responses of the sexes were apparent and these differences started at a very early age. Hence this project has highlighted that more data, from different countries, is vital to a correct understanding of the problems associated with maths anxiety issues and has added to the store of knowledge that can be included in future research projects in this area. It also showed that home based issues played a vital role and that schools could not be expected to deal with the issues independently.

CONCLUSION

This project demonstrated that a number of hitherto unstudied issues outside of the classroom pedagogy approach previously used were directly affecting student attitudes and progress within the classroom. It identified some areas where different stakeholders could make changes which would have a direct effect on the problems encountered, some simple and easy to implement and some that required a more long term structural approach. In addition, many areas requiring further research were apparent in the findings.

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