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MATHEMATICS – WHOSE DOMAIN IS IT? PERCEPTIONS OF SINGAPOREAN AND AUSTRALIAN STUDENTS

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Abstract: There has been a long held perception that mathematics is more appropriate for males than females. In some countries this belief seems to have influenced girls' participation and achievement in mathematics. However, gender differences in mathematics learning seem to have diminished in recent years. In this paper we report findings from a study conducted in 1999 to explore current gender-linked perceptions of mathematics by administering a 48 item Likert scale instrument. The sample comprised some 800 students. Of these, 525 attended a co-educational secondary school in Singapore and 274 students a co-educational school located in metropolitan Melbourne. The implications of our findings are also discussed.

Introduction

There has been a long held perception that mathematics is more appropriate for males than females. In some countries this belief seems to have influenced girls' participation and achievement in mathematics. However, gender differences in mathematics learning seem to have diminished in recent years. In the *Third International Mathematics and Science Study* [TIMSS], for example, gender differences in the performance levels of students in the middle years of schooling were found in relatively few of the participating countries (Beaton et al., 1996). If found, however, significant gender differences tended to favour boys.

Students from Australia and Singapore participated in the TIMSS. In neither country were statistically significant gender differences in performance levels found. On average, though, Australian girls performed slightly better than boys while in Singapore the reverse was true (Beaton et al., 1996). When the results for the two countries were compared, Singaporean students clearly outperformed Australian students. The TIMSS surveys also included a number of measures of students' attitudes towards mathematics. Despite their higher achievement scores, the Singaporeans agreed less strongly than the Australians that they usually did well in mathematics, reported liking mathematics less, and were generally less positive about mathematics (Beaton et al., 1996).

The extent to which mathematics is perceived to be a male domain (ie. more appropriate for males than for females) is included among a range of variables in many of the models put forward to explain gender differences in participation rates and performance levels in mathematics (see Leder, 1992). Commonly reported findings on students' perceptions of mathematics as a male domain indicate that the view is held more strongly among boys, on average, than among girls. We were interested to know if this pattern of beliefs was still evident, and whether differences would be found among Australian and Singaporean students.

One of the most frequently used instruments for measuring students' perceptions of mathematics as a male domain is the *Mathematics as a male domain* [MD] subscale of the Fennema-Sherman *Mathematics Attitude Scales* (Fennema & Sherman, 1976). Forgasz, Leder and Gardner (1999) recently argued that the wording used in some of the MD items was anachronistic, that the interpretation of responses to other items was questionable, and that some of the assumptions underpinning the MD were invalid. For example, there is growing evidence that some people regard mathematics as a *female domain*, a view not accounted for in the MD. A new instrument, the *Mathematics as a gendered domain* scale was devised to address these criticisms of the MD. Following a first trial, a few changes were made and the scale was re-trialed. The findings reported here are from the second trial of the new instrument.

The Study

What does the new instrument look like?

The *Mathematics as a gendered domain* scale is made up of three subscales: *Mathematics as a male domain, Mathematics as a female domain*, and *Mathematics as a neutral domain*. Some items included in the new scale are loosely based on those from the Fennema-Sherman *Mathematics as a male domain* subscale. Items reflecting contemporary research findings in the field were also written. On each subscale, items were included which related to the following factors identified from the research literature: ability, career, general attitude, environmental factors, peers, effort and task. Sample subscale items and the factors they represent are shown on Table 1.

Table 1: Some items from the Mathematics as a gendered domain scale

SUBSCALE & FACTOR	ITEM
Male domain – ability	Boys understand mathematics better than girls do
Female domain – ability	Girls are more likely than boys to believe they are good at mathematics
Neutral domain – ability	Being good at mathematics comes as naturally to girls as to boys
Male domain – career	Career choices make the study of mathematics more important for boys than for girls
Female domain – general	Girls enjoy mathematics more than boys do
Neutral domain – environment	Parents are as likely to help their daughters as their sons with mathematics
Male domain – peers	There are more popular boys than popular girls who are good at mathematics
Female domain – effort	Girls are more careful than boys when doing mathematics
Neutral domain – task	Students who get poor marks on mathematics tests are just as likely to be boys as girls

Each subscale consists of 16 items. The response format for each is a 5-point Likert-type scale ranging from SD (strongly disagree) to SA (strongly agree). A score of one is assigned to SD responses and five to SA responses. The range of possible scores on each subscale is 16-90.

The questionnaire used in this study included all 48 items. They were presented in a mixed order. A space for comments was provided at the end of the questionnaire.

The sample and methods

Australian and Singaporean students in grades 7-10 completed the questionnaire. In each country, the students attended a single large co-educational secondary school. The sample sizes are summarised in Table 2.

Table 2: Sample sizes

Country	Female	Male	Unknown gender
Australia	148	128	3
Singapore	261	264	-

Data from the completed questionnaires were analysed using $SPSS_{PC}$. For each of the three scales, statistical tests were conducted to compare the responses of boys and girls and to examine if differences existed in the views of students in the two countries.

Results

The results of the analyses (2-way ANOVAs) exploring for differences in mean scores on each subscale by country and gender are shown on Table 3. Statistically significant results are indicated.

Table 3: Mean scores1 by country and gender

MALE DOMAIN		FEMALE DOMAIN		NEUTRAL DOMAIN	
Australia	Singapore	Australia	Singapore	Australia	Singapore
2.20	2.59***	2.68	2.63	3.88	3.94
Female	Male	Female	Male	Female	Male
2.24	2.70***	2.73	2.55***	3.98	3.85***

[1] Scores recorded are the means of the mean item score on each subscale
p-levels: * = <.05; ** = <.01; *** = <.001

The results shown on Table 3 can be summarised as follows:

Male domain: Students did not stereotype mathematics strongly as a male domain (mean scores < 3). However:

- Singaporean students believed more strongly than Australian students that mathematics was a male domain. For the Singaporean students, this was true for the females and for the males (see Table 4)
- males believed more strongly than females that mathematics was a male domain
- Female domain: Students did not stereotype mathematics strongly as a female domain (mean scores < 3). However:
- females believed more strongly than males that mathematics was a female domain.

Interestingly, mathematics was stereotyped slightly more strongly as a female domain than as a male domain by students in both countries.

Neutral domain: In general, students strongly agreed that mathematics was a gender neutral domain (mean scores > 3). However:

- males were less convinced of this than were females

We were also interested to know if there were differences in the views of: males and females within each country. The results of these analyses (independent groups t-tests) are shown on Table 4.

Table 4. Mean scores for Australian and Singaporean males and females

	MALE DOMAIN		FEMALE DOMAIN		NEUTRAL DOMAIN	
	Female	Male	Female	Male	Female	Male
Australia	2.03	2.38***	2.75	2.60	3.90	3.86
Singapore	2.33	2.85***	2.72	2.54***	4.03	3.84***

p-levels: *=<.05; **=<.01; ***=<.001

The data on Table 4 can be summarised as follows:

Among Australian students, males were:

- more convinced than females that mathematics is a male domain

Among Singaporean students, males were:

- more convinced than females that mathematics is a male domain
- less convinced than females that mathematics is a female domain
- less convinced than females that mathematics is a neutral domain

Comments made by students

Australian students

Many Australian students wrote comments in the space provided on the questionnaire. On the whole the comments were thoughtful and implied that the students had taken the task seriously. A few claimed the questionnaire was "sexist", "stupid", or a "waste of time". Several picked up on the repetitive nature of many of the items.

Many students' comments reflected views about the stereotyping of mathematics. The frequencies of these comments were consistent with the scores reported in Table 3. That is, most of these comments revealed beliefs that mathematics was a neutral domain. Fewer students stereotyped mathematics in one direction or the other. Some students were aware that it was politically incorrect to stereotype. A few examples of student comments are reproduced below:

- Each boy is different and each girl is different. It is impossible to say girls like maths more than boys because no two people are the same (M, Gr.7)
- Although some girls' attitudes are different, girls have just as good a chance to excel at maths as boys. (M, Gr.8)
- I think that boys and girls are both equally good at maths, it makes no difference if you're a boy or a girl. (F, Gr.9)
- My brother always says that he is smarter than me because I'm a dumb girl (F, Gr.9)
- You can't take a stereotyped approach to these type of questions these days (F, Gr.10)
- Boys and girls are generally equal. It all depends on the individual. (M, Gr.10)

Singaporean students

A few Singaporean students wrote comments in the space provided on the questionnaire. These comments ranged from thoughtful ones to claims that the questionnaire was "irritating", "irrelevant" or "sexist". A number also picked up on the repetitive nature of many of the items.

Many of the thoughtful comments revealed beliefs that mathematics was a neutral domain. A few examples of students' comments are reproduced below:

- Boys and girls are equally good in mathematics if they really put in effort in their work.(M, Gr.7)
- Mathematics is a subject to study, whether you are male or female, you still have to study. But for our future, to excel is better, so whether you are a boy or a girl, it is always better to grip the skill. Everyone has his or her own talent, it does not mean that being a guy, you must be good at mathematics. (F, Gr.8)
- People think that boys are better than girls in mathematics but this is not true. (M, Gr. 8)
- Why the survey on boys and girls? Seems kind of sexist. Boys and girls are almost the same, same opportunities. We have the same teacher, same textbook, same homework to do. When we grow up, both sexes have equal chances to work as e.g. manager, accountant, etc. (F, Gr. 9)
- Though it would seem that boys generally do better than girls, there are also many girls who do well. Just that to my opinion girls have slightly more trouble understanding mathematics concepts than a literary metaphor. (F, Gr.10)
- Girls and boys are equally talented in mathematics. They both excel in the same range. They both show lots of interest and excitement in doing well in mathematics. (M, Gr.10)

Conclusions

Since the data presented in this paper were gathered from students in only one school in each country, interpretations of the findings are necessarily very tentative. One of the most significant findings, however, is that, in general, students in Singapore and in Australia were more likely to consider mathematics to be a gender-neutral domain (i.e. equally appropriate for males and for females) than either a male or a female domain. Interestingly, it was found that, on average, students in both countries appeared to believe slightly more strongly that mathematics was a female domain than a male domain. This finding is worthy of further investigation. It should be noted that in Singaporean schools, there are often more female than male teachers and hence more female than male mathematics teachers. Their written comments suggest that Singaporean students view mathematics as an important component of their school curricula.

Among those who did hold stereotyped perceptions about mathematics, the Singaporeans appeared to hold such views more strongly than the Australians. Are the cultural and social expectations of males and females with respect to mathematics different in the two countries? Might this explain the differences observed? It was noteworthy that in both countries the males believed more strongly than the females that mathematics was a male domain, and less strongly that mathematics was either a female domain or a gender-neutral domain. These findings are consistent with those previously reported in the literature.

Having used a new instrument in this study, no conclusions can be drawn about any possible changes over time in the extent to which the beliefs reported in this paper are held. Small differences in beliefs across cultural boundaries have been reported here. However, more data from a larger sample are needed to explore these findings in greater depth. Extending the study to include a wider range of cultural/ethnic backgrounds would enable further explorations of any cultural links to the gender-stereotyping of mathematics.

In the past, the stereotyping of mathematics as a male domain was found to restrict opportunities for some women. It is important to continue monitoring such beliefs, particularly if culture and gender are found to interact and impact on learning options.

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