Teachers' and pre-service teachers' GENDERED BELIEFS: STUDENTS AND COMPUTERS

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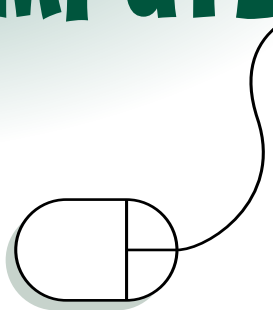

The focus of this article is on Australian teachers' and pre-service teachers' gendered beliefs about their students and about computer use for mathematics learning. To illustrate what is happening in these areas, I will draw on results from two studies in which I have been engaged in recent years. I will also present the findings from other relevant Australasian research studies. Based on the body of work presented, a number of implications for professional learning programs and for pre-service education programs emerge and are put forward.

The studies

Study 1: Pre-service teachers' beliefs about students' views about the gender-stereotyping of mathematics

Recently, the construct mathematics as a male domain (the notion that mathematics is more suited to males than to females) was recently re-examined using two new instruments (Leder, 2001; Leder & Forgasz, 2002). The beliefs of a large sample of Australian grade 7–10 students were found to be inconsistent with previous research (Forgasz, 2001; Forgasz & Leder, 2000). The vast majority of students did not gender stereotype mathematics. With respect to the minority who did, their beliefs about certain aspects of mathematics learning appeared to have changed since earlier times. Girls, for example, were considered more likely than boys to be good at mathematics, to enjoy it, and to find it interesting. Boys were thought more likely than girls to find mathematics difficult and to need additional assistance. Findings such as these appear to challenge notions of mathematics as a masculine endeavour. On the other hand, in some respects things had not changed. Boys, for example, continued to be seen as more likely than girls to distract others in class and to tease classmates (male and female) who were good at mathematics.

A slightly modified version of one of the instruments devised by Leder and Forgasz (2001) was administered to a large sample of pre-service teachers in three Australian universities. The pre-service teachers were asked how they believed students in secondary schools would respond to the items presented. That is, their beliefs about students' gender stereotyping of mathematics, and not their own beliefs, were being tapped. The findings indicated that the pre-service teachers believed that students still held traditional stereotyped views of mathematics (Forgasz, 2000, 2001) including, for example, the complete reverse of the students' findings mentioned above. Similar results were found with cohorts of US students and pre-service teachers (Forgasz, 2001).

Study 2: Teachers' beliefs about learning mathematics with computers

As part of a larger study on the use of computers for secondary level mathematics learning, teachers' beliefs about the efficacy of computers for enhancing students' understanding of mathematics were tapped. The teachers were also asked if they believed boys and girls learned differently using computers. There were 96 teachers of grades 7–10 who completed survey questionnaires; six other grade 10 teachers also completed questionnaires as well as being interviewed and having their mathematics classes observed for two weeks.

Of the 96 teachers, 61% indicated that students' mathematical understandings are helped by using computers, about 10% of the teachers disagreed, and the rest were uncertain if computers helped mathematical understanding. No differences by teacher gender were found. A much smaller proportion of students was positive about the efficacy of computers on mathematical understanding. Fewer than 30% of over 2000 students agreed that computers had helped their understanding of mathematics; 41% disagreed and the remainder was uncertain. Among the students, there was a statistically significant gender difference; a higher proportion of males (37%) than females (20%) believed that computers had helped their understanding.

On the questionnaire and at interview, the teachers were asked if there were any differences in the ways boys and girls learned mathematics and used computers in mathematics classes and whether this affected the way they taught. Following are the responses of five of the teachers who were interviewed and whose mathematics classes were observed (drawn from Forgasz, 2003, pp. 355–356).

Teacher: Jack
Boys/girls different? Unsure
Teaching affected? No
Survey: Since I regard computers as a tool, I treat all students the same.
Interview: …in over twenty years of teaching, I think girls tend to be a little bit more careful with the way they're doing things whether… on pen and paper… or doing things on a computer… they will go through the activity in a more methodical manner… whereas I think boys [will] get the job done in a more haphazard fashion… as far as I'm concerned boys tend to think better in 3D, girls find drawing 3D shapes much more difficult than boys do.
With respect to computers specifically: …I've noticed that the girls have got through the program at least as well as the boys have. I would say that a couple of the boys have finished quicker and that may be because…those particular boys…are fairly computer adept, they're only average students… but they picked up the program very quickly and they got finished. The girls… got to the same point a little slower, much more methodically.

Teacher: Kevin
Boys/girls different? Yes
Teaching affected? No
Survey: Boys in this class appear to be the more confident & competent. I'm conscious of it. Let people help each other.
Later, in writing: I feel the girls have less confidence and competence in using computers… I can think of two or three girls… Kate… who struggles in using computers and Lyn who's very quiet… so you don't know whether they're asking or needing help or whether they're getting it from others and… [there are] about two or three girls that seem to seem to hang back, they just idle through things anyway, so you're not too sure whether… that's slowing them down in computers at all… I probably noticed the boys more than the girls… it was just that a few of the boys stood out more as being… able to do things with computers… which didn't make me happy.

Teacher: Fred
Boys/girls different? Yes
Teaching affected? Yes
Survey: Girls need more practice of the concepts learned.
Interview: …my observation that girls naturally are not… as good in mathematics as boys are… [T]hey are better in language skills and they have different strengths than the boys… [It] doesn't apply to everyone, but it's the general trend… [S]o the reason is that because they're…not good in maths as naturally boys are, so I suggest to them to have a bit more practice so the concepts are… more consolidated and they could use it when they need. So I think they need a bit more practice than boys.

Teacher: Irene
Boys/girls different? Unsure
Teaching affected? No
Survey: The instructions for the features of the computer software are given to all students. However, it seems that boys tend to NAVIGATE the software more effectively.
Interview: …some of the girls in that class are just sort of helpless types and they don't seem to want to take initiative. Not all of them… some girls who are very independent learners and get on with it. [T]he back row girls, they tend to just put their heads down and do it, and the others… seem to lack the confidence just to do it… I'm just… thinking of the girls that always seem to lag behind and always seem to be not sure of where to go next.
Probed further about girls' learning of mathematics, Irene added: I think the girls tend to be more reticent… but I'm generalising again, I think the boys tend to be a bit more vocal in sharing some of their ideas…[and] to be a bit physically bigger… there's more of a presence of them… I think girls tend to fade that little bit into the background…. I can think of counter examples where the girls dominate and are vocal and tend to volunteer what they know, maybe more in the junior classes… but I think maybe in the senior classes perhaps the girls tend to be a bit more quiet.
Effect on teaching: Well I have to be aware of drawing the girls in, making sure they're not ignored or feel that I'm only directing my attention to the boys …and not giving the girls a chance…

Teacher: Edna
Boys/girls different? No
Teaching affected? No
Interview: …some of them [students] are very resistant to actually learning mathematics when they're in the computer room. They think it's for playing games. As you noticed I had to tell quite a few of them to get out of the games and get back to the maths… [O]thers will get stuck into what ever it is you give them to do and rise to the challenge, like the girls who were working out how to do the surface area of a cone without being given the slant edge… they were really extending themselves today. But it's difficult because you spend so much time trying to keep the ones who either don't have the skills or aren't interested in doing the work on track but you don't have a lot of time to spend with those kids who are….It would be really great if we could… but it doesn't happen in real life.
Source: Forgasz (2003, pp. 355–356)

From the above, it can be seen that Jack, Kevin, Fred and Irene (pseudonyms) identified differences in the behaviours of boys and girls in their mathematics classrooms and/or in using computers for mathematics learning. Fred's belief that males had natural mathematical superiority over females was the basis of his conclusion that girls needed more practice with computers. Neither Jack nor Kevin had reflected on their observations. They were concerned about the girls' less functional behaviours but did not appear to have strategies to address them. Although not specific to computer use, Irene had made similar observations and was able to describe the actions needed to deal with the situation. Edna's specific observations about the girls getting on with a computer-related mathematics task were consistent with previous research about girls' behaviour in mathematics classrooms. It can be inferred from the teachers' comments that they believe that students who are competent with computers, rather than necessarily mathematically strong, gain most from computer use for mathematics learning; boys were seen as more computer savvy than girls.

Other Australasian studies: primary and tertiary examples

Lee (2002) observed that early childhood teachers were five times more likely to identify and nominate boys than girls for a mathematics and science enrichment program; these findings echo past research results indicating that boys are more likely than girls to be identified as gifted. Sixteen early childhood teachers who had identified students for the program were interviewed and a model of teachers' conceptions of giftedness among young children was developed. Lee concluded that the teachers' conceptions were overlaid with their beliefs about gender and that girls were disadvantaged by each of the seven categories of giftedness that guided teachers' behaviours. Girls, Lee contended, would have significantly fewer opportunities than boys to be identified using the model that emerged.

Wood, Viskic and Petocz (2003) examined gender differences in the use of technology in three tertiary mathematics learning environments. The study involved both the teachers and the students, and in each class, a different mathematics subject was being taught. The teachers all adopted inclusive pedagogical practices with respect to the learning environment they created, the assessment methods and teaching materials they adopted, and in monitoring their own teaching. Students' attitudes towards the use of computers were gathered. There were no gender differences found in attitudes towards computers or the use of computers. The authors concluded that the use of inclusive practices may be a contributing factor in eliminating gender differences in attitudes to the use of computers and that group work may account for the positive attitudes among females.

Summary of findings

There appear to be some common patterns evident in the findings from the studies described above.

- The pre-service teachers in Study 1 and the surveyed classroom teachers in Study 2 seemed to be out of touch with students' views. The pre-service teachers believed that students would hold patterns of gender-stereotyped views that are likely to have been prevalent when they were in high school some years earlier. The secondary mathematics teachers believed much more strongly than their students that computers helped mathematical understandings.
- The classroom teachers whose mathematics lessons had been observed were all very experienced. Their views of boys' and girls' behaviours with computers and their explanations for them reflected fairly traditional gender-stereotyped expectations consistent with beliefs that males are more suited to mathematics than are females.
- Gender-stereotyped expectations can also be inferred from the identification by early childhood teachers of more males than females for participation in a gifted mathematics and science programme.
- The findings from the study of tertiary mathematics learning settings suggest that pedagogical approaches may contribute to gender differences in students' beliefs about technology.

Implications for professional learning and pre-service education

There are some in the wider educational community who no longer believe that gender is an educational issue. Among others there is growing concern about boys' educational disadvantage. Research findings and examination results support contentions that girls excel over boys in many subject areas. It is also clear, however, that girls still encounter disadvantage in the hard sciences, mathematics, and computing fields.

The findings from the studies reported here indicate that it cannot and should not be assumed that teachers and pre-service teachers hold gender-balanced beliefs about their students or about computer use for mathematics learning. A second major concern is that many teachers and pre-service teachers appear to be out of touch with contemporary students' beliefs. It is also important to recognise that teachers' gendered beliefs can affect children's learning at all stages of the educational process, including

the very early years of schooling.

When dealing with sensitive issues such as gender stereotyping, it is not always easy to identify stereotyped beliefs or behaviours. This suggests the continuing need to raise gender-related issues with school administrators, teachers, parents, and students. Discussions should also be encouraged and appropriate actions taken to eliminate potential factors that may contribute to identifiable gender differences at all levels of education.

In primary and secondary pre-service teacher education programmes, it is important that gender issues are brought to the forefront. This also means that pre-service teachers should somehow be challenged to confront their own belief systems. They need to become aware of the potential educational consequences of holding stereotyped beliefs and expectations of students and their capabilities.

In the continued pursuit of educational equity, gender needs to remain on the agenda.

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Diversions

Solutions

Triangular numbers

$$T_7 = \frac{7(7+1)}{2} = 28$$

$$T_8 = \frac{8(8+1)}{2} = 36$$

and the general form

$$T_n = \frac{n(n+1)}{2}$$

works for all values of n.
Gauss's method leads to the same expression: 1 is the first term, n is the last and there are n terms, so $n/2$ pairs of $n + 1$.

Square numbers

The gnomons for the squares are the odd numbers, 1 is the first, 3 is the second, 5 is the third, etc. so each is double its position minus 1, or the nth odd number is $2n - 1$, so $S_n = 1 + 3 + 5 + \ldots + 2n - 1$.
Apply Gauss's method and we get

$$S_n = \frac{(1+2n-1)n}{2}$$
$$= \frac{(2n)n}{2}$$
$$= n^2 \quad \text{as expected.}$$

Pentagonal numbers

Hopefully you found the sequence for Pn to be
1, 5, 12, 22, 35, 51, 70, 92,
with the gnomons being the sequence
4, 7, 10, 13, 16, 19, 22,
i.e. increasing by 3 each time.
This sequence has the general term $3n+1$ so that

$$P_n = 1 + 4 + 7 + \ldots + (3n-2)$$

Using Gauss' method of pairing from the ends

$$= \frac{(1+3n-2)n}{2}$$
$$= \frac{n(3n-1)}{2}$$