

Classics Counts Over Calculus: A Case Study

Fiona Shannon

University of Otago, New Zealand

<fshannon@maths.otago.ac.nz>

Jane was a mathematically talented female who chose not to study mathematics in Year-13 at secondary school. Jane had many “open doors” available to her and opted to continue with an arts course. She preferred classics to calculus. Her reasons included that calculus was boring, not enjoyable, and had no perceived future use. Jane stated she “hated maths”. This article aims to determine the factors that caused this dislike and influenced her decision to choose an alternative path away from mathematics.

Mendick (2003) asks, “Why [do] a disproportionate number of girls opt out of powerful areas of the curriculum” (p. 169) including mathematics? Mathematics operates as a “critical filter” (Sells, 1978) controlling entry into many high-status areas of academia and employment, and because many girls choose not to participate in higher levels of mathematics, they consequently limit their future opportunities.

The gendered pattern of participation ... in mathematics has been presented ... as a major and direct cause of gendered patterns of participation in further education and employment. Mathematics is imbued with an almost mystical power to make and remake futures. (Kenway, Willis, Blackmore, & Rennie, 1998, p. 38)

At the end of the 2001 school year, I was helping with the timetable at my school for the subsequent year. As part of this process we check the subject selections of each student. As I was entering the data for Jane, one of our most able and talented mathematics students, I was concerned to discover that she had not chosen any mathematics courses for her Year 13 selections.

Jane told me that she did not want to do mathematics any more as it was too boring; she did not enjoy it; and she had no use for it in the future. Her most common explanation was, “I hate Maths”. She was going to do a final year course that included English, German, and photography, subjects she was also very talented at. I have often thought about Jane and reflected on whether this situation was common, or if it was just a ‘one-off’ case. I have wondered what mathematics teachers as a group can do to ensure that all our girls see mathematics as a serious option for study. I have speculated whether girls arrive at secondary school with a ‘built-in’ attitude towards mathematics, or if it is their experiences within the secondary sector which ‘turn them off’ mathematics as a chosen subject choice at the post-compulsory stages.

Jane allowed me to undertake a qualitative semi-structured interview with her. I was required to produce a case study to correspond to the assessment criteria for a post-graduate education paper during 2003. This paper evolved from data collected during that specific study. The resulting transcript was analysed for key themes related to the literature using a post-structuralist lens. I noted both parallels and differences during my interpretation of the transcript material for this case study. All interpretations are my own and my analysis cannot be considered conclusive due to the small scale of this study.

Teacher /Student Conflict

The interview process may have been inhibited by the ‘power positions’ between Jane and me. I brought a “position of power to the research that must be taken into account”

(Alice, 2003, p. 67). I was Jane's mathematics teacher for one year of her secondary schooling and, although Jane no longer attends school, it seems only fair to recognise that she may still view me as a teacher and herself as a student. This creates a "hierarchical relationship between the researcher and the subject" (Alice, 2003, p. 67) and makes it difficult to equalise the research/researched relationship when our previous relationship is based on a subordination role as constituted through the experience of being at school.

I noted in my field notes that

Jane seemed inhibited from speaking freely during the interview process. At first I interpreted this as an issue of age, where Jane was enacting the role of 'typical teenager' and not conversing freely. On reflection I considered the power relations as construed from our past relationship. Even though I no longer view Jane as a school student, I cannot assume that she no longer views me as teacher. (Research field notes, August 2003)

I anticipated prior to the interview that Jane would freely communicate her feelings about, and experiences of school mathematics to me. Unfortunately, this was not the case and I had to work hard during the interview process to get Jane to answer in detail. I assumed that Jane would just 'open up and talk to me' as a peer. She may also have felt inhibited by the fact that she was going to criticise mathematics, a subject that she knew I enjoyed, liked teaching, and promoted at school.

"It is through a range of discourses of mathematics that an individual's education choices and experiences are constituted" (Mendick, 2003, p. 171). The dominant discourses that thread through Jane's narrative are: maths is irrelevant; maths is taught differently to other subjects; and, *others* say that classics is better than calculus. In this article, I will focus on how Jane constituted and was constituted by these discourses and how her gendered identity was and is constructed.

"I Hate Maths"

When I came across Jane earlier in the year and told her I was doing some post-graduate study on girls and mathematics, her instant response was, "I hate maths". During the interview, I initiated discussion on this statement in an attempt to unpack what this really meant for Jane. We started by discussing what she did like about maths and her responses included the following:

What did I like about maths, well, like at, I mean, like at primary school and stuff ... it was just like ... you work something out and you use their rules and you got results, and it was just like logical challenge ... not like real challenge, and just like, and because you knew you were going to get results it was like, yeah well, so you felt good because you knew you were going to get the results. (Interview with Jane, August 2003)

The two key messages I drew from this were that mathematics was about "getting results" and about following "their rules". The use of the word "their" was expanded on later in the interview and I interpreted "their" as being mathematics teachers.

Jane was reinforcing many views from the literature that mathematics is seen as an abstract, absolutist subject, where it is perceived as having right or wrong answers only, and where getting things right makes you feel good and, conversely, wrong answers reiterate that maths is difficult. (see Mendick, 2003; Willis, 1990). Jane admitted that, as she got older, she stopped liking mathematics. Her explanations included the following:

There's only one way of doing it, so you've got to do it, and you've got to get this answer and it doesn't really like, you don't really get to, it doesn't lead you anywhere, you're just like, yeah, that's it, full stop. (Jane)

Jane's comments identify the pattern of doing mathematics as; do the work, get an answer, and then experience over. Nowhere in the interview did she mention 'learning' as part of her experience in mathematics, but described mathematics as more to do with following rules and getting to the point that the teachers expect you to get to. Willis (1990) reinforces this view of mathematics in the statement:

Mathematics curricula often convey an entirely false sense of the absoluteness of mathematics: one right answer, true in all possible worlds, dissociated from experience and independent of culture. In several ways, this presentation of mathematics may alienate more girls than boys. (p. 202, see also Willis, 1989, p.27)

Jane did not think that the teachers made mathematics relevant to her. Jane's comment below reinforces this idea.

Like you make all these problems and give them real life situations ... but I like really didn't see ... like, why do I need to know how fast or how far away *he's* going to land if *he's* jumping at this speed, or whatever, like basically as long as I can make it work I don't mind. (Jane, my emphasis)

This introduces the view that although teachers may have tried to make mathematics relevant, the reality for Jane was that it did not help her interest levels or enjoyment of mathematics. It is also interesting to note that she uses the word "he's" twice in her description of a real life mathematics problem. I believe she was describing a kinematics problem in her comment where male oriented examples about cars, rockets, parachutes, and sports are often used to describe the motion of objects. By using "he's" she was identifying the male oriented context of the mathematics she was doing in class. Forgasz and Leder (1996) have noted that there is a "conspicuous lack of discussion about the usefulness of mathematics in everyday life or to students' futures" (p.168). The 'real world' is only apparent in the context of some tasks and a "preponderance of male-stereotyped task contexts" (Forgasz & Leder, 1996, p. 168) subtly conveys messages that mathematics is only relevant to the future of males.

Jane's comment that "maths is just like it's all numbers" reinforces the view of Willis (1990) that European middle-class males have for centuries defined mathematics in their own terms and around their own "conception of mathematics as disembodied thought" (p. 206). Mathematical disembodied thought does not value the incorporation of relevant context into problems. Students, particularly girls' backgrounds, daily experiences, culture, or lived realities are ignored to maintain the power of mathematics as a male domain. The 'maleness' of mathematics permeates society and "regardless of how mathematically competent a woman becomes she can never escape discursive practices that reify the idea that mathematics is, indeed, a male domain" (Damarin, 1995, p. 250).

Jane was a mathematically successful girl but her "conception of mathematics as dissociated from experience" (Willis, 1990, p. 202) has added to her dislike for the subject and to discouraging her from studying the subject at a higher level. Willis (1990) believes that girls, more than boys, prefer more context-bound tasks but Jane's comments accentuate that the context has to be relevant and realistic, not just contrived.

"Maths is Different from Other Subjects"

There are many implications for mathematics pedagogy where educators and reformers need to shift the "discursive invention of maths from that of a subject of abstract rules and absolutes to that of a more relational and collaborative discipline" (Mendick, 2003, p. 184). Many authors (Alton-Lee & Praat, 2000; Fennema & Meyer, 1989; Forgasz & Leder, 1996; Fox & Soller, 2001; Haynes, 1994) stress that co-operative activities are preferred by

many girls in mathematics whereas many boys prefer to work in a ‘traditional’ competitive environment. “Individual differences in learning preferences and styles are ignored as teachers initiate ‘analytical models of instruction’ which tend to favour males more than females” (Fox & Soller, 2001, p. 16). Forgasz and Leder (1996) suggest that there are many positive influences from cooperative learning environments that can be employed. These include non-cognitive variables such as self-esteem and a liking of both the class atmosphere and classmates. (See also Holton, Anderson et al. 1999; Holton, Ahmed et al. 2001)

However, it is interesting that Jane’s discussion in the interview does not support claims that girls prefer co-operative styles of learning as she stated, “I preferred to work by myself rather than in a group”. Jane mostly sat with less able female students in mathematics and her role often included aiding them.

When we were given, like, stuff to do, like a set of problems, I would have to just sit there and do them, like I couldn’t talk while I was doing them ... and like all the time ... whenever Sue (friend) used to ask me “how do I do this one, how do I do this one” and she’d just get really annoyed with me cause I’d always just put up my hand and say “wait, wait, I can’t talk until I finish this”. She went on to say “I didn’t mind helping her, it was just I had to, I couldn’t be interrupted or I’d just get frustrated, ‘cos it sort of happened too much. (Jane)

Jane seemed to be placed in a paradox of wanting to finish her own work and at the same time helping her less able friend. Walkerdine (1990) terms this role as a helper for others as a “subteacher”. Jane takes up the position of being nice, kind, and helpful, which is how many teachers describe the girls in their mathematics classrooms (Walkerdine, 1990). Girls are at the centre of a set of complex practices where there is a “contradictory relationship between gender and intellectuality” (Waldene & Walkerdine, 1986, p. 144). Jane is intellectually able, but as a girl, is positioned in the feminine role of being helpful to her peers. However, another interpretation could be that she is taking on the “position of teacher” (Walshaw, 2001, p. 10) which Walshaw (2001) suggests actively places her in a powerful position in the class instead of the usual position of “the powerless female learner” (p. 10). The discourses of ‘nice, kind and helpful’ have “traditionally shaped a girl’s classroom peer interactions [and] prompted and sustained the idea of her as a passive and dependent product of a large-scale patriarchal system” (Walshaw, 2001, p. 10). Walshaw (2001) also points out that this account “does not adequately deal with subjectivity in which relations of power are continually changing” (p. 10). Jane was able to be both powerful and powerless in the mathematics classroom, depending on how her subjectivity was constituted.

Examples of how I view Jane as often powerless in the mathematics classroom come from her interview where she describes the mathematics classroom’s physical environment, the way the mathematics teacher teaches, and how experiencing school mathematics is different to experiencing other school subjects, such as English and German. The following excerpts from the interview transcript follow these themes:

Maths and science like, all desks all facing forward, one or two in a row, and like, you just focus on the teacher and forget about the other people in the class, kind of, and for other subjects it was kind of more often more discussion from the set up and around the room.

Maths is always the kind of thing where the teacher knows it all and the students are still learning and in things like English the teachers can actually give, I mean, the students can give the teacher a new perspective on things so it kind of works both ways. (Interview with Jane, August 2003)

Jane’s memory of the mathematics classrooms as being regimented “make visible some of the seamless ways in which everyday school practices operate to discipline the body”

(Kamler, Maclean, Reid, & Simpson, 1994, p. 128). Mathematics classrooms operate in a ritualistic way and students learn to live by the routines and the systems of rules and controls. The placement of the furniture regulates how a student in mathematics must sit and be in class. Kamler et al. (1994) suggest that this process of regulation may be seen to be deeply and invisibly gendered. “The discourses of power that perpetuate the symbolic binaries of gendered practice” (Kamler et al., 1994, p. 114) are demonstrated in the mathematics classroom where the physical bodies of the students were forced to face in a particular direction, that being forward, with the main focus being on the teacher. Lee and Taylor’s (1996) term “dilemma of obedience” is a good way of describing how mathematics students are formed by the actions of the teacher and the organisation of the classroom. “Students receive and then...give back what they have received [and learners are] formed into a receptive and obedient relationship to the teacher and to the knowledge being purveyed” (Lee & Taylor, 1996, p. 65).

Jane saw communication with her peers as an important part of the classroom learning experience but she considered that the mathematics classroom did not provide for this communicative aspect to occur. This controlled environment reflects Foucault’s (1977) writing about “institutionally regulated docile bodies” (cited in Kamler et al., 1994, p. 114). During mathematics instruction Foucault’s notion of “power/knowledge” is mostly bound up in the construction of the learning environment. Regulation, normalisation, and the production of knowledge can be read as forms of discipline in mathematics. This “determines who may act and speak, how, and for whom” (Lee & Taylor, 1996, p. 67). It is worthy of note that Jane felt regulated in mathematics, but not in German or English classes. In these subject classes, she felt able to communicate with both her peers and the teacher in a discussion mode.

In Jane’s mathematics classrooms, the teacher was seen to be a transmitter of information who *knew* all of the mathematics knowledge, and the students were passive recipients of that knowledge. In contrast, she saw her German and English classes as the opposite where she was fully involved in collaboration with her peers and the teacher, all learning together. Jane reports her own experiences in arts subjects as being actively involved, and in mathematics as being passively involved. This binary is in opposition to the socially perceived view of mathematics as a masculine subject and the arts as being feminine if girls are active (a male gendered term) in the arts and passive (a female gendered term) in mathematics. It could also be considered ironic that in a masculine subject students are constructed as passive, which is considered a feminine position.

“Classics is a Better Subject than Calculus”

Mathematically able females are somewhat more likely than their male peers to have multiple talents and that whether or not mathematically talented girls chose to study mathematics further was related less to their conceptions of their mathematical abilities and more to their conceptions of their range of abilities. (Hollinger’s (1985) study reported in Willis, 1989, p. 29)

Jane fits Willis’ (1989) view of a talented girl. Willis argues that girls who “perceive themselves to have a range of options are less likely to choose mathematics” (p. 30). She suggests that many “egocentric analyses” of girls’ lower participation in mathematics often assume that if you happen to be able to do mathematics, and you know you can and that it ‘opens doors’ for the future, then you will automatically choose to continue with mathematical studies. Jane, like many other mathematically able girls, chose not to continue with mathematics but to go through one of the many other ‘open doors’ available to her. Jane was quite passionate about her desire to continue with arts subjects as shown

by her comment “I *love* German...and I *love* absolutely *love* the theatre. I mean I like arts subjects; I’ve looked at, you know, all other things at University, but well ... why would I do anything else because my interest is just arts subjects (Jane, my emphasis).” Talking to Jane now, she seems to have no regrets about her choice to discontinue her mathematics studies and she believes abandoning mathematics will not inhibit her future options. In fact, Jane was adamant that if a future job required more mathematics study then the job was not for her. As a girl, Jane, slots nicely into those who, feeling they “have a choice and [are] able to decide not to study mathematics, do so decide!” (Willis, 1989, p. 32).

There were other events which surrounded Jane’s decision to discontinue with mathematics including the influence or lack of influence of ‘significant others’ in her life. Davies (1991) discusses the post-structuralist concept of agency where there is no such thing as an “essential self” (p. 42) as an individual can only take up the subject positions made available to them in the dominant discourses of their being. Often choices are made *for* the individual and they may be unaware of this happening. Davies (1991) calls these choices “forced choices” (p. 43).

The subject’s positioning within particular discourses makes the “chosen” line of action the only possible action, not because there are no other lines of action but because one has been subjectively constituted through one’s placement within that discourse to *want* that line of action. (Davies, 1991, p. 43, emphasis in original)

In my opinion, Jane does seem to believe that her decision to not study mathematics further was solely her *own* choice. However, as the excerpts below demonstrate, she has been constituted in the discourse of ‘classics as being a far better option than calculus’ by the actions/voices/opinions of significant others in her life.

Even up until the day before seventh form started, I was trying to figure out, well should I do calculus or should I do classics. And, just after talking to pretty much every single person I spoke to had said “calculus is a waste of time, just don’t do it” and “classics is great” and everyone I talked to who had done classics had enjoyed it so much.

[My parents] pretty much just said, “do what you choose, do what you’re going to be [happy with]”, because, I mean they knew I didn’t like maths.

My cousin did calculus and she went on to do health sci...and she just said calculus is ridiculous... (Jane)

Fox and Soller (2001) believe that “support and encouragement from parents were crucial for girls” (p. 14) choosing higher-level mathematics courses. Jane was more influenced by the comments of her peers than her teachers and her parents were not actively involved in her decisions. This may be because Jane had, in her mind, already decided to opt out of calculus and wanted support so she looked for advice from those she knew would uphold her decision. This support to withdraw from calculus would not have been forthcoming from her teachers, who saw her as having plenty of mathematical potential.

The subject position made available to Jane was constructed through the views and voices of her peers, her brother, and her cousin. That she chose not to allow the discursive construction of any alternative options further implicates her as being discursively produced by *others*.

Conclusion

Given the nature of much that is offered in school mathematics, many girls must consider that we are asking them to sacrifice their present to their future; that they substitute subjects they value and

enjoy for subjects they value and enjoy less, and replace their own set of values in terms of the relevance of the curriculum to their lives with ours. (Willis, 1990, p. 207)

Jane, a mathematically-able girl, has shown, in my 'readings' of her interview, that she saw no advantage for her prospective future by undertaking a higher-level mathematics course. Jane could and would have done advanced mathematics if she had considered it would have benefited her personally, but her statement "it didn't improve me, I thought I wasn't getting anywhere, it didn't take me anywhere" really does sum up her attitude to mathematics throughout the interview.

Jane *hated* mathematics and my interpretation of her use of the word *hate* pointed to her reflections on how the curriculum was delivered in mathematics. She saw *doing* mathematics as a process whereby students follow the *rules* of mathematics to wade through problems all about numbers and get the correct answer. Jane also described mathematics as irrelevant as she failed to see any context-relevance in the subject, that is, nothing of real-life interest to keep her connected and thinking.

Jane preferred the methods of teaching that she experienced in her arts subjects. She liked to really *get into* a subject, she enjoyed discussion, and she appreciated her teachers being fully involved on her level in the classroom. For Jane, mathematics class was a regimented, regulated, and ritualistic environment. This type of environment did not allow her to grow as a person.

Jane chose classics over calculus. Her decision was based on advice from peers and similar-aged relatives. For Jane, these *others* were *significant* in confirming her choice of classics. Her talent in all subjects allowed her a perceived freedom to access whichever path she chose and the voices of *others* guided her in the direction of classics.

For me, Jane not continuing with calculus seems "such a waste of talent". A mathematically capable girl choosing to discontinue mathematics begs the questions:

"How have mathematics teachers contributed to this happening?"

"How can we change the teaching and learning of mathematics to make it more accessible?"

"What must be done to ensure that *all* girls see further mathematical study as a viable, friendly, engaging experience?"

"How can we open doors to a future where girls' mathematical skills can be appreciated and fully utilised?"

When girls "become intimidated by the 'authority' of mathematics" (Willis, 1990, p. 202), they do not perceive any intrinsic value in studying mathematics at higher levels.

For many who are concerned with equal opportunity today's problem is that girls limit their post-school options by choosing not to study certain mathematics courses; for others it is the waste of talent implied when girls, as a group, 'underparticipate' in mathematics. In either case, the solution is seen to be to require that more girls be encouraged to undertake more mathematics. (Willis, 1989, p. 3)

I see encouraging girls into advanced mathematics as a noble goal. However, 'fixing' mathematics so that girls are not alienated by its current pedagogical structure is, in my opinion, a much more important and critical goal to be addressed. Until girls *enjoy* mathematics, I believe that we will find it difficult to justify to them that it is socially relevant and a way of improving their quality of life.

Acknowledgements

I would like to thank Dr Karen Nairn, Faculty of Education and Professor Derek Holton, Department of Mathematics, University of Otago, Dunedin, New Zealand.

References

- Alice, L. (2003). Power, experience, and process in feminist research. In: C. Davidson & M. Tolich (Eds.), *Social Science Research in New Zealand* (2nd ed., pp. 62-68). Auckland: Pearson Education.
- Alton-Lee, A., & Praat, A. (2000). Mathematics. In: A. Alton-Lee & A. Praat *Explaining and addressing gender differences in the New Zealand compulsory school sector. [Chapter 5]* (pp. 107-147). Wellington: Ministry of Education.
- Damarin, S. K. (1995). Gender and mathematics from a feminist standpoint. In: W. G. Secada, E. Fennema & L. B. Adajian (Eds.), *New directions for equity in mathematics education*. (pp. 242-257). Cambridge, New York: Cambridge University Press.
- Davies, B. (1991). The concept of agency: A feminist poststructuralist analysis. *Social Analysis*, 30, 42-53.
- Davies, B. (1993). *Shards of glass: Children reading and writing beyond gender identities*. Sydney: Allen and Unwin.
- Fennema, E., & Meyer, M. R. (1989). Gender, equity and mathematics. In: W. G. Secada (Ed.), *Equity in education*. (pp. 146-157). London: Falmer Press.
- Forgasz, H., & Leder, G. C. (1996). Mathematics classrooms, gender and affect. *Mathematics Education Research Journal*, 8(1), 153-173.
- Fox, L. H., & Soller, J. F. (2001). Psychosocial dimensions of gender differences in mathematics. In: J. E. Jacobs, J. R. Becker & G. F. Gilmer (Eds.), *Changing the faces of mathematics: Perspectives on gender*. (pp. 9-23). Reston, Virginia: National Council of Teachers of Mathematics.
- Haynes, M. (1994). *Gender equity in society and in mathematics education in New Zealand*. (Paper presented at NZARE December 1994). Auckland: Auckland College of Education.
- Holton, D., A. Ahmed, et al. (2001). On the importance of mathematical play. *International Journal of Mathematical Education in Science and Technology*, 32(3), 401-415.
- Holton, D., J. Anderson, et al. (1999). "Mathematical problem solving in support of the curriculum?" *International Journal of Mathematical Education in Science and Technology*, 30(3), 351-371.
- Kamler, B., Maclean, R., Reid, J., & Simpson, A. (1994). *Shaping up Nicely. The Formation of Schoolgirls and Schoolboys in the First Month of School*. A Report to the Gender Equity and Curriculum Reform Project, Department of Employment, Education and Training. Canberra: Australian Government Publishing Service.
- Kenway, J., Willis, S., Blackmore, J., & Rennie, L. (1998). *Answering back: Girls, boys and feminism in schools*. Sydney: Routledge.
- Lee, A., & Taylor, E. (1996). The dilemma of obedience: A feminist perspective on the making of engineers. *Educational Philosophy and Theory*, 28(1), 57-75.
- Mendick, H. (2003). Choosing maths/doing gender: A look at why there are more boys than girls in advanced mathematics classes in England. In: L. Burton (Ed.), *Which way social justice in mathematics education?* (pp. 169-187). Westport: Praeger.
- Sells, L. W. (1978). Mathematics - a critical filter. *The Science Teacher*, 45, 28-29.
- Waldene, R., & Walkerdine, V. (1986). Characteristics, views and relationships in the classroom. In: L. Burton (Ed.), *Girls into maths can go*. (pp. 122-146). London: Holt, Rinehart and Winston.
- Walkerdine, V. (1990). *Schoolgirl fictions: Schooling for girls*. London, New York: Verso.
- Walshaw, M. A. (2001). A Foucauldian gaze on gender research: What do you do when confronted with the tunnel at the end of the light? *Journal for Research in Mathematics Education*, 32(5), 471-493.
- Willis, S. (1989). *Real girls don't do maths: Gender and the construction of privilege*. Geelong, Victoria, Australia: Deakin University.
- Willis, S. (1990). The power of mathematics for whom? In J. Kenway & S. Willis (Eds.), *Hearts and minds: Self-esteem and the schooling of girls*. (pp. 191-211). London: The Falmer Press.