Who a Student Sits Near to in Maths: Tension between Social and Mathematical Identities

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This paper reports on an investigation into the seating arrangements of a mathematics classroom, and the effect of these arrangements on students' affect and learning. A seating arrangement is successful depending on whom a student is sitting near. Students need to be surrounded by others whose behaviour does not disrupt or distract them, and who they like and feel comfortable with. The study suggests that adolescent students do not have the power or control to stop other people's behaviour affecting them, nor do they have the power to sit where they want to ensure their academic identities are being fulfilled. By instituting seating plans, teachers can ensure students' academic and social needs are met therefore improving student learning through positive discussion and help-seeking.

Introduction

At all levels of schooling, mathematics classrooms are social places where students pursue both social and academic goals. This social environment is likely however to be particularly important to young adolescents, 13-15 years. Not only do they have increasingly strong social needs (Ryan, 2001), but they are also self-conscious and sensitive as "more so than at other ages, young adolescents doubt their abilities to succeed … question the value of doing their schoolwork, and decrease their effort towards academics" (Ryan & Patrick, 2001, p. 439).

The relationships between students impact on the adolescent social environment. This paper describes one contextual dimension of these relationships, the effect of seating arrangement on students' mathematical identities and affective responses. It begins by outlining previous research surrounding interactions between students in close proximity to each other, presents the theoretical framework used in the investigation, and then describes the effect of seating arrangements in the context of a mathematics classroom.

Seating Arrangements

Sullivan, Tobias, and McDonough (2006) surveyed and interviewed 50 students, aged 13, investigating students' perceptions of success in mathematics. One, unanticipated finding was that a significant minority of students suggested "students deliberately do not try in order to comply with a particular classroom culture or avoid the perception of trying due to threats of sanctions by peers" (p. 96). In later research (Sullivan & McDonough, 2007) students further suggested how sitting in close proximity with another may affect them. "Some people who are sitting next to smart people felt like being smart and doing it, but sometimes there's a dumb group and they don't want to look like a nerd in front of everyone" (Sullivan & McDonough, 2007, p. 703).

Students sit near each other in the mathematics classroom according to the desk arrangement, teacher direction, and social norms. It is probable that many adolescent students, if allowed, choose to sit with friends because of the high value placed on friendship in adolescence (Crosnoe, Cavanagh, & Elder Jr., 2003). Whom the student sits next to exposes them to a number of influencing beliefs and behaviours allowing a context to emerge with regards to the "norms, values, and standards that concern academic motivation and achievement" (Ryan, 2001). Crosnoe et al (2003) highlight that research into adolescence is often focussed on the negative influence of friends, whereas research into other stages of life view friendships as a social resource. They, therefore, introduce the concept of adolescent friendship as *social capital* which they define as "the resources accessed through relationship ties" (p. 333). When two individuals form a relationship, they are gaining access to resources such as their values, social support, knowledge and skills relating to schooling and academic subjects, and emotional support for the meeting of challenges.

Affect and Identity

Not only is learning fundamentally social, it is an *emotional practice* and studying the affective domain, which includes constructs such as beliefs, attitudes, emotions and feelings, values, confidence, anxiety, and motivation, is important. It is difficult to assume a direct link between positive affect and mathematical achievement (Leder & Forgasz, 2006), or even to know the direction of influence between them (Zan, Brown, Evans, & Hannula, 2006). Nonetheless, affect has been linked to declining participation in mathematics (Norton & Irvin, 2007), and affective processes are now understood to be an integral part of problem solving and learning (Op 'T Eynde, De Corte, & Verschaffel, 2006). The domain has unique methodological issues and limitations (Leder & Forgasz, 2006, p. 404), and developments in educational, psychological and social psychological research have encouraged a variety of new theoretical perspectives (Hannula, Evans, Philippou, & Zan, 2004). Students' socio-cultural backgrounds are a focus, and there is interest in the notion of identity. Sfard and Prusak (2005) equate identities to reifying, endorsable, and significant stories about a person. People have a number of stories told about them by a variety of people, including themselves. Each person has multiple identities, split into two sets of *actual identities* (stories about the actual state of affairs) and *designated identities* (a state of affairs expected to be the case). Sfard and Prusak suggest that when there is a perceived and persistent gap between these sets, there is likely to be a sense of unhappiness in that person. In this research, Sfard and Prusak's notion of identity has been used and the existence of a gap between a student's actual and designated identity signalled by their affective responses (positive or negative).

Methodology

To capture reifying, endorsable, and significant stories about the emotions and feelings of students is difficult, especially for adolescents in the complex environment of a mathematics class. The research methodology must have length, breadth, and depth. It needs to be longitudinal because students become less resilient to negative emotions and feelings about mathematics as they move through school (McLeod, 1992), and therefore their dynamic identities need to be captured over time. The research needs breadth through the use of a broad range of rich data collection methods, with a range of data sources and identity narrators. Depth is gained through the richness of the analysis that inductive data collection allows. This research has been informed by a grounded theory approach, which is the derivation of theory from data "systematically gathered and analysed through the research process" (Strauss & Corbin, 1998, p. 12). Decisions made about each stage of the data collection process are grounded in the data itself and the emerging categories and themes (Strauss & Corbin, 1998). Supporting the grounded theory approach, the analysis software NVivo helped to manage and analyse the large quantity of qualitative data.

Three strands of data were collected. These were students' mathematical identities that relate to seating arrangements, related instances of affective responses, and descriptions of the mathematical context. Data were collected over two years and included classroom observations, teacher interviews and feedback, student interviews and written responses (questionnaires, autobiographies, metaphors, drawings, personal journey graphs, journals, evaluations), parent written responses, and school documents. Students were also asked to comment on seating plans specifically and, more generally, on how who they sat next to affected their feelings and learning. For every observed lesson, a plan of the classroom was drawn and each student's seating noted.

Sfard and Prusak's structure was used to differentiate between multiple identities of an individual; for example, a story about a student told to the researcher by a teacher in 2007 would be identified by ($_{\text{Teacher}}$ Student$_{\text{ResearcherInterview2007}}$), situating each story in both time and space. In this paper, the recipient has been assumed to be the researcher. The identities were analysed for indicators of affect using as a guide the work of Evans, Morgan, and Tsatasroni (2006). Indicators sought included verbal expressions of feelings, body language, physiological reactions, gesturing, or resistance to authority figures. A seating arrangement in this research was deemed successful for a student when their mathematical identities and related affective responses were positive.

Describing the Context

The research was conducted in an urban coeducational school in New Zealand. The 31 students involved in the study were New Zealanders of European descent, and, in 2006, were together in a Year 10 class (aged 13-14 years) for their core subjects Mathematics, English, Science and Social Studies. In 2007, the students were split into seven different mathematics classes.

During the first 10 weeks of 2006, the research students were seated in pairs in an alphabetic seating plan in their mathematics class. Seating plans are not unusual across subjects or schools in New Zealand, especially in the first term of the year. They enable the teacher to learn the students' names and separate social groups, thus contributing to a perceived improvement in classroom discipline. For the rest of the year, the students remained in pairs and chose where to sit, except during a research intervention when they were seated in groups. In 2007, the students were in self-choice seating in pairs or groups, depending on desk arrangement.

Results and Discussion

In this research, students entered their mathematics classroom and either sat according to a prescribed seating plan or sat where they wanted. During the lesson, students interacted at some level with all the students in the classroom, but they were mainly aware of and interacted with those students immediately sitting next to them *and* those in close promixity. In this research, when the desks were arranged in pairs for example, roughly one third of the students were against a wall and many of them leant against it, changing their orientation 90° and giving them more frequent interactions with students in front and behind them. This research suggests that who a student sat *near* was related to how they felt about the mathematics they were doing, the amount of mathematics they did, and on their mathematical discussions. Regardless of whether students were in self-choice seating or in a seating plan, seating arrangements were successful when two conditions operated; *other students' behaviour did not negatively affect the student* and the student *liked and felt comfortable with the others they were sitting with.* The following examples provide evidence for these conditions, and then other aspects of seating arrangments are discussed.

Other Students' Behaviour

For the students who had strong learning goals and a good work ethic, it was important that the people sitting near were not disruptive. "If I was next to people who didn't concentrate on their work and were loud … it would be hard to concentrate" ($_{\text{Corrina}}\text{Corrina}_{\text{Interview2007}}$). More commonly, for other students, this same behaviour was distracting, rather than disruptive. "Who I sit next to totally affects me. I don't do anything. I find it hard to focus. I get distracted really easily"($_{\text{Moira}}\text{Moira}_{\text{Interview2006}}$). "If I'm sitting next to someone who works hard, I'll work hard. If I'm sitting next to people that don't, I just won't" ($_{\text{Susan}}\text{Susan}_{\text{Interview2006}}$). Students largely felt powerless to control others' behaviour and could only work if a person's behaviour *allowed* it.

Liking and Feeling Comfortable with Others

The second condition is that seating arrangments appear more positive when the student is near someone they like and feel comfortable with. While the amount of mathematics done sometimes increased if the student sat near someone they did not like, mathematical discussion often did not occur, and, in general, if the students were not near to someone they liked, they felt less positive and became bored because of the lack of social talk. "If I'm sitting next to someone who I don't really like then I'll just get on and do the work because I don't really want to talk to them" ($_{\text{Katrina}}\text{Katrina}_{\text{Interview2007}}$).

Importantly, how comfortable a student felt with another student seemed to make a difference to whether or not a student asked for help. "If I sit next to friends … it makes me feel more comfortable because … we help each other. If I sit beside someone I don't like or don't know … I don't feel comfortable asking them" ($_{\text{Bridget}}\text{Bridget}_{\text{Interview2006}}$). Students at a similar level mathematically were noticeably more comfortable using words like "discuss" and "figure it out" rather than "help" and "ask". Students at a lower level mathematically to their neighbours were often uncomfortable.

> If I sat next to Colin I would feel stupid ... he's really smart ($_{\text{Cheryl}}\text{Colin}_{\text{Interview2006}}$).

> I know [Angela] can hear [Jason and I discussing] ... and I can hear [her] thinking you're supposed to be bright ... I avoid asking her for help because I don't want her to know that I need it … sitting next to a brainbox makes me feel intimidated and stupid ($_{\text{Robyn}}\text{Angela}_{\text{Interview2006}}$).

Other students would not necessarily feel negative pressure, but would be aware of the different level of perceived mathematical ability. "You sort of look over every now and then to see what they're up to" ($_{\text{Connor}}\text{Connor}_{\text{Interview2006}}$). Sitting near to a stronger mathematician can be positive. "I always ask Katrina

because she knows how to do maths. I just ask her … and ... she helps me" ($_{Debbie}Katrina_{Interview2006}$).

The stronger mathematicians sometimes enjoyed and saw the benefits in helping others. "Explaining … is beneficial as it helps clarify things" ($_{Katrina}Katrina_{EndofTrig2006}$). The experience of helping others can be negative for regular helpers and the following stories no doubt contribute to the negative affect of the people being helped. Note the "responses" to Robyn and Cheryl's earlier concerns.

> If I'm trying to do my own work and Robyn's like Angela how do you do this and I'm like you'll have to ask the teacher ... I don't have a lot of patience as a person. Sometimes it is a little frustrating when I can see the answer and no one else can ($_{Angela}Angela_{Interview2006}$).

> Cheryl is quite a challenge for me to explain something to 'cause sometimes it's really funny that she doesn't know it and I'm laughing on the inside. I take a deep breath and explain it to her ($_{Colin}Cheryl_{Interview2006}$).

> … other people in the class always ask me what to do because I … get it. I understand. I say I don't get it either ... because then I'd just be helping them the whole time. I don't get paid to help them. The teacher does ($_{Ruth}Ruth_{Interview2007}$).

> They just keep bugging me ($_{Peter}Peter_{Interview2007}$).

Seating Plans and Self-Choice Seating

Most of the students stated they did not like seating plans. Indeed, only two of the students stated an unreserved approval of seating plans. They were perhaps well aware of the *socially correct* answer. In an individual interview, one student who had stated in the written response that she did not like seating plans said " ... if I sit next to someone I don't really like I concentrate more and I'll do my work. I shouldn't be saying that [trails off in a small voice]" ($_{Corinna}Corinna_{Interview2006}$). Even without a seating plan, an adolescent rarely has a choice about where to sit. "We're expected to sit together because we're such good friends" ($_{Robyn}Angela_{Interview2006}$). In interviews, however, the students often confessed that sitting with friends was often difficult because of social disruption, their own distraction, or negative affect due to being at different ability levels. They acknowledged that they may need to sit somewhere else but seemed generally powerless to do so, often admitting they needed the teachers help to prevent others from affecting their learning.

> If I wanted to do my work really well, I wouldn't sit with [my mates]($_{Jason}Jason_{Interview2006}$).

> Where I sit affects me lots. In the last few weeks, [since a discipline meeting about behaviour] I sort of walk into the room and see who's where and if there's a place ($_{Connor}Connor_{Interview2006}$).

> [If I got to choose where I sat all the time] I wouldn't learn anything. That's where seating plans help ($_{Ben}Ben_{Interview2006}$).

Mathematics vs Other Subjects

In both mathematics and English, the students were observed to be affected by who they sat near to in terms of other students' behaviour disrupting and distracting them; to a lesser extent in English, perhaps because a greater proportion of the time was spent in whole-class discussion. The students reported a greater level of discomfort in mathematics due to seating arrangments however and this affected student talk, both in terms of discussion and help, particularly if a students' preferred learning style was to talk about the mathematics.

> In maths, it's a subject where talking helps you ... talking to the people beside you helps ... so if you're silent, you don't learn as much ($_{Jill}Jill_{Interview2006}$).

Compared with other subjects, students seemed to feel more discomfort in maths when they were at a lower level academically than other students. They discussed how they could write a sentence in English and it was not so obviously wrong, while in maths there seemed to be more visual clues to failure, such as calculator use, working, or the incorrect answer.

Working in Cooperative Groups

For several weeks, the students worked in cooperative learning groups of similar ability levels, with some support from someone they liked and felt comfortable with. Attempts were made to separate the disrupters from the distracted and the dependent students from those with less patience when it came to helping people. A large majority of the students found the explicit expectation and license of support and discussion helpful and this increased their comfort when asking for help from each other. "I *worked with* people that weren't super intelligent and could grasp it instantly. That was good for me because sometimes I feel inferior or not smart enough" ($_{Saskia}$Saskia$_{Interview2006}$). The atmosphere of mutual support enabled one student, who had been absent, to catch up from his peers on missed work and more importantly, missed understanding. "It made me feel better as I could ask for help. I would have not caught up the same if I hadn't been in a group" ($_{Connor}$Connor$_{EndofTrig2006}$). Journals, designed to collect students' affective thoughts on a day-to-day basis, were used by many students as another avenue for help from the teacher.

When the group work did not go well, the reasons were similar to those encountered with other seating arrangements. One or two students still felt that they could not get on with their own work because of students asking for help. "I don't really like group work, because then we have to go at the pace of the slowest person" ($_{PeterPeterEndofTrig2006}$). Others were distracted or disrupted by their group members on occasion. Many of the students however stated that what they enjoyed most about the unit was working in groups. It made them feel good about the mathematics they were doing, it was fun, it gave them variety, and they got to know people they previously had not talked to before, despite having been in a class together for nearly two years. This was perhaps because both their social and academic needs were being met.

Accepting and Harnessing the Social

In general, an important focus for this group of students was being social. In Year 10, the students were already settled into social groups, but these changed and mixed as students became more confident with the opposite gender. By Year 11, this had developed and intensified "… there's more like the puberty thing. People more like to have sex and have boyfriends and girlfriends and that's where the focus of school is. You're meant to be focussed on school" ($_{Saskia}$Class$_{Interview2006}$). Both the parents and teachers are certainly aware of it, seeing the social element as negative.

> Moira likes being social and that's more important to her than doing her work. I don't think she's here to learn really ... it doesn't cross her mind at all … talking is more important than doing maths ($_{Teacher1}$Moira$_{Interview2006}$).

> Jason's mother told me at the parent interview I needed to stop him talking because he *shouldn't be* talking and that I should be harder on him and I shouldn't sit him with Ben ... that they'll talk and talk and talk" ($_{Teacher1}$Jason'sMum$_{Interview2006}$).

> Works well in class *despite* social nature ($_{Teacher6}$Ben$_{Feedback2007}$).

This causes tension for many of the students because of conflict between their designated social and academic identities (what they should or want to be achieving both academically and socially) and the gap between their designated and actual academic identities (what they are achieving academically). Despite this tension, a social element is necessary. Talking is something that they "have to do" and they still "need social time".

Conclusions and Recommendations

In summary, regardless of whether the students were in seating plans or in self-choice seating, how they felt about and learnt mathematics was related to who they sat near to in the mathematics classroom. The importance of positive social interactions in a mathematics class is well established. What is significant in this research is that, because of their stage in life, these students were, in general, not able to control the behaviour of others, and were not able to choose where to sit to fulfill their designated mathematical identities because of their strong social needs. This suggests that mathematics teachers may need to account for this by accepting the social needs of adolescents, instead viewing aspects of them as social capital to be harnessed. The relationships between students, in particular, are a resource, and accessing this resource can lead to better mathematical learning through mathematical discussion, emotional support, and the sharing of knowledge and skills.

To harness this resource, and to account for the students' powerlessness to control their own strong social identities, the teacher can ensure the conditions for positive seating arrangements are met every day through sensitive seating plans. Teachers might do this by getting to know the students better in terms of both their social and mathematical identities and the students could be seated in pairs with the pairs in front or behind ready to turn to form a larger cooperative learning group. The teacher also may need to give explicit messages regarding students' interactions with their classmates such as: students are valuable resources to work with to increase learning; and a students' behaviour affects others. Sullivan and McDonough (2007) usefully suggest that teachers seek responses from individual students about negative influences of peers, and use these responses as a basis for class discussion, story-writing, or role play.

By ensuring the seating arrangements are positive both academically and socially, the students are more willing and able to work towards fulfilling their designated mathematical identities.

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