Influences of friendship groupings on motivation for mathematics learning in secondary classrooms

Debra Deacon and Julie-Ann Edwards

University of Southampton, Southampton Education School

This small scale study examines the influence of friendship groupings in key stage 4 mathematics classrooms on students' motivations to engage with mathematics. We use evidence from questionnaires and individual interviews to describe the motivational factors identified in two key stage 4 mathematics classes, and the influence of environmental factors on students' understandings of their motivation to learn and their knowledge construction. Findings confirm the multi-faceted nature of motivation and suggest some gender differences in interpreting classroom relationships and differences between groups of close friends and those of friends by association. Our findings are interpreted in the context of mathematics classrooms organised by student levels of attainment.

Keywords: Friendship groups; motivation for learning mathematics.

Introduction

Friendship groupings in mathematics classrooms are a rarely researched phenomenon, yet they are often used as a pedagogical tool in mathematics classrooms, either briefly for a few minutes discussion or as a more sustained means of learning. This study aimed to explore how the use of pedagogical strategies, such as regular and sustained group work, influenced the perceptions students have about doing mathematics. Hamm and Faircloth (2005) propose that motivation is subject specific. The focus on students aged 14 to 16, working towards final schooling examinations, is therefore a key phase of schooling to investigate, since mathematics represents one of only a few subjects students are required to study until ending compulsory education.

Ollerton (2003) claims that mathematics, unlike other subjects, seems to cause students significant anxiety. The generation of such strong emotions in students supports the need for greater understanding about motivation within mathematics. In measuring the attitudes students ascribe to different things, Hannula (2002) suggests that it is often difficult to connect what is being seen outwardly with the elements that are not seen. This reflects Pintrich and Schunk's (1996) arguments that motivation is a process and that only the product is what is seen. Hannula also observes that only when emotions are sufficiently powerful are they outwardly visible. Investigating the motivational beliefs students express concerning work in mathematics is important for school mathematics where emotions such as frustration, boredom and anxiety can be seen in outward behaviours. The intention is to identify processes at work leading to outcomes seen by teachers.

Goos, Galbraith and Renshaw (2002) claim that the research undertaken on small group arrangements within mathematics have largely focussed on outcomes. These authors emphasise the need for research examining how students think and learn as they interact with peers in small groups, asserting the need for examination of the processes at work. Whilst much research exists concerning both theories of

motivation and the influence of peers on learning, there is less evidence regarding how these areas interact, specifically within mathematics.

Theories of motivation

Lord (2005) argues that several elements form learner motivation. He claims motivation is unique to each individual, can be expressed in a variety of ways, and is aimed towards an end point or a goal. How a student engages with learning is recognised by Brown as reflecting their knowledge of themselves as a learner and the learning process, describing this as "metacognitive knowledge" (1988, 312). For learning to be truly effective, Brown argues that participants need to have reasons for learning and ownership of knowledge. Ryan and Deci (2000) are adamant that, too frequently, motivation is defined as a single entity, claiming that individuals not only experience different kinds of motivation but how much motivation is experienced depends on situations and individuals. As Pintrich and Schunk (1996) have recognised, only outcomes of motivation are seen in students' behaviour(s). Therefore, labelling motivation as a single aspect underestimates the varying emotions students experience when completing different tasks.

The most basic distinction between the types of motivation individuals experience, as identified by Ryan and Deci (2000, 55) is the contrast between intrinsic motivation and extrinsic motivation: "intrinsic motivation refers to doing something because it is inherently interesting or enjoyable and extrinsic motivation refers to doing something because it leads to a separable outcome". Grouws and Lembke (1996) recognise that true motivation is intrinsic, coming from within individuals. They also acknowledge the significance of the classroom culture in establishing intrinsic motivation.

Ryan and Deci present a continuum of motivation beginning with amotivation, the lack of motivation, through four stages of extrinsic motivation to intrinsic motivation. The distinctions between the different stages of extrinsic motivation represent the degree of control students experience, moving from amotivation, where individuals feel that control is impersonal, to intrinsic where control is internal and self-directed. The significance of the different levels of extrinsic motivation demonstrates that, whilst students may value an activity for its own sake, the enjoyment of the task, in and of itself, may not be the goal being worked towards. A student may value a task for its own sake but this is because it allows them to progress to something else, for example, a college course, requiring a particular grade. This reflects the notion of tasks leading to external rewards, hence having elements of extrinsic motivation, although the individual is controlling the effort personally.

Motivation and friendship

Research by Berndt (1992, 1999) examines the influence friendships during adolescence have on adjustment in and engagement with schooling. The 1992 study explored the impact adolescent friendships have on affective relationships with school. Berndt identifies two elements that influence adolescents' friendships: the characteristics of the individual friends and the quality of the friendship. Therefore, how each individual is placed within their friendship groups will alter the influence they have. Berndt's 1999 study recognises that areas such as achievement and motivation may not be common features of conversations amongst adolescents, as participants in Ryan's (2000) study described. Berndt also acknowledges the role of

trust within friendships and how its presence allows friends to share experiences, emotions and rely on one another. It is possible, therefore, that relationships built on trust may be evident within mathematics classrooms between peers who are not friends.

If students are able to engage in relationships where trust exists, whether these be friendships or not, the benefits may be greater than students working in isolation. Furthermore, if mathematics classes are organised around attainment levels, as is frequently found in English classrooms, it is likely that each class will have its own identity generated through the participants within. The more consistent these classes are over time, the stronger this identity will be. For students studying mathematics at key stage 4, their classes are likely to have been established over several years. It is likely that students are aware of those they can trust within this context. However, if classes are arranged using attainment levels, the existence of friendships within these groups may not be utilised in the most beneficial way. Participants in Nardi and Steward's (2003) study reflect this situation, highlighting issues of isolation and feelings that mathematics is not presented as a subject that allows opportunities to work with friends.

More recently, a large-scale quantitative study by Nelson and deBacker (2008), examined 253 middle school students' assessments of peer classroom climate, beliefs relating to a best friend's influence on achievement, achievement goals and self-efficacy. They found that positive outcomes relating to achievement were reflected by those students reporting a perception of being valued and respected by peers. As in Berndt's (1992) study, these authors also found that the quality of friendship and the relationship of best friends with academic achievement correlated directly with students' motivation for learning.

Context for the study

The study was undertaken in a large comprehensive 11-16 secondary school in southern England with approximately 1700 students on roll. The school is successful, with mathematics examination results at the end of key stage 4 significantly above the national average. Within mathematics, students are taught in classes arranged by attainment level, determined by testing shortly after students enter the school. Each year group comprises 11 or 12 mathematics classes, with the mathematics classes studied here being in the middle of these attainment levels in year 10. The year group represented a gender imbalance, of approximately two thirds males to one third females. This imbalance was reflected in the classes studied.

Research instruments

A questionnaire was designed to gather students' opinions about elements of their motivation, the influence of their peers including the reciprocal nature of these relationships and the use of peer groups as a tool within the classroom. The questionnaire items were allocated to a 'strand', such as individual motivation, influence of environment/classroom culture, and influence of peers on motivation/knowledge construction/accessing help. It comprised fifteen statements in which students were asked to express their level of agreement using a 5-point Likert-style scale. The middle value was given the description "uncertain" rather than "neutral" to allow students to use this if they were unsure about their view on the

statement rather than if they did not hold a view. Students were offered the opportunity to participate in the interviews that formed the second part of this study.

The interview schedule was a semi-structured format, based around five broad questions, where the questions and plan for the interview were the same with each participant, but the ordering and specific follow-up questions used were flexible to probe particular issues identified in responses. The questions were structured to identify general elements of students' work in mathematics, their motivation(s), their interpretations of the relationships with their peers, the overlapping elements of motivation and peers, including the reciprocal nature of being a peer to others. Although not identified in the interview schedule, reference was made to the task students had completed in groups prior to completing the questionnaire.

Findings – friendships

Findings from the questionnaire were analysed on the range of scale indicators from the Likert scale, since such a small sample does not warrant the use of percentages. Here, we present those outcomes which focus solely on the friendship categories, self-identified by students as *All friends* or *Some friends* on the questionnaire.

Category	Questionnaire item	All friends		Some friends	
		Range	Scale	Range	Scale
Influence of peers on motivation	5	2	3 – 5	4	1 – 5
Influence of peers on motivation	6	1	2 – 3	3	1 – 4
Influence of peers on motivation	7	2	2 – 4	2	2 – 4
Influence of peers on motivation	10	3	2 – 5	3	2 – 5
Influence of peers/knowledge construction	8	1	4 – 5	3	2 – 5
Influence of peers/knowledge construction	9	1	3 – 4	2	2 – 4
Influence of peers/accessing help	11	2	3 – 5	3	2 – 5
Peer contexts/ Reciprocal help	12	1	3 – 4	4	1 – 5
Peer contexts/ Reciprocal help	13	1	3 – 4	3	1 – 4
Peer contexts/ Reciprocal help	15	2	2 – 4	2	2 – 4
Individual motivation	1	2	2 – 4	2	3 – 5
Individual motivation	14	2	1 – 3	1	2 – 3

Figure 1: Comparison of ranges between *All friends* and *Some friends* responses for twelve questionnaire statements

This comparison of ranges indicates that the *All friends* subgroup has greater consistency in agreement between different statement categories and in responses to items with the same statement categories. This is shown through both influence of peers/knowledge construction and peer contexts/reciprocal help having a range of 1 for two statements each. The consistent responses to the statements in these categories highlight the learning enhancements that can occur in groups where participants are working with peers who are all their friends. The more varied ranges for the corresponding statements in the *Some friends* subgroup indicates that, whilst students value the contribution their peers are able to make, this is not as strongly held a view as in the *All friends* subgroup.

The findings from the interviews indicate that students working in mathematics at key stage 4 see their peers as a valued resource for learning. Students emphasised the contribution the classroom environment makes and how it influences changes within their motivation. They expressed a strong level of agreement over the benefits of being able to discuss new concepts with their peers. The interview responses also highlight how the physical arrangement of groups allows for greater flexibility and ease of accessing help from peers. Interviewees indicated a preference for gaining help from peers, rather than the teacher, due to understanding peers better and not appearing foolish through publicly requesting help.

Males and females expressed different views on the role of peers within their learning. In particular, females were less confident about the support they are able to provide towards motivating their peers, despite indicating the advantages having peers to work with provides for them. In general, too, female responses to the questionnaire statements are more consistent than male responses.

Using the category distinctions of all friends and some friends, in groups where participants considered all members to be their friends, the responses are more consistent. A greater degree of individual motivation is expressed in peer groups where participants considered only some group members to be their friends, therefore highlighting the potential benefit friendships can bring to mathematics classrooms. Evidence from the interviewees' responses shows that participants' motivation in mathematics is changeable, not necessarily linking to elements of the classroom culture, but rather to external factors, such as time of the day or week, or experiences in other lessons.

Discussion

The strongest links to previous research are shown in evidence relating to the significance of the classroom culture and the role this has in student motivation. The questionnaire and interview responses indicate that students place considerable emphasis on the classroom culture as a resource for motivation within mathematics. However, whilst students recognise the influence the environment can have on their motivation, the personal element to motivation, described by Lord (2005) is also acknowledged. Female responses indicate less clarity about the sources of motivation. Whilst there is a strong indication that motivation can change and depends on environmental factors, there is less certainty expressed about the sources of motivation. This could indicate that females have variable motivational trends. Evidence suggests that students display some form of intrinsic motivation for mathematics. However, questionnaire responses also indicate that this is more likely to be a form of extrinsic motivation, with a greater level of internal control, as defined by Ryan and Deci's (2000) continuum of motivation.

The findings from this research both reflect and support a number of different areas of evidence from the literature, whilst challenging others. It is clear from this study that motivation for mathematics is not a single aspect, supporting Valås and Søvik's (1993) claim. This is especially shown through the interview responses which broadly reflect extrinsic motivation with elements of internal control. Additionally, this study supports Ryan and Deci's (2000) appeal not to consider motivation as either present or not, but as a continuum.

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