CLASSROOM GROUPINGS FOR MATHEMATICS LEARNING: THE IMPACT OF FRIENDSHIPS ON MOTIVATION

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The importance of small groups as a pedagogical tool in mathematics classrooms is widely researched and acknowledged to be a successful means of engaging students in mathematics learning. This small scale study examines the influence of close friendships, and friendships by association, in mathematics classrooms of 14-15 year olds on students' motivations to engage with mathematics. We use evidence from questionnaires and individual interviews to describe the motivational factors identified in two classes of students. Findings confirm the multi-faceted nature of motivation in interpreting classroom relationships and the differences in working relationships between groups of close friends and those of friends by association.

INTRODUCTION

The rationale for using talk in small groups as a pedagogic strategy in classrooms is well established. In a review of small group talk, Good, Mulryan and McCaslin (1992) describe "clear and compelling evidence that small group work can facilitate student achievement as well as more favourable attitudes towards peers and subject matter" (p. 167). While much research has been undertaken on the composition of small groups in classrooms in relation to gender, levels of mathematical attainment and age (see, for example, Bennett & Dunne 1991), there is little research on group composition by definition of levels of friendship. According to Slavin (1989), for effective collaborative learning, there must be *group goals* and *individual accountability*, but little is known about how social relationships impact on these factors. A review of group processes in the classroom by Webb and Palincsar (1996) identifies two individual actions associated with increased learning; 1) giving elaborated explanations to other group members, and 2) applying explanations (either received or self-generated) to solve problems or perform tasks (p. 854). Yet there is little research on how these group processes are affected by working with friends.

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 over longer periods of time. 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. Since Hamm and Faircloth (2005) propose that motivation is subject-specific, students aged 14 to 15, working towards final mathematics

examinations, are therefore in a key phase of schooling for investigation, given that mathematics represents one of only a few subjects students are required to study in England until the end of compulsory education.

Goos, Galbraith and Renshaw (2002) assert that, since the research undertaken on small group arrangements within mathematics have largely focussed on outcomes, there is a need for research examining how students think and learn as they interact with peers in small groups, emphasising the need for an exploration 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 friendship groups in mathematics classrooms.

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 knowledge of themselves as a learner and the learning process, describing this as "metacognitive knowledge" (1988, p. 312). This reflects Lord's definition of motivation, that learning and motivation are both individual at the initial level. 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 Hannula (2002) has 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 mathematical tasks. In analysing data in our study, we utilise Ryan and Deci's model of a continuum of motivation.

The most basic distinction between the types of motivation individuals experience, as identified by Ryan and Deci (2000, p. 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".

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, perhaps, to higher education, requiring a particular examination 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.

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. This brings into focus questions concerning whether students generate motivation for mathematics from within themselves or through their classroom experiences.

Forman and McPhail (1993) take a sociocultural approach to their study of collaborative groups in classrooms. From this perspective, rather than locating the source of individual motivation and understanding within or between individuals, they locate it in sociocultural practices in which children have the opportunity "to observe and participate in essential economic, religious, legal, political, instructional, or recreational activities" (p. 218). Through guided participation, "children internalize or appropriate their affective, social, and intellectual significance" (p. 218). Findings by Skaalvik and Valås (2010) contradict Forman and McPhail in that these former authors argue that both self-concept and motivation develop with age and are closely connected to personal achievement. From very different viewpoints, these studies raise questions about the effect that friendships are likely to have on motivation.

In measuring 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. Ollerton (2003) claims that mathematics, unlike other subjects, seems to cause students significant anxiety. Investigating the motivational beliefs students express concerning the ways in which they work in mathematics is important where emotions such as frustration, boredom and anxiety can be observed in outward behaviours. A study of friendship groupings is likely to explore both emotional and motivational relationships. One of the intentions of this study was to identify processes at work leading to the outcomes seen by teachers.

MOTIVATION AND FRIENDSHIP

Research by Berndt (1992, 1999) examines the influence that friendships during adolescence have on adjustment in and engagement with schooling. His 1992 study explored the impact adolescent friendships have on affective relationships with school. He 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 also indicated. 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 are close friendships or friendships by association, the benefits may be greater than students working in isolation. Furthermore, if mathematics classes are organised around attainment levels, as is usually found in English classrooms, it is likely that each class will generate its own set of friendship relationships, dependent on the particular students within each class. Evidence that the more consistent these classes are over time, the stronger these structures become (Edwards, 2003) means that students in classes established over several years are likely to be 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. Such a claim is highlighted by participants in Nardi and Steward's (2003) study in their descriptions of feelings of isolation and the sense 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.

SETTING FOR THE STUDY

This study was undertaken in a large comprehensive secondary school in southern England with approximately 1700 students, aged 11 to 16. The school is deemed, by national inspection processes, to be successful, with mathematics examination results, at age 16, significantly above the national average. Within mathematics, students are taught in classes arranged by attainment level, determined by testing shortly after students transfer to the school at age 11. Each year group comprises 11 or 12 mathematics classes, with the mathematics classes studied here, at age 14 to 15, being in the middle of these attainment levels. There were a total of 62 students in

these two classes. This age group, in this particular school, represented a gender imbalance of approximately 65% males to 35% females. This imbalance was similarly reflected in the two classes studied.

DATA COLLECTION

A questionnaire was designed to gather students' opinions about elements of their motivation, the influence of their peers which included 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* or *influence of peers on construction/accessing help*. For example, a statement from the *influence of environment/classroom culture* strand was "My motivation in mathematics can change based on what is happening around me". The questionnaire comprised of fifteen statements in which students were asked to express their level of agreement using a 5-point Likert-style scale. The lowest value (1) indicated "strongly disagree". The middle value (3) was given the description "uncertain" rather than "neutral" to allow students to state that they were unsure about an opinion on the specific statement rather than that they did not hold an opinion. The highest value (5) indicated "strongly agree". At the time the questionnaire was completed, students were offered the opportunity to participate in the interviews that formed the second part of this study.

Students were also asked to classify their relationship with others in the group in which they worked as '*All friends*' or '*Some friends*'. The former of these categories was described, for students, as peers who were friends outside of lessons, with the latter category as friends because of association with them within the mathematics class. 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 of questions and the use of specific follow-up questions was sufficiently flexible to probe particular issues identified in individual 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 working with peers, including the reciprocal nature of being a collaborative peer to others. Participation in the interviews was voluntary for participants who undertook the questionnaires. Nine participants, four females and five males, volunteered for the interviews.

OUTCOMES – ROLE OF FRIENDSHIPS

Findings from the questionnaire were analysed using the range of scale indicators from the Likert scale, since the sample size of 62 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: Working with my peers in mathematics lessons improves my motivation	2	3 – 5	4	1 – 5
Influence of peers on motivation	6: When I don't work with peers in mathematics, it makes no difference to my motivation	1	2 – 3	3	1 – 4
Influence of peers on motivation	7: Working in a group at a table in mathematics lessons improves my motivation	2	2 – 4	2	2 – 4
Influence of peers on motivation	10: Seeing my peers succeed in mathematics motivates me to pursue similar success	3	2 – 5	3	2 – 5
Influence of peers/knowledge construction	8: I understand things better in mathematics when I can discuss new concepts with my peers	1	4 – 5	3	2 – 5
Influence of peers/knowledge construction	9: I make better progress in mathematics when I work in groups	1	3 – 4	2	2 – 4
Influence of peers/accessing help	11: Being able to gain help from my peers in groups motivates me more than gaining help from the teacher	2	3 – 5	3	2 – 5
Peer contexts/ Reciprocal help	12: I am able to positively influence the motivation of my peers	1	3 – 4	4	1 – 5
Peer contexts/ Reciprocal help	13: My actions in mathematics lessons do not influence the motivation of my peers	1	3 – 4	3	1 – 4
Peer contexts/ Reciprocal help	15: My influence on my peers' motivation is no greater when working in groups than when working individually	2	2 – 4	2	2 – 4
Individual motivation	1: My motivation in mathematics comes from within myself	2	2 – 4	2	3 – 5
Individual motivation	14: Working in peer groups does not motivate me any more than working on my own	2	1 – 3	1	2 – 3
Influence of environment/ classroom culture	2: My motivation in mathematics comes from things around me	3	2 – 5	2	2 – 4
Influence of environment/ classroom culture	3: My motivation in mathematics comes from a range of different things	3	2 – 5	1	3 – 4
Influence of environment/ classroom culture	4: My motivation in mathematics can change based on things happening around me	2	3 – 5	2	3 – 5

Table 1: Comparison of ranges between responses for *All friends* and *Some friends*

This comparison of ranges of responses indicates that the *All friends* subgroup has greater consistency in their agreement on 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 close friends. This evidence appears to support findings of both Berndt (1999) and Nelson and deBacker (2008) that trustful relationships amongst friends improve motivation for learning. 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, these are not as strongly held views as in the *All friends* subgroup.

It might be expected that, in groups where only some participants are friends, students place a greater emphasis on individual motivation. Evidence of this is seen where the statements reflecting individual motivation reflect greater agreement amongst the *Some friends* category. This is paralleled by the range of 1 for questionnaire item 14, where a low value might be expected; however, *Some friends* did not express disagreement as strongly as *All friends* about the difference not working with peers makes to their motivation. An inference of this finding might be that when students are working in peer groups, where only some members are their friends, they are required to generate more motivation from within themselves, rather than this coming from the closer friendships that they have elsewhere.

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. Evidence from the students' interviews indicates that their motivation in mathematics is also changeable, not necessarily linking to elements of the classroom culture, but rather to external factors, such as time of the day or week, or prior experiences in lessons in other subjects: "And I probably work harder on the Mondays than Thursdays [last mathematics lesson of the week] … cos on, like, a Monday I'm, like, all ready for work cos it's Monday morning … and then on Thursdays, it's a bit more laid back cos it's Thursday". The choice of working peers was also considered important to individuals: "I chose people that I knew, but at the same time I knew I could work well with them … through things like sports teams and things outside of school".

The findings from the interviews also indicate that students working in mathematics at age 14 to 15 view their peers as a valued resource for learning: "If they're your friends and, umm, maybe you can talk to each other which, like communication … you can help each other, which may help my motivation"; "I think it motivates me more if I ask my peers … they're easier to talk to sometimes … and they understand

you more … as opposed to teachers who sometimes don't …". Students emphasised the contribution the classroom environment makes and how it influences changes within their motivation: "If you're not having a good day then it [motivation] doesn't, you don't really feel very motivated, just want to get the lesson over with … and if you're having a fine day, you don't mind learning and being motivated". They expressed a strong level of agreement over the benefits of being able to discuss new concepts with their peers: "If you don't want to ask the teacher, then asking them [friends] works as well". The interview responses also highlight how the physical arrangement of groups allows for greater flexibility and ease of accessing help from peers: "If you're in a, like, square table, then you can talk to anyone around the table … I think it motivates me more if I ask my peers …". In general, the students 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. Such need for public acceptance amongst adolescents is identified by Warrington and Younger (2011).

DISCUSSION

Students in this study indicate that their motivation for mathematics is affected by several factors, supporting Lord's (2005) research. Evidence from questionnaires and interviews suggest that students place considerable emphasis on the classroom culture as a source of motivation for mathematics. However, whilst students recognise the influence the environment can have on their motivation, the personal element to motivation, described by Lord is also acknowledged.

In terms of Ryan and Deci's (2000) study, in which they argue that individuals not only experience different kinds of motivation but the extent of this depends on situations and individuals, all students in our study displayed some form of intrinsic motivation for mathematics. However, questionnaire responses also indicate that this is more likely to be a form of extrinsic motivation on Ryan and Deci's continuum of motivation. It is also evident in student interview responses that motivation for mathematics is not a single feature, supporting Valås and Søvik's (1993) research. These interview responses broadly reflect variations of extrinsic motivation moderated by an internal locus of control, as described by Ryan and Deci (2000).

These 14-15 year old students express an awareness of a relationship between their motivation for mathematics and their relationships with their peers, though the nature of this relationship is not explicitly identified in the interviews. What is highly evident, despite the small scale of this study, is that relationships with peers have a significant influence on these 14-15 year old students' motivation to work in mathematics.

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