STUDENTS' MOTIVATION AND TEACHERS' PRACTICES IN THE MATHEMATICS CLASSROOM

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This paper presents five different families of social cognitive motivational constructs: efficacy, control, interest, values and goals. Two motivation theories will be developed further, namely achievement goal theory and self-determination theory. Research on the relationship between teachers' practice in the mathematics classroom and students' motivation, in terms of intrinsic motivation and goal orientation, will be reviewed. It seems like some aspects of mathematics teachers' instructional practices have a positively influence on both students' intrinsic motivation and goal orientation.

Keywords: Motivation, goal orientation, intrinsic motivation, teachers' practice

INTRODUCTION

The importance of motivation in mathematics education has been well documented (Hannula, 2006b; Pantziara & Philippou, 2007). It is believed that motivation is one of the energizing forces to learning and adaptive behaviour in school settings (Pintrich, 2003; Zhu & Leung, 2010). As Hannula (2006b) points out "To understand students' behaviour we need to know their motives" (p. 165). Theorists believe that motivation has a determinative role in students' success and failure in school (Cury, Elliot, Fonseca, & Moller, 2006; Pintrich, 2003).

Motivation is characterized by its complex nature due to its different definitions, different theoretical perspectives and the various ways that has been measured (Hulleman, Schweigert, & Harackiewicz, 2008; Pintrich, 2003). Motivation cannot be observed directly, but it can be manifested in cognition, emotion (affect) and/or behaviour. In this paper motivation is defined as "the preference to do certain things and to avoid doing some others (Hannula, 2006b). A vast number of theoretical perspectives have been developed in the realm of Educational psychology in order to better describe motivation. These theoretical perspectives can be seen as complementary to one another as each of them accounts for different aspects of motivation. Pintrich (2003) identifies five different social cognitive constructs that have dominated recent research on motivation in school settings. In this paper we will present these five basic families of motivational constructs. Two motivation theories will be developed further, namely achievement goal theory and self-determination theory, which integrates multiple social cognitive constructs. We will discuss research studies on how different aspects of teachers' instructional practices influence students' motivation, in terms of intrinsic motivation and goal orientation in mathematics.

MOTIVATIONAL CONSTRUCTS

One family of motivational constructs refers to self-efficacy beliefs and competence perceptions. Many different constructs are related with this theoretical family like self-efficacy, expectancy, perceptions of competence, self-worth, and self-determination (Bandura, 1994; Bouffard & Couture, 2003). Even though these constructs are defined differently they all focus on the same idea. Students who believe they are capable, and that they will do well, are more expected to be motivated, to have persistence and a more adaptive behaviour than students who believe that they cannot do well and therefore they will not succeed (Kaplan & Midgey, 1997; Pajares & Graham, 1999; Pantziara & Philippou, 2007). Research (Pintrich, 1999, 2003)) also revealed that these self-assured students are more engaged in learning and thinking than students who mistrust their abilities.

A second family of motivational constructs are adaptive attributions and control beliefs (Pintrich, 2003). Basically these theoretical perspectives argue that students who believe that they have control on their learning and behaviour are expected to perform well and have higher achievement than those students who do not believe that they have the control of their learning. Similar to these notions are also entity and incremental theory of ability. Entity theory describes ability as steady and unalterable, whereas incremental theory characterizes ability as open to change (Cury, et al., 2006). Entity theory is posited to predict a poor set of outcomes, like low levels or persistence, performance and interest while incremental theory is posited to predict beneficial outcomes like high levels of persistence, performance and interest (Dweck & Leggett, 1998). In this family of research also belongs self-determination theory, which together with the fifth family of motivational constructs, which is achievement goals, will be developed further.

Self-determination theory is a model that integrates psychological needs and social-cognitive constructs (Ryan & Deci, 2000a). This model is built on the assumption that human beings have three basic psychological needs: the needs for competence, relatedness, and autonomy. Competence refers to the feeling of mastery and effectiveness in interactions with the environment. Relatedness reflects the feeling of being together with other persons in a secure community. Autonomy refers to being in control or being the perceived origin of one's own behaviour. When individuals are autonomous they experience themselves as volitional initiators of their own actions (Ryan & Deci, 2002). Cobb et al (Cobb, Gravemeijer, Yackel, McClain, & Whitenack, 1997) use the concept of intellectual autonomy as a characteristic of a student's way of participating in the practices of a classroom community. They speak of the students' awareness and willingness to draw on their own intellectual capabilities when making mathematical decisions and judgments as they participate in mathematics activities. The concept of need is useful because it allows the specification of the social-contextual conditions that will facilitate motivation. According to self-determination theory, students' motivation will be maximized within social contexts that provide them with the opportunity to satisfy their basic needs for competence, autonomy and relatedness (Ryan & Deci, 2000a, 2002). Self-determination theory makes a distinction between intrinsic motivation and extrinsic motivation. Intrinsic motivation refers to doing of an activity for its own sake and enjoyment. In contrast, extrinsic motivation reflects a behaviour that is undertaken in order to attain some separable outcome (Ryan & Deci, 2000a). Research from self-determination theory has demonstrated the importance of perceptions of autonomy and competence in adaptive behaviour, and the theory highlights the importance of providing some autonomy, choice, and control for students, in order to facilitate students' intrinsic motivation (Ryan & Deci, 2002). Research has shown that there is a positive correlation between students' feeling of autonomy and more positive feelings, better learning and performance in school (Deci & Ryan, 2000).

A third family of constructs related to motivation is interest and intrinsic motivation. Interest can be defined as a psychological state in which someone is engaged, and entirely absorbed by an activity (Hulleman, et al., 2008). A distinction in this area is made between personal and situational interest (Pintrich, 2003). Personal interest is a more stable and lasting disposition of an individual who is attracted, enjoys or likes to be involved in an activity for its own sake (Hulleman, et al., 2008; Pintrich, 2003). Situational interest refers to the psychological state of interest that develops through the interactions with a task's characteristics, like pictures, humor etc. (Hulleman, et al., 2008). Research on personal and situational interest has revealed that high levels of both types of interest are related with more cognitive engagement, learning and achievement (e.g. Pintrich & Schunk, 2002). Interest is one of the central features of intrinsic motivation in self-determination theory (Deci & Ryan, 1985). Students who are intrinsically motivated work with an activity for the enjoyment or challenge entailed. They experience high levels of interest. Research found that intrinsic motivation is positively related to a number of desired cognitive and motivational outcomes such as students' academic performance and self-esteem (Gottfried, 1985; Ryan & Deci, 2000b).

Another family of constructs refers to students' thoughts about the importance of a task. This family of constructs is reflected in expectancy-value theory. Theorist argue that individuals' choice, persistence and performance can be explained by their beliefs about how well they can do a task and how they value this task (A. Wigfield & Eccles, 2000). Expectancy beliefs refer to children's beliefs about how well they can do on forthcoming tasks in the immediate or longer future (Allan Wigfield & Eccles, 2002). Task value beliefs are defined by four components: intrinsic interest; utility, importance and cost (Pintrich, 2003). Research has found that task value beliefs predict choice behaviour, such as the intentions to enrol in future math courses. Expectancy beliefs like efficacy or competence perceptions found to predict achievement as students are enrolled in the course (Pintrich, 2003; A. Wigfield & Eccles, 2000).

The fifth family of constructs is goals and goal orientation, and within this family there have been two main programs of research on student motivation. One program focuses on goal content and the students' goal structures. These approaches assume that the students' goal structures are complex, and that the students tend to pursue multiple goals in the classroom. The goals are related to one another, and pursuing one goal might be necessary to attain another goal or different goals may be seen as contradictory (Boekaerts, 1999). Research shows that students' pursuit of social goals such as making friends and being responsible are related to effort and achievement (Pintrich, 2003). The second program has focused on the nature of achievement goals or goal orientations. This has been one of the most active areas of motivation research on students' motivation. Achievement goal theory is concerned with the purposes of students' behaviour. Students with mastery goal are oriented toward learning and understanding as an end in itself. In contrast, a performance goal orientation refers to seeking to demonstrate that one has ability by outperforming others (A. J. Elliot, 2005). Recently, there has been a theoretical distinction between performance-approach goals, where the student is focused on outperforming others, and performance-avoidance goals, where the student is concerned with avoiding the demonstration of low ability or appearing incompetent or stupid in relation to others (Cury, et al., 2006). These goals have been related consistently to different patterns of achievement-related affect, cognition and behaviour. Mastery goals have been related to adaptive perceptions including feelings of efficacy, achievement, and interest (Anderman, Patrick, Hruda, & Linnenbrink, 2002; Cury, et al., 2006; A. Elliot & Church, 1997). Research on performance goals is less consistent, but students' performance orientation has been associated with maladaptive achievement beliefs and behaviour like low achievement, fear of failure and superficial cognitive commitment, i.e. copying, repeating and memorizing (Cury, et al., 2006)

HOW DOES TEACHERS' INSTRUCTIONAL PRACTICES INFLUENCE STUDENTS' MOTIVATION?

Most social-cognitive models of motivation assume that students' motivation is influenced by classrooms interactions, activities, practices and culture (Pintrich, 2003). Therefor the teacher's instructional practice has a crucial role in facilitating students' motivation. Within mathematics education there has been some research on the relation between different aspects of teachers' instructional practices and students' motivation in mathematics. In this paper we focus on two motivation theories, namely self-determination theory and achievement goal theory, and we will discuss research studies that have made use of these theories in order to understand or interpret how students' motivation in mathematics is influenced by teachers' instructional practices.

Students' needs and goals

Hannula (2006a, 2006b) claims that there is little room to meet the students' need for competence, autonomy and relatedness in teacher-centred mathematics classrooms that tends to focus on the learning of routine procedural skills and individual work. More student-centred or reform-classrooms where the emphasis is on meaningmaking and collaborative work would give the students more opportunities to fulfil their needs. Hannula (2004) suggested the need for more research to examine how students' motivation is influenced by the mathematics classroom practice.

Wæge (2008, 2010) examined students' motivation in mathematics in terms of needs and goals. The results showed a close relation between the students' feeling of competence, in terms of relational understanding (Skemp, 1976) and learning, and their enjoyment in engaging in mathematical activities. Students who developed a feeling of relational understanding experienced higher levels of enjoyment than students with instrumental understanding. The study also showed that there were particularly three aspects of the teaching approach that conduced toward students feelings of competence and sense of autonomy during action: 1) instructional activities, such as projects, problem solving activities, and real life problems, 2) the students' collaboration with each other, and 3) encouragement and acceptance of students' own strategies for solving problems. The three factors were closely related to each other. The results indicated that the instructional activities positively influenced the students' enjoyment in mathematics, because they fulfilled their needs for competence and autonomy. Further, the study showed that the students' need for competence and autonomy were realised into more specific goals. The students realised their need for competence into a general goal of mastery in mathematics and a more specific goal of developing relational understanding. The students were concerned about knowing what to do and why. The need for autonomy was translated into the more specific goal of using own thoughts and ideas and generating own solutions.

These findings are consistent with previous research on students' motivation in mathematics (Boaler, 1997; Cobb, Wood, Yackel, & Perlwitz, 1992). Boaler (2004) describes how teachers at a high school employed a reform-oriented mathematics teaching approach in order to develop good relationships between the students and to reduce social and academic status differences in the mathematics classrooms. The teachers encouraged students to take responsibility for each others learning and they created multidimensional classes where many dimensions of mathematical work was valued, such as generating multiple solution methods, asking good questions, justifying and explaining their answers. The results show that the students learned to treat each other in more respectful ways and they enjoyed mathematics more than students taught in more traditional approaches.

A study by Stipek and her colleagues (Stipek, Salmon, Givvin, & Kazemi, 1998) showed that three aspects of mathematics teachers' practices were positively associated with students' positive feelings as well as their learning: 1) a positive affective climate, which means that the teacher treated the students with respect, listened to their ideas and valued all student contributions, 2) teachers' emphasis on learning and understanding and the encouragement of autonomy, and 3) teachers' providing substantive, constructive feedback. The more teachers focused on these aspects, the more students experienced positive emotions and enjoyed learning.

The findings presented here are consistent with self-determination theory and research on students' motivation, indicating that students' feeling of relatedness, autonomy and competence facilitate enjoyment and intrinsic motivation in activities. According to Ryan and Deci (2002), intrinsic motivation represents a prototype of self-determined activity. They suggest that there is a strong relation between intrinsic motivation and the need for autonomy and competence. Mathematics classrooms that support the students' needs for autonomy and competence will engender their intrinsic motivation in mathematics. Contextual events that students experience as thwarting satisfactions of these needs will undermine their intrinsic motivation.

Students' learning orientation

One of the strengths of goal orientation theory in understanding students' motivation is that it considers how the role of the teacher and the instructional context might influence students' goal orientations. Thus a major tenet of achievement goal theory is that students' adoption of goals is partly influenced by the goal structures promoted by the classroom environments (Anderman, et al., 2002). Goal orientation theorists often focus on six categories when studying classroom motivational environment. The categories are often described by the acronym TARGET, which refers to task, authority, recognition, grouping, evaluation and time. Task includes activities, such as problem solving or routine algorithm tasks, and open or closed questions or tasks; Authority refers to the level of autonomy in the classroom; Recognition refers to whether the focus is on the learning process or the final outcome of the students' performance; Grouping refers to whether the teacher divide the classroom into groups according to their performance or not; Evaluation refers to teachers' assessment of students' learning and whether they focus on grades and test scores or feedback as a means for improving students' learning; Time refers to the flexibility of the schedule.

A study by Anderman, Turner and colleagues (Anderman, et al., 2002; Turner et al., 2002) showed that aspects of mathematics classroom environments in which students adopted mastery goals differed from classrooms in which students adopted performance goals, in terms of avoidance goals. In mastery oriented classroom teachers focused on the process of learning and understanding (recognition), challenging students and learning from mistakes (evaluation). The instruction was adjusted to the developmental level and interest of the students (task), and the students were encouraged to generate own strategies and solutions (authority) and to collaborate with each other (grouping). The teachers also valued the time during the lesson referring to time allocation for different activities (time).

Pantziara and Philippou's study (2007, 2010) showed similar results. In order to analyse teachers' instructional practice they developed a list of six categories based on achievement goal theory and mathematics education reform literature (Stipek, et al., 1998). These categories were: task, instructional aids, practices towards the task, affective sensitivity, messages to students, and recognition. This list of categories has some commonalities with the categories proposed by Anderman et al (2002). Both models included the categories Task and Recognition. Anderman et al (2002) incorporated also the categories Authority, Grouping, Evaluation and Time. Pantziara and Philippou (2010) included practices towards the task and the use of instructional aids, practices that Anderman et al (2002) included in the category Task. Moreover, they (2010) refer to affective sensitivity and messages to students. Pantziara and Philippou (2010) found that in classrooms with high interest and low performance teachers used problem solving activities, visual aids, as well as open questions. New mathematical ideas were connected to students' prior knowledge and teachers focused on understanding and worked with students' misconceptions. In addition, the teachers developed a warm environment in which the teacher cared for and respected the students.

These findings are consistent with previous research studies on the relation between teachers' instructional practices and students' goal orientation in mathematics (Mendick, 2002; Nicholls, Cobb, Wood, Yackel, & Patashnick, 1990). Stipek et al. (1998) found that some of the same aspects of teachers' instructional practices that had a positive impact on students' intrinsic motivation also were a powerful predictor of students' goal orientation. Classroom in which teachers created a positive climate and in which they focused on substantive constructive feedback to students rather than test-scores were associated with a mastery orientation. These findings are consistent with a study by Cobb et al. (1992) indicating that students who experience a reform-based teaching approach are more likely to develop a mastery orientation in mathematics than students in more traditional classrooms.

The findings presented here are consistent with more general research on students' goal orientation, and they reveal that design principles and instructional practices suggested by goal orientation theorists (Pintrich, 2003; D. J. Stipek, 1996) promote students' mastery orientation in mathematics. These instructional practices are similar to ones promoted by the mathematics reform literature (D. Stipek, et al., 1998)

CONCLUSION

Pintrich's identification of five different families of social cognitive motivation constructs provides a structured overview of the different perspectives of motivation and research that has been done. Research studies on the relationship between teachers' practice in the mathematics classroom and students' intrinsic motivation and goal orientation indicate that some of the same aspects of teachers' instructional practices that have a positive impact on students' intrinsic motivation also positively influence students' goal orientation, in terms of mastery goals. It seems like a focus on learning and understanding, generating own solution strategies and a good affective climate positively influence both students' intrinsic motivation and learning orientation in mathematics. There is still a great deal of research needed to understand students' motivation for learning mathematics and how teachers' instructional practice influences their motivation.

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