ENDORSING MOTIVATION: IDENTIFICATION OF INSTRUCTIONAL PRACTICES

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This paper presents some results of a larger study that investigates the relationship between instructional practices in the mathematics classroom and students' motivation and their achievement in mathematics. Data were collected from 321 sixth grade students through a questionnaire comprised of three Likert-type scales measuring motivational constructs, a test measuring students' understanding of the fraction concept and an observation protocol for teachers' instructional practices in the classroom. Findings revealed the importance of multi-level modelling in the analysis of instructional practices suggested by achievement goal theory and mathematics education research that promote both students' motivation and achievement in mathematics.

INTRODUCTION

Research on achievement motivation provides substantial evidences of instructional practices that foster students' motivation (Anderman et al., 2002; Turner et al., 2002). These instructional practices are alike the ones developed by mathematics educators to achieve both learning and motivational outcomes (Stipek et al., 1998). Motivation is treated in mathematics education as a desirable outcome and a means to enhance understanding (Stipek et al., 1998). In broad, the socio-constructivist perspective on learning (Op't Eydne et al., 2006) underlines the interplay between cognitive, motivational and affective factors but also it highlights the influence of the specific classroom context in the whole process.

In this respect, the present study investigates variations in instructional practices and their impact on students' achievement motivation and outcome. Understanding the interplay between the characteristics of a particular instructional setting, and students' achievement-related goals and outcomes is an important direction for both motivational and mathematics education research (Anderman et al., 2002; Stipek et al., 1998). In the next section we consider the basic concepts and define the research questions.

THEORETICAL BACKGROUND AND AIMS

Motivation

Motivation cannot directly be observed but it can be noticeable only by its interaction with affect, cognition and behaviour. Hannula (2006) defines motivation as the preference to do certain things and to avoid doing some others. In regards to students' motivation four basic theories of social-cognitive constructs have so far been identified: achievement goal orientation, efficacy beliefs, personal interest in the task, and task value beliefs (Pintrich, 2003). In this study we conceptualise motivation according to achievement goal theory because it has been developed within a social-cognitive framework and it has studied in depth many variables which are considered as antecedents of students' motivation constructs. Some of these variables are students' competence based variables, such as need of achievement or fear of failure, self-based variables, such as self efficacy beliefs, and demographic variables, e.g. gender (Elliot, 1999). In addition, one of the strengths of goal orientation theory in understanding students' motivation is that it explicitly considers the role of teachers and instructional contexts in shaping students' goal orientations. Thus a major tenet of goal theory is that students' adoption of personal goals is influenced even in part, by the goal structures promoted by the classroom and boarder school environments (Anderman et al., 2002).

Achievement goal theory is concerned with the purposes-goals students perceive for engaging in an achievement-related behaviour and the meaning they ascribe to that behaviour. A mastery goal orientation refers to one's will to gain understanding, or skill, whereby learning is valued as an end in itself. In contrast, a performance goal orientation refers to wanting to be seen as being able, whereby ability is demonstrated by outperforming others or by achieving success with little effort (Elliot & Church, 1997). Recently, there has been a theoretical and empirical differentiation between performance-approach goals, where students focus on how to outperform others, and performance-avoidance goals, where students aim to avoid looking inferior or incompetent in relation to others (Cury et al., 2006).

These goals have been related consistently to different patterns of achievement-related affect, cognition and behaviour. Being mastery focused has been related to adaptive perceptions including feelings of efficacy, achievement, and interest (Anderman et al., 2002; Elliot & Church, 1997; Cury et al., 2006). Although the research on performance goals is less consistent, this orientation has been associated with maladaptive achievements beliefs and behaviours like low achievement, fear of failure and superficial cognitive commitment, i.e. the use of 'surface' learning strategies such as copying, repeating and memorizing (e.g. Cury et al. 2006). Efficacy beliefs encountered as an antecedent variable in the achievement goal theory, refers to the beliefs in one's capabilities to organize and execute the courses of action required to manage prospective situations (Bandura, 1997).

Instructional practices

Environmental factors are presumed to play an important role in the goal adoption process and eventually in students' achievement (Anderman et al., 2002). Elliot & Church (1997) underline that if the achievement setting is strong enough it alone can establish situation-specific concerns that lead to goal preferences for the individual, either in the absence of a priori propensities or by overwhelming such propensities.

Earlier studies on achievement goals specify various classroom instructional practices as contributing to the development of different types of goals and consequently, eliciting different patterns of motivation and achievement outcomes (e.g. Ames, 1992). Goal orientation theorists lying on a large literature on classroom motivational environments focus on six categories that contribute to the classroom motivational environment. The categories, represented by the acronym TARGET refer to task, authority, recognition, grouping, evaluation and time. *Task* refers to specific activities, such as problem solving or routine algorithm, open or closed questions in which students are engaged in; *Authority* refers to students' level of autonomy in the classroom; *Recognition* refers to whether the teacher values the progress or the final outcome of students' performance and how the teacher treats students' mistakes (as a a part of the learning process or as cause for punishment); *Grouping* refers to whether students work with different or similar ability peers; *Evaluation* refers to how the teacher treats assessment, giving publicly grades and test scores, or focusing on feedback as a means for improvement and mastery; *Time* refers to whether the schedule of the activities is rigid or flexible.

This framework has been adapted and developed by goal theory researchers working within classroom context (Anderman et al., 2002; Turner et al., 2002). Using classroom observations and qualitative analysis, they found that instructional practises in classrooms in where students adopted mastery goals differed from instructional practises in classroom characterized by students' low mastery goals or high performance goals. Specifically, according to the task variable, in mastery oriented classrooms teachers used an active instructional approach, ensuring that all students participated in classroom talk and adapted instruction to the developmental levels and personal interests of their students, while in low mastery oriented classrooms, learning was processed by students listening to information and following directions (Anderman et al., 2002; Turner et al., 2002). Regarding authority, in high mastery oriented classrooms teachers engaged the class in generating the rules, while in low mastery oriented classrooms the teachers presented their rules to the students (Anderman et al., 2002). In high mastery classrooms teachers emphasized the intrinsic value of learning, while recognition practices were characterized by warm praise, which was also task oriented, clear, consistent and credible (recognition). High levels of genuine enthusiasm, positive affect and enjoyment by these teachers with respect to engaging in academic tasks was also observed. In low mastery oriented classrooms teachers used punishment and threats with students who did not do what they were told (Anderman et al., 2002). In high mastery orientation classrooms students had considerable freedom within the classroom-e.g. talking to classmates (autonomy) and peer collaboration (grouping) (Anderman et al., 2002). Reversely, in high mastery classrooms teachers emphasized students' performance, relative performance and differential prestige (evaluation) while in low mastery classrooms teachers emphasized test scores and grades or students' differential performance on tasks (evaluation). Moreover teachers in high mastery classrooms valued the time during the lesson referring to time allocation for different activities (time) while students in the low mastery oriented classrooms were allowed to work on their paces (Anderman et al., 2002).

In mathematics education domain, Stipek et al. (1998) in a relevant study referring to instructional practices and their effect on learning and motivation found that affective climate was a powerful predictor of students' motivation and mastery orientation. Students in classrooms in which teachers emphasized effort, pressed students for understanding, treating students' misconception and in which autonomy was encouraged reported more positive emotions while doing math work and enjoying mathematics more than other students while they also scored higher in a fraction test. Teachers' provision of substantive feedback to students rather than scores on assignments was also associated with mastery orientation.

Despite the apparent utility of the list concerning the classroom practices both by achievement goal researchers and mathematics educators, very few studies have examined these practices in relation to students' perceptions of achievement goals and outcomes in the ecology of regular classroom. To the best of our knowledge none of these studies had employed multilevel statistical tools for the identification of teachers' practices that influence students' specific goals and vis-à-vis students' achievement. In this respect the purpose of this study was:

- To test the validity of the measures for the six factors: fear of failure, self-efficacy, interest, mastery goals, performance-approach goals and performance-avoidance goals, in a specific social context.
- To construct and test the validity of an observational protocol that includes convergent variables referring to instructional practices in the classroom from the mathematics education domain and the achievement motivation one.
- To identify instructional practices suggested by achievement motivation theory and mathematics education theory that affect students' motivation (mastery and performance goals) in the mathematics classroom applying multilevel analysis.

METHOD

Participants were 321 sixth grade students, 136 males and 185 females from 15 intact classes and their 15 teachers. All students-participants completed a questionnaire concerning their motivation in mathematics and a test for achievement in the mid of the second semester of the school year.

The motivation questionnaire comprised of six sub-scales measuring: a) mastery goals, b) performance goals, c) performance avoidance goals, d) self-efficacy, e) fear of failure, and f) interest. Specifically, the questionnaire comprised of 35 Likert-type 5-point items (1- strongly disagree, and 5 strongly agree). The five-item subscale measuring mastery goals, the five-item subscale measuring performance goals, the four-item subscale measuring performance-avoidance goals, as well as the five item subscale measuring efficacy beliefs were adopted from the Patterns of Adaptive Learning Scales (PALS) (Midgley et al., 2000); respective specimen items in each of these four subscales were, "one of my goals in mathematics is to learn as much as I can"

(Mastery goal), "one of my goals is to show other students that I'm good at mathematics" (Performance goal), "It's important to me that I don't look stupid in mathematics class" (Performance-avoidance goal), and "I'm certain I can master the skills taught in mathematics this year" (efficacy beliefs). Students' fear of failure was assessed using nine items adopted from the Herman's fear of failure scale (Elliot & Church, 1997); a specimen item was "I often avoid a task because I am afraid that I will make mistakes". Finally, we used Elliot and Church (1997) seven-item scale to measure students' interest in achievement tasks; a specimen item was, "I found mathematics interesting". These 35 items were randomly spread through out the questionnaire, to avoid the formation of possible reaction patterns.

For students' achievement we developed a test measuring students' understanding of fractions. The tasks comprising the test were adopted from published research and specifically concerned students' understanding of fraction as part of a whole, as measurement, equivalent fractions, fraction comparison and addition of fractions with common and non common denominators (Lamon, 1999).

For the analysis of teachers' instructional practices we developed an observational protocol for the observation of teachers' mathematics instruction in the 15 classes during two 40-minutes periods. The observational protocol was based on the convergence between instructional practices described by Achievement Goal Theory and the Mathematics education reform literature. Specifically, we developed a list of codes around six structures, based on previous literature (Ames, 1992; Anderman et al., 2002; Stipek et al., 1998), which were found to influence students' motivation and achievement. These structures were: task, instructional aids, practices towards the task, affective sensitivity, messages to students, and recognition.

The structure *task* included algorithms, problem solving, teaching self-regulation strategies, open-ended questions, closed questions, constructing the new concept on an acquired one, generalizing and conjecturing. We checked whether teachers made use of instructional aids during their lesson. *Practices towards the task* included the teacher giving direct instructions to students, asking for justification, asking multiple ways for the solution of problems, pressing for understanding by asking questions, dealing with students' misconceptions, or seeking only for the correct response, helping students and rewording the question posed. Behaviour referred to *affective sensitivity* included teachers' possible anger, using sarcasm, being sensible to students, having high expectations for the students, teachers' interest towards mathematics or fear for mathematics. *Messages to students* included learning as students' active engagement, reference to the interest and value of the mathematics tasks, students' mistakes being part of the learning process or being forbidden, and learning being receiving information and following directions. Finally, *recognition* referred to the reward for students' achievement, effort, behavior and the use of external rewards by the teachers.

During the two classroom observations lasted for 40 minutes for each teacher, we identified the occurrence of each code in each structure.

RESULTS

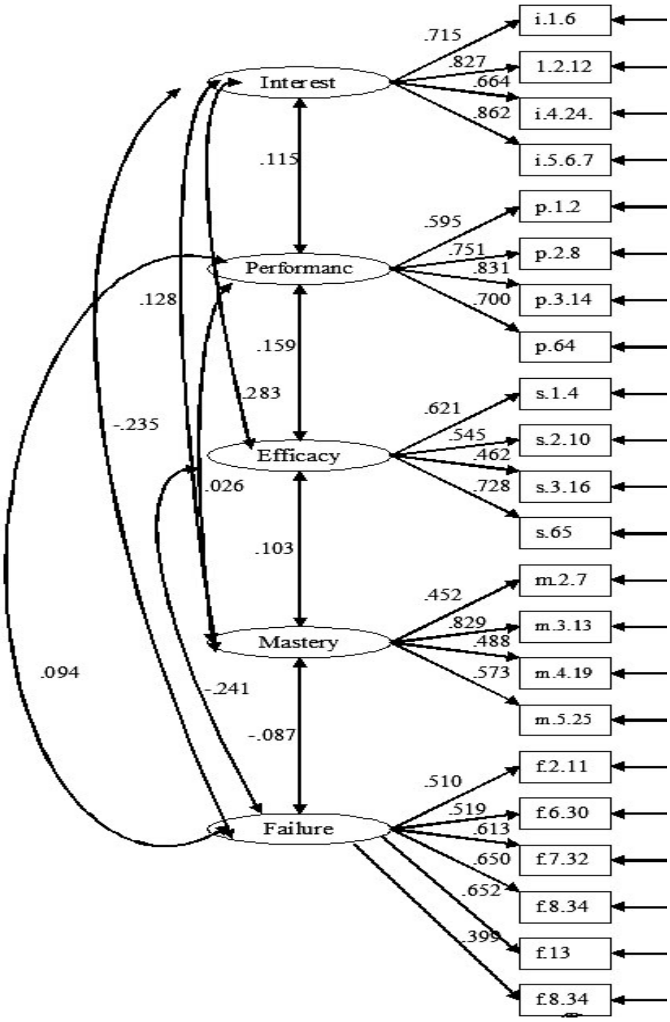


Fig 1: The factor model of students' motivation with factor parameter estimates.

With respect to the first aim of the study, confirmatory factor analysis was conducted using EQS (Hu & Bentler, 1999) in order to examine whether the factor structure yields the six motivational constructs expected by the theory.

In the analysis for the identification of the six factors, we followed a process including the reduction of raw scores to a limited number of representative scores, an approach suggested by proponents of Structural Equation Modelling (Hu & Bentler, 1999). Particularly, some items were deleted because their loadings on factors were very low (e.g. for the factor interest the item i.3.18. and for the factor fear of failure the item f.5.28) and some other items were grouped together because they had high correlation with each other (e.g. for the factor fear of failure the items f.1.5 and f.3.17). From the analysis the factor performance-avoidance goals failed to be confirmed. Then in line with the motivation theory, a five-factor model was tested (fig. 1). To assess the overall fit of the model we used maximum likelihood estimation method and three types of fit indices: the chi-square index, the comparative fit index (CFI), and the root mean square error of approximation (RMSEA). The chi square index provides an asymptotically valid significance test of model fit. The CFI estimates the relative fit of the target model in comparison to a baseline model where all of the variable in the model are uncorrelated (Hu & Bentler, 1999). The values of the CFI range from 0 to 1, with values greater than .95 indicating an acceptable model fit. Finally, the RMSEA is an index that takes the model complexity into account; an RMSEA of .05 or less is considered to be as acceptable fit (Hu & Bentler, 1999).

Items from each scale are hypothesized to load only on their respective latent variables. The fit of this model was (x^2 =691.104, df= 208, p<0.000; CFI=0.770 and RMSEA=0.086). After the addition of correlations among the five factors the measuring model has been improved (x^2 =343.487, df= 198, p<0.000; CFI=0.931 and RMSEA=0.049).

Concerning the second aim of the study, analysis of the observations involved estimating the mean score of each code for the two 40 minutes observations using the SPSS and creating a matrix display of all the frequencies of the coded data from each classroom. Each cell of data corresponded to a coding structure. From a first glance, the observational protocol succeeded in detecting differences in teachers' practises during the mathematics lessons. Notably, teachers 4, 9, 13, 15 used more algorithmic tasks than the others, while teachers 2, 4, 7 used more problem solving activities than their other colleagues. Open-ended questions were used more by teachers 3, 5 while teachers 8 and 14 used more the closed type of questions. Very few teachers made use of the visual aids (4, 7, and 8). From the category practices towards the task justification of students' answers were asked from almost all teachers expect from teachers 2, 3, 10, 13. Press for understanding characterized teachers' 6 and 13 practices, while asking for multiple problem solutions was not popular to this sample of teachers. Teacher 5 was characterized by her willingness to help students. Regarding teachers' affective sensitivity, teacher 1 expressed anger while teacher 7 showed great sensitivity to students. Concerning the structure messages all teachers apart from teachers 1 and 15 treated students' erroneous responses as part of the learning process, while the other codes regarding this category were met rarely during these lessons. Regarding recognition, teachers 1 and 7 rewarded students for their performance.

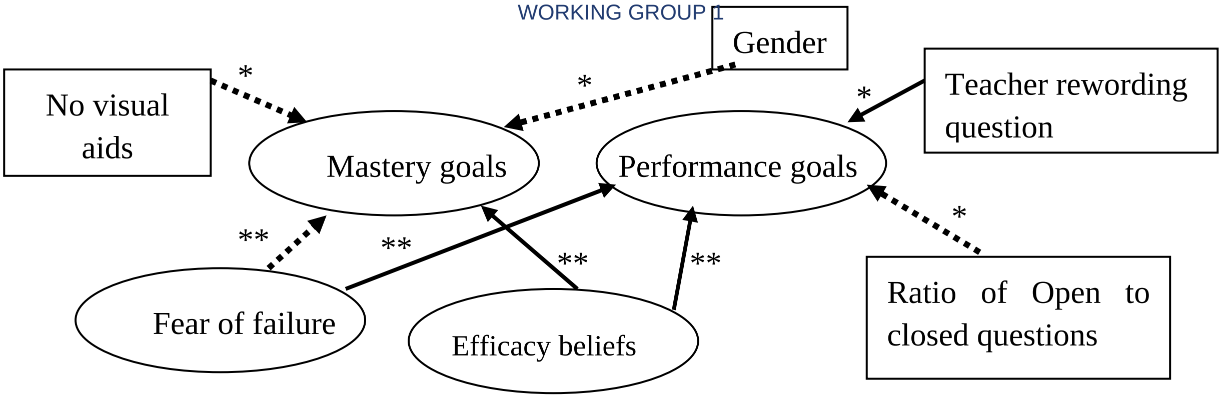
According to the third aim of the study, the identification of instructional practices suggested by achievement motivation theory and mathematics education that affect students' mastery and performance goals, we applied Multilevel analysis using the program MLwin (Opdenakker & Van Damme, 2006). Multilevel analysis is a methodology for the analysis of data with complex patterns of variability, with a focus on nested sources of variability: e.g. students in classes, classes in schools, etc. The main statistical model of multilevel analysis is the hierarchical linear model, an extension of the multiple linear regression model to a model that includes nested random effects. Multilevel statistical models are always needed if a multi-stage sampling design has been employed (a sample of pupils and a sample of teachers) because the clustering of the data should be taken into consideration avoiding the drawing of wrong conclusions (Opdenakker & Van Damme, 2006). The simplest case of this model is the random effects analysis model (null model). The null model exhibits only random variation between groups and random variation within groups. (e.g. students and teachers). Estimating the variance at the distinguished level (e.g. students and teachers) it is possible to see which level is important for the estimation of the variance. For example if the estimation variance at student level (level one) is much higher that the estimation of the variance at the teacher level, then this means that differences between students with respect to the characteristics under study are largely related to individual students and not to the teachers. The null model can be expanded by the inclusion of explanatory variables. With the explanatory variables, we try to explain part of the variability of the dependent variable. It is possible to explain variability at level one as well as in a next-step at level two (Opdenakker & Van Damme, 2006).

In our case a two level model was employed with students' performance or mastery goals as the depended variable and students' motivational constructs and teachers' practices as the exploratory variables. The first test in the analysis regarding variables that influence the development of mastery goals was to determine the variance at the student level and teachers' level without explanatory variables (null model 0). The variance at each level reached statistical significance ($p<0.05$) and this implied that MLwiN could be used to identify the variables which were associated with achievement in each subject. Regarding mastery goals, student effect was much higher than teachers effect (91% and 9% respectively). Following the procedure we added in model 1 student demographic variables. Model 1 explained 2% of the total variance. From the three variables (education mother-father and gender) only gender had statistically significant effect on students' mastery goals. The variance was explained solely to student level (2%). Explicitly, female students demonstrated higher mastery goals than male students. In model 2 all affective variables according to achievement goals theory were added to the model. Specifically the antecedent variables fear of failure and efficacy beliefs were added to the model and also performance goals. Model 2 explained 26% of the total variance. The antecedent variables had a statistically significant effect to the model, with fear of failure to have negative effect, while performance goals did not have any effect. From the 26% of the total variance 23% was at the student level and 3% at the teacher level. In Model 3 we added teachers' educational background but it turned out not to have any statistical significant effect on students' mastery goals. Then we added to the model teachers' practices concerning the structure Task and again they did not have any statistical significant effect to the model. We continue adding the other categories of teachers' practices. The only one that had negative statistical significant effect on students' mastery goals was the absence of visual aids. Model 3 explained 2% of the total variance and this variance was explained exclusively to teacher level.

We followed the same process to identify variables that had significant effect on students' performance goals. We ended that from student level, fear of failure and self efficacy had statistically significant effect on students' performance goals while from teacher level the practice, "teacher rewords the question asked" had statistically significant effect to students' performance goals.

Next, we followed Stipek et al. (1998) process grouping instructional practices in each of the six categories regarding the observational protocol together with the ratio of open-ended questions to closed questions. The ratio related to the questions had statistically significant negative effect on students' performance goals.

Figure 2 presents the results of the multilevel analysis in identifying exploratory variables that affect students' mastery and performance goals in mathematics. Dotted arrows represent negative effect.



*p<0.05, **p<0.001

Fig 2: Results of the Multilevel analysis on mastery and performance goals.

CONCLUSION

Regarding the first aim of the study, data revealed that factors referred to the five of the six motivational constructs were confirmed in the Cypriot environment. The factor regarding performance-avoidance goals failed to be confirmed in contrast to the results of other studies (Cury et al., 2006). This may be due to students' age-usually this factor is confirmed in elderly students or to the different cultural context.

Regarding the second aim of the study, the data revealed important differences in the instructional practices used in the mathematics classrooms in line with other studies (Anderman et al., 2002; Pantziara & Philippou, 2007; Stipek et al., 1998). However the need for in-depth analysis of these practices born due to the study's evidence that while in some classrooms teachers applied the practices suggested by motivation and mathematics education to foster students' motivation, students' motivation was high while their mathematics performance was poor.

As far as the third aim is concerned, taking into consideration the clustering of the data in the multi-stage sampling (sample of pupils and sample of teachers) we applied the multilevel analysis to identify variables that have statistically significant effect on students' achievement goals. The results revealed that more effect on students' motivation had students' variables (gender, fear of failure, efficacy beliefs) while only few of the numerous instructional practices suggested by other studies (Anderman et al., 2002; Stipek et al., 1998) found to have statistically significant effect on students' motivation. This may be due to the new analytical tools used considering the variance between the different level of the depended variables or to the small number of teachers involved in the study. Whatever the case is, further research is needed using multilevel analysis in domains regarding achievement goals and mathematics education for the identification of instructional practices that endorse motivation and achievement in mathematics.

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