Increasing Students' Mathematics Achievement at University by Changing Their Non-Mastery Goals into Mastery Learning Goals

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Abstract: Despite the implementation of various motivation theories suggested by researchers, the achievements of students in mathematics have persistently been poor, hence there is a great need to explore the best ways to increase students' achievement in mathematics. The goals that students have in the process of study are essential for reaching success. Thus, the aim of this study is to investigate the influence of the achievement goal motivation theory on students' learning outcomes in mathematics. Three types of goal orientation were specified in this study, which are mastery-learning goal orientation (MG), performance-approach goal orientation (PAG), and performance-avoidance goal orientation (PAvG). The research asserts that possessing mastery-learning goal motivation has a more positive impact on university students' academic achievement than the performance approach goal orientation, while the performance-avoidance goal orientation has a negative impact.

This research is a quantitative study and experiment. Experimental study was held in 2015/2016 academic year at private Suleyman Sah University in Turkey with 39 students majoring in Business and Administrative Science, which would define, whether, as a result of teaching, following the offered model, the students of the experimental group would change their learning goals and improve their academic achievement. The results show that mastery-learning goal orientation is the best fit for achievement in mathematics at university. The experiment held according to the model developed by the researcher revealed that the model was really effective and helped many students who were initially performance-approach or performance-avoidance goal-oriented to change their goals into mastery goals.

Key words: Achievement Goal theory, Motivation Related Questions Based on Theories, Mathematics Achievement

1. Introduction

Mathematics is a human activity which arises from experiences about the logic of shapes, quantity and arrangement of sets of numbers or objects which becomes an integral part of culture and modern civilization of everyday life and work. Teaching mathematics effectively is quite hard to attain, usually students find mathematics a boring and very difficult subject if they do not have enough capacity. However, their teachers must know how to change their views.

There are three motivational questions that every person ask to themselves when they have a task to do. Considering especially education context when a student is given a task which she/he wants to fulfil, the first question they ask themselves is: *Can I do this task?* This question is focused on self-efficacy theory,

self-worth theory and attribution theory. In order to gain successful results students have to answer this question. If they answer it affirmatively, they show a better performance, persist longer in the face of difficulties, and they are also motivated to select more challenging tasks. Students not only need to have the ability and acquire the skills to perform successfully the academic tasks, they also need to develop a strong belief that they are capable of completing analogous tasks in real life, when they need it, successfully. The second question, whether the student wants to do the task, is connected with theories integrating expectancy and value constructs, in particular, to expectancy-value theory.

In order that students positively answer the motivation related questions: '*Can I do this task*?' and '*Do I want to do this task*?' they need to have some practical motives. Teacher's duty is to show them how problems from various spheres of everyday life can be solved by application of mathematical methods. Theoretical mathematical topics have to be followed by practical tasks dealing with authentic problem-solving: in biology and architecture, text analysis and engineering, etc. The last question: *'Why do I want to do this task*?' deals with the theory focused on the reasons for engagement or achievement goal theory.

The study, hopefully, will contribute to the development of achievement goal theories of learning, in particular, based on these motivational foundations to teaching mathematics at university. The approach to changing students' goals to optimal ones has been viewed in the study, a corresponding model was developed and suggested as well as tested via experimental research.

2. Literature Review

Motivation is an important factor for all educators to evoke energy and persistence among students. It is reasonably accepted that motivation and achievement affect each other. According to the definitions of motivation theorists, it is a kind of "psychological forces that determine the direction of a person's behavior, a person's level of effort, and a person's level of persistence in the face of obstacles" (Jones, Jennifer & Hill, 2000, p. 427). As contemporary achievement motivation theories concentrate on students' beliefs, values, attributions and goals as essential factors having an impact on motivation, this study is also founded on these essential components of motivation for learning mathematics.

Unfortunately, too many students either hate mathematics or find it boring and too difficult (Lahey, 2014). As result, even some students who are smart at mathematics still fail it (Lloyd, 2016). Also university students who major in mathematics or learn it as a compulsory course have problems learning mathematics and their motivation is often low. Bal (2015), for example, states that among a hundred and thirty eight freshman mathematics students at a Turkish university almost a third (31%) had a low level of mathematical problem-solving skills, while a little bit more (only 37%) had a high level of mathematical problem-solving skills. Cue and Nie (2016) in their research found that 254 international undergraduate students learning in Hong Kong had higher intrinsic motivation levels of learning mathematics (mean 4.70 on a 7-point Likert scale) than their 144 local counterparts (mean 3.73 on the same scale). However, both results are insufficiently high. Such researches reveal to us that there are significant problems in learning and teaching mathematics (students cannot learn well, unless they are taught well). To solve the existing problem, teachers need to find more efficient motivational approaches to teaching mathematics.

During the inquiry process motivation theorists try to understand how motivation affects choice, persistence, and effort. Some of them argue that individuals' activity choice, persistence, and effort can be explained by their judgments about their ability to complete the activity and the extent to which they value the activity (Wigfield, 1994). Bandura's self-efficacy theory is a social-cognitive theory which emphasizes students' expectations for success and help students' to find out whether they can do given task. This theory also helps researchers and teachers to understand deeper students' motivation for doing the task and behaviours received as result of fulfilment of this task. Perceived self-efficacy is defined by Bandura (1994) as learners' self-constructed judgments about their capabilities to produce the designated levels of effort, in order to behave in a certain way, to get a certain result or to achieve certain aims. Self-efficacy beliefs have a strong impact on learners' feelings, thinking, and goals. These beliefs motivate learners most effectively in the face of difficult tasks. Bandura and his colleagues (Bandura et al., 2001) name two types of expectancy beliefs (efficacy expectations and outcome expectations) absolutely different from each other. What makes them so different is that learners may have an idea that a particular behavior will yield a particular outcome (outcome expectation), on the other hand, they may not hope that they can perform that behaviour (efficacy expectation). These two kinds of expectancy beliefs are necessary and inseparable in terms of success. Based on this, Bandura, Barbaranelli, Caprara and Pastorelli state that "unless people believe they can produce desired outcomes (outcome expectations) by their actions (efficacy expectations), they have little incentive to act or to persevere in the face of difficulties" (p. 187). Bandura suggested that learners' efficacy expectations are especially important for their goal orientation, activity choice, desire to be involved in activities, and going on doing the difficult tasks even irrespective repeated failure.

Students' self-worth and their attributions for success and failure can also help answer the question whether the student can do the given task. The need to protect self-worth first of all deals with the threat of failure. The failure-avoiding strategy model may also be viewed from a performance-avoidance goal perspective (a student is not involved in a certain activity in order not to look stupid or be laughed at by others to protect his/her self-worth). Therefore, if failure seems likely, some students will not try precisely because trying and failing threatens their self-worth. Covington and Omelich (1979) have written about the ways in which school environments can be changed to lessen the emphasis on relative competence of children, thereby allowing more children to maintain a sense of self-worth at school. In order to understand the effect of school environments it is important looking at pre-school children. Pre-school children are basically focused on mastery goals, but at school, surrounded by peers, they naturally begin to compare themselves with others. They want to see whether they are as successful as others or probably more or less successful as them. This is not always good for their self-efficacy beliefs, as they may be disappointed in themselves and be demotivated to pursue the studies (why study, if this does not yield any effect). As educators we need to take into consideration that emotional state of students matters much. This is why funny creative tasks are important. Funny / entertaining tasks help students forget about the hardness of mathematics as a subject. Students should not all the time think about being assessed. Sometimes they need to feel that doing mathematical tasks may be fun / enjoyable. Besides, when students make mistakes, the feedback that they get from the teacher should be constructive: first underlining what they did correctly and then suggesting better ways to develop their skills. Also, to develop a positive emotional climate in the class, a celebration of earlier less successful students' positive and especially high grades can become a good tradition in mathematics class.

Among the motivation-related question the second one that learners can ask themselves during the mathematic class is whether the student desires to do a certain task, which deals with the modern expectancy-value theory. If students are confident in achieving an academic task (have a high self-efficacy) and they believe that the academic task is worth pursuing (the task-value is high for them), they are more likely to engage in an activity and learn things that have a value for them.

Theories dealing with efficacy, self-worth, attribution and expectancy-value provide powerful explanations of individuals' performance on mathematical achievement tasks. However, these theories do not systematically address another important motivational question, what the reason for doing a task is. This motivation-related question deals with Achievement Goal Theory, which is focused on the reasons for engagement. The majority of researchers have articulated three types of achievement goal orientations: mastery goals (MG), where students pursue their competence by developing and improving their ability; performance-approach goals (PAG), where they do their best to demonstrate their ability; and performance-avoidance goals (PAvG), where students' main concern is hiding their lack of ability (Elliot, 1999).

Based on the scientific researches previous studies consistently reveal that mastery goal orientation is related to positive patterns of learning, preference for challenge, task achievement, self-efficacy, self-regulation of learning, positive emotions and strategy use (such as Ames, 1992; Dweck and Leggett, 1988; Elliot & McGregor, 1999; Mirzaei et al., 1997; Pajares, Britner, & Valiante, 2000). Moreover, some researchers (e.g., Anderman & Wolters, 2006; Harackiewicz et al., 2002; Meece, Blumenfeld, & Hoyle, 1988; Wolters, 2003) also assert that mastery goals are related to adaptive behavioral and cognitive outcomes, while performance-avoidance goals are related with less adaptive outcomes (Kaplan & Maehr, 2007; Midgley et al., 1998; Skaalvik, 1997). Studies of performance-approach goals report more inconsistent findings. Several researchers report that it is related to a number of positive outcomes, for instance effort, persistence, and performance (Elliot, & Church, 1997; Harackiewicz et al., 2002; Law, Elliot, & Murayama, 2012, Senko, Hulleman & Harackiewicz, 2011). Also some researchers identified correlations between performance goals and maladaptive thoughts, emotions and behaviors (Ames, 1992; Dweck & Leggett, 1988). In contrast, the majority of researchers have found weak or moderate correlations between performance goals and self-efficacy, the use of effective learning strategies, grades, attitudes and positive emotions (such as Elliot, 1999; Urdan, 2004; Kaplan & Maehr, 2007). Also some other studies report performance goals to be unrelated to self-efficacy, CGPA (Cumulative Grade Point Average) as well as to correlate less on the beneficial strategy using and the deep learning (such as Mirzaei et al., 2012; Middleton & Midgley, 1997). Thus, inconsistencies have been found about the consequences of adopting performance goals orientation in achievement situations. Therefore, the literature concerning performance-approach goals is not conclusive enough and performance-approach goals are controversial. For instance, an important issue is whether a performance-approach goal may turn into a performance-avoidance goal when the student encounters greater challenges (exploring this prediction requires longitudinal studies).In other words it is important to make sure that the performance goals do not promote failure-avoidance (performance-avoidance-oriented) behavior, such as avoiding unfavorable judgments of capabilities and looking incompetent in order to protect sense of self-worth. Also they should not be used to compare students' accomplishments. As mentioned before, this competitive assessment strategy may disrupt learning by inspiring avoiding failure (performance-avoidance orientation), rather than endeavor for success

(Covington, 2000). The empirical evidence for this view has been provided by Federici, Skaalvik, & Tangen (2015) in a study, examining the effects of mastery and performance-avoidance goal orientations on students' achievement-related behaviors. These researchers found that "mastery goal orientation is associated with lower levels of anxiety and more use of help-seeking behavior, whereas performance-avoidance orientation predicted higher levels of anxiety and less use of help-seeking behavior" (Federici, Skaalvik & Tangen, 2015, p. 146).

Correspondingly, this study will try to reveal that students majoring in mathematics are more likely to be active and ready to tackle with challenging tasks, have positive feelings toward learning mathematics, and invest greater effort into the learning, when they adopt a mastery goal orientation rather than performance-approach or – especially - performance-avoidance goal orientation.

3. Model of Effective Application of Goal Theory to Teaching Mathematics

To change students' goals it is important to develop the theoretical framework of teaching, and among the issues classroom management is very important. Only via improved planning and organization, responsibility-based pattern of discipline, applying pair and small group work can the teacher realize the mastery-goal developing teaching. To develop the model of teaching in a way beneficial for the development of mastery-goal orientations, it was necessary to answer three questions, whether students can do the given tasks, whether they want to do them and find out the reasons why they want (or do not want) to be engaged in fulfillment of mathematical tasks.

To contribute to the student's perception of mathematics as a whole as well as of a particular mathematical task as doable, the teacher has to provide a clear explanation, make one's presentation well-organized, to serve as a model of mathematical problem-solving. The visual component of teaching should effectively use colors, shapes, italics and bold fonts, to draw students' attention to the most important information.

Students need a positive experience of learning, to form self-efficacy and to increase it step by step. This is why teaching by the didactic principle 'from the easy to the difficult' is essential. In order to develop students' mastery goal orientation, teachers should use:

- **Explanation and persuasion**: teachers, in the process of feedback, should underline the success of those students who keep trying irrespective of failure, they should give examples of mathematics geniuses who were viewed by teachers as underachievers, etc. The teacher needs to show the applications of each concrete studied theoretical materials, to prove that the course has a high value. Explaining the value of the knowledge of mathematics on the whole is also mathematics teacher's task.
- **Attitude change**: Even if students try hard in mathematics, but fail due to low ability to study the subject, their self-worth should not suffer. Teacher should respect all students as personalities and demonstrate this respect. In private talk the teacher might recommend the student to change the specialty, before it is too late, so that the student's self-worth would not need to suffer during a long professional lie.
- **Modelling**: teachers should share with students their own experiences of failure and how they overcame them, teachers should serve as problem-solving models themselves, then

choose student-models who can solve the problems well, and eventually put from time to time the 'weakest' students in the roles of successful problem-solvers (especially, presenting the results of group-work).

- **Organization of activities**: providing interesting and authentic tasks, applying pair and group work in order to let students share knowledge and strategies; arranging activities from the easy to the difficult ones. Independent work, such as projects, should be stimulated, to increase students' autonomy.
- **Creating a friendly classroom atmosphere**: the teacher using supporting comments and cues, the students not permitted to laugh at each other's mistakes.
- **Assessment**: applying students self and peer-assessment; providing constructive feedback during the formative assessment, in order to let students increase their achievement; avoiding giving negative assessments in the beginning of the course, giving a chance to retake a quiz or to redo unsuccessful homework, before it is eventually graded.

Of course, none of these (except activities and assessment) can be pre-planned parts of the class, they just occur, when the need arises. During the experiment, the students of the experimental group were encouraged to develop their competence rather than to pass a test or get a high grade.

- Initially the teacher informed the students about when and where the skill would be used practically and the benefits of mathematical education in order to stimulate their higher-order cognitive skills.
- Examples were also chosen which were meaningful for the students and attracted their attention to learning the given topics.
- Jobs where mathematical skills are useful were discussed. For instance, geometry (the part of mathematics that is concerned with the question of size, shape, relative position of figures and properties of space) is used in the construction of buildings, bridges, etc. (in engineering and architecture), to find the area of anything.
- Teacher's and students' real world examples were discussed.

It is essential, first of all, that teachers themselves have positive views on students' abilities to fulfill mathematical tasks that students' success depends on their effort and comprehension (at least) no less than it depends on their genetic capacities. Only on that condition will teachers be able to pass these views to students.

Teachers who set goals for students as getting a positive (a passing or a high) grade, who talk all the time about the forthcoming difficult text, etc., will never have students who pose mastery goals for themselves. Teachers need to inspire their students to learn mathematics as a very useful and interesting subject. In the process of formative assessment, after a student does something wrongly, she/he should be given a chance to retake the task / test. This will permit him / her to concentrate on the mastery goal rather than on performance. Some teachers do not give any grade on a particular component of assessment to the student during the semester, until she/he manages to get a positive/high grade (according to the level of the student's previous achievements), in order to stimulate them to for a needed skill, instead of moving to the new task, without forming the prerequisite skills).

Thus, the model of mastery-goal-oriented teaching mathematics at university is schematically presented in Table 1.

Table 1: The model of mathematics teaching supporting the development of mastery goals in students

Teacher →	Activities →	Assessment →	Students
Develops positive views in him/herself, concerning students' abilities to learn mathematics in general and do the particular task.	Are doable (follow the path from easy to difficult), some of them – used as bonus - also challenging, They are numerous and various enough, many of them are authentic.	Formative assessment is emphasized. The feedback provided is constructive (underlining success and the ways to overcome failures) and leaves the student a chance to improve one's skills.	Under teacher's impact develop positive views on the course as a whole, as well as on particular tasks. They develop a view that their efforts will be rewarded – a positive view on themselves as learners of mathematics.
Serves as an effective model of problem-solving, also chooses effective models / experts among students to help him/her teach	Among activities there are whole-class, individual, pair and small group ones, which provides involvement of all students and sharing knowledge, skills and strategies.	Peer and self-assessment is employed, so that students develop their self-efficacy and self-motivation.	Due to enough effective tasks, teacher and peer-support boost their self-efficacy and motivation to learn mathematics (to do a particular task), realizing its value.
Teacher clearly presents the materials, doing his/her best to make them learnable.	Among activities are finding examples to illustrate the theoretical materials learned, problem-solving	Typical errors are discussed, but their discussion is not linked with a particular student. When individual comments are needed, this happens between teacher and student, not publicly.	Teacher is not the only material presenter in the class, all students are involved in material presentation.
Creates a safe, friendly, supportive classroom atmosphere	Some activities are funny and for entertainment;	Not all activities are assessed. A chance is left to improve the results and to overcome the failure.	Feel relaxed, debilitating anxiety is avoided, which contributes to higher motivation.

Mathematics teachers have to be flexible and creative enough to achieve that students choose mastery goals. The tasks that they use should be various, in order not to cause boredom. Teachers should provide opportunities for students to demonstrate and communicate conceptual and procedural knowledge by using mathematics related to real-world examples. Thus the mastery-learning approach will help teachers to create learning experiences that challenge and engage students to think critically, creatively and deeply about mathematics. They will realize that mathematics is all around us and it is the art of explaining the world around us and of everything we do. Moreover, it is the integral part of our lives, for instance, money, engineering, sports, architecture, art, even in nature and animal lives. Teachers should believe that integration of math subject with real world events and application is the most effective way for mastery of the subject-related skills. Besides, mastery-goal oriented learning eliminates too much competition among learners and encourages them to work together towards common goal.

4. Research Methods and Instruments

As it is mentioned before the research methods is quantitative and experimental study. Experiment was held in 2015/2016 academic year at private Suleyman Sah University with 39 students majoring in Business and Administrative Science, which would define, whether, as result of teaching, following the offered model, the students of the experimental group would change their learning goals and improve their academic achievement.

4.1 Research Questions

At the end of the experiment two questions should be answered, based on the results:

1. Did students who were non-mastery initially show a better academic success by gathering mastery-learning goals through experiment?
2. How much success has been reached in the experiment?

4.2 Questionnaire for Assessment of Goal Type in Students

The questionnaire applied for defining the type of students' goal motivation type was created by Elliot (Elliot and Church, 1997). It is called Elliot's AGQ - Achievement Goal Questionnaire. This questionnaire focuses on three dimensions: Mastery Goals, Performance Approach Goals and Performance Avoidance Goals. It is normally used to find out which goals are used by students in achievement situations. It was modified in connection with learning mathematics. The questionnaire items are very important for several reasons. Firstly, students' achievement goal orientations are important to understand their reasons or purposes of engagement in academic behavior, because learners' goals in academic behaviour increase or decrease the amount of effort and energy that they apply during the activities. Secondly, different goals foster different responses of learning patterns, which include cognitive, affective, and behavioral components. They are very essential domains of motivation. These components help us to decide which one is more or less effective in achievement situation.

The instrument consists of 18 items with 3 subscales including mastery goals, performance-approach goals, and performance-avoidance approach goals. The response scale for all the items in the survey was a 5-point Likert scale: maximum point (5) for 'completely agree' and minimum point (1) for 'completely disagree'. The items were in three sections: mastery goals, performance-approach goals and performance-avoidance goals. Each section involved six items. When given to the students, the items were mixed up, not to lead them to choosing one group of goals, but to assess each item as it is. The mean value for each goal has been found by adding up the points obtained for all items and dividing the sum by the number of items (six).

This questionnaire instrument was used twice during the term:

- Initially, before the experiment, to all 39 students who volunteered to participate in the survey.
- Second time, at the end of the term, to the 20 experimental group students. The questionnaire was not given to the control group students as there was no intervention done which could have caused any significant change in their learning goals.

4.3 Participants

In the experimental study, AGQ was applied to 39 volunteer sophomore students from the faculty of Business and Administrative Science in spring semester of 2015-2016 education year. 41.1% of the sample were female and 58.9% were male. They were selected randomly from volunteer students in mathematics class. Further, AGQ was given to 20 (experimental group) sophomore students after the treatment. 40% of the sample were female and 60% were male.

4.4 Results of Experiment

As correlational study permits to see the relations between two or values, but does not permit to say which variable is the cause, and which is the result, an experimental study was necessary to find out that the goal orientations are the cause and the level of students' skills were the results, and not vice versa. This is why the independent variables in the experiment were mastery, performance-approach and performance-avoidance goals, while the dependent variable was the level of students' mathematics test results. Students with non-mastery goals were selected and underwent a special treatment to modify their goals to mastery ones.

The experiment involved the following studies:

1. Finding out the correlation between students' tests results and the goals adopted by students while learning mathematics (empirical correlational study)
2. Experiment per se, with two sub-groups (performance-approach and performance-avoidance students) who were treated according to the suggested mastery-goal-developing model, to increase their mastery goal and to help them change their non-mastery goals to the mastery goals. The results of the students who maintained non-mastery goals ('control group') were compared to the results of the students who developed mastery goals ('experimental group').

4.5 Correlation Between Students' Pre-Test Results and the Goals Adopted By Students While Learning Mathematics

Students' pretest results were compared to their MG (mastery goal), PAG (performance approach goal) and PAvG (performance avoidance goal) achievement goal orientation, like in the case study. In order to show whether students' mean grades' changes were based on their adaptation of achievement goal motivation one-way ANOVA was used.

- Null hypothesis (H_0): The mean results of MG-oriented students is less than or equal to the mean results of PAvG and PAG.
- Alternative hypothesis (H_1): The mean results of MG-oriented students were higher than from the mean results of PAvG-oriented and PAG-oriented students.

The obtained quantitative data were analyzed using Elliot's AGQ. In order to identify students' goal orientation, it was given twice to 39 students who were selected randomly among volunteers in mathematics class. And then their course exam results were compared to their motivational types.

According to students' first AGQ results from the table 2 it can be seen that among 39 students 16 have PAvG, 15 have MG, and 8 - PAG. The mean results of those students whose goal orientation is mastery learning is 75 (out of 100 possible), while for performance approach it is 72 and for performance-avoidance is 59. Therefore, the null hypothesis was not confirmed and it is possible to say that the mean results of mastery-goal-oriented students is higher than that of students with performance-avoidance and performance approach goals. Mastery-oriented students showed the highest success.

Table 2: Average grades in mathematics of MG, PAG and PAvG-oriented students according to the pre-test exam result

GPA/ goals types	Number of students (out of 39)	Mean result (out of 100)	Standard deviation	Standard error
Mastery goals	15	75.33	13.82	3.58
Performance-Approach Goals	8	71.88	10.99	3.89
Performance-Avoidance goals	16	58.75	17.28	4.78

According to the standard deviation from Table 2 it is seen that the variability of mean value (mean grades) is the highest for the students with performance-avoidance goals, it means that their results differ

substantially from each other. The standard deviation is still high for the students with MG and the lowest – for the students with PAG.

Table 3: ANOVA left-tail test shows significant difference between MG, PAG and PAvG oriented students' mean of grades

	Sum of squares	df	Mean square	F	p
Between groups (combined)	2294.535	2	1147.268	4.566	0.017
Within groups	9045.208	36	251.256		
Total	11339.744	38			

According to table 3 it is possible to say that MG, PAG and PAvG-oriented students' mean grades are significantly different from each other, since $p < 0.05$.

Table 4: Correlations between students' types of achievement goal orientations and math score

variables	N (out of 39)	Correlation (r)
Grade & MG	15	0.35
Grade & PAG	8	0.07
Grade & PAvG	16	-0.20

Table 4 reveals the existence of a positive correlation between MG and students' academic success (average grade in mathematics is positively correlated to mastery goal orientation: $r = 0.35$). The PAG yielded a positive, but very weak relationship with the mean grade in mathematics ($r = 0.07$). On the other hand, PAvG correlation with the mean grades in mathematics is negative ($r = -0.20$). All this supports the hypothesis about the interdependence between the learning goal orientation and students' level of mathematical skills.

4.6 Experimental Group Students' Pre and Post-Treatment Results and Their Analysis

The aims of this experiment were:

- to assess the efficiency of the suggested model of changing students' non-mastery (PAG and PAvG) goals to mastery goals (to see if the students' goals remained the same or changed) – with the help of the repeatedly held questionnaire;
- to find out, whether the students' grades in mathematics would increase as result of goal change.

In this study also it has been frequently emphasized that for long-term engagement and the increase in students' effort on the task they should have a vital belief concerning success that competence increases due to hard work. So, when students become mastery goal-oriented, they will believe that success depends on effort and persistence (beliefs of mastery-learning goal- oriented students) rather than on luck or ability (beliefs of performance-approach-goal-oriented students). Thus, they will have more chances to use effective learning and other self-regulatory strategies and to be better learners to achieve their goals for learning mathematics successfully. In this experiment the teacher of the 'experimental group' tried to inspire in her students a strong desire to become proficient for the sake of knowledge and the belief that effort is the key for success, not ability. Everything was done so that they would prefer challenging tasks, and their perseverance in completing the task would even increase when they would face difficulties.

Elliot's AGQ had been given to 39 sophomore students who were selected randomly in mathematics class in order to identify students' goal orientation type before the experiment began. According to first AGQ results, 15 students out of 39 had MG, while 24 had non-mastery goals: 16 had PAvG and 8 - PAG. Among 24 students, who were non-mastery goal-oriented, 20 students volunteered to continue the research, 8 with PAG and 12 with PAvG. During the experiment the non-mastery-goal oriented 20 students, upon their consent, underwent a one-semester-long treatment according to the model, presented in the study.

Table 5: Second AGQ questionnaire results

Goal type/average points received by the students for the corresponding section	MG-oriented students' GPA	PAG-oriented students' GPA	PAvG-oriented students' GPA
PAG students (8 → 5)	3.0	1.0	2.0
PAvG students (12 →2)	2.7	1.3	1.0

If in the beginning of the experiment there were 8 students with PAG, at the end, according to questionnaire results, there were 5, and even they received lower mean results in the PAG category questions than before. Also, if in the beginning of the experiment there were 12 students with PAvG, at the end, according to questionnaire results, there were only 2, and even they received lower mean results in the PAvG category of questions than before. The experiment has reached 65% success, which is a very good result for a one-semester period.

Table 6: Those students' mean of pre-test and post-test results who had non-mastery goals, but during the experiment changed their orientation to mastery goals

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	pre-test &	67.82	13	8.567	2.376
	post-test	83.85	13	10.439	2.895

Table 6 reveals that the students' post-test mean results (83.85) are 16.03 points or 23.6% higher than pre-test results (67.82). To check whether the difference between students' mean pre-test and post-test results was statistically significant, Paired Sample t-test was applied.

Table 7: Those students' mean of pre-test and post-test results who had non-mastery goals, and during the experiment did not change their orientation to mastery goals

Pre-test & post-test	Mean	N	Std. Deviation	Std. Error Mean
Pair 1 pre-test & post-test	58.57 66.43	7 7	11.073 5.563	4.185 2.103

Table 8: Those PAG and PAvG students' mean of pre-test and post-test results who had non-mastery goals, who maintained non-mastery goals

Non-Mastery goals	Mean pre-exp.	Mean post-exp.	Increase
PAG	55.00	61.00	6.00 (=10.9%)
PAvG	67.50	70.00	2.50 (3.7%)

In Tables 7 and 8 the results of the students who had non-mastery goals, and during the experiment did not change their orientation to mastery goals are presented. They only partially developed the relevant views and showed less improvement in their academic success. Performance-approach goal students' results improved by almost 11%, and performance-avoidance goal-oriented students' results almost have not improved (by 3.7%). And, of course, the result is not good enough and is negatively related to good academic standing. This result in the experiment shows that the quality of student learning as well as the will to continue learning largely depends on mastery-learning goals students bring to the classroom. The

hypothesis dealing with the positive impact of mastery goal orientation on students' mathematics achievement was supported by the results of the experiment.

5. Limitations of the Study and Suggestions for Further Study

Although this research was carefully prepared and reached its aim, it had some limitations. First of all, because of the time limit, this research was conducted only a small size of population in a single university in Turkey. Although it was representative enough for the given university, it would be difficult to generalize these findings for university students at other institutions and countries. This limitation can be overcome through replications and additional larger-scale and longer-period studies that would use the same or similar methodology of research.

These findings suggest that mastery goals are the most efficient ones, so it is desirable to diagnose students' goal orientations and to persuade those undergraduate students, who come to university with performance-approach and performance-avoidance goals to apply mastery-learning goals while learning mathematics at university. Teachers also need to help the students who initially have mastery goals to maintain them. To persuade students change their goal orientations, it is necessary to bring to their minds that they may be at risk of failing as well as dropping out of university due to their inefficient goal orientation. It is necessary to explain to them that PAvG and even PAG will only temporarily help them save the face, but eventually they will lose their face – the thing they are so afraid of - will inevitably happen.

Teachers should inspire the belief that mathematical competence increases due to intensive and thoughtful work. Teachers should help students realize that mathematics is not only practically useful and theoretically beautiful, but also broadly - intellectually and cognitively -beneficial and it can be also used as a tool for cognitive development. Teachers also should help students by avoiding stressful situations and reducing negative assessments of students' genetic capacity of learning mathematics. Students who adopt ego-involved goals want to boost positive assessments of their competence in order to perform better than others. However, the wish to get high points triggers anxiety and the temptation to cheat. Debilitating levels of anxiety drop the students' grades, while cheating in the process of testing may let the students get passing grades for the exam, but will create grave problems for tackling with challenges during their professional careers. Teachers, who use frightening their students with test failure in the hope that the students will work harder, are deeply mistaken. This will only provoke cheating, as students' anyway low self-efficacy will drop still lower with their 'help'.

Another important suggestion according to findings is that, in order to improve students' achievement in mathematics in school or at university, educators should focus on enhancing students' academic self-efficacy beliefs through mastery-learning-goal-oriented classroom activities. The research was held at university, but largely the conclusions are applicable to teaching mathematics at school, too. In that case additional research might be needed.

6. Conclusion

Based on the theoretical and experimental results mastery-learning goal adaptation enhances students' achievement in mathematics and bridges the gap between students with high and low abilities in

mathematics by supporting the belief that competence increases due to hard work. This belief is important component to keep trying, irrespective the difficulties and obstacles on the way to achievement.

According to the obtained results, it is possible to state that non-mastery students who had not possessed mastery-learning goal motivation initially demonstrated a better academic success after they became mastery-learning-oriented. Their post-test mean result was almost 24% higher than their mean pre-test result and it was positively related to a good academic standing. On the other hand, those students who resisted to becoming mastery-learning- oriented, remained non-mastery and only partially developed the relevant views showed less improvement in their academic success. Performance-approach goal students' results improved by almost 11%, and performance-avoidance goal-oriented students' results almost have not improved (by 3.7%). And, of course, the result is not good enough and is negatively related to good academic standing. This result in the experiment shows that the quality of student learning as well as the will to continue learning largely depends on mastery-learning goals students bring to the classroom. The hypothesis dealing with the positive impact of mastery goal orientation on students' mathematics achievement was supported by the results of the experiment.

If learners attribute success to ability, it has situational positive motivational consequences, whereas when they fail fulfilling a task in some cases, they attribute this failure to the lack of ability, which has negative consequences. On the other hand, increasing students' perceived self-efficacy (efficacy expectations: belief that the learner can accomplish a task & outcomes expectations: belief that a given action will lead to a given outcome may enhance students' mastery goal orientation awareness and improve their ability to persevere when approaching challenging tasks, because, according to Bandura (1997), mastery experience is the most influential source of creating a strong sense of efficacy. Bandura proposed that individuals' efficacy expectations are the major determinants of goal setting, activity choice, willingness to expend effort, and persistence.

Research findings also proved that using authentic assessment tasks (research assessments) that emphasize mastery learning and non-evaluative normative criteria can stimulate students' interest while they are learning mathematics. If teachers choose to design their teaching objectives and pedagogical strategies in order to awake mastery goal orientation (e.g. 'mathematics in natural science'), they can increase students' awareness of real world events which are related to mathematics.

It is also possible to conclude that performance approach is not completely useless. When it is used as a supplement to mastery goals, such as checking that specific steps are being accomplished toward a mastery goal, performance goals might also be useful in the classroom as long as mastery goals should be the main focus. Supporting ideas are given by some researchers (Harackiewicz et al., 2002) endorsing the performance-approach goals is beneficial, if mastery goals are also endorsed. It might be necessary to emphasize that students adopt combinations of goals in different achievement situations. The consideration of multiple goals (except performance-avoidance ones) for success in learning mathematics might be useful within the achievement goal theory.

Figure 1: Motivation Related Questions and Their Position in Math Achievement Motivation (made up by the researcher)

Central constructs of goal theory to mathematics motivation include the above-mentioned theories in Figure 1 Like Maslow's (1943) Pyramid of Needs, this figure is also hierarchical: Achievement Goal Theory embraces all other theories and eventually answers the questions why students can do or fail the given tasks, whether they want or have no desire to try and why this is the way it is.

In the center of the figure there is the question *Can I do this task*? Firstly students have to answer this question, if they answer it affirmatively, they try harder, persist longer, perform better, and are motivated to select more challenging tasks. Students not only need to have the ability and acquire the skills to perform successfully on academic tasks, they also need to develop a strong belief that they are capable of completing tasks successfully. Students' self-worth, self-efficacy and their attributions for their success and failure can also help to answer this question.

The second motivation-related question that children can ask themselves during the learning process in mathematics lessons is *Do I want to do this task*? The question deals with the modern expectancy-value theory. If students are confident in achieving an academic task (self-efficacy) and they believe that the academic task is worth pursuing, they are more likely to engage in an activity and learn things that have a value for them.

As for the question dealing with reasons why students want to do the task, or for the Goal Motivation, individuals often have different purposes or goals for doing different activities, which also can impact their motivation for doing the task, but the efficient goal is mastery goal – the desire to develop mathematical knowledge and skills in order to solve educational as well as authentic (real-life) problems, based on that knowledge.

Table 9: Mastery and performance-oriented classroom management compared

Mastery-goal-oriented classroom management:	Performance-goal-oriented classroom management:
Teacher emphasizes success / competence due to hard work and effort.	Teacher emphasizes success / competence due to ability and intellectual capacity.
Teacher focuses on students' effort and strategy use (when a student fails, s/he gives constructive feedback about student's effort and strategy use).	Teacher focuses attention on comparing students' performance and capacity to each other.
Teacher gives tasks from easy to difficult, increasing difficulty step by step.	Teacher avoids challenging tasks to let students succeed.
Teacher is a modelling problem-solving and assessment, then a student who is often successful fulfils the task, then weaker students are guided by the teacher (or peers)	Teacher simply uses problem-solving and assessment, without explaining their logic (e.g., does not present rubrics to students).
Teacher's main belief is that students' mathematics-efficacy can be increased with mastery goal oriented behaviors.	Teacher's main belief is that competitive lesson activities make students more confident and so mathematics-efficacy will be higher.
Students' desire for developing skills is higher than their fear of failure. Formative assessment is emphasized.	Students' desire to pass / get a high grade is emphasized. Summative assessment is emphasized.
Pair and group work is used, to let students share problem-solving strategies.	Whole-class and individual work is used, to boost competition.
Students give importance to self-improvement and mastering tasks, because teacher wants students to work for the sake of learning.	Students give importance to outperforming others and getting the highest grades, because teacher wants students to work for the sake of a grade.
When competition is organized, it is between groups, not between individual students.	Competition (who finishes the task first and correctly is rewarded) is often applied.
There is no limit in the way of success.	Students determine their level of success and put limit to it, comparing themselves to their peers.

From the table it is reasonable to see that mastery goals are more beneficial to students in terms of mathematics achievement. However, it does not mean that performance approach and extrinsic

motivation are completely useless. When they are used as a supplement to mastery goals and intrinsic motivation, such as checking that specific steps are being accomplished toward a mastery goal, performance goals might also be useful in the classroom as long as mastery goals are the main focus. Supporting ideas are given by some researchers (Harackiewicz et al., 2002) that endorsing the performance-approach goals is beneficial, especially when mastery goals are endorsed first of all. However, very little research has been conducted on the relation of multiple goal contexts (with mastery and performance-approach goal structures) to student learning.

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