# Predicting model of mathematics problem solving: the role of achievement goal & self-regulation strategies

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*Abstract:* -The purpose of this study was to develop and test a model of math problem solving performance based on achievement goals and self- regulation strategies. 435 male and female students from first grade high schoolers in Yazd were selected. To collect data, a math test and two questionnaires were applied, i.e. achievement goals ( Elliot & Mc Gregor, 2001) and Motivated Strategies for Learning Questionnaire (Pintrich et al, 1991).The results indicated that the obtained model fits the data adequately. Motivational strategies had a direct effect on problem solving. Furthermore, mastery and performance approaches had affected cognitive, metacognitive, motivational, and resource management strategies directly. Goal approaches had affected students' problem solving performance indirectly. Performance avoidance goals had no effect on motivation strategies and mathematics problem solving.

*Key-words:* achievement goals, self- regulation strategies, mathematics problem solving

## 1 Introduction

The importance of motivational and cognitive components of learning has been shown in many studies such as (Garcia & Pint rich, 1994, Pint rich, 2000). The majority of the theoretical and empirical works conducted in achievement motivation literature in the past decades have used an achievement goal perspective. The primary emphasis on goal perspective has been on two goal types :mastery goals which is manifested as a desire to develop competence and performance goal as the desire to demonstrate competence.

According to Elliot and his colleagues (Church, Elliot & Gable, 2001), the original Performance goal include performance –avoidance goal orientation as the wish not to disclose lack of competence, and performance approach goal orientation as the desire to demonstrate competence. Mastery goal orientation has been clearly found to be related to adaptive outcomes such as self-efficacy, self-regulation, interest, intrinsic motivation, and deep strategies in learning." In fact some theories equate mastery goals with intrinsic motivation and virtually all portray mastery goals as the ideal form of competence based regulation" (Elliot & Mc Gregory, 2001, p.502).

Ames and Archer (1988), Schmidt and Ford (2003), have shown a positive relationship between mastery goals and met cognitive strategies. However, the relationship between performance approach and met cognition is not clear. Ams & Archer (1998), have found a weak positive relationship between performance-approach goal and met cognition. In contrast, mastery-goal orientation represents a focus on learning, understanding, task mastery, and personal improvements (Ames, 1992; Dweck, 1986; Pint rich & Schunk 2002).

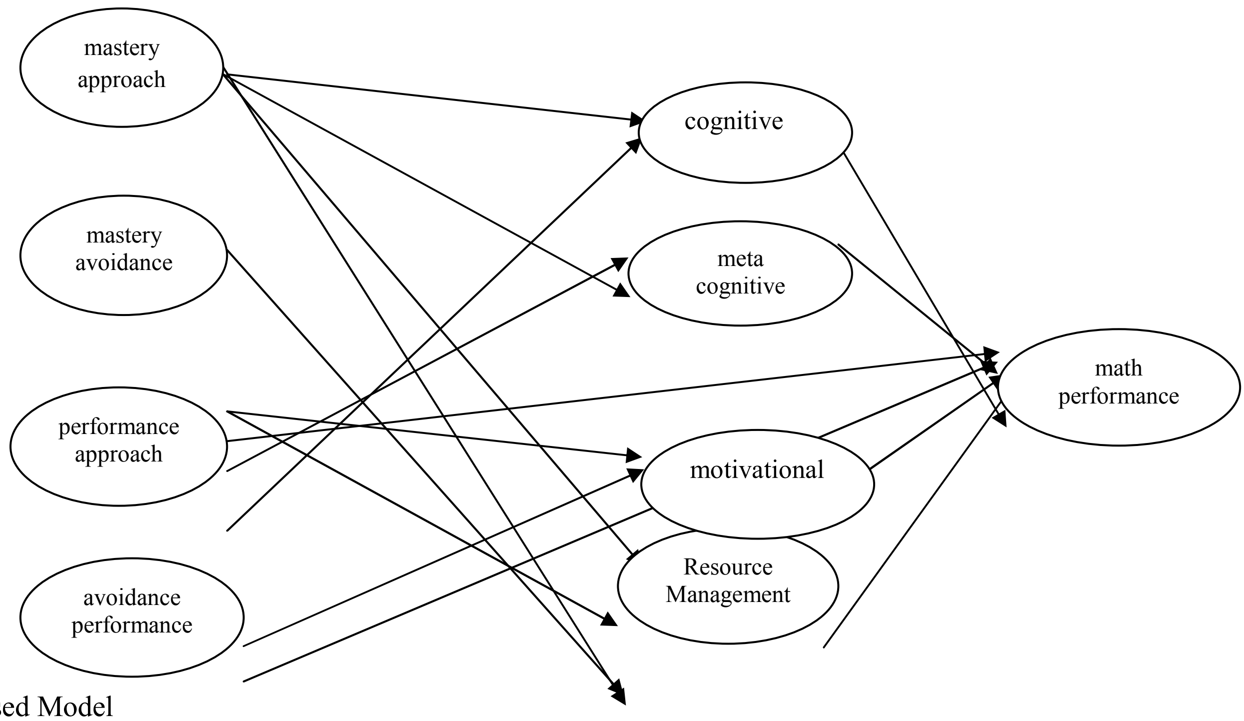
The first two sets of goals can be differentiated in terms of whether learning is perceived and valued as an end in itself or as a means to a goal external to the task (e.g. gaining social approval, demonstrating superiority, etc.). On the basis of this distinction, students may engage in tasks for trying to outperform their peers or to impress their teachers (i.e., performance gols), on the other hand they imay engage in tasks to develop competence by learning as much as they can about a subject (i.e., mastery goals).

The relationship between self-efficacy, self-regulation, academic goals, and academic achievements in mathematics were examined by Middleton and Midgley (1997). They found that mastery goal orientation positively predicted academic self-efficacy and reported the use of self-regulated strategies in learning.

Self-regulation comprises three sub processes: self-observation, self-judgment, and self-reaction (Bandura, 1986; Schunk, 1994; Zimmerman, 1989). The performances related to sub processes are not mutually exclusive. They, rather interact with one another in a reciprocal fashion.

Self-observation refers to the learner's deliberate attention to his or her own performance, which usually involves systematic monitoring (Schunk & Zimmerman, 1994; Zimmerman, 1989). In the second process of self-regulation, or self-judgment, the learner compares the present performance with his or her goal. The third process of the individual's self- regulation involves self-reactions to one's performance. Then new model of self-regulation (Pint rich, 1999) puts an emphasis on two factors (motivation & cognition).

The problem solving ability is recognized as a complex interplay between cognition and meta-cognition. A primary source of difficulty in problem solving may be in the pupil's inability to actively monitor and subsequently regulate the cognitive processes engaged in the problem solving process (Artzt & Armour-Thomas, 1992). It is known that individuals with a higher level of meta-cognitive ability perform better in problem solving tasks. They take a great care to understand the relationships among the facts of a problem. In the field of mathematics achievement, several studies used structural equation modeling or path analysis for determining the important variables that effect mathematics performance directly or indirectly. In the present study we proposed the following model:




Proposed Model

# 2 Method

## 2.1. Participants

A total of 435 (220 males and 215 females), all of which were first grade high school students participated in this study and completed achievement goal Questionnaire (Eliot & Macgregor, 2001), Motivational strategies for learning Questionnaire (Pint rich et al, 1991) ,and math-achievement test.

## 2.2. Measures:

**1- Achievement Goal Orientations Questionnaire:** The Achievement Goal orientations Questionnaire (AGQ) was used in this research to assess four widely studied goal orientations: mastery approach, mastery avoidance, performance approach and performance avoidance (Elliot & McGregor, 2001).

**2- Self- regulation scale:** self-report questionnaire on self-regulation was administered to access students' motivation, cognitive strategy usage, meta cognitive strategy usage, and management of effort. Students were instructed to respond to the items on a 7-point Liker scale (1 = not t all true of me to 7 = very true of me)

**3- Mathematics Performance test**: In order to measure math-Performance 10 questions of TIMSS, (The international Mathematics and Science Study 2003, 2007), in cognitive domain (logic) were used.

Validity and reliability of the measures in this study were found respectively for mastery approach, mastery avoidance performance approach, performance avoidance, met cognitive, motivational strategies, resource management, and math performance as follows: 0.66, 0.74, 0.70, 0.51, 0.85, 0.74, 0.86, 0.67, 0.80, which are summarized in the following table:

**Table 1- Validity & reliability of the measures**

| Variables | Kronbach α |
|---|---|
| Mastery approach | 0.66 |
| Mastery avoidance | 0.74 |
| Performance approach | 0.70 |
| Avoidance performance | 0.51 |
| Cognitive | 0.85 |
| Met cognitive | 0.74 |
| Motivational | 0.86 |
| Resource management | 0.67 |
| Math performance | 0.80 |

# 3 Results

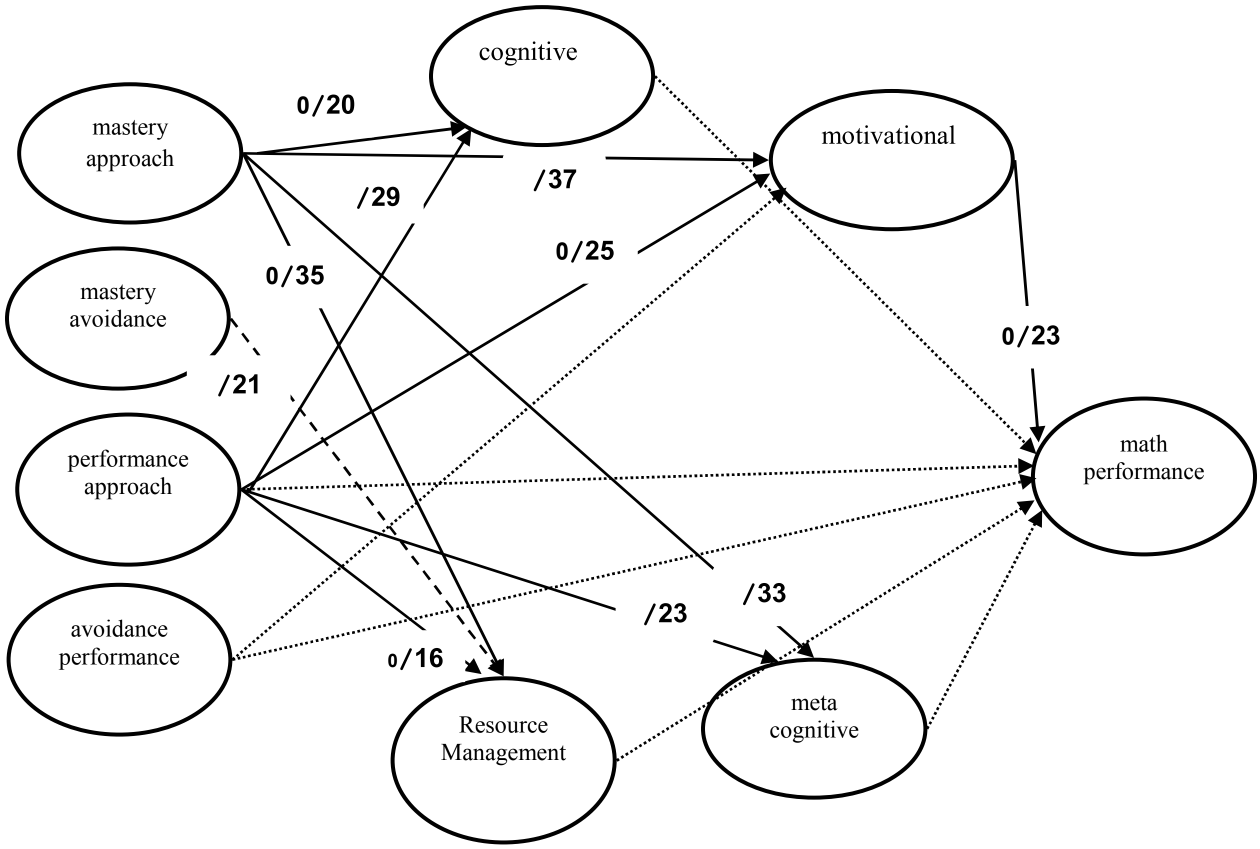
**Table 2- correlations among measured variables.**

| Latent variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Achivement gol | mastery approach (1) | 1 | | | | | | | | |
| | mastery avoidance (2) | *0/17 | 1 | | | | | | | |
| | performance approach (3) | *0/40 | *0/13 | 1 | | | | | | |
| | avoidance performance (4) | *0/24 | *0/19 | *0/35 | 1 | | | | | |
| Self regulation Strategies | cognitive (5) | *0/31 | 0/08 | *0/37 | *0/21 | 1 | | | | |
| | met cognitive (6) | *0/41 | 0/05 | *0/36 | *0/20 | *0/27 | 1 | | | |
| | Motivational (7) | *0/46 | 0/02 | *0/40 | *0/23 | *0/45 | *0/55 | 1 | | |
| | resource management (8) | *0/37 | *–0/12 | *0/26 | *0/15 | *0/47 | *0/60 | *0/44 | 1 | |
| math performance (9) | | *0/18 | 0/02 | *0/15 | 0/05 | 0/02 | *0/09 | *0/23 | *0/11 | 1 |

P<0/05*

The above table shows the relationship between indigenous and exogenous variables in the study.
The results show a meaningful relationship between all the variables, except for mastery abidance, cognitive, met cognitive and motivational strategies. Considering that the equation modeling analysis is based on correlation, the no significant relations were omitted from the theoretical model of the study.




## 4 Discussions

Examining the effect of approach goals on indigenous variables in the model, it was found that goal approaches affect the cognitive, meta cognitive, motivational, and resource management. The direct effect of mastery goals on cognitive, meta cognitive, emotional, and resource management is supported by Pint rich Degeroot (1990) and Eliot, Mc Greg or (2001).

Students with mastery goals devote more efforts to monitor their learning and use higher level strategies to manage their resources. While, mastery avoidance had a negative effect on resource management. This results is comparable with Eliot & Mc Greg or(2001), in which mastery avoidance was Predictive of disorganization in goal orientation.

As discussed in the introduction a substation amount of research showed a positive relationship between mastery approach goals and the use of effective learning strategies, such as cognitive, meta cognitive, motivational, self-regulated and resource management. In the theoretical model of the present study, we proposed that achievement goal orientations predict the use of learning strategies and eventually affect the students' performance through meta cognitive self-regulated learning skills. It is clear from the results that mastery goal orientation has a direct effect on cognitive, meta cognitive, motivational, and resource management, but not on math-performance.

The results revealed that the impact of mastery approach and performance approach on motivational strategies, leads to an indirect affect on performance problem solving. However, there was no direct affect of mastery goals on the total score and there was no significant exogenous parameter found from performance-approach in the model. These unexpected findings could be verified by the usage of self-reports measures of goal orientation.

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