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# The Effect of Students'Individual Factors on the Self-monitoring Ability of Mathematics Problem Solving

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**Abstract**
*Mathematics learning process is not only a cognitive process of identifying, processing and understanding the learning materials, but also a dynamic self-monitoring process of positive feedback and regulation. This paper first gives the definition of self-monitoring ability of mathematical problem solving, and then analyses the influence of students'cognitive and non-cognitive factors on self-monitoring ability of mathematical problem solving.*

**Key words**
*Mathematical Problem Solving, Self-Monitoring Ability, Cognitive Factors, Non-Cognitive Factors, Motivation*

## I. Introduction

Mathematical problem solving is not a mechanically implemented process according to a pre-determined degree. Pre-determined solutions are often superficial and tentative, and the process of solving problems sometimes interrupts or deviates from the correct direction. In the process of solving problems, we are likely to change our point of view again and again, or change the way we think about problems. The process of solving mathematical problems is a dynamic process that needs to constantly self-evaluate whenever is necessary. The main characteristic of mathematical problem solving is subjectivity. Students'individual factors have an important influence on the self-monitoring ability of mathematical problem solving.

## II. The Meaning of Self-monitoring in Mathematical Problem Solving

In the term of self-monitoring, "monitoring" means supervision, feedback, control and regulation. Self-monitoring refersthatmonitoring subject is the same as the monitoring object, which essentially belongs to people's self-awareness and self-control of their own activities. Brown (A.L.) thinks that there are five kinds of self-monitoring activities that are more important: (1) making plans for the next step when implementing a strategy; (2) monitoring the effectiveness of individual steps in the strategy; (3) testing them when implementing the strategy; (4) modifying the strategy when necessary; (5) evaluating the strategy to determine its effectiveness.

The concrete meaning of self-monitoring of mathematical problem solving is that in order to ensure the success of solving problems, improve the efficiency of solving problems and achieve the goal of solving problems correctly and fast, the solver takes himself as the object of solving problems in the whole process of solving mathematical problems, and plans, supervises, inspects, evaluates, feedback, controls his thinking and consciousness actively and consciously.

## III. The influence of students'cognitive factors on self-monitoring ability in problem solving

In the process of solving mathematical problems, some of the functions of self-monitoring are intentional and some are unintentional, but no matter what form it takes, it must have a corresponding "material basis" in the cognitive structure. That is to say, students'self-monitoring ability is inseparable from students' mathematical cognitive factors. Polia once said, "If we are poor in knowledge of this topic, it is not easy to have good ideas. If we have no knowledge at all, it is impossible for us to have good ideas. A good idea is based on past experience and existing knowledge. The basic elements of mathematical cognitive structure are: (1) theoretical knowledge of mathematics; (2) prerequisite knowledge of mathematics; (3) empirical knowledge of mathematics. These knowledge and experience constitute the precondition of students'self-monitoring in the process of solving problems.

### 1. Mathematical theoretical knowledge

Mathematical theoretical knowledge mainly includes concepts, formulas, rules, definitions in mathematics and the way in which they relate. They are the "hardware" in the mathematical cognitive structure and the basis of all effective mathematical activities. Of course, in order to carry out self-monitoring of mathematical problem solving, students must also have rich and perfect theoretical knowledge.

### 2. Prerequisite Knowledge of Mathematics

The prerequisite knowledge of mathematics mainly includes the core idea of mathematics, the mode of mathematical thinking and the strategic knowledge of mathematics. The core idea of mathematics refers to the basic mathematical ideas and concepts that play a central role in the understanding of the essence of mathematics. It plays a dominant role in the self-monitoring of students'problem solving. Mathematical thinking mode is a procedural summary of the general thinking process of problem solving. Because it is a general way of thinking, it can regulate students'mathematical behavior. Strategic knowledge is monitoring knowledge that make mathematics learning or problem solving effect better. Strategic problem solving can reduce the arbitrariness of attempt and error, shorten the time to solve the problem, and improve the efficiency of solving the problem successfully.

### 3. Mathematical Empirical Knowledge

Mathematical empirical knowledge mainly includes mathematical procedural knowledge, mathematical situational knowledge and mathematical evaluation knowledge. Mathematical procedural knowledge refers to the knowledge that how to use mathematical skills. It provides corresponding rules for students'problem solving activities and plays a controlling role in self-monitoring in problem solving. Mathematical situational knowledge refers to the knowledge of applying the mathematical method or knowledge under what conditions and backgrounds. Question situational knowledge can activate students'thinking activities,

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and can consciously combine or construct to discover the hidden relationship in the topic. Therefore, this kind of knowledge can guide and support students'self-monitoring behavior. Evaluative knowledge is the knowledge of judging whether it is correct or not. It can make timely evaluation on the correctness of problem understanding, the feasibility of drawing up plans and the simplicity of solution. Therefore, it can check and regulate the self-monitoring behavior.

## IV. The influence of students'non-cognitive factors on self-monitoring ability of solving mathematical problems

Students'non-cognitive factors include temperament, personality, cognitive style and motivation, attribution, self-efficacy and so on. From the meaning of self-monitoring, we can see that one of the fundamental reasons why students can effectively self-monitor themselves in the process of solving mathematical problems lies in students'subjective initiative, which requires that problem solvers have strong motivation and self-efficacy of self-monitoring. Here, we mainly discuss the influence of these two factors on students'self-monitoring ability in problem solving.

Firstly, motivation and self-efficacy have the functions of initiation and maintenance for self-monitoring of problem solvers, which directly affect the value evaluation and behavioral response tendency of problem solvers to their own problem solving activities. Solvers who are confident and interested in self-monitoring in problem solving can actively regulate their problem solving process. Similarly, they will keep this behavior in time and direction. Students who conduct self-monitoring problem-solving activities based on the two can usually complete the task as independently as possible without relying on the help of others, and evaluate the success or failure of their problem-solving process by their own internal standards.

Secondly, motivation and self-efficacy affect the level of self-monitoring by determining the problem solver's choice of problems. Students with strong motivation and high self-efficacy are enthusiastic and confident about their problem-solving activities, and tend to choose problems that are suitable for their current level and have certain obstacles solving, which means that they also put forward higher requirements for their self-monitoring ability of problem-solving. However, students with weak motivation and low self-efficacy show insufficient confidence in their problem-solving ability, and tend to choose problems that are easy to do, less difficult or no difficult, which makes them lose the opportunity to strengthen their self-monitoring ability, thus this reduce the possibility of improving their self-monitoring ability.

Thirdly, motivation and self-efficacy directly affect the strategy choice of the problem solver, thus affect the self-monitoring level of the problem solver. Compared with those with strong motivation and self-efficacy, the problem-solvers with weak motivation and low self-confidence are reluctant to try new strategies because of their low estimation of their abilities and lack of interest in problem-solving activities. It is difficult to choose appropriate strategies and put them into practice independently according to the actual situation, which hinders the enrichment of their self-monitoring strategies. Students with strong motivation and high self-efficacy are willing to try new methods and strategies, which will constantly enrich self-monitoring strategies and improve their ability to monitor their problem-solving process.

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