



# Research on the Influencing Factors of Postgraduate Research Innovation Behavior Based on MATLAB Software

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## Abstract

Master student research innovation behavior is influenced by many factors. Through literature review and expert interviews, this study summarizes the influencing factors of research innovation behavior of postgraduate students from the three levels of individual, interpersonal and school. The interpretation structure model and hierarchical analysis are used in the analysis of influencing factors of system the complicated relationship between various influencing factors, and the hierarchical structure relation model is built. The hierarchical structure relationship model was constructed to determine the relative importance of complex factors in the hierarchy by pairwise comparison. The results show that personality and emotion are the surface influencing factors, research pressure and research ability are the middle influencing factors, and peer support, training mode, graduation requirements and research conditions are the deep influencing factors.

**Keywords:** Master student, Research innovation behavior, Interpretative Structural Model, Analytic hierarchy process, MATLAB

## 1 INTRODUCTION

In July 2020, Sun Chunlan, deputy prime minister, said in a national conference on postgraduate education "to study as the basic indicators to measure the quality of the graduate student", to strengthen training graduate students scientific research and innovation spirit and innovation ability of scientific research, and promote the output more influential scientific research innovation [8]. Graduate education is the core element to implement the innovation-driven development strategy and build an innovative country, and the ability of scientific research innovation is an important assessment standard to measure the quality of graduate education and academic level. As the first stage of graduate education development, the importance of graduate students is self-evident. However, it is found in the existing research that there are many problems in the process of postgraduate research.

First of all, postgraduate students have short-term utilitarian motives, different professional basic levels, lack of academic quality, and relatively weak

independent accumulated academic ability and innovation consciousness [11], resulting in a low conversion rate of research results during postgraduate study. Secondly, as the first person who is responsible for postgraduate training, supervisors directly affect the quality of postgraduate education [2]. However, existing studies show that many problems exist in tutor guidance in China, such as the ignorance of the graduate course teaching, not taking the graduate student degree thesis work, not following the graduate students teaching norms, and discrimination in the process of recruiting students' guidance [13]. Finally, the training plans, teaching contents and teaching methods of some universities fail to make more systematic and practical teaching plans for different majors and disciplines, and fail to teach students in accordance with their aptitude [17].

## 2 LITERATURE REVIEW

### 2.1 Individual Level

(1) Personality traits. It is found that individual enterprise has a significant positive impact on the innovation ability of postgraduates. When students are highly enterprising, they will take the initiative to collect information, increase learning opportunities, be willing to acquire new knowledge, make up for the defects of existing knowledge and cope with the possible changes in the future, which is conducive to improving innovation ability [3]. Therefore, personality traits can be used as influencing factors of graduate research innovation (marked as S<sub>1</sub>).

(2) Emotions. Positive emotion refers to the pleasant subjective experience generated by individuals' behaviors or environmental atmosphere. It not only is conducive to improving individuals' activity ability and enthusiasm, but also promotes individuals to have positive behaviors [25]. Isen (2009) [10] found that positive emotions can promote the improvement of cognitive ability and flexibility, as well as the ability to solve difficult problems in a timely and creative manner. On the contrary, when an individual is in a negative mood, he or she is usually unambitious and content with the status quo, and his or her thinking and reaction will slow down, which is not conducive to the generation of innovative ideas [12]. Therefore, emotion can be used as the influencing factor of research innovation of graduate students (marked as S<sub>2</sub>).

(3) Research pressure. Existing research shows that most graduate students in the face of the research stress would produce two kinds of difference as a result, and the pressure is a kind of research can stimulate the graduate student engaged in academic activities, to promote scientific research ability [23]. Another result is the huge pressure to research seriously increases graduate students' psychological burden, causing them to produce psychological anxiety. This may breed academic corruption and misconduct [6]. Therefore, research pressure can be used as the influencing factor of graduate research innovation (marked as S<sub>3</sub>).

(4) Scientific research ability. In this study, scientific research ability refers to the ability of graduate students to actively acquire information in the process of scientific research, and the ability to effectively use scientific research information to solve academic problems [4]. Existing research shows that the higher ability in scientific research, scientific frontier insight, accumulate abundant knowledge information, identification of various scientific research problem, to make reasonable value evaluation, to carry out scientific research activities independently, solve practical problems, to accumulate practical value of scientific research is the concentrated reflection of graduate student research innovation ability

[1]. Therefore, research ability can be used as the influencing factor of graduate research innovation (marked as S<sub>4</sub>).

### 2.2 Interpersonal Level

(5) Mentor style. The scientific research level of the supervisor and the guidance style of the student play a major role in the influence system of postgraduate training quality, in which the guidance style of the supervisor takes the largest proportion and plays the most crucial role in the influence system of postgraduate training quality [21]. Through literature review, abusive mentors [14], transformational tutors [22], supportive tutors and controlling tutors [20] have a significant impact on graduate research ability and training quality. Therefore, tutor style can be used as an influential factor of graduate research innovation (marked as S<sub>5</sub>).

(6) Same-door support. Although graduate students in the process of conducting scientific research may from many different sources of support, but in the process, students contact most is the teacher as the center of the academic team, and because of the effect of "master culture", often from the stuff for the most support, also has the most relevant and scientific research [24]. After students are supported by their peers, they will become positive psychologically and emotionally, thus improving their innovation ability. Therefore, peer support can be an influential factor of graduate research innovation (marked as S<sub>6</sub>).

(7) Scientific research guidance by tutors. As the model followed by graduate students, tutors play the most critical role in the socialization of graduate students, establishing standards and norms of behavior for graduate students [9]. Studies have shown that graduate students and tutors generally believe that the guidance of tutors is the primary factor affecting the quality of graduate training. Innovation ability and scientific research ability are the indicators that can best reflect the quality of research and cultivation [19]. Therefore, the research guidance of the supervisor can be the influencing factor of the research innovation of graduate students (marked as S<sub>7</sub>).

### 2.3 Organizational Level

(8) Cultivation mode. Training mode is the particular background of education thought, education theory and multi-factor comprehensive product of graduate education as a kind of innovation education, based on the cultivation of the innovative practice process is more advantageous to stimulate the graduate student's innovative thinking, improve the comprehensive quality of graduate students [18], the existing research has shown that, Innovation-based training mode has a positive impact on the innovation ability of postgraduates [7]. Therefore, the cultivation mode can be used as the

influencing factor of graduate scientific research innovation (marked as  $S_8$ ).

(9) Graduation requirements. In the process of graduate education, the dissertation system and academic management mechanism are a big mountain for graduate students to face, and also the starting point for students to gradually become scholars. Because some schools require papers to be original and innovative, graduate students must constantly improve their scientific research ability and innovation ability in order to meet the graduation requirements [16]. Therefore, graduation requirements can be used as the influencing factor of graduate research innovation (marked as  $S_9$ ).

(10) Research conditions. Scientific research condition as an indispensable part of scientific research environment, to a certain extent affect the graduate student's scientific research and innovation, especially in science and engineering professional research, laboratory facilities and samples if you can't use, or can't meet the demand of the experiment, then the experimental level and the results will be compromised, resulting in a decline in the innovation ability of the students. Therefore, scientific research conditions can be used as the influencing factors of graduate scientific research innovation (marked as  $S_{10}$ ).

Through combing and comparison of literature found that, the scholars from the individual factors (personality health, stress, emotions, etc.), and environmental factors (mentor style, cultivating system, etc.), research and innovation ability of graduate students has explored before, some scholars also will be different levels of a certain factors or combine a few influence factors were studied. However, individual behavior is influenced by the interaction of multiple factors. At present, few scholars have studied the relationship between the influencing factors of graduate research innovation behavior. Starting from individual, interpersonal and organizational levels, this paper uses Interpretive Structural Modeling (ISM) method to construct a hierarchical structure model of graduate students' scientific research innovation behavior, and analyzes the hierarchical structure among factors, in order to be able to help graduate students in the process of cultivating

scientific research. The aim is to provide theoretical guidance for improving graduate students' scientific research innovation ability and promoting the transformation of scientific and technological research achievements.

### 3 RESEARCH METHODS and PROCESS

#### 3.1 Research Methods

Interpretative Structural Model (ISM), proposed by American systems engineering theorist Professor J. N. Warfield in 1973, is used to transform ambiguous thought relations into intuitive models with good Structural relations [15]. ISM is suitable for analyzing and understanding systems with multiple influencing factors and complex relationships among them [5].

In this article, through expert interviews and the form of a questionnaire survey, expert interview is composed of six direction graduate student education experts, questionnaire distributed object is composed of four colleges and universities teachers and graduate students, a total of 232 people, a total of 232 questionnaires, recycling questionnaire 186, eliminate invalid questionnaire (have obvious regularity, missing data), 28, 158 valid questionnaires. SPSS23.0 was used to analyze the reliability and validity of the sample data. The Cronbach  $\alpha$  coefficient was  $0.88 > 0.8$ , and the KMO value was  $0.824 > 0.7$ , indicating that the questionnaire was effective.

#### 3.2 Research Process

In section 2, each influencing factor has been listed and numbered. In this paper, the 16 factors and the relationship with 10 six college graduate student, supervisor of postgraduate, graduate school of the four leadership has carried on the investigation and expert interview, the interview result to carry on the summary, combined with the feature of factors and experts point of view, in order to establish the contact relationship between various factors, ultimately form the adjacency matrix of two elements, as shown in table 1.

**Table 1** Adjacency matrix

	$S_1$	$S_2$	$S_3$	$S_4$	$S_5$	$S_6$	$S_7$	$S_8$	$S_9$	$S_{10}$
$S_1$	0	0	0	0	0	0	0	0	0	0
$S_2$	0	0	0	0	0	0	0	0	0	0
$S_3$	0	1	0	1	0	0	0	0	0	0
$S_4$	0	1	0	0	1	0	0	0	0	0
$S_5$	0	1	1	1	0	0	1	0	0	0

S <sub>6</sub>	0	1	1	0	0	0	0	0	0	0
S <sub>7</sub>	0	0	1	1	0	0	0	0	0	0
S <sub>8</sub>	0	0	1	1	0	0	0	0	0	0
S <sub>9</sub>	0	0	1	1	0	0	0	0	0	0
S <sub>10</sub>	0	0	0	1	0	0	1	0	0	0

According to the adjacency matrix in Table 1, the corresponding reachable matrix is calculated in Matlab2016a. as shown in Table 2.

**Table 2** Accessible matrix

	S <sub>1</sub>	S <sub>2</sub>	S <sub>3</sub>	S <sub>4</sub>	S <sub>5</sub>	S <sub>6</sub>	S <sub>7</sub>	S <sub>8</sub>	S <sub>9</sub>	S <sub>10</sub>
S <sub>1</sub>	1	0	0	0	0	0	0	0	0	0
S <sub>2</sub>	0	1	0	0	0	0	0	0	0	0
S <sub>3</sub>	0	1	1	1	1	0	1	0	0	0
S <sub>4</sub>	0	1	1	1	1	0	1	0	0	0
S <sub>5</sub>	0	1	1	1	1	0	1	0	0	0
S <sub>6</sub>	0	1	1	1	1	1	1	0	0	0
S <sub>7</sub>	0	1	1	1	1	0	1	0	0	0
S <sub>8</sub>	0	1	1	1	1	0	1	1	0	0
S <sub>9</sub>	0	1	1	1	1	0	1	0	1	0
S <sub>10</sub>	0	1	1	1	1	0	1	0	0	1

According to the results in Table 2 and the relationship between two pairs in the adjacency matrix, a hierarchical structural relationship model of influencing

factors of graduate research innovation behavior can be established, as shown in Figure 1.



**Figure 1** Hierarchical structure relationship model of influencing factors of research innovation behavior of graduate students

## 4 CONCLUSIONS

There are many factors influencing the research innovation behavior of graduate students and their relationship is complicated. Through reading the literature, this paper constructs the influencing factors index of graduate students' scientific research innovation behavior from the individual level, interpersonal level and school level. ISM constructs a multi-level hierarchical model and qualitatively analyzes the relationship between the factors of the research results are as follows.

The top influencing factors are personality trait (S1) and emotion (S2), which belong to the direct influencing factors of research innovation behavior of graduate students. The four factors at the bottom are peer support (S6), training mode (S8), graduation requirements (S9) and research conditions (S10), which are the most basic and fundamental influencing factors of graduate students' research innovation behavior. The other four factors in the middle layer are the continuation of direct influence factors and fundamental influence factors.

## 5 SUGGESTIONS

First, schools should pay attention to the importance of research conditions, research incentive system and graduation requirements. Improve the quantity and quality of scientific research resources, communicate with students regularly, collect scientific research resources needed by students, optimize the process of obtaining scientific research resources for postgraduate students, and provide a good scientific research environment for postgraduate students in the process of scientific research. Set up a scientific and reasonable incentive system to encourage postgraduate students to actively participate in scientific research, and give different degrees of reward to postgraduate students who publish excellent papers, forming a good scientific research atmosphere in which you catch up with me. Set reasonable hard graduation requirements, improve the academic paper review system, urge postgraduate students to actively read journal literature and write papers during their postgraduate study, encourage postgraduate students to actively participate in scientific research and take the initiative to carry out scientific research innovation in different ways and systems.

Second, postgraduate supervisors should strengthen the guidance and cultivation of postgraduate academic ability. Lead by example, set up the practical scientific attitude to the student, to establish a diversified group, to encourage graduate student within the group actively carry out academic exchanges, and actively participate in team outside of the academic lecture or academic salons, encourage academic advisor for master's graduate students actively participate in the study of the topic, to strengthen the guidance of graduate student academic

papers, Master the progress of postgraduate research in time, and constantly optimize and adjust the guidance. To encourage postgraduate students to participate in scientific and technological innovation competition in their spare time, so as to improve their own scientific research innovation ability and stimulate scientific research innovation behavior.

Third, master students should strengthen the study of theoretical knowledge and improve the ability of scientific research. Knowledge reserve is the basis of improving the ability of scientific research innovation. Master students should conscientiously study professional knowledge, cultivate the ability of independent learning, pay attention to knowledge accumulation, exercise the ability of actively obtaining information, and cultivate the ability of effectively using scientific research information to solve academic problems. A rigorous and pragmatic attitude towards scientific research should be set up to avoid academic fraud and misconduct. At the same time, attention should be paid to the frontier of discipline development to cultivate scientific interest and promote the improvement of scientific research innovation ability.

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