

Examining Graduate Student Innovation Ability: Insights from Chinese Research

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Abstract: Researchers posit that innovation ability is a comprehensive trait developed through the accumulation of skills, knowledge, cognitive abilities, and external influences. Psychologists emphasize that it evolves with age and environmental factors. It is viewed as both an intellectual and personality characteristic, driven by innovation thinking, intellectual capabilities, and personal traits. Five core dimensions for assessing innovation ability in graduate students include personality, thinking, practice, results, and knowledge. Postgraduates should excel in scientific research, problem-solving, and knowledge transformation and they should possess key traits for innovation such as risk-taking, self-efficacy, motivation, and teamwork. Theoretical models used in the conduct of research in innovation ability include Implicit Theory of Innovations, Explicit Theory of Innovation Ability, Investment Theory of Innovative Ability and Creativity System Model.

Keywords: Graduate Students; Creative Ability; Connotation; Influencing Factors; Cultivation Way.

1. Introduction

The cultivation of innovative talents is not only a need to enhance the competitiveness of individual graduate students, but also a strategic need for the country to realize long-term sustainable development. The cultivation of innovation ability in postgraduate education can provide the country with a steady stream of innovative talents, who will drive scientific and technological progress, economic growth and social progress in the future. The combination of government policy support and the practice of innovation education in colleges and universities will form a synergy and lay a solid foundation for the country's innovation-driven development strategy. Therefore, the cultivation of innovative talents is of importance and far-reaching significance in postgraduate education, which is not only related to the career development of individuals, but also to the prosperity and development of the country.

In 2020, the Ministry of Education, the National Development and Reform Commission and the Ministry of Finance of the Peoples Republic of China jointly issued the Opinions on Accelerating the Reform and Development of Postgraduate Education in the New Era, which proposes to improve the nurturing mechanism of science-education and industry-education fusion, aiming at reforming the mode of postgraduate cultivation with the goal of enhancing innovation ability. This guiding document provides a policy framework and directional guidance for the cultivation of innovative talents in postgraduate education, and pushes colleges and universities to pay more attention to the implementation and landing of innovative education in the cultivation process.

2. Definition of relevant concepts

2.1. Innovation

The concept of "innovation" was proposed by the Austrian economist Joseph Alois Schumpeter in 1912 in the book "Theory of Economic Development", which was mainly used

in the economic field at first. In essence, innovation is the transformation, recombination, and extension relative to the original thing, so as to create a new thing different from the original thing. The following are definitions of innovation from different perspectives: (1) Pedagogical perspective. Innovation is a cultural process, which is the process of promotion and popularization of new ways triggered by the emergence of a new idea, a new behavior, and a new thing. (2) Sociological perspective. Innovation is the acceptance of a new change in an organization or related environment, specifically a new idea, a new practice, or a new manufactured object that is recognized by the relevant use sector. In this study, "innovation" refers to the creation of the new and the abandonment of the old, which is new and creative.

2.2. Innovation Ability

Innovation ability is the ability of an individual or team to use creative thinking and skills to come up with novel and effective solutions when faced with a problem or challenge. It includes the comprehensive ability to discover new ideas, integrate existing knowledge and resources, realize breakthroughs through experimentation and practice, and transform these innovations into practical results. Innovation is not solely dependent on individual creativity; it also requires hands-on skills, teamwork, adaptability, and a keen awareness of new trends. According to Prof. Lin Chongde (2010), who synthesizes both domestic and international perspectives, innovation ability is an intellectual trait characterized by purposeful thinking based on existing information, resulting in something new, unique, and valuable. This ability encompasses various elements, including innovative outcomes, personality traits, thinking processes, and knowledge.

3. The Theoretical Basis of Innovation Ability

3.1. Implicit Theory of Innovation

Implicit Theories of Innovation is proposed by psychologist Robert J. Sternberg. Implicit theory mainly refers to the unconscious cognitions and beliefs that individuals hold about certain traits, and these beliefs influence their behaviors and judgments (Sternberg, 1985). In the implicit theory of innovativeness, Sternberg states that people's perceptions of innovativeness are not based on objective criteria, but are influenced by their personal experiences, cultural background, and social norms. This underlying perception of innovative ability determines how people recognize, evaluate, and foster creativity.

3.2. Explicit Theory of Innovation Ability

This theory was originally proposed by Amabile (1983), who argued that human innovativeness is the result of the interaction of a number of factors, including an individual's intrinsic motivation, innovativeness skills, and knowledge and competence in related domains. Gruber et al. (1988) further developed the Explicit Theory by proposing an evolutionary system to understand innovativeness, which includes an individual's motivation system, knowledge system and effect (affect), after many interactions among the three, some kind of deviation encountered by the individual in problem solving is continuously amplified, and the product of innovative ability is finally obtained.

3.3. Investment Theory of Innovative Ability

Sternberg et al. (1991) also put forward the investment theory of innovation ability. The theory takes stock trading as an analogy, and borrows the economics term "buy low and sell high" to describe the creation process. Creativity requires six interrelated resources: intelligence, knowledge, mindset, personality, motivation and environment.

3.4. Creativity System Model

In the field of psychology, many experts regard creativity as a mental process, and M. Csikszentmihalyi, based on the views of his predecessors, adds that creativity is not only a process of individual mental development, but also a cultural and social event.

4. Researches on Graduate Students' Innovative Ability

4.1. Research on the Connotation of Graduate Students' Innovation Ability

Psychologists believe that ability is a comprehensive quality formed by individuals after mastering certain skills and talents. This quality develops gradually with the individual's age and the influence of external environment. As a comprehensive quality, innovation ability not only relies on the accumulation of individual knowledge and skills, but also is affected by multiple factors such as cognitive ability, personality traits and external social environment. Zhang (2000) pointed out in "Theory of Educational Innovation" that innovative ability is not only embodied as an intellectual characteristic, but also a personality characteristic, which is an organic combination of intellectual and non-intellectual factors. According to Zhang et al. (2002), innovation ability

is a psychological quality unique to human beings that utilizes certain conditions to produce novel, unique, feasible and applicable products. Chen(2003) proposed that innovation ability is the inner integrator of innovation thinking ability and innovation intellectualization ability and innovation personalization ability manifested by the subject in innovation activities, in which innovation thinking ability is the core and key, innovation intellectualization ability is the foundation and means, and innovation personalization ability is the driving force and direction. Xu et al. (2016) redefined graduate students' innovation ability based on the multidisciplinary vision of pedagogy, psychology, sociology and other disciplines, constructed the evaluation index of innovation ability, which includes five first-level indexes which are innovation personality, innovation thinking, innovation practice, innovation results and knowledge structure. From the perspective of human resources, scholars such as Geng(2006) regarded postgraduates as the main body of human resource management, and believed that postgraduates should have the ability of scientific research and innovation in their study and research. Zhang(2010) and Dong(2013) and other scholars believe that postgraduates' innovation ability should be composed of their ability to construct knowledge, ask questions, solve problems, and enhance the ability to transform. Wu(2013) and other scholars analyzed the key qualities that graduate students should possess from the perspectives of psychology and pedagogy, including five aspects of risk-taking consciousness, innovation self-efficacy, divergent thinking, innovation intrinsic motivation, and teamwork spirit. Wang (2019) defines innovation capability as the ability of enterprises, universities and research institutions, intermediary service institutions and other organizations in the region to effectively integrate and utilize innovation resources to promote innovation activities in a certain innovation environment.

4.2. The Current Situation of Research on Graduate Students' Innovation Ability

Various scholars have studied the innovation ability of graduate students based on different perspectives, and most of them have adopted the forms of empirical investigation and quantitative analysis. Dong(2013) and other scholars prepare a questionnaire from the components of innovation ability, divide innovation ability into four parts: knowledge construction ability, problem discovery ability, problem solving ability and transformation and enhancement ability, and carry out a study with more than 4,000 graduate students from a university in central China as the research object. The study found that in knowledge construction, China's graduate students perform better, focusing on the accumulation of knowledge and the establishment of the system, but in the discovery and problem solving, as well as the transformation and enhancement ability needs to be improved. Tang (2013) and other scholars conducted a three-year research on the quality of postgraduate education in 22 "985" colleges and universities, using a combination of questionnaires and in-depth interviews. The results of the survey show that the graduate curriculum system is not able to effectively improve the innovation ability of graduate students, the teaching methods of teachers are not able to effectively stimulate the enthusiasm of students, and the instructors have a wide range of guidance levels. Luo and Lin (2016) conducted a questionnaire survey on the current situation of innovation ability of graduate students in higher medical schools in less

developed regions, and found that graduate students in higher medical schools in less developed regions lack innovation motivation themselves, the construction of university faculty is not strong, and the national support is insufficient. Ye Jun and Chen(2016) et al. conducted a random questionnaire survey and in-depth interviews in six universities in Zhejiang Province and found that the overall innovation ability of graduate students is low and is affected by a variety of factors, such as instructors, learning motivation, university environment and training system. Hu and Wang(2021) analyzed the current situation of innovation ability of science and engineering graduate students, and the study showed that the contradiction between the growth of the number of graduate students and the limited internal resources of universities instructed that the graduate students have fewer opportunities for scientific research and practice, and that their own passive way of learning instructed that the thinking ability was lacking, and that the imperfection of the cultivation system further affected the quality of pedagogy. Chen(2020) designed and distributed a questionnaire with full-time engineering masters from four universities in G province that have the ability to cultivate full-time engineering masters as a sample, and found that most of the full-time engineering masters are still stuck in individual innovation in their consciousness, and they have not yet been correct to the mainstream trend of team innovation and other problems. Huang(2023) selected nursing students in five colleges and universities in Hunan Province as the research object, and found that female students, students who live in the city and have served as student cadres and participated in scientific research and practice activities have the highest innovation ability, and cut the correlation between innovation self-efficacy, independent learning ability and professional identity and innovation ability.

Despite the different specialties investigated, the results of a large number of surveys consistently show that the overall level of China's postgraduate students' innovation ability needs to be improved, which is mainly manifested in low motivation to innovate, average innovation ability, poor innovative thinking, and the quality of academic achievements is not high.

4.3. Influencing Factors of Graduate Students' Innovation Ability

After reading and organizing and analyzing a large amount of literature and combining with our own observation and experience, we found that there are many factors affecting graduate students' scientific research and innovation ability. Zhou(2011) proposed that the cultivation and enhancement of innovation ability is influenced by the enrollment method of the country, the management system of the school and the atmosphere of scientific research and innovation, as well as the mentoring method of the supervisor. Han(2012) believes that the subjective factors affecting the innovation ability of graduate students are: general insufficient accumulation of knowledge, little interest in learning and research, and weak innovation ability; and the objective factors are: talent cultivation mode, education system, scientific research environment and social environment. Yang(2012) believes that the influencing factors of graduate students' innovation ability include research management style, course management style and daily management style and so on. Through empirical analysis, Yang (2014) proved that graduate students' own personal characteristics, such as gender,

enrollment motivation, educational background and other factors have an impact on innovation ability. Supervisor is the leader of graduate students' scientific research and plays an important role in the cultivation of their scientific research innovation ability.

Luo(2017) proposed from the perspective of family education that due to the large number of only children, parents tend to pamper their children too much, resulting in their lack of hands-on ability and weaker practical ability, which in turn affects the keen perception of innovation. This limits the cultivation and development of innovation ability to a certain extent. Zhang (2020) and others pointed out that whether a school has an innovative teaching team largely determines the difficulty of cultivating innovative talents. Xue(2020) et al. pointed out that the innovative spirit of teachers plays a crucial role in the cultivation of students' innovative consciousness and innovative ability. The study of Pan(2022) and others proposed that the influencing factors affecting the innovation ability of college students are mainly learning ability, grade level, whether they are student cadres and so on. There is a significant positive correlation between the level and ability of the supervisor and the research and innovation ability of master's degree students (Hu and Liu ,2022). Li and Wang (2022) and others explored the cultivation of master's degree students and found that the scientific research atmosphere of the school has a greater impact on the innovation ability of graduate students.

4.4. Ways to Cultivate Graduate Students' Creative Ability

Chen(2020) proposed that educational authorities should take the initiative to create favorable conditions to encourage students to develop their interests, expand their knowledge, highlight students' spontaneous personalized development, and cultivate the ability to achieve engineering innovation. Li(2023) proposed adjusting the curriculum system, expanding the scope of students' knowledge and substantially advancing the integration of disciplines to stimulate students' innovative thinking. Yuan(2023) proposed the cultivation mode of mutual cooperation among government, production, teaching and scientific research. Through the platform of cooperation among government, school and enterprise, the government, school and enterprise can realize the mode of "complementing each other's advantages, sharing resources, mutual benefit and common development. Huang (2023) advocates: universities give full play to the role of the management system to create a favorable environment for innovation; tutors give full play to the role of leading and guiding the students to exercise innovative thinking; students give full play to the role of self-motivation, focusing on the shaping of the innovative personality, which are the three major aspects of the Master's degree, respectively, to explore the countermeasures for the enhancement of the innovation ability of postgraduate students.

5. Research Review and Prospect

The research of domestic and foreign scholars on the innovation ability of graduate students mainly covers the theoretical foundation, connotation interpretation, current situation, influencing factors and cultivation paths. By sorting out the existing results and shortcomings, the author provides ideas and reference for future research on the innovation ability of doctoral students in China.

Firstly, most of the existing studies target the graduate student group in a broad sense, lacking the targeting of specific disciplines or specialties, and variables such as gender, age, disciplinary background, and type of school have not been fully considered. Secondly, in terms of research methodology, there are more analysis based on discursive thinking, while the empirical research on large samples is insufficient, and some of the research stays at the level of empirical discourse or simple descriptive statistics. Finally, the evaluation of postgraduate students' innovation ability mostly relies on students' self-assessment or university evaluation, and lacks objective assessment by third-party organizations. Whether to introduce a third-party evaluation organization to improve the objectivity and authenticity of measurement still needs to be further explored. Based on the findings and shortcomings of the existing studies, the evaluation index system of innovation ability needs to be further optimized in the future. This evaluation system should take individual self-assessment, university evaluation and third-party evaluation into account, rather than relying only on innovative achievements (e.g., journal rank, impact factor, number of citations, etc.) as the core indicators. At the same time, attention should be paid to the human-oriented factors in the process of postgraduate training, and corresponding measures should be taken to start from subjective and objective factors in order to comprehensively improve the overall innovation ability of postgraduate students.

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