

Study of Mentor Guidance Behavior and Learning Motivation on Master's Students' Innovation Capability

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Abstract: Innovation capability is a crucial indicator for assessing the quality of graduate education, with mentor guidance behavior and learning motivation playing pivotal roles in its enhancement. Based on survey data from 221 graduate students, this study employs correlation and regression analyses, combined with the AMO theory, to investigate comprehensively the effects of mentor guidance behavior and learning motivation on the development of graduate students' innovation capability, as well as the mediating role of learning engagement. The results indicate that both mentor guidance behavior and learning motivation significantly promote graduate students' innovation capability. Particularly, learning engagement serves as a critical mediator between mentor guidance behavior and learning motivation. These findings not only deepen our understanding of the mechanisms behind graduate students' innovation capability but also provide theoretical support and practical guidance for improving the quality of higher education teaching.

Keywords: Mentor Guidance Behavior; Learning Motivation; Learning Engagement; Innovation Capability.

1. Introduction

Graduate education represents a pinnacle in the educational hierarchy, crucial for cultivating innovative talents. In the face of intensifying international competition, countries worldwide view the cultivation of innovative talents as key to enhancing their comprehensive national strength. Graduate education, as the advanced stage of talent development, provides a continuous stream of talent essential for innovative nations, robustly supporting the realization of the Chinese Dream of national rejuvenation.

Responding actively to national calls, especially amid the massification of higher education, major research universities have significantly expanded their graduate admissions. According to data released by the Ministry of Education, after a 21.22% increase in applicants in 2022, the number of master's degree applicants surged to a record-breaking 4.74 million in 2023, marking a 3.72% increase from 2022. However, alongside these developments, concerns over the quality of graduate education have become increasingly prominent, particularly in the cultivation of graduate students' innovation capabilities.

The cultivation of graduate students' innovation capabilities is influenced by various conditions and factors. Current scholarly focus tends to analyze and verify these issues from the perspective of institutional mechanisms and structures. Yet, existing studies often narrowly focus on specific aspects of graduate innovation capability without undertaking a systematic and comprehensive exploration. This study thus investigates the impact of graduate innovation capabilities from the perspectives of supervisors, students, and institutions. Following this approach, the study utilizes the AMO (Ability–Motivation–Opportunity) theoretical framework to examine the effects of "ability" (mentor guidance behavior), "motivation" (student motivation), and "opportunity" (student engagement) on graduate innovation capabilities.

2. Theoretical Background and Hypotheses

2.1. AMO Theory Model

In the field of behavioral science, capability and willingness are considered two fundamental premises underlying employees' work behaviors, garnering sustained and widespread attention. It is posited that individual behaviors are a function of capability and motivation, and that capability and willingness are key dimensions for identifying subordinates' readiness and leadership situations. Later, some scholars (Blumberg & Pringle, 1982) [1] supplemented this with the opportunity dimension, suggesting that even if individuals have the willingness and ability to engage in a specific activity, actual engagement may depend on objective environmental factors, namely the influence of opportunity factors.

Appelbaum further systematically introduced the AMO theory [2], which posits that employee behaviors and performance are influenced by a combination of capability, motivation, and opportunity, as depicted in Figure 1. Here, capability refers to the psychological and cognitive ability that aids individuals in effectively performing an activity; motivation refers to the psychological and emotional tendency influencing individuals to engage in an activity; and opportunity refers to uncontrollable events or people in the external environment that drive or hinder individual behaviors. Decreases in the psychological endowments of any of these dimensions—capability, motivation, or opportunity—can potentially lead to reduced behaviors and performance levels.

Due to its simplicity and rigor, the AMO theory finds application across various domains. For instance, it has been used to study the impact of "motivation, opportunity, and ability" on brand communication effectiveness in consumer processing of advertising information (MacInnis et al., 1991) [3]. Additionally, it has been instrumental in exploring the role of "opportunity, motivation, and ability" in the exchange

of intellectual capital portfolios (Nahapiet & Ghoshal, 1998) [4]. The AMO theory is also widely applied in discussions on the relationship between human resource management and organizational performance—where effective human resource practices that meet the needs of employee capability, motivation, and opportunity are conducive to higher organizational performance and maximizing benefits.

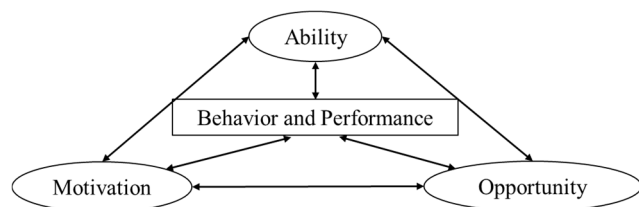


Fig 1. AMO Theory Model

2.2. Mentor Guidance Behavior and Innovation Capability

Based on previous relevant research theories, mentor guidance behavior refers to the professional activity where mentors guide and instruct graduate students to enhance their research capabilities, promote their professional competence and overall development, and ensure research productivity [5].

The more frequent the mentor's guidance behavior during the process of mentoring students, the more tightly paced the students' research activities become. This is beneficial for graduate students to absorb the essence of their mentors' ideas and can stimulate their innovative thinking. Through continuous interaction with mentors, graduate students often spark new ideas, become more confident in expressing themselves, and engage in discussions to exchange their own thoughts and insights. Such academic guidance and inspiration are crucial for the development of graduate students' innovative abilities, fostering research competence and enhancing their innovation capabilities.

Moreover, mentors, as the primary figures responsible for graduate student training, not only provide academic guidance but also directly influence various aspects of students' behavior. When students feel discouraged or lack sufficient interest in research innovation, timely psychological guidance from mentors encourages them to identify problems, actively seek solutions, and motivates them to engage in innovative activities. With the drive for research, new research outcomes can be generated, gradually forming a positive cycle of "innovation - outcomes - innovation." Therefore, this study proposes:

Hypothesis H1: Mentor guidance behavior significantly positively influences innovative capability.

2.3. Learning Motivation and Innovation Capability

Graduate students' learning motivation refers to a psychological force or intention that drives them to engage in learning, which profoundly influences their academic pursuits. Innovation capability, on the other hand, is the capacity required for intellectual creative activities aimed at exploring truths within a disciplinary domain, serving as a critical measure of graduate education quality[6].

Learning motivation plays a crucial role in the development of individuals' knowledge and capabilities. The innovation capability of graduate students arises from a combination of innate intellectual factors and acquired non-intellectual factors. Stimuli from both internal and external environments

can influence learning motivation to varying degrees. Research indicates that higher motivation intensity correlates with superior academic performance. A significant factor restricting the enhancement of graduate students' innovation capability is the lack of research interest and knowledge reserves[7]. The diminishing levels of research interest and study effort are attributed to variations in the strength of learning motivation.

Moreover, individual student factors such as academic motivation and academic quality significantly influence the improvement of graduate students' innovation capability, generating synergistic training effects. Assessing education quality is crucial in the developmental process of graduate education. Institutions actively enhance education quality to stimulate student learning motivation and elevate their interest in learning. Innovation capability manifests as proactive behavior, where students strengthen their subjective initiative and further enhance innovation capability through institutional training programs. Therefore, this study proposes:

Hypothesis H2: Learning motivation significantly positively influences innovation capability.

2.4. The Mediating Role of Learning Engagement in Mentor Guidance Behavior and Innovation Capability

Based on Schaufeli et al. (2002)[8], the concept of learning engagement in this study refers to the positive and fulfilling mental state of graduate students during their learning process. This includes vigor (showing strong resilience in learning, not backing down from difficulties encountered, and putting effort into learning), dedication (having intense enthusiasm for learning, perceiving the significance and value of learning, and accepting challenges), and absorption (fully concentrating on learning and experiencing enjoyment in learning).

Jang (2010) study suggests that learning engagement, as a mediator, indicates that the more social support perceived by students as individuals in learning, the more positively they engage in learning to achieve higher academic achievements[9]. According to Self-Determination Theory, mentors are the most significant influencers on students' learning motivation and behavior during their graduate study careers. Mentor guidance behavior stimulates students' learning motivation, encouraging them to actively engage in learning. Mentor guidance and encouragement can enhance graduate students' interest and enthusiasm for academic research, motivating them to actively learn and explore new knowledge, clarify learning goals and directions, and understand the knowledge and skills they need to master, thereby enhancing motivation and level of learning engagement. Learning engagement can promote students to deeper understanding and mastery of mentor guidance content through continuous practice and reflection, improving students' innovative thinking and problem-solving abilities. In this process, graduate students can systematically and comprehensively learn and master related fields, cultivate research thinking and innovation awareness. Through continuous learning and practice, graduate students can enhance their problem-solving and innovative thinking abilities, gain deeper understanding of theoretical and practical aspects in the research field, and better apply this knowledge and skills to drive innovation development, laying a foundation for the development of innovation capabilities

and further enhancing their innovation capabilities. Based on this, the following hypotheses are proposed in this paper:"

Hypothesis H3: Learning engagement mediates the relationship between mentorship behaviors and innovation capability.

2.5. The Mediating Role of Learning Engagement between Learning Motivation and Innovation Capability

Motivation is the direct force that drives individual behavior, and different motivations lead to different behaviors, which in turn result in different outcomes. According to previous research, an individual's academic achievement depends on their own goals and the implementation of their actions. Due to variations in individuals' hierarchical needs and goals, there are significant differences in their performance in learning behaviors. Learning motivation, as an internal state of goal-oriented needs, effectively stimulates individuals to consider the time and energy they invest, enhancing their learning actions, which is learning engagement. Research creativity is another form of academic achievement expression, and the academic needs and goals formed by individual motivations are realized through learning engagement, thereby promoting the generation of innovation capabilities.

Related studies indicate that learning motivation not only affects learning outcomes but also indirectly promotes the occurrence of learning gains through learning engagement. From the perspective of graduate research, scholars have explored the mediating effect of learning engagement between academic passion and innovation capability. Academic passion, as a necessary component in research, effectively stimulates students' learning engagement, driving them to invest more time and effort to better achieve their learning goals, thereby enhancing innovation capability. Learning motivation is a need and drive that students develop in their learning, which cannot directly affect innovation capability but needs to be realized through the mediating action of learning engagement. Only through the practical behavior of learning engagement can it be transformed into the realization of real goals. In summary, this article proposes the following hypothesis:"

Hypothesis H4: Learning engagement mediates the relationship between learning motivation and innovative ability.

In summary, the conceptual model of this study is shown in Figure 2.

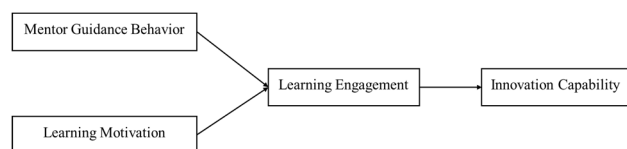


Fig 2. Conceptual model

3. Methods

3.1. Research Approach and Content

This study employs a questionnaire method with master's students as participants. It focuses on variables such as supervisor guidance behaviors, learning motivation, learning engagement, and innovation capability. A comprehensive literature review was conducted to compile widely used scales for these variables. Modifications were made to some

questionnaire items while preserving their original intent. The questionnaire, designed using Likert's 5-point scale, consists of five modules: personal information of graduate students, supervisor guidance behaviors, learning motivation, learning engagement, and innovation capability. Surveys were distributed online via "Wenjuanxing" to master's students in universities. A total of 211 valid responses were collected.

3.2. Measures

To ensure the feasibility of the data collected, established scales developed by scholars both domestically and internationally were used. These scales underwent rigorous testing and validation. However, adjustments were made to certain items to ensure logical coherence and appropriateness in language.

3.2.1. Control Variables

This initial section of the questionnaire gathers basic information about the graduate students. It also includes basic information about supervisors, such as age and gender.

3.2.2. Mentor Guidance Behaviors

The formal scale comprises 15 items across four dimensions: "supervisor guidance content," "supervisor guidance opportunities," "supervisor guidance attitude," and "supervisor guidance authority." Items are rated on a 5-point Likert scale ranging from "completely disagree" to "completely agree." The scale's reliability was confirmed through factor analysis and reliability testing, indicating high reliability for use.

3.2.3. Learning Motivation

Learning motivation is divided into two dimensions: intrinsic motivation (NB1-NB8) and extrinsic motivation (WB1-WB8). The Cronbach's α coefficients for intrinsic and extrinsic motivations are 0.8023 and 0.8231, respectively, demonstrating good reliability and validity. The scale uses a 5-point Likert scale where "1" indicates "completely disagree" and "5" indicates "completely agree," with higher scores indicating higher levels of learning motivation.

3.2.4. Learning Engagement

Based on literature review, the study adopted the Chinese revised version of the Utrecht Work Engagement Scale for Students (UWES-S) from Schaufeli et al. (2003)[10]. The scale consists of 17 items across three dimensions: vigor (HL1-HL6), dedication (FX1-FX5), and absorption (ZZ1-ZZ6). Cronbach's α coefficients for vigor, dedication, and absorption are 0.857, 0.826, and 0.919, respectively, indicating good reliability and validity. It uses a 5-point Likert scale, where higher scores indicate higher levels of learning engagement.

3.2.5. Innovation Capability

The self-assessment scale for master's students' innovation capability includes 18 items across five dimensions: "knowledge construction ability," "innovative thinking," "innovative personality," "innovation motivation," and "innovation practice." Items are rated on a 5-point Likert scale ranging from "completely disagree" to "completely agree." The scale has a retest reliability of 0.900, indicating high reliability and meeting psychometric standards.

4. Results

4.1. Correlation Analysis

Correlation analysis was conducted using Pearson correlation coefficient to examine the relationships among the

independent variables (supervisory guidance, learning motivation, mediating variable learning engagement) and the dependent variable (innovation capability). A Pearson coefficient greater than 0 indicates a positive correlation, while a coefficient less than 0 indicates a negative correlation.

(1) Through Pearson correlation coefficients among the variables, it was found that supervisory guidance is significantly correlated with learning engagement, with a correlation coefficient of 0.580, and both Sig values are less than 0.01. Supervisory guidance also shows a significant

correlation with innovation capability, with a coefficient of 0.588, and both Sig values are less than 0.01.

(2) Learning motivation is significantly correlated with learning engagement, with a coefficient of 0.755, and both Sig values are less than 0.01. It is also significantly correlated with innovation capability, with a coefficient of 0.627, and both Sig values are less than 0.01.

The mean, standard deviation, correlation, and reliability of the variables are shown in Table 1.

Table 1. Means, standard deviations, correlations, and reliabilities of variables.

Variables	M	SD	1	2	3	4	5	6	7	8	9
1. Gender	1.630	0.484	1								
2. Age	1.991	0.258	0.048								
3. Grade	1.536	0.725	-0.017	.154*	1						
4. Mentor Gender	1.427	0.496	0.105	-0.005	0.024						
5. Mentor Age	2.147	0.571	-0.061	0.074	-0.064	-.391**	1				
6.LM	3.920	0.603	-0.133	0.112	0.120	-0.114	0.122				
7.MGB	3.884	0.717	-0.073	0.114	.194**	-0.088	0.089	.698**			
8.LE	3.663	0.686	-0.083	0.126	.197**	-0.005	0.041	.755**	.580**	1	
9.IC	3.439	0.687	-0.096	0.103	.139*	-0.078	0.001	.627**	.588**	.681**	1

Notes: N = 211. * $p < 0.05$. ** $p < 0.01$. LM, learning motivation; MGB, mentor guidance behavior; LE, learning engagement; IC, innovation capability

4.2. Hypothesis Testing

4.2.1. Testing the Relationship Between Supervisor Guidance and Innovation Capability, and the Mediating Effect of Learning Engagement

Four models were employed to test the mediating effect of learning engagement and the relationship between supervisor guidance and innovation capability. In Model 1, the dependent variable is learning engagement, with supervisor guidance and control variables as independent variables. For

the remaining models, the dependent variable is innovation capability. In Model 2, the independent variables consist of control variables only. Model 3 includes supervisor guidance in addition to the variables in Model 2. Model 4 extends Model 3 by adding learning engagement as a new variable, to validate the mediating effect of learning engagement between supervisor guidance and innovation capability, and to verify the relationship between supervisor guidance and innovation capability. Specific results can be found in Table 2.

Table 2. Regression outcomes

Independent Variable	Dependent Variable: LE				Dependent Variable: IC			
	Model 1		Model 2		Model 3		Model 4	
	Standardized β	sig	Standardized β	sig	Standardized β	sig	Standardized β	sig
Control variables								
Gender	-0.068	0.262	-0.092	0.185	-0.073	0.225	-0.038	0.462
Age	0.057	0.328	0.076	0.255	0.046	0.431	0.016	0.746
Grade	0.084	0.163	0.086	0.207	0.011	0.856	-0.033	0.526
Mentor Gender	0.067	0.287	-0.099	0.17	-0.051	0.414	-0.086	0.111
Mentor Age	0	0.997	-0.009	0.914	-0.048	0.506	-0.048	0.436
MGB	0.593	0.000			0.542	0.000	0.235	0.001
LE							0.519	0.000
R^2	0.366		0.171		0.369		0.539	
Adjusted R^2	0.328		0.125		0.330		0.509	
F	9.488		3.712		9.580		17.660	

Based on the results from Table 2:

In Model 1, the F-value is 9.488 with a p-value < 0.005 , passing the F-test. The regression coefficient for supervisor guidance behavior has a significance level of 0.000, indicating that supervisor guidance significantly affects learning engagement.

Models 2, 3, and 4 all pass the F-test. In Model 2, the regression coefficients for frequency of communication with supervisors and time spent talking with supervisors are both

significant at levels of 0.000 and 0.021 respectively, indicating that these variables significantly affect innovation capability. Other control variables do not significantly impact innovation capability. In Model 3, the regression coefficient for supervisor guidance behavior has a significance level of 0.000, indicating a significant effect on innovation capability. The adjusted R^2 increases from 0.125 in Model 2 to 0.330 in Model 3, demonstrating that supervisor guidance behavior plays a decisive role in innovation capability, supporting

hypothesis H1.

In Model 4, after including the mediating variable of learning engagement on top of supervisor guidance behavior, the overall adjusted R^2 increases from 0.330 to 0.509, indicating increased explanatory power. The regression coefficient for supervisor guidance behavior remains significant at a level of 0.000, showing a significant positive correlation. This suggests that the mediating effect of learning engagement is significant; supervisor guidance behavior affects innovation capability through learning engagement. This supports hypothesis H3, indicating that learning engagement mediates the impact of supervisor guidance behavior on innovation capability.

4.2.2. Testing the Relationship Between Learning Motivation and Innovation Capability, and the Mediating Effect of Learning Engagement

here are four models used to examine the mediating effect

of learning engagement and the relationship between learning motivation and innovation capability. In Model 1, learning engagement is the dependent variable, with control variables and learning motivation as independent variables. The dependent variables in the other models are all related to innovation capability. Model 2 includes control variables as independent variables. Model 3 builds upon Model 2 by adding learning motivation as an additional independent variable. Model 4, based on Model 3, introduces learning engagement as a new variable to verify its mediating role between learning motivation and innovation capability, and to explore the relationship between learning motivation and innovation capability further. Specific results can be found in Table 3.

Table 3. Regression outcomes

Independent Variable	Dependent Variable: LE				Dependent Variable: IC			
	Model 1		Model 2		Model 3		Model 4	
	Standardized β	sig	Standardized β	sig	Standardized β	sig	Standardized β	sig
Control variables								
Gender	0	0.996	-0.086	0.211	-0.028	0.624	-0.028	0.59
Age	0.032	0.497	0.075	0.255	0.032	0.559	0.017	0.738
Grade	0.094	0.051	0.083	0.222	0.033	0.553	-0.012	0.82
Mentor Gender	0.07	0.169	-0.104	0.147	-0.055	0.354	-0.088	0.105
Mentor Age	-0.004	0.948	-0.012	0.882	-0.043	0.531	-0.041	0.512
LM	0.593	0.000			0.572	0.000	0.209	0.009
LE							0.48	0.000
R^2	0.591		0.174		0.439		0.533	
Adjusted R^2	0.567		0.128		0.405		0.502	
F	23.885		3.807		12.891		17.291	

According to the results in Table 3:

Model 1 shows an F-value of 23.885 with a significance level (P-value) < 0.005 , passing the F-test. The regression coefficient for learning motivation is significant at a level of 0.000, indicating that learning motivation significantly affects learning engagement.

Models 2, 3, and 4 all pass the F-test. In Model 3, the regression coefficient for learning motivation is significant at a level of 0.000, indicating that learning motivation significantly affects innovation capability. The adjusted R^2 increases from 0.128 in Model 2 to 0.405 in Model 3, suggesting that learning motivation decisively influences innovation capability, supporting hypothesis H2.

In Model 4, after adding learning engagement as a mediating variable on top of learning motivation, the overall adjusted R^2 increases from 0.405 to 0.502. The explanatory power strengthens, with the regression coefficient for learning motivation significant at a level of 0.009 and positively correlated. This indicates a significant mediating effect of learning engagement, demonstrating that learning motivation influences innovation capability through learning engagement. This supports hypothesis H4, indicating that learning engagement plays a role between these variables.

5. Conclusion

5.1. Conclusion and Discussion

This study aimed to explore the impact of mentorship behaviors, learning motivation, and learning engagement on

innovation capability, as well as investigate the mediating role of learning engagement in these relationships. Through data analysis and discussion, the following conclusions were drawn:

Firstly, the results clearly demonstrate that mentorship behaviors have a significant positive impact on innovation capability. Support, feedback, and guidance provided by mentors during the mentoring process effectively promote the development of students' innovation capabilities. This finding aligns with existing research, emphasizing the critical role of mentors in educational environments, particularly in guiding and supporting academic and career development.

Secondly, learning motivation has also been shown to have a significant positive influence on innovation capability. Students' intrinsic learning motivations, such as interest, curiosity, and goal orientation, stimulate their desire for exploration and creation, thereby enhancing innovation capability. This suggests that stimulating students' learning motivation is an important strategy in educational practice to promote the development of their innovation capabilities.

Additionally, the study found that learning engagement plays a significant mediating role between mentorship behaviors and innovation capability. When receiving mentorship, students deepen their learning and exploration by investing more time, effort, and resources, thus strengthening their innovation capabilities. This emphasizes the crucial role of learning engagement in the academic growth process, especially in the context of communication and academic interaction with mentors.

Lastly, learning engagement was also found to significantly mediate the relationship between learning motivation and innovation capability. High levels of learning motivation not only prompt students to invest more learning resources but also enhance their development of innovation capabilities through this investment. This result further underscores the importance of stimulating students' learning motivation in educational practice, as well as the critical role of investment in academic growth and the development of innovation capabilities.

In summary, this study comprehensively analyzed mentorship behaviors, learning motivation, and learning engagement to deeply explore their complex impact mechanisms on students' innovation capabilities. The findings contribute not only to theoretical research but also provide important insights for educational practice, particularly in guiding and formulating strategies to enhance students' innovation capabilities and academic growth. Future research could further explore additional influencing factors and expand samples and research designs to validate and enrich these findings.

5.2. Limitations and Future Research

The questionnaire used in this study was adapted from previous research with revisions based on the author's own knowledge and capabilities. However, due to inherent limitations, the questionnaire may have some shortcomings. The primary method of assessing supervisor guidance behaviors in this research relied on self-assessment by master's students, which could introduce certain biases or errors. Additionally, the study is constrained by a relatively small sample size, which limits the generalizability of the findings.

Future research could enhance the evaluation of supervisor behaviors towards master's students' innovative capabilities by incorporating supervisors' assessments. This could broaden both the scope and depth of understanding supervisor guidance behaviors. Furthermore, employing a wider array of metrics could provide a more comprehensive measurement. Expanding the survey scope could also facilitate deeper exploration into the mechanisms through which supervisors

influence master's students' innovative abilities.

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