

Exploration of the Cultivation of Master's Degree Engineering Graduate Students

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Abstract: Graduate education is the highest level of national education, and graduate supervisors are the primary responsible persons for cultivating graduate students, bearing a noble mission. Graduate supervisors should guide students to clarify research objectives, select appropriate topics, identify problems through critical thinking, and develop effective collaboration and communication skills. Students should make full use of library resources, allocate time for reflection and summarizing, gradually practice thesis writing, and persistently engage in research to achieve academic success.

1. Introduction

Graduate education, as the highest level of the national education system, is the primary means of cultivating high-level professional talent and serves as a crucial support for national talent competition and is a core element in building an innovative country. It carries the important mission of cultivating high-level professional talent and fostering innovation and creativity ^[1]. With the rapid development of society, especially in the engineering field, graduate education in engineering is undergoing new challenges and opportunities ^[2]. The construction of "New Engineering" advocates the cultivation of high-quality applied talents through reforms in learning methods and teaching models ^[3]. New Engineering, in contrast to traditional engineering, places greater emphasis on the practicality, interdisciplinary nature, innovativeness, and comprehensiveness of various disciplines ^[4]. Graduate students are expected to innovate their professional knowledge rather than merely passively receive it. Such innovations, whether large or small, should contribute to social development. To achieve the training objectives for master's degree students in New Engineering, it is necessary to establish a robust training mechanism and ensure effective quality assurance systems, including components of professional practice ^[5].

Graduate supervisors, as the primary responsible persons in graduate education, bear the noble mission of cultivating high-level innovative talent ^[6]. In the face of a global technological revolution and talent competition, the goal of every supervisor is to cultivate their students to become high-level professionals who are "diligent, rigorous, pragmatic, collaborative, and innovative."

2. Comprehensive Guidance for Graduate Students in Academic Research

Graduate students are young and active, with a certain theoretical foundation in research and an openness to new things. However, they often lack social experience, practical skills, and self-discipline, making them susceptible to fluctuations in their thinking. Therefore, during the training process, graduate supervisors must understand students' mental state and ensure they progress towards correct research objectives through comprehensive guidance.

2.1 Guiding Graduate Students to Clarify Research Objectives

Supervisors should guide students to define their scientific research objectives. Academic research guidance plans should be developed for students, ensuring they have clear learning objectives and plans from the first semester. Students should not only understand what they need to accomplish over the next three years but also how to achieve these goals and what requirements they must meet. This guidance plan should help students learn to study independently and conduct research while building foundational skills in professional English, information collection, software operation, and data processing and analysis. By publishing relevant academic papers in journals, students can cultivate their comprehensive qualities and ultimately meet the requirements for graduation. To ensure students stay on track in their research, regular academic reporting sessions should be scheduled. This not only urges students to focus on their research but also allows supervisors to stay informed about students' progress. Students can also present their questions in group discussions, facilitating collective exploration of problem-solving methods.

2.2 Guiding Graduate Students to Choose Appropriate Topics

The selection of research topics is crucial throughout graduate cultivation. Choosing the right topic sets a solid foundation for subsequent research. Supervisors should guide students to select topics that are current, challenging, extendable, and at the forefront of their disciplines. This is essential for cultivating innovative professionals. Topics that are too difficult may overwhelm students, requiring excessive time to read relevant materials which may hinder timely graduation. Conversely, overly simple topics may lack research value and significance.

There are two common misconceptions when selecting topics. First, students may dismiss topics that have already been explored, believing they lack interest. In reality, conducting research is about "standing on the shoulders of giants" to continue innovating, true innovation rarely occurs "out of thin air." While avoiding mere repetition of previous studies, research must focus on innovation alongside imitation. Second, students may hesitate to attempt unexplored topics. However, without attempts, breakthroughs are impossible. In new fields with limited research, there is a greater potential for significant discoveries.

2.3 Guiding Students to Discover Problems with Critical Thinking

Supervisors must encourage students to shift their mindset. They should transition from passively receiving knowledge to actively innovating it. This shift from knowledge acceptance to knowledge innovation is a key characteristic of a graduate student. Supervisors should help students realize they are no longer mere containers waiting for knowledge to be poured in, they must develop and explore independently. Most knowledge requires students to delve deeply and engage in research. Graduate students should not accept existing knowledge without critical evaluation. Instead, they should adopt a questioning attitude, identify problems, and focus their studies on specific research questions, rather than merely understanding knowledge for examinations as undergraduate students do.

2.4 Guiding Students to Be Proficient in Collaboration and Communication

Graduate supervisors need to guide students in developing their collaboration and communication skills, which are essential qualities for graduate students. Supervisors can encourage students to engage in various research-related activities both on and off campus to cultivate these skills. Promoting mutual assistance, cooperation, and learning among students will foster collective growth.

3. Measures for Graduate Students to Achieve Research Objectives

3.1 Making Full Use of Library Resources

Graduate students can only quickly enter their research fields through extensive reading of relevant literature and guidance from their supervisors. Initially, many students may feel lost when starting a topic. They should be encouraged to utilize library resources comprehensively, seeking various related texts and continuously taking notes and reporting their findings. This iterative process of literature review and reporting is the most efficient way to acclimate to a new research area. As students increase their reading volume, they will naturally gain insight into the current state of research both domestically and internationally in their fields, as well as how to conduct their studies.

Supervisors should also teach students to be selective when reviewing literature. They should prioritize high-quality, relevant literature and texts. In an era of information overload, it is crucial to discern what is truly useful for research. When conducting literature searches, students should focus on reputable journals with high impact factors to ensure the quality of their sources. Some students may reference poorly constructed papers, which can diminish the quality of their own writing. Therefore, it is essential to guide students not only to utilize library resources but also to read high-quality, valuable literature.

3.2 Regular Reflection and Summarization

During research, students must read a large number of papers, but they should not simply skim through them, they must allocate time for reflection. "Learning without thinking leads to confusion." Blindly reading papers without reflection is a significant waste of time and a research pitfall. After reading a paper, students should consider its overall significance, the author's writing approach, what they have understood, and how it relates to their research topic. They do not need to read every paper in detail. Instead, they should focus their attention selectively.

Students should avoid feeling overwhelmed by the sheer volume of literature. They need to periodically step back and reflect on the broader implications of their findings and how these may connect to larger knowledge frameworks. They should also consider why others have written their papers in certain ways and whether they can approach their research with improved methods. Through such reflection, students can gradually refine their own ideas.

Whether a paper can attract the attention of experts and engage readers largely depends on its innovativeness. It is crucial to identify what distinguishes a student's work from similar studies and to prioritize the innovative aspects in the progress of thinking. If a paper merely reassembles existing literature without providing new insights, it lacks research significance. Therefore, it is essential to continually reflect and summarize throughout the research and learning process.

3.3 Gradually Practicing Thesis Writing

After reviewing relevant materials and gaining a clearer understanding of their research topics, students can build experimental platforms or programming environments and begin writing their

theses. They must cultivate the habit of adhering to academic formatting standards, whether for a few thousand-word journal article or a lengthy thesis. Attention to detail, including formatting, headers, spacing, and figure presentation, is critical. It is important to cultivate academic standards from the very beginning of graduate studies and to integrate these norms into the research process. If these habits are not established, reviewers may perceive the thesis as lacking rigor, which could result in poor evaluations. Moreover, subsequent revisions can also be time-consuming. Particularly for graduate theses, if these details are overlooked initially, comprehensive revisions may prove difficult and time-consuming.

"Articles are not written, they are revised." Completing a first draft indicates that initial ideas have been articulated, but substantial revisions are necessary to clarify thoughts and highlight innovations. The revision process is crucial. It is advisable to share drafts with supervisors, senior students, or collaborators for feedback. For journal submissions, multiple revisions will be required until the supervisor approves the manuscript for submission. After submission, students should remain open to feedback from reviewers for further revisions. It is crucial to ensure that journal articles are thoroughly revised before submission to avoid wasting time and a negative impression of being "unserious" or "uninspired."

3.4 Diligently Pursuing Research

The three years of graduate study can be intense, requiring students to plan their time effectively, determining which tasks to complete at each stage. It is important to avoid leaving all tasks until the last minute, as negative habits can develop, leading to low-quality work. Many students may spend their time idly without supervision, lacking direction and wasting precious time on trivial pursuits. Knowledge accumulation requires time and persistence, significant ideas often emerge from consistent effort.

Throughout their research journey, students must endure the monotony and diligently engage in their work while avoiding impatience. This is particularly true for engineering students, who may frequently have to perform repetitive tasks during experiments or programming. The process can be lengthy and complex, but these steps are unavoidable in order to achieve the ultimate research goals. Only through consistent effort can graduate students meet their degree requirements.

4. Conclusions

Graduate supervisors play a crucial role in the cultivation of graduate students. They should guide students in defining their research directions and encourage them to think critically, identify problems, and develop solutions. It is essential to foster effective learning and research habits, as well as a positive mind-set among students. Supervisors should promote collaboration and communication, foster perseverance, and encourage a grounded, step-by-step approach to achieve research objectives, ultimately helping students complete their master's degree requirements.

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