Study on Thesis Topic Selection for Applied Undergraduate Electromechanical Majors

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Abstract. The graduation thesis serves as a concentrated demonstration of students' accumulated learning over their four-year undergraduate tenure, representing a pivotal avenue for enhancing the overall competencies of graduates. This study, rooted in an analysis of the current landscape and identified challenges surrounding thesis composition, directs attention to the selection process for theses pursued by undergraduate students specializing in electromechanical engineering. Our investigation delves into pathways for augmenting thesis quality, proposing an implementation strategy centered on aligning educational objectives with industrial requisites. Through this framework, we aim to perpetually refine and elevate the caliber of electromechanical undergraduate theses.

Keywords: Applied undergraduate; Electromechanical majors; Thesis topic selection; Industry-teaching integration

1 Introduction

Drafting the thesis stands as a pivotal instructional nexus in the cultivation of undergraduate talent, serving as a methodical and exhaustive assessment of students' professional knowledge, learning aptitude, scientific inquiry skills, writing proficiency, and overall literacy [1-3]. It not only facilitates undergraduates in synthesizing outcomes from professional theoretical learning but also fosters their capacity to systematically and comprehensively employ professional knowledge to address practical challenges, directly influencing the caliber of talent development. Nonetheless, a substantial body of research underscores the current suboptimal quality of undergraduate theses, underscoring the pressing need to explore and enhance the management system for thesis quality with the objective of elevating undergraduate thesis standards. The main problems with the professional abilities of students majoring in mechanical and electrical engineering are weak theoretical knowledge, lack of practical ability, lack of innovation consciousness, and the literature review is not comprehensive. This study aims to scrutinize extant issues within theses of applied undergraduate electromechanical majors, chart a course for enhancing thesis quality, and propose an implementation blueprint for thesis topic selection grounded in the integration of industry and education.

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2 Present State of Theses and Challenges

The enhancement of thesis quality receives significant attention from educational authorities and higher education institutions [4-6]. In December 2020, the Ministry of Education released the "Sampling Measures for Undergraduate Thesis (Design) (Trial Implementation)", outlining the annual sampling of undergraduate thesis quality. The results of these samplings serve as crucial benchmarks for evaluating undergraduate education, advancing first-rate undergraduate programs, accrediting undergraduate majors, and allocating educational resources, including funding for program development. Subsequently, in July 2022, the Office of the Education Supervisory Commission of the State Council issued a notice regarding the effective execution of undergraduate thesis (design) sampling inspections. Additionally, provincial and municipal education departments have issued implementation guidelines to ensure the smooth and orderly implementation of the sampling process. However, feedback from expert reviews of the 2021-2022 academic year's sampling inspections reveals prevalent issues with undergraduate theses. Key challenges encompass unscientific topic selection, vague content, inadequate argumentation, limited innovation, non-standardized writing, inappropriate research methodologies, insufficient referencing, and weak structural coherence [7-11].

For applied undergraduate students, they have basically not participated in scientific research projects during their university years and lack experience in writing academic papers, which leads to problems such as the lack of prominent research subjects, chaotic structure, poor organization and logic in the papers. Mechatronics majors exhibit a high degree of practicality and are intricately linked with industrial production realities, and it has interdisciplinary and cross disciplinary characteristics. Therefore, the selection of thesis topics for mechatronics majors should stem from actual enterprise projects, with potential solutions formulated through research, analysis, and discussion [12-13]. Research indicates several prominent issues in the selection of thesis topics for undergraduate electromechanical studies: some topics lack relevance to the discipline's teaching, research, and societal advancements, failing to align with professional training objectives; challenges arise in adequately aligning topic selection with students' capabilities and instructors' expertise levels; instructors often lack a clear mission statement for selected topics and fail to assess whether students can achieve meaningful results within the allocated timeframe; certain topics tend to skew towards theoretical investigations, while others involve outdated professional applications, neglecting integration with contemporary practical production contexts within the field [14-18].

3 Implementation Plan for Thesis Topic Selection Grounded in Industry-Education Integration

Addressing the challenges present in the theses of undergraduates specializing in electromechanics, this paper suggests an implementation plan for thesis topic selection rooted in industry-education integration. The plan underscores collaborative cultivation efforts between educational institutions and enterprises to establish a novel cultivation

paradigm. It devises talent cultivation schemes aligned with the principles of industry-teaching integration, facilitates flexible and innovative teaching practices, employs dual mentors to oversee thesis development, and establishes a thesis topic selection database grounded in engineering practice.

3.1 Developing Talent Training Programs Aligned with Industry-Education Integration Principles

At the institutional level, there has been a drive towards reforming the talent training paradigm, advocating for the creation of training programs aligned with industry-education integration principles. As an illustration, the Guangdong Institute of Science and Technology has devised a talent training regimen characterized by "human-job alignment, tailored pedagogy, and specialized training" for electromechanical disciplines. The practical training component of this program adopts the 3+1 model, whereby students are encouraged and supported to engage in professional internships during the seventh semester, with assessment conducted by enterprise mentors. Simultaneously, comprehensive practical training courses are provided for students remaining on campus. For instance, some of the electromechanical majors' seventh-semester course arrangements are outlined in Table 1. Throughout the seventh semester, students and instructors engage in iterative communication to delineate thesis topics informed by enterprise practices and innovation systems. The resultant theses often manifest as design outputs, encompassing drawings, source codes, physical prototypes, patents, among other forms.

Table 1. Seventh Semester Curriculum for Selected Electromechanical Majors.

Major	Seventh semester curriculum	course credit	Course weeks
Mechatronics Engineering	Comprehensive practical training in mechanical manufacturing technology	3	6
	Comprehensive practical training for industrial robots	2	4
	Hands-on training in mechatronic system design	3	6
Electronic Information Engineering	Electronic products and debugging technology practical training	2	4
	Intelligent Home Appliance Maintenance Practical Training	3	6
	Practical training in the assembly of electronic products	2	4
	PCB design training	1	2
Automatization	Robot control system integration training	2	4
	Process control engineering design practical training	1	2
	Practical training in computer control applications	2	4
	Comprehensive practical training on control systems	3	6

Mechanical Design and Manufacturing and its Automation	Engineering mechanics practice	2	4
	Comprehensive practical training in mechanical manufacturing process	2	4
	Comprehensive practical training in mechanical system design	2	4
	Mechatronics system design practical training	2	4
Electrical engineering and its automation	Embedded system design training	2	4
	PLC comprehensive application practical training	1	2
	New energy power generation design practical training	2	4
	Comprehensive practical training in substation design	3	6
Robotics Engineering	Comprehensive practical training for industrial robots	2	4
	Comprehensive applications of machine vision technology	2	4
	Intelligent mobile robotics applications	2	4
	Intelligent equipment simulation and debugging	2	4

3.2 Fostering Adaptable and Inventive Pedagogical Approaches

Educational institutions ought to promote the advancement of adaptable and inventive pedagogical initiatives, employing diverse approaches to bolster the practical innovation aptitude of both educators and learners. For instance, schools may deploy qualified instructors to visit students' internship sites and collaborate with industry technicians on technical directives and challenges. Furthermore, schools can invite managerial or technical personnel from enterprises to deliver lectures on cutting-edge technologies to faculty and students. Additionally, schools may engage in collaborative curriculum development with enterprises, facilitating dual-mentorship for thesis guidance and other cooperative endeavors between academia and industry.

3.3 Implementation of Dual Supervision for Thesis Oversight

Educational institutions should proactively engage enterprise technicians as adjunct instructors to contribute to thesis supervision, employing the "on-campus tutor + enterprise tutor" dual supervision model. This approach maximizes the strengths of on-campus tutors, who possess robust theoretical expertise, familiarity with thesis management procedures, and adeptness in writing logic and norms. Simultaneously, it leverages the expertise of enterprise tutors, who offer extensive practical experience and robust innovation capabilities.

3.4 Establishing a Thesis Topic Selection Repository Grounded in Engineering Practice

The survey findings indicate a deficiency in novelty and innovation among numerous professional educators, particularly those affiliated with local undergraduate institutions, regarding the formulation of thesis topics. This inadequacy stems from their limited engineering exposure and inadequate tracking of technological advancements within enterprises, compounded by their scant comprehension of on-site production technologies. Conversely, full-time faculty members, leveraging their solid theoretical acumen, engage in active dialogue with enterprises to collaboratively establish a thesis topic repository grounded in practical production scenarios. This repository enables students to select topics aligned with their individual interests, with unchosen topics carried over for subsequent cohorts. Moreover, real-time updates to the topic database are essential to ensure both the quantity and quality of available topics.

4 Conclusions

This paper, after elucidating the current state and identified challenges concerning theses, with a specific focus on thesis topic selection within applied undergraduate electromechanical programs, delineates pathways for enhancing thesis quality. It presents an implementation blueprint for thesis topic selection grounded in industry-education integration, comprising four principal components: designing talent training programs aligned with industry-education integration principles, facilitating flexible and innovative pedagogical practices, implementing dual-advisor supervision for theses, and establishing a thesis topic database rooted in engineering practice. This implementation plan serves to ensure the feasibility of thesis topic selection, enhance thesis quality, and consequently augment students' proficiency in engineering practice and innovation.

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