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Typical problems of unqualified theses of engineering master: Analysis based on expert review opinions of Tianjin's sampling theses in 2017

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ABSTRACT

Background: The evaluation of the quality of professional master's degree theses has attracted less attention. This paper analyzes the content based on the expert review opinions of the engineering sampling theses in Tianjin in 2017. **Methods:** This paper focuses on the review opinions of unqualified theses, and extracts three core characteristics of unqualified theses: lack of innovativeness, academic inadequacy, and poor standardization. **Results:** Lacking in innovativeness means topics, method, and applied value are outdated. Academic inadequacy means the author does not possess adequate knowledge, does not pay sufficient intellectual effort and the dissertation's design is unreasonable with the content irrelevant to the subject. Poor standardization is manifested in poor writing, inappropriate disciplinary paradigm, and academic misconduct. **Conclusions:** Therefore, strictly monitoring the quality of theses from the system, setting up standardized courses for theses, and improving the academic quality of graduate students have become the priority to the cultivation of engineering masters.

Key words: engineering master, theses quality, theses sampling, typical problems

INTRODUCTION

Since the professional degree education system was established in China, the categories were enriched with the scales expanding. And the development of the professional degree of engineering is more remarkable within the professional degree education system. The engineering education system in China has formed a "Chinese model" featuring excellent student source, largest scales, coupling with economic development, combination of science and technology, and taking the lead in construction of emerging engineering education,[1] signifying China has been a veritable engineering country.[2] Engineering education undertakes the mission of cultivating outstanding engineers with innovative thinking and problem-solving ability. Meanwhile, how to ensure the quality of engineering talents cultivation has become a central issue. Dissertation, a key metric to measure cultivation quality, manifests the scientific research ability and problem-solving ability of postgraduates. To guarantee the quality of dissertations, a random inspection system for dissertations was established in China with a random inspection rate of about 5% for master's dissertations. However, there are many unqualified theses every year, what are the reasons for their disqualification?

In this context, a sample examination was conducted in 2017 in Tianjin with a total of 498 professional master's degree dissertations. Among them, there existed 177

engineering master's dissertations evaluated with 571 expert reviews totaling about 340,000 words. The evaluation data collected in this random inspection consists mainly of the overall assessment of the paper by the experts. Experts' opinions are extremely valuable, most importantly, and can reflect the expert's comprehensive judgment of dissertation.[3] In this paper, we will analyze the expert opinions of unqualified dissertations in detail, to find out the characteristics and specific shortcomings of unqualified dissertations in engineering, so as to provide suggestions for universities and research institutions and improve the quality of engineering talents cultivation.

LITERATURE REVIEW

Regarding the existing problems of dissertations, some scholars point out that the dissertations are not innovative,[4] and the data is unreliable and insufficient,[5] reflecting postgraduates are lack of the academic theory.[6] Besides, some dissertations are illogical, which are reflected on the concept definition, proposition argumentation, and system construction.[7] Some scholars analyze the opinions of peer experts in the sample examination, drawing that there are 11 typical problems in professional master's theses, namely, deviation in topic selection, inferior literature review, blurred concepts, deviation from the theme, unrealistic countermeasures, fuzzy logic, insufficient argumentation, inappropriate methods, random argumentative materials, lack of professional knowledge and serious plagiarism.[8] Besides, it's found that poorly reviewed papers are characterized with ambiguous topics, logical mess, improper methods, unsubstantiated conclusions, poor writing, bad attitudes, and lack of innovation.[9] The problems reflect that postgraduates cultivated are lack of adequate academic training and effective guidance.

What affects the quality of a dissertation? Factors such as supervisors, individual characteristics, socioeconomic factors, supervision system as well as time and money all have a large impact on the quality of a dissertation. The supervisor plays a key role in the process of graduate student's dissertation so the selection of the supervisor is crucial.[10] A good supervisor can be helpful to select a suitable topic and guide the revision of the thesis.[11] What's more, it is undesirable to rely too much on the student's self-awareness and supervisory process is indispensable.[12] In terms of internal factors, critical thinking is essential for dissertation writing,[13] and postgraduate's own knowledge, abilities, and attitude toward the dissertation profoundly affect the quality of the dissertation.[14] Some scholars focus on the correlation between the quality of students and dissertations, supposing that age, learning mode, and recruiting method exert an influence on dissertations.[15]

METHODS

A qualitative technique is used in this study to get a deeper understanding of the research problem. The intent of this research is to explore the characteristics of unqualified theses, arriving at a thick description grounded by the axial codes derived from textual analysis.[16] The evaluation opinions were analyzed using open coding techniques to extract expressions across all the evaluation opinions. The encoding results are presented in Table 1.

The most notable difference between professional and academic master's degrees is that the latter emphasizes theoretical and academic aspects more, while the former emphasizes practical and applied aspects. In this paper, the evaluation opinions of unqualified dissertations are coded on the basis of our repeated readings of the experts' comments (Figure 1). Among many indicators of dissertations, innovation is considered as the core evaluation indicator of dissertations,[17] and innovation is often regarded as a necessary characteristic of excellent dissertations. Usually, unqualified dissertations are lack of innovation, mainly in topics, methods, and applied value. Besides, academic inadequacy is another reason why some dissertations were regarded as unqualified. Since graduate education undertakes the task of cultivating high-level, innovative research talents, and therefore, experts regard "innovation and academic rationality" as elements of dissertation evaluation. What's more, thesis writing with standardization is the basic requirement of thesis, therefore, poor standardization was a crucial reason why the experts didn't recognize a dissertation.
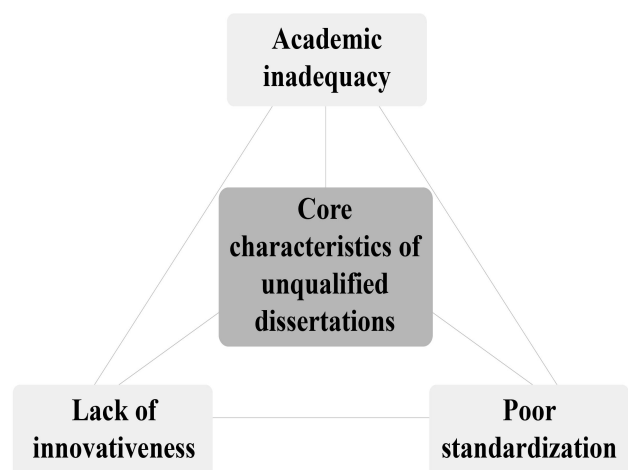

Figure 1. Visual model of core characteristics of unqualified dissertations.

Limited by the textual materials, expert opinions are only divided into "qualified" and "unqualified". To protect privacy, the information in the cited expert opinions that

Table 1: Codes by frequency of references across all experts' review

Axial or theoretical coding	Focused (selective and conceptual) coding	Initial (open) coding	Mentions
Lack of Innovativeness	Non-innovative topics	No application value	32
		Obsolete research content	17
	Lack of method innovation	Outdated methodology	18
		Lack of design description	8
		Unadvanced technology	11
	Trivial applied value	Non-innovative conclusions	35
		Unscientific explanation	7
Academic inadequacy	Inadequate knowledge	Misusing knowledge	18
		Insufficient research depth	43
		Incomplete experiment description	37
		Unclear understanding of the domestic and international research	6
		Poor English	19
	Unreasonable experimental design	Unidentified data sources	12
		Less research achievements and participation in projects	6
		Lack of debugging data	2
	Insufficient intellectual effort	Insufficient workload	8
		Low technical difficulty	33
	Irrelevant to the subject	Content detached from research questions	26
Poor standardization	Poor writing	Confusing structure	4
		Formal error	24
		Poor expression	48
		outmoded literature	23
		Textual errors	19
		Irregular diagrams	23
	Inappropriate disciplinary paradigm	Poor formatting	13
	Academic misconduct	Plagiarism	4

may reveal the details of the paper is anonymized. To present the text better, "M" is used on behalf of "Materials and Chemical Engineering", "E" stands for "Electronic Information Engineering", "ME" for "Mechanical Engineering", "P" for "Energy and Power Engineering", "R" for "Resources and Environment Engineering", "B" for "Biology and Medicine Engineering", "C" for "Civil Engineering and Water Resources Engineering", "T" for "Transportation Engineering", followed by a number representing the sequence number of the analysis sample, and the number after the dash representing a specific review expert. For example, "C03-01" means the first reviewer's opinion in the review of the 3rd dissertation of Civil Engineering and Water Resources Engineering.

RESULTS

Lack of innovativeness

The primary characteristic of an unqualified dissertation is the lack of innovativeness. Innovation is an essential feature of an excellent thesis. However, how to define innovation is not an easy task. Innovative features can be prominently reflected in topic selection and thesis results.[18] A dissertation was regarded as unqualified which mainly manifested as non-innovative topics, lack of method innovation, and trivial applied value.

Topics without innovation

Questions are the starting point of scientific inquiry and the beginning of academic discussion. Without questions, there is no research and no advance in knowledge. The topic chosen is the starting point of the paper and an important benchmark to measure the innovation and research value of the paper. The lack of innovation in the selected topics of the unqualified master's thesis in engineering is mainly manifested in two ways. On one hand, the selected topics are not of sufficient application value. On the other hand, the content of the study is too obsolete.

Firstly, insufficient application value is one of the features of unqualified papers. Cultivating high-level and innovative talents is the aim of postgraduate education. Therefore, the topic of the master's thesis in engineering focuses on the application orientation of the results. Judging from the experts' opinions, the significance of selecting a topic for engineering master is mainly

reflected on engineering application value. For example, one expert pointed out, "The thesis is of no theoretical significance and without sufficient technical difficulty. The topic chosen is of no theoretical or engineering application significance required by the master's thesis"(E16-03).

Secondly, obsolete content is another feature of unqualified dissertations. A topic is crucial to the quality of a dissertation. The leading role of topic in a dissertation is emphasized invariably by past research.[19] Selecting a topic means standing on the shoulders of those who researched before to innovate content and create undiscovered results. Innovation in the master's thesis is encouraged, and one of the important reasons why the thesis is considered unqualified is the lack of innovation in the content. For example, experts point out that "this paper designs and implements an attendance management system based on C/S, which can contribute to enterprises. However, the content of the paper is so obsolete, and the technology (C/S) chosen is thoughtless. Undergraduate students in 985 colleges would not use this topic for their graduation designs in previous years. Besides, this paper creates nothing new, both in terms of the technology used and content"(E47-01).

The method with less innovation

Engineering is the application of mathematics or natural sciences to research, development, design, manufacturing, or technical operations to create. Practical competency training can be described as the top priority of postgraduate education for engineering master's degrees. The practice-oriented training objectives and research content of postgraduates in engineering require postgraduates in engineering to learn by doing and thinking. Therefore, the dissertations should be innovative in the technology used in the thesis.

The lack of methodological innovation is mainly reflected in outdated methodology, unclear design description and unadvanced technology. Either proposing new methods, new processes, or optimizing existing process methods is regarded as innovations in research methods. For example, experts point out that, "The research work is reflected in the simulation analysis of the system. But there was no improvement in the methods used. The improvement of the methods used isn't a certain innovation"(P05-01), and "However, the discussion on the technical issues is relatively superficial. The paper only possesses a brief introduction of some discussions in the relevant literature, and no specific technical implementation plan is proposed"(P06-02).

Trivial applied value

In addition to topic selection and research methods,

master's dissertation problem is also reflected in its research conclusions. The practicality and applicability of the engineering degree stipulates that the research results or research conclusions of the thesis should possess practical application value and better promotion value. Based on expert review opinions, although the master of engineering is a professional degree education, the review is not only limited to the field of practical elements, but also attaches great importance to the theoretical value of the thesis results. Non-innovative conclusions and explanations are the main features of unqualified dissertations with trivial applied value.

For example, experts pointed out, "I don't think the paper reach the level of a master's paper due to the following problems: the thesis is not innovative enough. Neither the research methods of the thesis nor the conclusions reached the innovative standard"(ME10-02). Insufficient theoretical innovation is another reason why an expert regards one thesis as unqualified. "This paper focuses on the elaboration of the function, system composition, indicators, and other schemes of the engineering construction scheme, rather than the innovation; in addition, this paper is lack theoretical research results, which is out of innovation"(E06-01).

Academic inadequacy

In terms of scientific research level, knowledge and ability, workload and difficulty reflected in the paper is another indicator of the paper. The Regulations of China's degree[20] stipulate that graduate students in higher education and scientific research institutions need to master solid basic theories and systematic expertise in their own disciplines and have the ability to engage in scientific research or independent specialized technical work before they can be awarded master's degrees. With interdisciplinarity emerging, only with knowledge and ability can we form the ability of independent learning and improve the ability to analyze and solve problems. One of the great causes of the non-qualification of dissertations is the academic inadequacy, which is shown in inadequate knowledge, unreasonable experimental design, insufficient intellectual effort, irrelevant to the subject.

Insufficient knowledge

Engineering activity can be regarded as a process of constructing a specific artificial object in a planned and organized manner. It is an important goal of engineering talent training to master engineering knowledge and apply it to concrete engineering practice and be able to independently take charge of engineering activities. Mastering postgraduate expertise has become an important metric for evaluation by assessment experts.

Among unqualified dissertations, there are lots of dissertations reflecting that authors don't possess

sufficient expertise, which are reflected in misusing knowledge, insufficient research depth, incomplete experiment description, unclear understanding of the domestic and international research, and poor English. Besides, if there exist few citations or the citations are so outdated, a dissertation may be unqualified too.

For example, some unqualified dissertations have too few references. "In this paper, only one reference is cited, which reflects the author didn't have a comprehensive and systematic understanding about the literature review. (There are few references, and the newest citation cited is in 2014, only one reference)"(E07-03).

In addition, experts pointed out, "The structure of the thesis is basically reasonable. However, the thesis fails to reflect the professional knowledge and research capabilities that the author should possess. In my opinion, the thesis does not reach the level of a master's thesis. It is recommended to appropriately increase the difficulty of master thesis"(E16-03).

Unreasonable experimental design

Experimental teaching is a crucial link to improve the problem-solving ability of students as it undertakes the task of cultivating basic engineering qualities in students.[21] The experiment is a process of improving engineering ability and cultivating engineering postgraduates. The evaluation experts have put the development and design of experiment into the evaluation and assessment criteria of dissertations. Unreasonable experimental design is one reason why a dissertation is regarded as unqualified, which is reflected in unidentified data sources, less research achievements and participation in projects.

For example, "This paper only describes the research path in words, without presenting the specific process and the corresponding theoretical basis and foundation. For example, the author does not introduce the data sources. Chapters 4.1, 4.2, and 4.3 in the paper…cannot be given the data directly. Can the research results be used as evaluation criteria for equipment safety risks, and where is the basis? How to confirm the conclusion?"(ME01-01). The theses do not introduce the research process and data sources clearly.

Other examples are "The dissertation is only a brief listing of the results obtained from the study"(C17-03), "In the thesis, there is no corresponding discussion of the system test protocol and the results of the test analysis. Overall, the paper doesn't have an in-depth analysis and study of technical issues in the design and development process of the engineering project"(B16-01). There are mistakes in the design of conclusions and discussions.

Insufficient intellectual effort

The thickness and depth of the dissertation research are visual representations of the quality of the dissertation and are important measures of the problem-solving ability. Specifically, the thickness of the study is manifested on the amount of work, and the depth is reflected in the substantial research content of the paper. Judging from the actual feedback on the papers, almost every expert gave a review involving an assessment statement on the amount of work and its difficulty. For example, one expert pointed out that "The topic chosen for the dissertation is too simple…If there were really such a simple practical project, it would not be suitable for a master's thesis, because the workload is far from the requirement of a master's thesis. There exist so many problems in this paper like inconsistencies, and lack of logic"(E32-02).

Irrelevant to the subject

The lack of conformity between the title and the text is also the key to an unqualified dissertation, which is mainly reflected in the fact that content mismatched from research questions. Focusing on the research problem and solving is an inevitable requirement of dissertation writing. Based on the analysis of the expert review, the conformity of the title and the text is mainly reflected in the inherent correlation between the research content and the topic. The scientific design of the dissertation around the research question is an inherent requirement for the scientific and logical nature of the dissertation. This is reflected in the writing of the dissertation, which requires the author to organize the framework of the dissertation in a consistent manner by conducting literature research and research experiments around the research question.

For example, an expert pointed out in the review that "The title of the dissertation is not in line with the research content, and the title mainly studies the problem of regularity overrun, but the paper is actually an analysis of a high-rise frame structure with regularity overrun"(T09-02).

Poor Standardization

The normative elements of writing are mainly reflected in the normalization, rigor of structure, and academic ethics of thesis writing. Writing normalization is an important measure to indicate the systematic rigor of the thesis and the author's scientific attitude. Poor standardization of writing is a key factor leading to unqualified papers.

Poor Writing

The standard of dissertation writing is that the content and form of the dissertation is logical, that the content is truthful and objective, and that the form is accurate. Many reviewers said that it is difficult to tolerate poor

writing. Problems like structure confusion, unclear ideas, confusing diagrams, misusing punctuation and so on are very popular. The problems with thesis writing are mainly manifested in confusing structure, formal error, poor expression, outmoded literature, textual errors, and irregular diagrams. The failure of the proposed method is mainly reflected in the alignment of chapter structures, page numbers, literature citations, etc. The problem in dissertation writing is very common among unqualified dissertations. The issue of poor writing requires much attention, reflecting the need to regulate student research ability and writing attitude.

For example, experts point out that "There are so many intolerable errors just from the point of view of the writing and format specifications of this thesis. For example, (1) the English abstract does not correspond to the Chinese abstract, and the format is confusing. (2) Full-text body is not justified. (3) The title of the header of chapter 5 is not the title of the chapter! (4) The full text has a large number of textual errors, for example, there are as many as three errors on the acknowledgements page alone"(E52-02).

Inappropriate disciplinary paradigm
Dissertation is an important form of engineering masters' research. The cognitive object of engineering activities is man-made objects and scientists carry out research activities based on common practice and common operational skills. For example, an expert pointed out that a master's degree thesis in engineering should follow the logical paradigm of "theoretical basis-model constructing-computational process-research platform-research results", in which "The final results should be able to correspond to the objectives proposed in the abstract, and should provide all the data sources in the research process. The author should be able to provide all the data sources and the basis of use in the research process so that the final research results could have the corresponding methods to prove the feasibility and correctness of the research"(R01-01).

A dissertation was evaluated as an unqualified dissertation because it "presents a review article, which is not in line with the research content of a graduate research dissertation". "The key issues of the design wasn't put and the targeted analysis is not in-depth"(T09-02). Nominally, the author did not follow the paradigm related to engineering research, which reflected the graduate student lacked scientific research ability and necessary engineering practice literacy.

Academic misconduct
As a kind of academic speculation, academic misconduct of graduate students is a product of the misalignment between the cultivation goal of graduate students and the social system.[22] In the evaluation of dissertations,

the main behaviors of academic misconduct are "plagiarism and data fabrication". According to the evaluation opinions, the evaluation experts will also check the dissertation when evaluating the dissertation, for example, "The dissertation is suspected of plagiarism: (1) The content of this paragraph is similar to an uploaded documents in Baidu Library... (2) The paragraph on page 73, 'The function of this system is not yet perfect...' is exactly the same as the online document"(E16-01). The code of academic ethics can be called the academic bottom line. The inadequate academic supervision and punishment mechanism for graduate students are important causes of academic misconduct of graduate students. So, it is worth considering whether the graduate programs have really implemented the system to guarantee the quality of dissertations.

DISCUSSION AND CONCLUSIONS

In this paper, we analyze the basic data of the evaluation opinions of engineering experts in the 2017 sample of theses in Tianjin, focusing on the comments of the unqualified theses in the review. The main conclusions are as follows: Firstly, the typical problems of an unqualified master's thesis in engineering mainly are reflected in lack of innovativeness, academic inadequacy, and poor standardization. Specifically, non-innovative topics, lack of method innovation, and trivial applied value are the main features of innovative elements. Secondly, inadequate knowledge, unreasonable experimental design, insufficient intellectual effort, and irrelevant to the subject are the traits of academic inadequacy. Besides, poor writing, inappropriate disciplinary paradigm, and academic misconduct are the features of poor standardization. This paper simplifies the problems of an engineering master's thesis for research convenience. In fact, various issues are interrelated, such as topic selection, research methods, and conclusions. The lack of innovation reflects the authors' lack of engineering knowledge and experimental literacy. In addition, the reviews made by the experts are not based only on one criterion. And the evaluation criteria vary between different professional categories within the project.

In this paper, we have pointed out that there is a lack of innovation in the unqualified ME thesis, meaning that the topic, research methods, and research conclusions are not innovative. The reviewer's expectations for thesis innovation are based on prescriptive, adequate, and in-depth research.[23] There are many reasons for the lack of innovation in the theses as a tool for academic training. The lack of innovation in research methods and conclusions, actually, is due to the lack of innovation in the topic. The professional master's dissertation requires not only a certain depth of theory, but also application

and innovation. According a national survey data of engineering master's theses in 2021, 40.8% students expressed their topics were from the research projects participated during the study period, while 31.1% showed that their topics were designated by the supervisors, which shows that the topics designated by the supervisors and the research projects of the supervisors have become the main sources of engineering master's theses.[24] The supervisor plays a decisive role in the selection of topics. The lack of innovation in the selection of unqualified thesis topics makes it difficult for the paper to be innovative and contributive to knowledge. The supervisor has an inescapable responsibility in this process. Several scholars have provided guidance on how to choose a topic based on a methodological perspective. The supervisor should possess guidance methods, arrange, and promote postgraduates earlier, and strictly check the form and content of the paper.[25]

Lack of innovativeness and academic inadequacy indicates that postgraduates possess insufficient research training. Whether the curriculum and project engagement has improved postgraduates' problem-solving skills deserves considering. In addition, the intellectual effort is a key factor in the eligibility of the dissertation. A national survey report (2021) on the quality of professional master's training shows that 71% of professional masters spend 4–12 months on dissertation, of which 37.8% spend 4-6 months and 33.2% spend 7–12 months, 21.4% spend more than 12 months and 7.6% spend less than 3 months. Among the unqualified dissertations, some were noted unqualified with less content, reflecting that the authors did not devote themselves to the dissertation. Regarding the issue of poor standardization, format problems are abundant in unqualified papers, which means that relevant graduate programs are weak in regulation.

Based on the above analysis, the following proposal is presented in this paper.

Firstly, the graduate programs should establish a required course on thesis writing standards for engineering masters, raising the standard of thesis writing and enhancing the ability of writing. The requirements for the specification of the paper are presented. that the thesis should be clearly organized with standardized words and standardized expressions. Therefore, each graduate program should strictly stipulate the academic writing standards and set up relevant courses, strictly controlling the "norm gate" and strengthening the awareness of norms.

Secondly, Regulating the supervisory role of supervisors in the dissertation production process is of great importance. During postgraduate study period, supervisor is responsible for postgraduates. Due to the objective gap between supervisors and students in terms of experience, knowledge, and status, a kind of asymmetrical symbiotic relationship between the supervisors and students is formed. Mostly, postgraduates have to obey supervisors' rules and arrangements. Therefore, the role of the supervisor in supervising the selection of topics should be working.

Thirdly, strengthening quality management and establishing monitoring mechanism is a key to improve the quality of engineering master education. Implementing the arrangement of the dissertation system and setting timelines is imperative.

What's more, strengthening postgraduates' own ethics and improving their academic ability is the top priority. In the final analysis, the root cause of the unqualified thesis is that postgraduates are lack of professional academic knowledge and problem-solving ability. Fundamentally, improving academic and moral qualities is the key point for engineering master education.

DECLARATIONS

Author contributions
Gao Y: Writing—Original draft preparation, Data curation, Conceptualization, Resources. Wang J, Sun BC and Jiang YC: Writing—Reviewing and Editing.

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