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Exploration of the Dual-Tutor Mechanism for Graduation Theses in Physics Major

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Abstract: Against the backdrop of collaborative talent cultivation and the new college entrance examination reform, the graduation theses of physics normal university students face problems such as the disconnection between theory and practice, and the insufficient connection between students' research capabilities and teaching practice abilities. Combining the interview practice of the dual-tutor mechanism at Tianjiabing Middle School in Ya'an, and taking the Department of Physics of Sichuan Minzu College as an example, this paper analyzes the connotation and value of the dual-tutor mechanism for graduation theses in physics major, sorts out the practical dilemmas such as the low willingness of high school teachers to participate and the difficulty in coordinating tutors' opinions, and proposes optimized paths including hierarchical incentives and collaborative communication. It provides a reference for the talent cultivation of physics major and the coordinated development of basic education.

Keywords: Physics; Graduation Thesis; Dual-Tutor Mechanism

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1.Introduction

1.1 Research Background and Significance

Taking the normal university students of the Department of Physics of Sichuan Minzu College as an example, most of their graduation theses focus on the teaching reform of junior and senior high school physics and the research on question types. However, under the background of collaborative talent cultivation [1] [2], through personally guiding and investigating the graduation theses of the 2023 and 2024 graduates of the Department of Physics of Sichuan Minzu College, the author found that most graduation theses have problems such as overly broad topics and the disconnection between theory and practice. At the same time, with the gradual deepening of the new college entrance examination reform, the content that students learn in the three years of senior high school has been reduced. Now, a single question covers more knowledge points, is more comprehensive, and has a stronger ability to distinguish students' levels [3] [4]. These undoubtedly bring great challenges to senior high school teachers and students, but also provide many new directions for the topic selection of graduation theses of physics normal university students.

1.2 Review of Research Status

Fan Zhonghe, in his article "A Brief Discussion on the Writing of Undergraduate Graduation Theses in Physics", pointed

out several common types of topic selection for physics major graduation theses, mainly including teaching content type, teaching method type, teaching experiment type, educational theory type, and applied research type [5]. Liu Xuan, in his paper "Practical Exploration on Topic Selection of Graduation Theses in Applied Physics Major", pointed out that due to the continuous enrollment expansion in recent years, the number of students has been increasing, resulting in a relative shortage of supervisor resources and a relative increase in the number of students guided by each teacher [6]. Under such circumstances, it is very necessary to hire off-campus supervisors to assist in guiding students' graduation theses. Off-campus supervisors should be engineering and technical personnel or researchers with intermediate professional titles or above. In this way, while alleviating the pressure caused by the shortage of supervisors in the physics major, it can also promote the formation of a multi-level structure and a diversified model of the supervisor team [7]. At present, many colleges and universities have implemented the dual-tutor system for educational internships. For example, Shanxi Normal University has implemented the system of college teachers being stationed in counties, where college teachers and supervisors from internship schools jointly guide students' internships, which provides very good conditions for the dual-tutor system for students' graduation thesis creation [8]. Another example is that the chemistry normal major of Jinggangshan University invited some middle school chemistry teaching experts and some professional supervisors for students' internships to serve as middle school supervisors for students' graduation theses, established a "dual-tutor" team jointly guided by college teachers and middle school teachers, and implemented the whole-process "dual-tutor" guidance for students' graduation theses [9].

1.3 Research Methods and Objectives

Through methods such as online access to relevant materials, offline reading and guidance of normal university students' graduation theses, as well as multiple visits to Tianjiabing Middle School in Ya'an City to go deep into the frontline of teaching and internships, and combined with interviews with many teachers from Tianjiabing Middle School and staff of the Ya'an Municipal Bureau of Education, aiming at the many shortcomings in the graduation theses of students in the Department of Physics of Sichuan Minzu College, the author hopes to construct a system in which university teachers and senior high school teachers cooperate to jointly guide the graduation theses of normal university students, and propose solutions to the dilemmas existing in the dual-tutor mechanism, such as differences in teachers' willingness to participate and difficulties in coordinating tutors' opinions.

2.Connotation and Value of the Dual-Tutor Mechanism for Graduation Theses

Under the background of collaborative talent cultivation, the "dual-tutor system" for the graduation theses of physics normal university students has been endowed with more profound connotation and mission. Collaborative talent cultivation emphasizes breaking down the barriers between colleges and universities and society, integrating multiple resources, and comprehensively cultivating students to become compound talents who meet social needs. The "dual tutors" refer to arranging one college supervisor and one supervisor from the basic education practice base to jointly guide normal university students in the process of completing their graduation theses. Since off-campus tutors have a full understanding of the actual teaching in middle schools, the topic selection of normal university students' graduation theses can conform to the actual situation of middle school education and teaching under their guidance. From the perspective of the current implementation situation, many colleges and universities have established relatively complete dual-tutor communication and cooperation platforms under the promotion of collaborative talent cultivation projects. Taking the physics major of Sichuan Minzu College as an example, the dual-tutor mechanism for graduation theses takes "collaborative talent cultivation" as the core, clarifies the differentiated division of labor between college tutors and frontline physics teachers in senior high schools, and forms a closed-loop guidance system of "theoretical guidance - practical verification". The main responsibilities of college tutors lie in grasping the theoretical framework of the thesis and the standardization of formats, such as the citation format of references; the main responsibilities of senior high school teachers lie in guiding students to select topics based on the frontline of teaching, providing practical materials such as teaching cases, real questions from the college entrance examination, and students' learning feedback, and helping students transform theories into implementable teaching plans. The value of the dual-tutor mechanism for graduation theses is mainly reflected in the realization of a win-

win situation for students, college teachers, and senior high school teachers. For students, the guidance of senior high school teachers can prevent educational theories from being divorced from reality (becoming "empty talk on paper"). Through internship guidance and cooperative discussions, senior high school teachers can provide frontline teaching materials and feedback; the guidance of college teachers can help students construct a theoretical framework, standardize the format of the thesis, and improve their ability to write academic theses. The joint guidance of the two can enable students to achieve the integration of physics knowledge in senior high schools and universities. For college teachers, the guidance of senior high school teachers can not only share part of the heavy thesis guidance pressure of college teachers, but also improve the drawback of colleges and universities attaching importance to theory while neglecting practice through frontline teaching feedback. For senior high school teachers, jointly guiding thesis writing can improve their shortcoming of having rich practical experience but weak ability to organize written content, which is very helpful for the improvement of their research capabilities.

3.Practical Dilemmas and Optimized Paths of the Dual-Tutor Mechanism

3.1 Practical Dilemmas

(1) Low Willingness of Senior High School Physics Teachers to Participate and Lack of Incentive Mechanism

From the interview results, senior high school physics teachers generally face objective constraints such as heavy teaching tasks and great pressure from students' further education. Moreover, guiding undergraduate graduation theses is not linked to performance evaluation or professional title promotion. In addition, frontline senior high school teachers have been separated from the undergraduate curriculum teaching and research system for a long time, and many university-level knowledge has been forgotten. Due to these three reasons, the overall willingness of frontline senior high school teachers to participate in guiding the graduation theses of normal university students is relatively low.

(2) Insufficient Coordination of Dual Tutors' Opinions, Easily Leading to Confusion in the Guidance Direction for Students

College teachers and frontline senior high school teachers may have differences in the guidance of graduation theses. College teachers pay more attention to the integrity of the theoretical framework and may suggest significantly increasing the proportion of the theoretical part; frontline senior high school teachers pay more attention to the practical application value of theories, and they often hope that normal university students can conduct on-site investigations to identify problems, propose feasible solutions, and verify the feasibility of the solutions in subsequent teaching internships.

3.2 Optimized Paths

(1) Constructing a Hierarchical Incentive Mechanism to Improve the Willingness of Senior High School Physics Teachers to Participate

First of all, the guidance of senior high school physics teachers to undergraduate graduation theses can be linked to their performance evaluation. Since the School of Mathematics, Physics and Statistics of Sichuan Minzu College has established an internship base in Ya'an and has in-depth cooperation with Tianjiabing Middle School in Ya'an, the college supervisor corresponding to a student's graduation thesis can establish a cooperative relationship with the senior high school supervisor to help the latter improve their academic thesis writing skills, thereby indirectly assisting frontline senior high school teachers in their professional title promotion.

(2) Establishing a Dual-Tutor Collaborative Communication Mechanism to Unify the Guidance Direction

First of all, it is necessary to establish collaborative guidance rules and clarify the responsibilities of college supervisors and senior high school supervisors in different aspects and parts of the thesis. For example, in the topic selection stage, frontline tutors mainly propose practical directions, and college tutors are responsible for demonstrating the theoretical feasibility; in the first draft stage, college tutors review the format and theoretical logic, and frontline tutors review the authenticity of practical content; in the revision stage, a joint meeting is held to jointly determine the revision plan to avoid opinion conflicts.

4.Practical Case

Taking the graduation thesis of a student in the 2024 physics major- "Research on the Connection between Senior High School Physics and University Physics Knowledge - Taking Thermodynamics as an Example" - as an example. In the topic

selection stage, the student originally tended to choose a topic that did not involve a specific field but focused on the research of the entire physics discipline in senior high school and university. After communication between the college supervisor and the senior high school supervisor, the student was advised to select a narrower, more operable topic that could be combined with practical situations, and the student accepted this suggestion. In the research stage, the college supervisor provided the student with a theoretical framework, such as Piaget's "Cognitive Development Theory" and Vygotsky's "Zone of Proximal Development" theory, to demonstrate the feasibility of the research. The senior high school supervisor analyzed the specific knowledge points of senior high school thermodynamics content, studied the similarities and differences between many knowledge points and university-level content, and put forward some possible connection schemes. In the practical verification stage, with the assistance of the senior high school supervisor, the student carried out exploratory practical teaching during the internship period, guiding senior high school students to think about and discuss some in-depth questions in the classroom, so as to realize the connection between thermodynamics content in senior high school physics and that in university physics. Finally, the university supervisor helped the student revise the thesis format, and finally completed an excellent graduation thesis with prominent practical value and clear theoretical logic.

Conclusion

Since the graduation theses of physics normal university students often have problems such as the disconnection between theory and practice and the insufficient connection between students' research capabilities and teaching practice abilities, this paper takes the normal university students of the Department of Physics of Sichuan Minzu College as an example, integrates the interviews with Tianjiabing Middle School in Ya'an, and constructs a guidance system of the dual-tutor mechanism for graduation theses based on the actual situation. This system can not only avoid the drawback of normal university students' graduation theses attaching importance to theory while neglecting practice, but also realize a win-win situation for students, college teachers, and senior high school teachers. This scheme can provide a reference for the guidance of graduation theses of normal university students in the Department of Physics in the future.

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Conflict of Interests

The authors declare that there is no conflict of interest regarding the publication of this paper.

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