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An Interview-Based Study of the Factors Influencing the Quality of Professional Training of Science Education Graduates

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Abstract: The proposal of the strategy of developing the country through science education has clarified China's demand for the development of the science and education industry and the cultivation of science and education talents, and the birth of Science Education majors is an important link in the cultivation of scientific literacy. Based on the grounded theory, we interviewed three Science Education graduates from a university and coded the interview data by using NVivo 12.0 to find eight important factors affecting their professional training and employment choices. The factors are "social factors," "individual career choice factors," "campus resources," "employment advantages," "professional self-development," "teacher factors," "planning for further education and employment," and "student motivation." This study analyzes the interaction between the influencing factors, constructs a theoretical model of the influencing factors of the quality of Science Education professional training, explores the problems of the training process of Science Education majors and employment dilemmas, and puts forward corresponding suggestions.

Keywords: Science Education; Teacher training; Professional development; Influencing factors; Rooted research

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1. Introduction

Scientific and technological development relies on talent, and talent cultivation relies on education [1]. China's new round of basic education curriculum reform, launched in 1999, places greater emphasis on the balanced, comprehensive, and selective nature of the curriculum structure [2]. The integrated curriculum organically integrates multiple subjects to form a new type of course [3], which puts higher demands on teachers' comprehensive literacy. The age of science and technology has made scientific literacy more important in the process of personnel training, and science education requires the training of complex personnel who can engage in teaching and research and management affairs [4]. However, Science Education majors are also facing some problems and challenges in the process of development, such as problems in professional orientation, curriculum, faculty, professional visibility, etc., which need to be solved [5]. In addition, the fit between Science Education majors and social needs requires further strengthening in order to solve the problems of professional

employment counterparts and the actual needs of society for science education talents [6]. The development of science education requires not only the improvement of the professional training system of science education but also the synergy between the government and society [7].

This study attempts to analyze the existing problems in the development of the Science Education profession by interviewing the graduates of the Science Education major in a university, discovering their dilemmas in the actual professional training and employment process based on the grounded theory, with a view to providing constructive suggestions for its development.

2. Research methods

Grounded theory closely links empirical research and theory construction, allowing the researcher to develop concepts and construct theories by using a systematic analytical approach to generalize and construct theories from primary sources [8]. In-depth interviews form a large amount of textual information through in-depth conversations with interviewees, and use the grounded theory to compare and analyze individual experiences and gradually abstract relevant concepts and categories, so as to understand the lifestyles and experiences of a certain social group and analyze the process of formation of a specific social phenomenon, and then construct social theories reflecting the reality of life on this basis [9].

3. Interviewees information

The interviewees were graduates of a college or university majoring in Science Education. The screening criteria were those who were pursuing further education in the field or were employed in the same field, i.e., currently engaged in a science education career (e.g., elementary school science teachers) or pursuing graduate studies in a science education-related field (e.g., Science and Technology Education majors). The details of the three interviewees are shown in **Table 1**.

Table 1. Basic information of interviewers

Code	Employment / Further education
LHY	XX University, Master's Degree in Science and Technology Education in progress
HBJ	XX Elementary School, 1st and 2nd grade science teacher
LWX	XX Elementary School, 1st and 2nd grade science teacher

4. Information collection

Interview outlines were prepared in advance, with 15 main questions, based on which specific interview questions were adapted, and each person was interviewed for about twenty minutes.

Due to location constraints, online video interviews were conducted, and the interviews were recorded after obtaining their consent. After the interviews, the recordings were converted into textual information and organized. Secondary interviews were conducted on issues that were not well understood or that they wanted to know further. The final textual information on the interview recordings was obtained, which was about 15,000 words. At the same time, the basic information of the interviewees was coded, and the real names and places involved in the raw data of the interviews were anonymized accordingly, and the final interview data were confirmed by the interviewees before the follow-up study was conducted.

5. Data analysis

According to the grounded theory, this study coded the original interview data level by level, conceptualized the original discourse, integrated the concepts into categories, and then formed the core categories. Subsequently, it sought the factors with correlation in the data, and finally realized the level-by-level generalization of the factors influencing the quality of Science Education professional training and the relationship between the factors.

In the first-level coding process, on the basis of respecting the principle of "localization" of concepts, the key statements in the original interview data were named and conceptualized, and 43 open codes were obtained. The secondary coding aimed to establish the connection between each conceptual category, further integrated the open codes organically to form new codes, and finally formed 8 associative codes from the 43 open codes. Tertiary coding aims to analyze the conceptual attributes and their intrinsic connections, and identify the core conceptual attributes with strong associative capacity and key roles, i.e., the core codes that play a central role in the whole network of relationships. The three core categories of social factors, campus resources, and teacher factors were ultimately identified as key influences on the quality of training in science education programs.

6. Results

6.1. Eight important influences on the quality of professional development

The factors affecting the quality of professional development involve a wide range of aspects (**Table 2**), including the richness of campus resources, such as whether the school can provide students with appropriate internship opportunities, whether it can organize academic activities and competitions in line with the development of the profession, whether it emphasizes the development of the profession and so on, which all have an impact on the quality of student training; whether the school's positioning of the profession is clear, and whether the course curriculum and the selection of content are reasonable [10], which also exert an impact on the long-term development of the profession; teachers' teaching level and teaching attitude, whether they care about students and students' independent initiative are also important influencing factors for professional development [11]. Whether the school has a clear orientation of the specialty and whether the curriculum and content are selected reasonably will also have an impact on the long-term development of the specialty [12]; and whether the teachers care about the students and their autonomy and motivation are also important influencing factors for the development of the specialty [13]. At the same time, some social factors, such as the popularity of the specialty and social culture, will also affect the willingness to apply for the specialty and the quality of employment. The quality of employment is related to the quality of professional training, and at the same time, the employment situation in turn affects the enrollment of the program and the investment of resources, thus affecting the quality of professional training. In addition, the impact of these factors is not a single effect, but the result of the interaction of the outcome formation.

Table 2. Important factors influencing the quality of professional training

Factors	Key indicators	Frequency
Social factors	Teacher recruitment channels Social recognition of Science Education Professional visibility in Science Education Social atmosphere Social requirement School-local government coordination issues Government's emphasis on science classes School's emphasis on science lessons in elementary school	49
Individual career choice factors	Working conditions Workplace Working environment Teaching group preferences Degree of employment relevance Teacher education students' identity Elementary science teacher identity	44
Campus resources	Guidance for further education and employment Internship Peer influences Development of students' academic abilities Academic activities or competitions conducted Degree of relevance of academic activities to the profession Level of school School's emphasis on Science Education majors	32
Employment advantages	Competitiveness in employment Practical ability Knowledge of elementary school science teachers Professionalism needs of elementary science teachers Competence in teaching Education level	25
Professional self-development	Course content Curriculum Students' willingness to enroll Positioning of disciplines	23
Teacher factors	Teachers' care about students Teaching level Teachers' attitudes towards teaching Communication between teachers and students	18
Planning for further education and employment	Ideas for work Ideas for graduate studies Difficulty of the examination	18
Student motivation	Students' capacity for active learning Students' goal planning Academic activity participation	10

6.2. Theoretical model of factors influencing the quality of professional training

The correlation between the eight important influencing factors was analyzed based on the original data of the interviews, and the theoretical model of the influencing factors of professional training quality was constructed (**Figure 1**). In order to better understand the correlation between the factors, two outcome variables, "professional

training quality" and "employment quality," are added to the theoretical model. The logic is that the influence between the quality of professional training and the quality of employment is a cyclic process, and one factor may affect the quality of professional training and the quality of employment at the same time, so that the path of each factor can be seen more clearly.

Taking campus resources as an example, abundant campus resources can be an employment advantage for students, which in turn promotes students' intention to be employed in their own specialty; at the same time, abundant campus resources can also provide students with suitable employment opportunities, such as campus recruitment, which directly contributes to the employment of students in their own specialty. In addition, it may also promote students' motivation, such as abundant practical activities (e.g., teacher skills competitions) that allow students to increase their teaching experience to enhance employment advantage. It can also increase the autonomy of the student initiative and achieve employment goals for independent planning, to enhance the quality of professional training as well as promote the quality of employment.

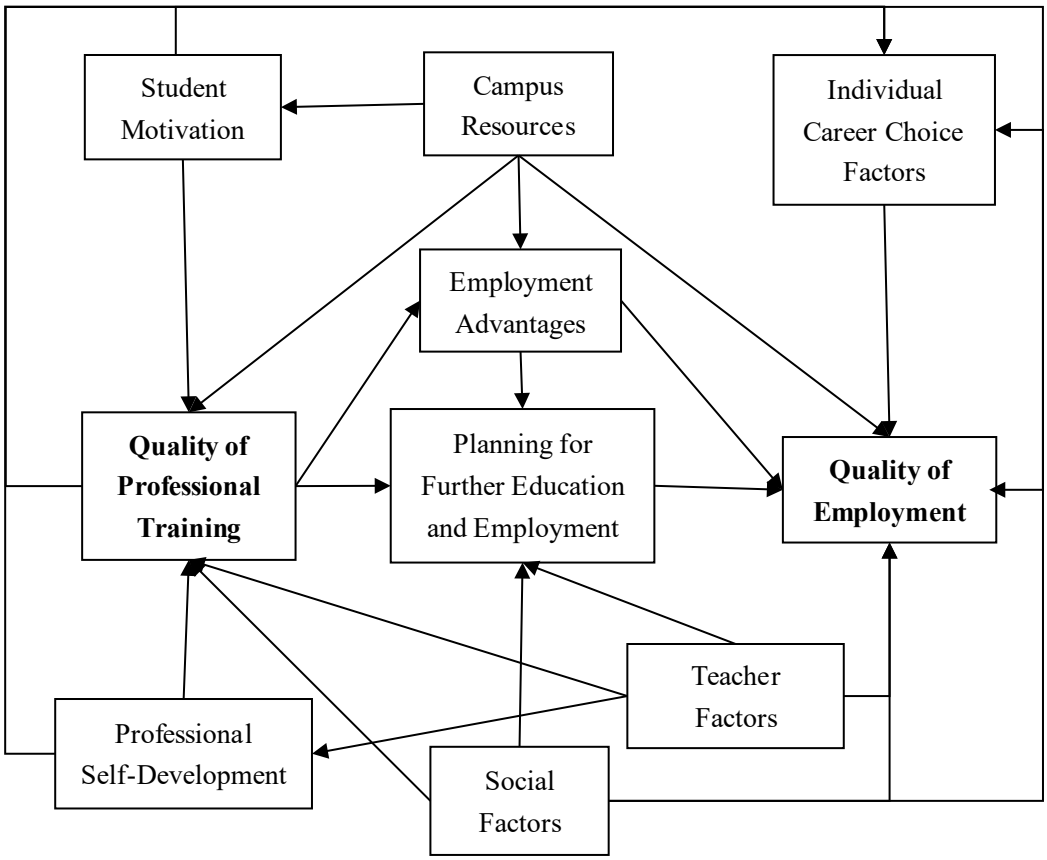

Figure 1. Theoretical model of factors influencing the quality of professional training

6.3. Pathways to the role of the three key factors in the quality of professional development

According to **Figure 1**, it can be seen that social factors, campus resources, and teacher factors have the largest influence on other factors and play a key role in the whole network of role relationships (the specific paths of action are shown in **Table 3**). For example, society's emphasis on science education affects students' willingness to enroll in Science Education majors and their employment choices [14].

Table 3. Pathways of the three key factors acting on the quality of professional training

Direct factor	Acting on other relevant factors
Social factors	Planning for further education and employment Individual career choice factors
Campus resources	Student motivation Employment advantages
Teacher factors	Planning for further education and employment Professional self-development

7. Discussion

Important influences on the quality of professional training include "social factors," "individual career choice factors," "campus resources," "employment advantages," "professional self-development," "teacher factors," "planning for further education and employment," and "student motivation." The frequency of each part of the factors mentioned in the interviews is shown in **Figure 2**.

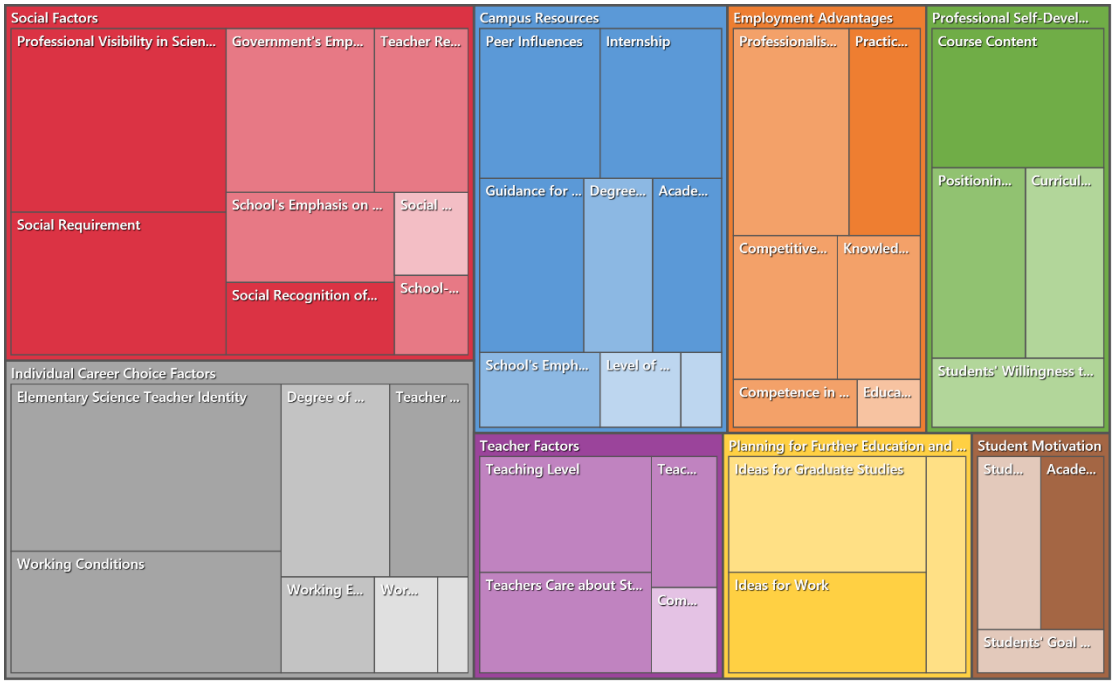

Figure 2. Percentage of factors influencing the quality of professional training

Overall, the contribution of Science Education majors to the development of China's science and education cause still has a lot of room for action. The development of Science Education majors is a long-term project, of which the most important thing is that institutions of higher education should clarify the professional positioning, ensure the characteristics of the specialties, and should avoid conveniently and arbitrarily relying on faculties and departments and arbitrarily setting up the curriculum. At the same time, they should pay as much attention as possible to the development of the Science Education majors, provide certain related academic activities and opportunities for competitions, and increase the practicability of the courses to ensure the effect of internships for the students. Through the school's professional training, students have more employment advantages and broader space for sustainable development in pursuing a career as a science teacher, and the

policy support of the local government is indispensable [15].

Disclosure statement

The author declares no conflict of interest.

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