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# Reflection on the Current Situation of Pre-service Teachers' Data Literacy and Exploration of Cultivation

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**Abstract: With the global development of digitalization, the application of digital technology in the field of education is becoming increasingly widespread. The investigation and cultivation of data literacy among normal university students is crucial to providing strong support for educational digitalization, education for all, and lifelong learning. This study takes normal university students from Zhaoqing University as the research object and conducts a comprehensive survey on four aspects of their data literacy: data awareness, data skills, data application, and data ethics. Based on the analysis of the current situation, corresponding strategies and measures are proposed for their cultivation and improvement.**

**Keywords: Normal University Students; Data Literacy; Current Situation Reflection; Cultivation Mechanism**

## 1. Introduction

With the deep integration of information technology and various fields, the amount of data is growing rapidly. People use big data analysis to discover patterns and assist in decision-making. The development of big data has had a revolutionary impact on economic and social development as well as people's thinking and concepts. In May 2021, the Ministry of Education in China issued five documents including the "Standards for Teacher Professional Competence of Normal University Students in Secondary Education (Trial)". In September 2022, the Ministry of Education in China also released the "Industry Standard for Teacher Digital Literacy". This standard clarifies the specific connotations of teacher digital literacy, including the framework standards of five dimensions: digital awareness, knowledge and skills of digital technology, digital application, digital social responsibility, and professional development. This provides a clear reference for normal university students, helping them to cultivate the ability with high digital literacy in the new era. These documents set specific requirements for the educational background, professional knowledge, teaching ability, etc. of normal university students, aiming to enhance their teacher professional competence. The "Data Quality Movement" in the United States defines elements such as "data exchange" and "data ethics", and defines teacher data literacy as follows: educators with data literacy continuously, effectively, and ethically acquire, interpret, process, and communicate various types of data from various sources in order to improve student outcomes in a manner that aligns with their professional roles and responsibilities [1]. Teacher data literacy is a necessary condition for transforming raw data into teaching knowledge and then into teaching practice. By accessing, collecting, analyzing, understanding, communicating, and using data ethically, problems in teaching can be addressed through inquiry, creatively establishing a connection between research and practice [2], achieving scientific decision-making, and promoting educational development.

## 2. Investigation Design and Implementation

### 2.1 Investigation Design

This study mainly uses the questionnaire survey method to investigate normal university students in Zhaoqing University. Based on the connotation of data literacy, a total of 35 questions are designed, including 7 questions on data awareness, 6 questions on data ethics, 10 questions on core skills, and 12 questions on personal satisfaction and willingness. These questions cover the four dimensions of teacher

data literacy assessment.

### 2.2 Basic Situation Analysis of Samples

A total of 335 valid questionnaires were collected. According to the analysis using SPSS software, it is evident that there are more female than male respondents among the normal university students in this survey, with females accounting for approximately 73% and males accounting for approximately 26%. The proportion of students in different grades is also different, with sophomores accounting for the largest proportion at around 75.5%, juniors accounting for about 12%, freshmen accounting for about 10%, and seniors accounting for about 3%. Among the samples, 40.92% come from rural areas, 41.5% come from urban areas, and the remaining 17.58% come from urban areas. In terms of the major categories of normal university students collected, humanities account for approximately 51.2%, science and engineering account for approximately 43.1%, and arts account for approximately 6.7%.

## 3. Results and Analysis

### 3.1 Data Awareness of Normal University Students

Firstly, regarding the concept of "data literacy", about 60% of the pre-service teachers are not familiar with the concept of data literacy, and only 2.94% of them have a very good understanding of it. Therefore, the overall data awareness of normal university students is not strong. The survey results further show that most respondents have some understanding of data processing techniques, data quality, and the role of data in education. In terms of data processing techniques, 35% of the respondents can name at least one common data processing technique and describe its characteristics, indicating a certain level of understanding. Training on data visualization and statistical analysis can be provided to those with less knowledge in data processing skills to enhance their abilities. Regarding data quality, 60% of the respondents agree or strongly agree that data quality requirements include completeness, accuracy, consistency, and timeliness. It is suggested to conduct training for those with lower awareness of data quality concepts, emphasizing the importance of data integrity, accuracy, consistency, and timeliness [3]. Regarding the perception of data in education, 69% of the respondents acknowledge that as normal university students, they have a clear understanding of the importance of data in today's educational field. However, a small portion of respondents have a relatively low understanding of these concepts and may require more education and training to enhance their data awareness. These results provide useful references for developing customized educational plans to improve the knowledge level of respondents in data-related fields.

Secondly, regarding the application of data literacy, the level of normal university students in Zhaoqing University needs improvement. Approximately 76% of the students can express at least one basic data tool or software (such as using Excel, SPSS, etc.) and its purpose, and can perform basic function operations. However, there are also 24% of students who cannot use any data processing tools. Nevertheless, 97% of the students agree that it is important to verify the authenticity when obtaining different sources of teaching data. It can be seen that normal university students in Zhaoqing University have a high demand for data awareness, but their overall application level is at an intermediate level. Both theoretical and practical aspects need to be improved to enhance their data awareness.

### 3.2 Ethics of Data for Teacher Education Students

Data ethics is particularly crucial in the field of education, especially when it comes to teacher education students utilizing internet data. The focus is primarily on two key aspects: privacy handling attitudes and copyright awareness. The aim is to gain a comprehensive understanding of the attitudes and behaviors of teacher education students at Zhaoqing University in their data operations [4]. This allows us to better understand the ethical challenges they face when using internet data and provides valuable insights for cultivating future educators with more cautious and ethical data usage concepts in the digital age.

The survey results show that in terms of data ethics, during the process of data collection, processing, and analysis, 70% of teacher education students consciously indicate the sources of data when utilizing relevant resources on the internet. Around 90% of these

students pay attention to collecting and searching for data from official websites and handle the real names of individuals in the data with privacy considerations. When conducting data collection, they respect the rights of the respondents, adhere to relevant laws, regulations, and ethical norms, ensuring the legitimacy and fairness of data collection. They understand the importance of protecting personal privacy and, when processing and analyzing data, should safeguard the personal privacy and sensitive information of the respondents to avoid leakage or misuse of data. They should also comply with relevant academic, industry, and corporate regulations and standards to ensure the legality and credibility of data processing and analysis.

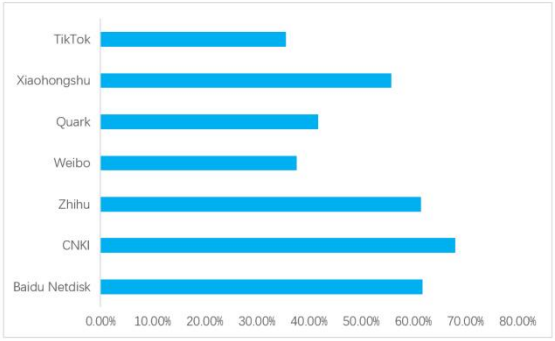


**Figure 1. Survey on Data Usage Platforms**

According to the survey results shown in Figure 1, teacher education students primarily use Baidu Netdisk, CNKI, and Zhihu as platforms for collecting or integrating data. In addition, they also frequently use Xiaohongshu, Quark, and Weibo. When conducting data processing and analysis, it is important to ensure the accuracy and completeness of the data to avoid misleading or erroneous conclusions caused by data errors or omissions. Teacher education students should adhere to principles of honesty, fairness, objectivity, and transparency when processing and analyzing data. They should comply with relevant laws, regulations, and ethical norms to guarantee the legality and credibility of data processing and analysis [5].

### 3.3 Data Skills of Teacher Education Students

Data skills mainly focus on attitudes and abilities in data processing and analysis, as well as the use of data tools. Through surveys on these dimensions, a comprehensive understanding of the skill level of teacher education students can be obtained, providing useful references for their training and development.

According to the survey, about 70% of students are able to apply data and data results to their learning in order to improve their learning effectiveness. When searching for information, they often quickly and accurately obtain the required data, can filter and organize the collected data well, and make scientifically reasonable descriptions and classifications based on the filtered and organized results. However, nearly 30% of teacher education students still have poor performance in data acquisition and analysis capabilities.

In terms of data usage and practical tools for teacher education students, their ability to save data is strong, with about 87% of students being able to use tools such as cloud storage well. However, only 56% of students are able to handle and analyze data well, indicating that there is still much room for improvement in this aspect.

### 3.4 Data Literacy and Personal Willingness of Teacher Education Students

A survey was conducted to explore the attitudes and perspectives of education major teacher education students on data literacy, focusing on their curriculum needs. Through statistical indicators such as standard deviation and median coefficient of variation, a comprehensive perspective was provided to gain a deeper understanding of the perceptions and evaluations of teacher education students at Zhaoqing University towards the construction of data literacy courses and systems. This is significant in understanding the demands of teacher education students at Zhaoqing University for data education and their level of satisfaction with the current curriculum system.

According to the data analysis in Table 1, the coefficients of variation According to the data analysis in Table 1, the coefficients of variation (CV) for individual planning, school outlook, satisfaction with school data literacy courses, and awareness of data literacy in school planning are 0.473, 0.632, 0.495 respectively, all of which are greater than 0.15. Analysis was conducted on the indicators that performed prominently. Most teacher

education students have a clear understanding of their own positioning, and the vast majority of them expressed the need to establish separate "data literacy"-related courses and strengthen the construction of the curriculum system related to it while enhancing data awareness training. This reflects the importance and developmental needs that teacher education students place on data literacy.

**Table 1. Curriculum Demands**

| Question | Sample Size | Max | Min | Mean | SD | Median | Variance | Kurtosis | Skewness | CV |
|---|---|---|---|---|---|---|---|---|---|---|
| Do you think it is necessary to set up a separate course related to "data literacy" and strengthen the construction of the relevant course system? | 340 | 5 | 1 | 1.953 | 0.924 | 2 | 0.853 | -0.546 | 0.545 | 0.4729829268 |
| Are you satisfied with the school's emphasis on teacher data literacy and curriculum development? | 340 | 5 | 1 | 2.112 | 1.335 | 2 | 1.781 | -0.086 | 1.105 | 0.6319522339 |
| During your study in the normal education major, do you believe that the courses planned by the school have led to a qualitative improvement in your data awareness compared to before? | 340 | 5 | 1 | 1.988 | 0.984 | 2 | 0.967 | 0.225 | 0.922 | 0.4946957018 |

## 4. Suggestions for Improving Teacher Education Students' Data Literacy

In today's information society, data literacy has become one of the essential core competencies for teacher education students. In order to enhance their awareness and abilities in data literacy, universities need to take a series of measures.

### 4.1 Increase Teacher Education Students' Awareness of Data Literacy and Enhance Their Interest and Motivation in It

Firstly, increase the number of data literacy courses and strengthen practical teaching. Add relevant courses on data literacy to the curriculum for teacher education students, including basic knowledge of data, data processing and analysis skills, data visualization, etc. Through systematic learning, teacher education students can master the core skills of data literacy and improve their sensitivity and understanding towards data. At the same time, in the data literacy courses, the practical aspects should be emphasized. Allow teacher education students to operate and experience data tools themselves, engage in practical applications and operations, and enhance their practical operation capabilities and problem-solving abilities. For example, teacher education students can be arranged to participate in practical activities such as data collection, processing, analysis, and visualization, allowing them to deeply understand and master data literacy skills through practice [6].

Secondly, organize data literacy competitions and strengthen cooperation and exchange. Organize teacher education students to participate in data literacy competitions, allowing them to hone their data literacy skills through competitions and stimulating their interest in the field of data literacy. Prize mechanisms can be set up in the competitions to encourage more teacher education students to participate. Collaborate and exchange data literacy knowledge and skills with other schools or institutions, sharing resources and helping each other. Through cooperation and exchange, teacher education students can gain access to more data literacy knowledge and skills, broadening their horizons and perspectives.

Lastly, cultivate autonomous learning ability and increase data initiative. Teacher education students need to recognize the importance of data in the field of education and understand how to utilize data to improve teaching and learning outcomes. Encourage teacher education students to explore and learn data literacy knowledge independently. Besides course learning, teacher education students can read relevant books, participate in online courses, attend academic lectures, etc., to independently acquire knowledge and skills in

the field of data literacy.

### 4.2 Establish a Data Literacy Platform to Enhance Teacher Education Students' Data Literacy Skills

To enhance teacher education students' data literacy skills and establish a corresponding data literacy platform, different methods and strategies can be adopted for teacher education students, university teachers, and universities.

Firstly, establish a data literacy platform and encourage students to participate in practical projects [7]. Universities can establish a data literacy platform that provides data tools and resources to facilitate teacher education students' data practice and learning. The platform can include online courses, data tools, and case libraries, among other resources, to support teacher education students' learning and practice. Teacher education students can actively participate in data practice projects such as conducting research surveys and analyzing teaching data. Through practice, they can gain a deeper understanding of the value and role of data, and improve their data literacy skills.

Secondly, strengthen teacher training to provide guidance and support for students. Universities can provide teacher training and support to help teachers update their educational concepts and teaching methods, and enhance their data literacy skills and ability to guide teacher education students. This way, they can provide guidance and support for teacher education students, helping them master the skills and applications of data literacy. Teachers can promote the learning and development of teacher education students by organizing discussions, providing practical opportunities, and providing feedback.

### 4.3 Establish a Teacher Education Student Data Center and Introduce Online Educational Resources

Firstly, establish a teacher education student data center to provide relevant data resources and tools. The center can be equipped with professional teacher guidance and technical support to create a favorable learning environment for teacher education students. In addition, make use of online educational platforms to introduce high-quality data literacy teaching resources, including online courses, video tutorials, practical projects, etc. Teacher education students can enhance their data literacy level through online learning and interact with teachers and other students.

Secondly, by introducing appropriate resources, it can help teacher education students improve their data literacy and capabilities, preparing them for future educational work [8]. For example, for liberal arts teacher education students, social survey data, historical data, cultural research data, etc. can be introduced along with relevant online courses and lectures. For science and engineering teacher education students, scientific research data sets, engineering design data, etc. can be introduced along with relevant online science and engineering courses.

### 4.4 Improve the Data Literacy Assessment Mechanism and Conduct Skills Assessment Tests Regularly

To establish a sound data literacy teaching management and supervision mechanism for teacher education students in universities, it is necessary to work with professional teachers to develop a comprehensive plan for cultivating teacher education students' data literacy abilities. This will ensure that both teachers and teacher education students have a clear understanding of the goals to be achieved at each learning stage [9]. Teachers should come from among teacher education students and return to them, conducting regular assessment tests that include linking and applying data content interpretation, selecting appropriate digital devices or platforms to present data analysis processes, etc. This will enable teachers to accurately grasp the strengths and weaknesses of teacher education students, identify common problems and individual differences in their learning of data theory and operation courses, improve the education and teaching system of the data literacy curriculum modules, and gradually promote teacher education students to become qualified data literates [10].

## 5. Conclusion

In recent years, the development of educational informatization in China has been rapid, and the network teaching environment in schools has significantly improved. The "Educational Informatization 2.0 Action Plan" issued by the Ministry of Education in 2018 pointed out that by 2022, digital campus

construction would cover all schools. Currently, the internet access rate of primary and secondary schools has approached 100%, providing ample hardware support to enhance teachers' data literacy. The normalized application of various learning platforms also offers unique conditions for the generation of educational big data. Whether teachers can obtain and process data scientifically and rationally and make informed decisions is a necessary condition for improving the quality of education in the era of big data. All departments should strive to create conditions for the improvement of data literacy for pre-service teachers, and teacher trainees themselves should also work hard to improve and enhance their data awareness, data skills, and data responsibility.

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