

# *Research on the Current Situation of Pre Service Teachers' Data Literacy and Training Countermeasures*

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**Abstract:** The era of big data has put forward higher requirements for pre service teachers' data literacy. Data literacy is described from six dimensions: Data awareness, data acquisition ability, data organization and management, data processing and analysis, data ethics and data sharing. A questionnaire survey is conducted to investigate the current situation of pre service teachers' data literacy in Zhaoqing University Guangdong Province. The results show that the pre service teachers' data awareness, data acquisition ability and data ethics ability are relatively strong, while the ability of data organization and management, data processing and analysis and data sharing need to be improved. The results of this article provide a reference for future teacher training, and provide suggestions and directions for pre service teachers to better improve their own data literacy.

## **1. Introduction**

With the development of the new generation of information technology, mankind is entering the era of big data. Data has become the world's basic strategic resource. Big data has attracted more and more attention from countries and fields. In 2015, the State Council issued the action plan for promoting the development of big data, which clearly stated that it would comprehensively promote the development and application of big data and accelerate the construction of a data power [1]. Obviously, big data is gradually gaining popularity and rapidly integrating into all walks of life, which has a great impact on human work, life and thought. The "power" of big data also has a violent impact on the education system, bringing new ideas to education, bringing overturning forces to promote innovation and reform of the education system, and showing the infinite charm of future education.

As big data is widely used, data literacy has become an indispensable literacy for teachers. Pre service teachers are future teachers. As front-line educators in the era of big data, only with data literacy that conforms to the development of big data can they adapt to the development trend of the digital age and help the development of education in the future. The online teaching under the COVID-19 in 2020 highlights the importance and necessity of improving teachers' data literacy.

Zhaoqing is located in the underdeveloped area of western Guangdong, with relatively backward economic structure and relatively delayed information construction. To explore the data literacy of students in Zhaoqing University, provide reference and direction for pre service teachers to better improve their data literacy, and is of great significance to promote the development of data literacy education in Zhaoqing and similar areas.

## 2. Overview of Data Literacy

### 2.1 Connotation of Data Literacy

Y. eshet alkalai, an Israeli scholar, first proposed "digital literacy" in 1994 and summarized it as "the ability to understand and use various digital resources and information presented by computers" [2]. In 1997, Paul gilster defined digital literacy in his book digital literacy as the ability to acquire, understand and integrate digital information [3]. In August, 2017, IFLA released the first international systematic Declaration on digital literacy, the IFLA digital literacy declaration. The declaration emphasizes the importance of digital literacy for individuals and society, that is, digital literacy refers to the ability to use digital tools to realize this potential. Having digital literacy means that we can make full use of digital technology (or guide us how to use science and Technology) in an efficient and reasonable way to meet the information needs of individuals, society and professional fields [4].

Combined with its application characteristics in education and teaching, teachers' data literacy can be summarized as educators' ability to identify, collect, manage, process, analyze, share and innovate data, as well as the ethics and code of conduct to be followed in this process [5].

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### 2.2 Elements of Pre Service Teachers' Data Literacy

Fesler divides the process of teachers' professional development into eight stages, and calls the preparation stage of teachers' specific roles as the pre service stage. This paper defines the students in normal universities as pre service teachers. Pre service teachers have not formally entered the field of education and teaching, and lack of educational practice, but they have acquired some professional knowledge, skills and ideas. The data development direction of pre service teachers is different from that of post service teachers.

The constituent elements of pre service teachers' data literacy include six aspects, which are not isolated, but interrelated and mutually reinforcing (Figure 1).

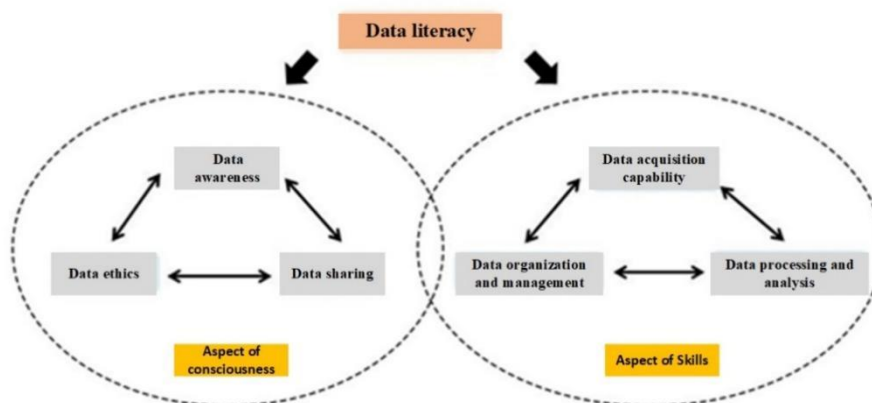


Figure 1: Elements of data literacy

### 2.2.1. Data Awareness

Data awareness is the psychological tendency of teachers when collecting and analyzing teaching related data in the process of teaching practice [6]. In the era of big data, pre service teachers with strong data awareness can more actively find the data relevance in education and teaching, and can better optimize teaching through data analysis. Good data awareness is the core condition to improve pre service teachers' data literacy.

### 2.2.2. Data Acquisition Capability

Data acquisition ability refers to the ability of teachers to use data tools to obtain relevant educational data, which is reflected in the ability of teachers to record various data of learners in daily teaching tasks in databases or electronic reports, standardize and classify the data, and format the data for data analysis.

### 2.2.3. Data Organization and Management

Data management ability refers to the ability of teachers to use appropriate management methods and tools to effectively store data, timely update data and manage by category. In the daily teaching work, teachers can carry out standardized management and classified summary of various data in the teaching process.

### 2.2.4. Data Processing and Analysis

Data processing and analysis refers to the ability to clean and organize data and use tools to analyze data. Teachers can choose appropriate analysis tools to analyze different types of data, master the results and feedback the results to education and teaching.

### 2.2.5. Data Ethics

Data ethics refers to the cognition level of pre service teachers on the legality, security and privacy of data use [7]. Teachers must abide by the law when using data, especially to protect students' personal privacy.

### 2.2.6. Data Sharing

There is no sharing and exchange of data and resources in education and teaching, which will only

make teachers complacent and the development of education stagnate. Data sharing is the ability to share your own data for others to perform various operations. Teachers can establish data exchange channels, share data and make common progress.

### 3. Investigation Design of Pre-service Teachers' Data Literacy

#### 3.1 Investigation Purpose

The purpose of this survey is to have a systematic understanding of the actual situation of pre service teachers' data literacy, so as to analyze learners' data literacy and the deficiencies of current learners' ability. On the premise of analyzing the current situation of the survey, according to the survey results, provide the direction for the development of learners' data literacy.

#### 3.2 Respondents

The research object is the pre service teachers of Zhaoqing University. Considering the objectivity and accuracy of the sample, the data literacy ability of pre service teachers of different grades and majors is investigated by random sampling. In this survey, 325 valid questionnaires were collected through questionnaire distribution and collection. According to gender, there are 243 female students, accounting for 74.77%, and 82 male students, accounting for 25.23%. By major, 159 students are in education, accounting for 48.92%, and 60 students are in engineering, accounting for 18.46%. See Table 1 for the distribution of sampling population by gender, grade and major.

Table 1: Distribution of sampling population by gender, grade and major.

Grade	Total number	male	female	economics	Law	education	literature	history	Neo Confucianism	Engineering	agronomy	Management	Art Studies
Freshman	59	16	43	1	0	44	5	0	6	2	0	0	1
Sophomore	70	21	49	1	1	28	5	1	9	24	0	0	1
Junior	97	19	78	1	1	55	7	1	11	17	0	3	1
Senior	99	26	73	5	3	32	1	4	12	17	1	23	1
total	325	82	243	8	5	159	18	6	38	60	1	26	4

#### 3.3 Investigation Contents

Based on the understanding of data literacy, the questionnaire is divided into two parts: basic information survey and data literacy survey, with a total of 33 questions, mainly single topic, supplemented by multiple-choice questions. The first part mainly understands the basic personal information of pre service teachers, including gender, grade, professional attributes and basic understanding of data literacy. The second part mainly investigates the data literacy of pre service teachers, involving the specific connotation of data literacy: Data awareness (9-13), data acquisition

ability (14-17), data organization and management (18-21), data processing and analysis (22-25), data Ethics (26-28) and data sharing (29-31). Questions 32-33 mainly understand how students hope to acquire knowledge about data literacy.

Through the collection of the questionnaire, the questionnaire has six dimensions  $\alpha$  the coefficient values are all higher than 0.7 and the minimum is 0.719. Therefore, it is proved that the reliability quality of the data is good and the survey data is authentic (Table 2).

Table 2: Reliability analysis results corresponding to six dimensions.

Dimension	Corresponding items	$\alpha$ coefficient
Data awareness	5	0.821
Data acquisition capability	4	0.790
Data organization and management	4	0.883
Data processing and analysis	4	0.879
Data ethics	3	0.860
data sharing	3	0.719

## 4. Survey Results and Analysis of Pre Service Teachers' Data Literacy

### 4.1 Data Awareness Level Analysis

From the survey results (Table 3), the overall level of data awareness is high. More than 90% of pre service teachers are aware of the importance and value of data in all areas of life. However, 30% of pre service teachers are not clear about the use of statistical websites to find data, describe data in a quantitative way and understand the intrinsic value of data. This shows that the data sensitivity and data thinking awareness of pre service teachers are not enough.

Table 3: Survey results of pre service teachers' data awareness (N=325).

Questionnaire title	Completely non-compliant	Basic nonconformity	Un-certain	Basically conform to	Fully compliant
Aware of the value and significance of data in all areas of life	2.15%	2.77%	3.69%	62.15%	29.23%
Be able to understand the meaning of simple statistical charts	1.54%	2.15%	12%	65.54%	18.77%
Awareness of using relevant official statistical websites and database resources to find data	0.29%	6.46%	20.31%	59.69%	12.62%
Ability to interpret data in a quantitative manner	1.85%	8.31%	32.31%	47.38%	10.15%
Be able to understand the implicit intrinsic value of data	1.85%	6.46%	32.92%	51.69%	7.08%

## 4.2 Analysis of Data Acquisition Capability

As shown in Table 4, the data acquisition ability of pre service teachers is generally high, and the gap is small. Most pre service teachers can master the data collection methods and tools, and have a better understanding of the conventional methods of obtaining data from academic websites, using a variety of retrieval strategies, retrieval tools and designing questionnaires. However, the access to data is not broad enough. Only 58.15% of the teachers know how to obtain data from industry portals, official websites of national or local statistical departments and other channels. Pre service teachers should pay more attention to accumulation and master various ways to obtain data.

Table 4: Survey results of pre service teachers' data acquisition ability ((N=325).

Questionnaire title	Completely non-compliant	Basic nonconformity	Un-certain	Basically conform to	Fully compliant
Be able to use the database purchased by the school library to obtain the required data	2.15%	6.15%	19.08%	60.31%	12.31%
Know how to obtain data from industry portals, official websites of national / local statistical departments, etc.	0.31%	8.92%	32.62%	50.77%	7.38%
Be able to use a variety of search strategies (such as search methods, terms) and search tools to obtain data	0.62%	5.54%	24%	56%	13.85%
Ability to design simple questionnaires	1.54%	5.23%	16.62%	61.54%	15.08%

## 4.3 Data Organization and Management Level Analysis

According to the survey results in Table 5, the data organization and management ability of pre service teachers is generally low. 60% of college students say they can basically manage effectively, but only 23 people can manage data completely, accounting for 7.08% of the total; The same is true for those who can use appropriate tools to manage data, accounting for 60%. As for whether the data can be updated in time, up to 40% of pre service teachers are uncertain. In fact, it is not difficult to carry out effective data management, but most pre service teachers do not have the habit of managing data and updating data, and do not have high initiative in processing data. Most pre service teachers seldom use the data management platform, and only 51.69% of them can skillfully use the data management platform.

Table 5: Pre service teacher data organization and management survey results ((N=325)

Questionnaire title	Completely non-compliant	Basic nonconformity	Un-certain	Basically conform to	Fully compliant
Effectively manage data	1.23%	4%	33.54%	54.15%	7.08%
Ability to manage data using appropriate tools	1.23%	6.15%	30.77%	53.85%	8%
Update the data reserve in time and keep at the forefront of the research field with the development of the discipline	1.23%	9.85%	40%	43.38%	5.54%
Be familiar with the use of data management platform in this professional field	1.23%	11.69%	35.38%	46.46%	5.23%

#### 4.4 Data Processing and Analysis Level Analysis

According to the survey results in Table 6, the pre service teachers' data processing and analysis ability is the lowest. Fewer people can correctly select data analysis methods; Less people can use statistical analysis software such as Excel and SPSS to do appropriate statistical analysis on the obtained data; Only 45.23% of them were able to model and analyze the data and solve relevant problems; 46.47% of the pre service teachers could preprocess the original data. The main reason is that there are few courses on statistical analysis software. Most pre service teachers master this software through self-study and are not proficient.

Table 6: Pre service teacher data processing and analysis survey results ((N=325).

Questionnaire title	Completely non-compliant	Basic nonconformity	Un-certain	Basically conform to	Fully compliant
Can correctly select data analysis methods	0.62%	6.77%	33.54%	52.92%	6.15%
Be able to use statistical analysis software such as Excel and SPSS to make appropriate statistical analysis on the obtained data	3.08%	8.92%	32.31%	47.08%	8.62%
Data can be modeled and analyzed to solve related problems	3.69%	14.46%	36.62%	40.31%	4.92%
Capable of data preprocessing for original data	4.62%	14.46%	34.46%	41.85%	4.62%

#### 4.5 Analysis of Data Ethics

According to the survey results in Table 7, pre service teachers pay enough attention to the safety of data use, and can legally obtain data and scientifically standardize references. However, nearly 30% of pre service teachers do not understand the intellectual property, privacy and other issues involved in the data. Therefore, the data ethics level of pre service teachers still needs to be improved.

Table 7: Pre service teacher data ethics survey results (N=325).

Questionnaire title	Completely non-compliant	Basic nonconformity	Un-certain	Basically conform to	Fully compliant
Legally obtaining data and using information products	0.92%	3.08%	14.15%	59.69%	22.15%
Scientific and normative citation	0.62%	3.69%	15.38%	55.38%	24.92%
Learn about intellectual property and privacy of data	0.92%	4.92%	22.46%	53.54%	18.15%

#### 4.6 Data Sharing Level Analysis

According to the survey results in Table 8, the pre service teachers' awareness of data sharing needs to be improved. Seventy percent of pre service teachers can use data to write papers and are willing to share their own data. However, due to the imperfect laws and regulations related to data openness, there are many data intellectual property disputes in the society, and 54.76% of pre service teachers have concerns when sharing research data with others.

Table 8: Pre service teacher data sharing survey results (N=325).

Questionnaire title	Completely non-compliant	Basic nonconformity	Un-certain	Basically conform to	Fully compliant
Share your collected data with others	1.85%	5.85%	21.23%	61.85%	9.23%
Can use data and data analysis results to prepare papers and reports	1.23%	3.38%	21.54%	63.38%	10.46%
No worries when sharing research data with others	4.92%	11.38%	38.46%	39.08%	6.15%

#### 4.7 Group Difference Analysis

The data literacy of students in Zhaoqing University has significant group differences, which are



specifically reflected in gender and grade.

It can be seen from Table 9 that analysis of variance (ANOVA) is used to study the differences between different genders in data awareness, data acquisition ability, data organization and management, data processing and analysis, data ethics and data sharing. The data awareness, data acquisition ability and data ethics of samples of different genders are not significant ( $p>0.05$ ), which means that the data awareness, data acquisition ability and data ethics of samples of different genders are consistent and have no difference.

In addition, the gender samples showed significant effects on data organization and management, data processing and analysis, and data sharing ( $p<0.05$ ), which means that there are differences in data organization and management, data processing and analysis, and data sharing among different gender samples. After the posttest analysis (see table 10), different genders showed a significant level of 0.05 for data organization and management ( $f=4.556$ ,  $p=0.034$ ). The average value of girls (3.47) was obviously lower than that of boys (3.66). For data processing and analysis, different genders showed a significant level of 0.01 ( $f=7.025$ ,  $p=0.008$ ), and the average value of boys (3.59) was significantly higher than that of girls (3.34). For data sharing, different genders showed a significant level of 0.05 ( $f=4.365$ ,  $p=0.037$ ), and the average value of girls (3.55) was significantly lower than that of boys (3.73). It shows that boys are better than girls in data organization and management, data processing and analysis, and data sharing.

Table 9: Comparison of data literacy factors of pre service teachers of different genders by ANOVA.

Dimension	Gender: (mean $\pm$ SD)		F	p
	female (N=243)	male (N=82)		
Data awareness	3.79 $\pm$ 0.57	3.82 $\pm$ 0.71	0.129	0.720
Data acquisition capability	3.71 $\pm$ 0.64	3.78 $\pm$ 0.58	0.722	0.396
Data organization and management	3.47 $\pm$ 0.67	3.66 $\pm$ 0.65	4.556	0.034*
Data processing and analysis	3.34 $\pm$ 0.74	3.59 $\pm$ 0.71	7.025	0.008**
Data ethics	3.91 $\pm$ 0.72	4.03 $\pm$ 0.58	1.736	0.189
data sharing	3.55 $\pm$ 0.64	3.73 $\pm$ 0.67	4.365	0.037*

Table 10: Post multiple comparison results of data literacy factors of pre service teachers of different genders.

Dimension	(I) name	(J) name	(I) average value	(J) average value	D-value (I-J)	p
Data awareness	1.0	2.0	3.792	3.820	-0.028	0.720
Data acquisition capability	1.0	2.0	3.710	3.777	-0.068	0.396
Data organization and management	1.0	2.0	3.474	3.655	-0.181	0.034*
Data processing and analysis	1.0	2.0	3.343	3.591	-0.249	0.008**

Data ethics	1.0	2.0	3.912	4.028	-0.116	0.189
data sharing	1.0	2.0	3.554	3.728	-0.173	0.037*
* $p < 0.05$ ** $p < 0.01$						

It can be seen from table 11 that ANOVA is used to study the differences among different grades in six items: Data awareness, data acquisition ability, data organization and management, data processing and analysis, data ethics and data sharing. It can be seen from the above table that the four items of data awareness, data processing and analysis, data ethics and data sharing among samples of different grades are not significant ( $p > 0.05$ ), indicating that the samples of different grades are consistent in data awareness, data processing and analysis, data ethics and data sharing.

In addition, the data organization and management of samples in different grades showed significant difference ( $p < 0.05$ ), which means that the data acquisition ability, data organization and management of samples in different grades are different. After the post test analysis, it was found that the data acquisition ability of different grades showed a significant level of 0.01 ( $f = 6.567$ ,  $p = 0.000$ ); Data organization and management in different grades showed a significant level of 0.05 ( $f = 3.817$ ,  $p = 0.010$ ).

According to the comparison results of the average scores, it shows that the data literacy of college students is progressing with the increase of grade and academic year.

Table 11: comparison of data literacy factors of pre service teachers in different grades by ANOVA.

Dimension	Grade: (mean $\pm$ SD)				F	p
	Freshman (N=59)	Sophomore (N=70)	Junior (N=97)	Senior (N=99)		
Data awareness	3.78 $\pm$ 0.51	3.76 $\pm$ 0.54	3.82 $\pm$ 0.60	3.82 $\pm$ 0.70	0.205	0.893
Data acquisition capability	3.48 $\pm$ 0.61	3.63 $\pm$ 0.58	3.78 $\pm$ 0.64	3.89 $\pm$ 0.60	6.567	0.000**
Data organization and management	3.31 $\pm$ 0.70	3.44 $\pm$ 0.65	3.57 $\pm$ 0.63	3.65 $\pm$ 0.67	3.817	0.010*
Data processing and analysis	3.19 $\pm$ 0.77	3.39 $\pm$ 0.68	3.47 $\pm$ 0.70	3.48 $\pm$ 0.78	2.303	0.077
Data ethics	3.90 $\pm$ 0.54	3.89 $\pm$ 0.66	3.95 $\pm$ 0.71	3.99 $\pm$ 0.78	0.352	0.788
data sharing	3.50 $\pm$ 0.65	3.63 $\pm$ 0.57	3.59 $\pm$ 0.65	3.64 $\pm$ 0.72	0.626	0.599
* $p < 0.05$ ** $p < 0.01$						

## 5. Strategies and Suggestions for Improving Data Literacy of Pre Service Education

In the era of big data, data literacy has become one of the necessary qualities for pre service teachers. Combined with the survey results of Zhaoqing University, this paper puts forward some suggestions and Countermeasures for improving the data literacy of pre service teachers.

## 5.1 Data Awareness is the Premise

Consciousness determines behavior. School leaders, teachers and students should attach importance to data awareness, cooperate with each other, and infiltrate the concept of data literacy education into all aspects of school management and teaching. The formation of data sensitivity is a long-term process. In order to improve the sensitivity of educational data, pre service teachers need to have extensive knowledge reserves, take the initiative to learn educational data knowledge, and understand national laws and regulations on data [8]. Pre service teachers should consciously contact data, adhere to the "data" orientation in education and teaching activities, cultivate data literacy behavior, strive to form a data thinking mode, and treat data fairly and rationally.

## 5.2 Data Capability Improvement is the Key

The key is to improve the pre service teachers' abilities, including data acquisition ability, data organization and management, data processing and analysis ability. The process of cultivating pre service teachers' data literacy, optimizing teaching mode, creating a digital teaching environment and implementing situational teaching, so that students can feel, analyze and understand data in the big data environment [9]. According to the survey results, there are great differences in data literacy between male and female students. Boys are better than girls in data organization and management, data processing and analysis. Teachers should pay attention to gender differences and adjust teaching methods to optimize teaching results. College teachers should combine theoretical education with practical application. When teaching basic theories such as data analysis, they should pay more attention to the use of data processing software for data collection and collation, so as to improve students' ability to apply data; We can also use educational practice to understand the development of students' data literacy.

## 5.3 The Construction of Data Environment is the Core

Resource environment plays an important role in cultivating digital literacy. Digital literacy cannot be separated from the support of software and hardware equipment. Schools should integrate existing resources, optimize data management, create a safe data environment, encourage teachers to use data-driven teaching, and create an atmosphere for the improvement of teachers' and students' data literacy. Schools should increase investment in data literacy equipment and facilities, purchase necessary equipment and software for teachers to obtain and process educational data, and pay attention to the role of Libraries in data literacy training. Colleges and universities should set up a data literacy teaching team, widely absorb teachers from computer, educational technology and other related disciplines, rely on Librarians and relevant personnel from the Information Technology Department of colleges and universities, and work together to design data literacy education programs for students of different majors [10]. The school can increase activities related to data literacy, offer general courses and lectures related to data, and carry out relevant competitions. Creating a data literacy cultivation environment, on the one hand, helps college teachers better carry out data literacy teaching, on the other hand, it can have a subtle impact on pre service teachers' data literacy.

## 5.4 The Formation of Data Specifications is the Guarantee

In the era of big data, data sources are diverse and open, and the legitimacy and privacy of data have become a problem. The random dissemination, sale and purchase of educational data has constituted an illegal act, seriously harming the interests of others, units, society and even the country. Pre service teachers should abide by laws and regulations when acquiring, processing, applying and

sharing educational data, so as to be reasonable, legal and orderly. In particular, they need to strengthen the protection of students' personal privacy and pay attention to data security. Moreover, the data have limitations in some aspects of students' performance, and the data cannot fully explain students' psychology and behavior. Teachers must have a clear understanding and comprehensively evaluate students' performance and educational process.

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