A Study on the Composition and Improvement Paths of University English Teachers' Data Literacy in the Big Data Era

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Abstract. The rapid development of big data technology has propelled higher education into a phase of intelligent transformation, leading to profound changes in university English teaching models. Teachers, as the core leaders of teaching activities, find their data literacy becoming a key factor in adapting to the teaching demands of the big data era and enhancing the quality of English teaching. Against the backdrop of the big data era, and based on theories of teacher professional development, data literacy, and constructivist learning, this study employs literature review, questionnaire surveys, and in-depth interviews to systematically explore the constitutive dimensions of university English teachers' data literacy and propose targeted improvement paths. The research finds that university English teachers' data literacy consists of four core dimensions: data awareness, data knowledge, data skills, and data ethics. Currently, the overall data literacy of university English teachers in China is at a medium level, with issues such as weak data awareness, insufficient data skills, and an imperfect training system. Accordingly, this paper constructs a "trinity" improvement system from the individual teacher, university, and societal levels, aiming to provide theoretical reference and practical guidance for promoting the professional development of university English teachers and facilitating the reform of university English teaching.

Keywords: Big Data Era; University English Teachers; Data Literacy; Constitutive Dimensions; Improvement Paths

1 Introduction

1.1 Research Background

With the iterative upgrading of information technology, emerging technologies such as[1] big data, artificial intelligence, and cloud computing are deeply integrated with the

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field of education, giving rise to a new wave of digital transformation in education. The Education Informatization 2.0 Action Plan explicitly states the need to "vigorously promote educational informatization, build a new smart education ecosystem, and enhance teachers' information literacy"[1]. The advent of the big data era has not only changed the presentation of education and teaching but also reshaped the role positioning and professional competency requirements for teachers. As a foundational and instrumental discipline in higher education, the teaching objectives of university English have shifted from traditional language knowledge transmission to the cultivation of cross-cultural communication skills and critical thinking abilities. Big data technology provides a novel support path for achieving this goal.

In the context of university English teaching, big data technology can collect, analyze, and mine multidimensional data on students' learning behaviors, outcomes, and cognitive characteristics, providing data support for personalized and precision teaching. However, the realization of this process is inseparable from teachers' data literacy[2]. As the primary users and analysts of teaching data, university English teachers need the ability to extract effective information from massive teaching data to solve teaching problems[3]. However, currently, most university English teachers in China grew up under traditional teaching models, exhibiting significant deficiencies in their cognition and application capabilities regarding big data technology. Data literacy has become a bottleneck constraining the deepening of university English teaching reform.

1.2 Research Significance

1.2.1 Theoretical Significance.

Firstly, this study enriches the application of data literacy theory in the field of subject education. Existing research on data literacy mainly focuses on information technology, library science, or basic education stages, with relatively scarce research targeting subject teachers in higher education, especially university English teachers. By focusing on this specific group and combining the characteristics of English subject teaching, this study constructs a constitutive system for university English teachers' data literacy, which can compensate for the shortcomings of existing research and expand the application boundaries of data literacy theory. Secondly, this study deepens the connotation of teacher professional development theory in the context of big data. The big data era poses new requirements for teacher professional development[4]. By incorporating data literacy into the core content of university English teachers' professional development and exploring the internal relationship between data literacy and the enhancement of teachers' professional competence, this study can enrich the contemporary connotation of teacher professional development theory.

1.2.2 Practical Significance.

From a practical perspective, this study can provide clear directions and specific paths for improving university English teachers' data literacy. By systematically outlining the constitutive dimensions of their data literacy, teachers can clearly recognize their strengths and weaknesses in this area and carry out targeted self-improvement.

Furthermore, the "trinity" improvement system proposed in this study can offer practical references for universities, society, and other relevant stakeholders in formulating teacher training policies and building data support platforms[5]. This aids universities in cultivating a team of university English teachers with high data literacy, promoting innovation and optimization in university English teaching models, and ultimately enhancing the quality of English teaching and talent cultivation.

2 Current Status Investigation and Problem Analysis of University English Teachers' Data Literacy in the Big Data Era

To understand the current status of university English teachers' data literacy in the big data era, this study conducted empirical research using questionnaire surveys and in-depth interviews. Through analyzing the survey data, the overall level of university English teachers' data literacy, the development status of each dimension, and existing problems were clarified.

2.1 Survey Design and Implementation

2.1.1 Questionnaire Design.

Based on the previously constructed constitutive dimensions of university English teachers' data literacy (data awareness, data knowledge, data skills, data ethics), this study designed the Questionnaire on the Current Status of University English Teachers' Data Literacy in the Big Data Era. The questionnaire mainly consists of three parts: Part one collects basic information, including teaching seniority, professional title, educational background, and type of institution. Part two investigates the current status of each data literacy dimension using a 5-point Likert scale, ranging from "Strongly Disagree" (1 point) to "Strongly Agree" (5 points). Part three includes open-ended questions to understand the difficulties and needs teachers face in the process of improving data literacy.

2.1.2. Survey Subjects.

This study selected university English teachers from different types of higher education institutions in China (including comprehensive universities, science and engineering universities, liberal arts universities, and private universities) as survey subjects. A total of 350 questionnaires were distributed, 328 were returned, and 306 were valid, resulting in an effective response rate of 87.4%. The basic information of the respondents is shown in the table 1 below:

Table 1. The basic information of the respondents

Basic Info	Category	Number	Percentage (%)

Teaching Seniority	Less than 5 years	85	27.8
	5-15 years	142	46.4
	More than 15 years	79	25.8
Professional Title	Assistant Lecturer or below	43	14.1
	Lecturer	168	54.9
	Associate Professor or above	95	31.0
Institution Type	Comprehensive University	98	32.0
	Science & Engineering University	86	28.1
	Liberal Arts University	65	21.2
	Private University	57	18.7

2.1.3. In-depth Interviews.

Based on the questionnaire survey, 15 university English teachers with different teaching seniority, professional titles, and institution types were selected for in-depth interviews. Among them: 3 with less than 5 years seniority, 7 with 5-15 years, 5 with more than 15 years; 2 with Assistant Lecturer or below title, 8 Lecturers, 5 Associate Professors or above; 4 from comprehensive universities, 3 from science and engineering universities, 4 from liberal arts universities, and 4 from private universities. The interviews followed a semi-structured format, focusing on the current status of data awareness, knowledge, skills, and ethics, as well as difficulties and needs in the improvement process.

2.2 Analysis of Survey Results

2.2.1. Overall Level of University English Teachers' Data Literacy.

Through statistical analysis of the questionnaire data, the overall average score for university English teachers' data literacy was 3.26 points (out of 5), indicating a medium level. The average scores for each dimension, from highest to lowest, were: Data Ethics (3.68), Data Awareness (3.25), Data Knowledge (3.12), and Data Skills (2.98). This suggests that current university English teachers have relatively strong data ethics awareness, but their data skills level is lower, becoming the main bottleneck constraining the improvement of their data literacy.

2.2.2. Analysis of Current Status by Dimension.

Data Awareness: The average score was 3.25, at a medium level. Specifically, the indicator "Recognizes the importance of data for English teaching" scored relatively high (3.56), indicating most teachers recognize the value of data. However, indicators like "Actively collects and analyzes English teaching data" (3.02) and "Actively explores application scenarios for data in English teaching" (2.98) scored lower, suggesting teachers' data application willingness and innovation awareness need improvement. In in-depth interviews, some teachers stated: "Although I know data is important, the teaching workload is heavy, and I don't have time to actively collect and analyze data";

"I don't know much about specific application scenarios for data in English teaching, not sure where to start."

Data Knowledge: The average score was 3.12, at a medium-low level. Among them, "Possesses basic English subject teaching knowledge" (3.85) scored high, reflecting teachers' professional foundation. However, indicators like "Understands basic big data concepts and core technologies" (2.86) and "Masters integrated knowledge of data application" (2.78) scored low. The survey found that most teachers have a superficial understanding of big data-related knowledge and lack the ability to combine data knowledge with English teaching. For instance, some teachers said, "I have only a vague understanding of big data technology and don't know how to integrate it with English teaching"; "Unclear about which data in the English teaching process is valuable and how to use data to solve teaching problems."

Data Skills: The average score was 2.98, at a medium-low level, the lowest among the four dimensions. Specifically, "Able to use simple methods to collect teaching data" (3.21) scored relatively high. However, indicators like "Able to use data analysis tools (e.g., SPSS, Python) to analyze data" (2.56), "Able to interpret data analysis results and apply them to teaching decisions" (2.68), and "Able to use data visualization tools to present data results" (2.45) scored low. This indicates that current university English teachers generally lack sufficient data skills, particularly in data analysis and application capabilities. In in-depth interviews, several teachers reported: "Cannot use professional data analysis tools; usually just simply organize students' grade data"; "After analyzing data, I don't know how to interpret the results or how to apply them to teaching."

2.3 Analysis of Existing Problems

Based on the analysis of survey results, the main problems in improving university English teachers' data literacy include: First, weak data awareness, with insufficient willingness for active data application and innovation awareness. Second, lack of data knowledge, especially regarding big data-related knowledge and integrated data application knowledge. Third, inadequate data skills, with weak data analysis, interpretation, and application abilities, and a lack of mastery of professional data analysis tools. Fourth, data security protection capabilities need enhancement, and the practice of data ethics norms is not comprehensive. Fifth, the support system for data literacy improvement is imperfect, lacking targeted training and effective data support platforms.

3 Improvement Paths for University English Teachers' Data Literacy in the Big Data Era

Based on the previous status investigation and problem analysis, and combined with the constitutive dimensions of university English teachers' data literacy, this study constructs a "trinity" improvement path from the individual teacher, university, and societal levels to comprehensively promote the enhancement of university English teachers' data literacy[6].

3.1 Individual Teacher Level: Strengthen Self-Improvement Awareness and Enhance Core Competencies

The individual teacher is the main agent in improving data literacy. They need to actively change perspectives, strengthen self-improvement awareness, and enhance their data literacy through various means[7].

Transform Teaching Perspectives, Strengthen Data Awareness: University English teachers should actively break free from the constraints of traditional teaching concepts, fully recognize the trend of digital transformation in education during the big data era, and clarify the importance of data literacy for their own professional development and teaching quality improvement. Actively concern data application cases in the field of English teaching, cultivating sensitivity and willingness to apply teaching data. For example, actively participate in school-organized seminars on data-driven teaching, exchange experiences and outcomes of data application with other teachers, and stimulate innovative awareness in data application[8].

Engage in Self-Directed Learning, Enrich Data Knowledge: Teachers should identify their knowledge gaps, formulate personalized learning plans, and systematically learn data-related knowledge. On one hand, learn basic knowledge such as fundamental concepts of big data, core technologies, and data processing workflows. This can be acquired through online courses (e.g., introductory big data courses on MOOC platforms) and professional books (e.g., Research and Application of Educational Big Data). On the other hand, focus on learning integrated knowledge of data application, combining data knowledge with English subject teaching knowledge, and exploring the types, sources, and application scenarios of English teaching data[9]. For example, learn how to use data to guide specific teaching aspects like English writing or listening instruction.

Strengthen Practical Training, Improve Data Skills: The improvement of data skills requires extensive practical training. Teachers should actively apply data knowledge to English teaching practice, starting with simple data collection and analysis, and gradually enhance their data skills. [10] For instance, use Excel to organize students' English test scores for simple descriptive statistical analysis; try using SPSS to analyze the correlation between students' learning behavior data and learning outcomes. Simultaneously, actively participate in teaching reform projects to improve data collection, analysis, interpretation, and application abilities through project research. Additionally, proactively learn how to use data visualization tools (e.g., Tableau) to present data analysis results intuitively, enhancing the effectiveness of data communication and application[11].

3.2 University Level: Improve Support Systems and Provide Comprehensive Safeguards

Universities are crucial supporting entities for improving teachers' data literacy. They should strengthen overall planning, complete support systems, and provide comprehensive safeguards for enhancing university English teachers' data literacy[12].

Increase Emphasis, Strengthen Overall Planning: Universities should fully recognize the importance of improving university English teachers' data literacy, incorporate it into teacher professional development plans, and clarify the goals, tasks, and implementation steps for data literacy improvement. Establish dedicated leading groups to coordinate the work of relevant departments such as the Academic Affairs Office, Personnel Office, and College of Foreign Languages, forming synergistic efforts. For example, incorporate data literacy into the performance evaluation and professional title assessment systems for university English teachers to enhance their initiative and enthusiasm in improving data literacy[13].

Build Data Support Platforms, Optimize Teaching Data Environment: Universities should increase investment to build comprehensive university English teaching data management platforms. Integrate various teaching data resources to provide technical support for the improvement and application of teachers' data literacy. The platform should have data collection, storage, analysis, and visualization functions, enabling comprehensive collection and integration of data on student learning behaviors, outcomes, and teaching processes. Simultaneously, the platform should provide user-friendly data analysis tools to reduce the difficulty of data analysis for teachers[14]. Furthermore, universities should strengthen cooperation with enterprises, introduce advanced big data technologies and teaching resources to optimize the teaching data environment. For example, collaborate with English learning app companies to achieve sharing and integration of learning data; introduce AI-assisted teaching systems to provide teachers with data-driven teaching suggestions.

Establish Incentive and Evaluation Mechanisms, Motivate Teachers: Universities should establish complete incentive and evaluation mechanisms to motivate university English teachers to improve their data literacy. On one hand, set up special reward funds to recognize and reward teachers who excel in data literacy improvement and application, such as selecting "Outstanding Individuals in Data-Driven Teaching" or "Innovative Cases in Teaching Data Application." On the other hand, incorporate outcomes of data literacy improvement and application into teachers' performance evaluations, professional title assessments, and recognition and award systems. Provide policy preferences for teachers who actively participate in data literacy training and proactively apply data in teaching reforms[15]. Simultaneously, establish a teacher data literacy evaluation system to periodically assess teachers' data literacy levels, promptly identify issues, and provide targeted guidance.

3.3 Societal Level: Strengthen Policy Guidance and Foster a Favorable Development Environment

The societal level should strengthen policy guidance and resource support to foster a favorable development environment for improving university English teachers' data literacy.

Improve Relevant Laws, Regulations, and Policy Safeguards: Relevant government departments should further complete laws, regulations, and policy details for data application in the education field. Clarify teachers' rights and obligations during data collection, analysis, and application, standardize data application behaviors, and reduce

teachers' data application risks. For example, issue policy documents like Education Data Security Management Measures and Teacher Data Ethics Norms to provide legal safeguards for improving and applying teachers' data literacy. Simultaneously, increase investment in educational informatization, establish special funds to support universities in conducting teacher data literacy training and building data support platforms.

Unify Educational Data Standards, Promote Data Sharing: Relevant government departments should take the lead in formulating unified educational data standards to standardize data formats across different teaching platforms and management systems, achieving data interoperability, sharing, and integration. For instance, develop standards for university English teaching data, clarifying the types, definitions, and formats of English teaching data to facilitate teacher data collection and analysis. Additionally, establish regional educational data sharing platforms to integrate university English teaching data resources from different institutions, providing data support for teachers' data research and application

4 Conclusion

Against the backdrop of the big data era, this study systematically explored the constitutive dimensions and improvement paths of university English teachers' data literacy. Using methods such as literature review, questionnaire surveys, and in-depth interviews, the following main conclusions were drawn:

In the big data era, university English teachers' data literacy consists of four core dimensions: data awareness, data knowledge, data skills, and data ethics. Among these, data awareness is the foundation, data knowledge is the core foundation, data skills are the core competency, and data ethics are the crucial safeguard. These four dimensions are interrelated and mutually supportive, collectively forming a complete comprehensive literacy system.

Currently, the overall data literacy of university English teachers is at a medium level, with uneven development across dimensions. The data ethics dimension scores the highest, data awareness scores at a medium level, while data knowledge and data skills score lower. Particularly, data skills constitute the main bottleneck hindering the improvement of teachers' data literacy. Simultaneously, improving teachers' data literacy faces challenges such as an imperfect training system, lagging data support platforms, and inadequate incentive mechanisms.

A "trinity" improvement path for university English teachers' data literacy is constructed encompassing the individual teacher, university, and societal levels. Individual teachers should strengthen self-improvement awareness and enhance core competencies; universities should complete support systems and provide comprehensive safeguards; society should strengthen policy guidance and foster a favorable development environment. Synergistic efforts from these three levels can effectively promote the improvement of university English teachers' data literacy. Future research can proceed from the following aspects: Firstly, expand the coverage of survey samples by selecting universities from different regions and types to enhance the generalizability of research findings. Secondly, conduct action research by selecting some university English

teachers as subjects, applying the improvement paths proposed in this study for intervention, and long-term tracking and validating the effectiveness of these paths. Thirdly, further refine the constitutive dimensions of university English teachers' data literacy, constructing a scientific and precise evaluation index system to provide stronger support for assessing and improving teachers' data literacy.

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