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Research on the Lifting Path of Data Literacy Ability of Applied University Teachers under the Perspective of Organizational Learning

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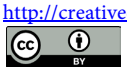

Abstract

With the arrival of the big data era, the modern higher education model has undergone radical changes, and higher requirements have been put forward for the data literacy of college teachers. The paper first analyzes the connotation of teacher data literacy, and then combs through the status quo and dilemmas of teachers' data literacy ability in applied universities. The paper proposes to enhance the data literacy ability of teachers from the perspective of organizational learning. Through building a digital culture, building a data-driven teaching environment, and constructing an interdisciplinary learning community to further promote the application of the theory and practice of datafication inside and outside the organization, and ultimately improve the quality of teaching.

Keywords

Organizational Learning, Teachers' Data Literacy, Lifting Paths

1. Introduction

In the era of big data, data and information are increasingly embedded in human practical activities, comprehensively subverting, and reshaping the way of thinking and practice paradigm in various fields. In the field of education, data enables the process of teaching practice to be quantified and visualized, which further helps teachers to accurately grasp the current status of teaching, reflect on their teaching, innovate teaching modes, and realize accurate teaching management [1]. Especially in recent years, the deep integration of information technology and education has prompted the teaching paradigm to show the trend of

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scientific, precise, intelligent, and personalized. In teaching activities, with the help of digital technology, educational data are constantly enriched and diversified. The hidden information behind these educational data can objectively reflect the potential phenomena and existing problems in education and is an important basis for teachers to formulate scientific educational and teaching programs and implement educational and teaching decisions. Therefore, how to transform educational data into information and knowledge, and then improve educational teaching, and enhance teachers' teaching ability has become an important issue. In November 2022, the Ministry of Education released "Teachers' Digital Literacy" as an educational industry standard, which provides a framework for teachers' digital literacy, stipulates five digital awareness, digital technology knowledge and skills, digital application, digital social responsibility, and professional development dimensions, emphasizing the need to continuously improve teachers' awareness and ability to use digital technology to improve education and teaching.

Teachers are the leaders of educational activities, the supportive elements of educational activities, and the key variable in the high-quality development of education empowered by digital technology. Teachers' data literacy is not only related to the improvement of students' comprehensive literacy, but also to the rational use of technology in education and the effective development of classroom collaboration or communication. For applied universities, how to further improve teachers' data literacy ability and adapt to the education reform and development driven by big data has become a major trend and a must. However, the improvement of teachers' data literacy ability is not achieved by teachers' efforts alone, but largely depends on the organizational learning within the team. Therefore, based on a systematic review of relevant literature at home and abroad, this article explores from the perspective of organizational learning how to enhance teachers' data literacy ability at the practical level, thereby forming a virtuous cycle of teachers using data to improve teaching, ultimately improving teaching quality and efficiency, and promoting the comprehensive development of students.

2. Connotation Analysis of Teachers' Data Literacy in the Context of Digital Transformation of Education

1) Connotation of Teachers' Data Literacy

The background of the concept of data literacy can be traced back to evidence-based medicine, and later, this concept was transplanted into the field of education. 2001, the United States in the No Child Left Behind Act pointed out the importance of the value of big data in teaching practice, and as a start, data-driven teaching has become the basic concept of improving the quality of education. Since 2009, organizations such as the American Council for Accreditation of Teacher Education have included data literacy as an element of teacher professional qualifications. Gummer and Mandinach [2] consider teacher data literacy to be the ability to transform information into actionable pedagogical

knowledge and practice by collecting, analyzing, and interpreting all types of data (assessment, school climate, behavior, impressions, longitudinal, dynamic, etc.) to help improve the quality of education knowledge and practices to help determine instructional steps. Drawing on the subject matter pedagogical knowledge for integrating technology (TPACK) framework proposed by Schulman, Gummer *et al.* propose a corresponding structural framework for teacher data literacy that specifically includes three domains, *i.e.*, data used for teaching and learning, subject matter content knowledge, and pedagogical content knowledge, which, in addition to emphasizing that teachers have a minimum of skills in analyzing and processing data, requires attention to the domains of subject matter knowledge and practice and the domain of pedagogical content knowledge. According to Liu *et al.* [3], teachers' data literacy is a comprehensive ability embodied in teachers' exposure to educational data, which contains four aspects: data awareness and attitude, basic knowledge of data, core skills of data, and data thinking methods. According to Xu *et al.* [4], teacher data literacy refers to the ability of teachers to collect, analyze, and interpret various types of data to transform the information into actionable pedagogical knowledge and practice, to improve students' learning habits. Holding similar views are Ebbeler *et al.* [5], Kippers *et al.* [6], Cristina *et al.* [7], Li and Ye [8], Wang and Lv [1], and Pan and Zhou [9].

Although different scholars are not consistent in defining the concept of teacher data literacy, most of them express their respective views on data application ability and conceptual awareness. Summarizing the views of various scholars, teacher data literacy is a systematic and comprehensive ability that emphasizes teachers' data thinking and data processing and application ability, *i.e.*, the comprehensive ability to consciously collect and mine various types of educational data with the help of digital technology to make accurate teaching evaluation and teaching decisions, so as to enhance the optimization of the teaching mode and to improve the student's learning performance and learning effect.

2) Teacher Data Literacy Competency Dimensions

Numerous scholars have divided teacher data literacy competencies from different dimensions and further refined the evaluation index system based on the division. In 2005, the data quality movement was launched in the United States, which formally opened the prelude to the development of teacher data literacy and measured teacher data literacy competencies from 10 dimensions. Gummer and Mandinach [2] proposed that teacher data literacy consists of five dimensions: clarifying instructional problems, using data, transforming data into information, transforming information into instructional decisions, and assessing instructional outcomes. Li and Zhao [10] constructed a data literacy evaluation index set for teachers, including four first-level indicators of data knowledge, data skills, teaching application, and awareness ethics. Liu *et al.* [3] argued that teachers' data literacy competence can be constructed from four aspects: the thinking method layer, the core skills layer, the basic knowledge layer, and the awareness and attitude layer. Ma and Sun [11] believed that teachers' data lite-

racy competence contains data awareness, data knowledge, data application skills, data thinking, and data ethics. Zhang *et al.* [12] provided an integrative framework from the psychological, knowledge, competence, and practice dimensions. 2022 The Ministry of Education (MOE) released the industry standard of Teachers' Digital Literacy, which measures teachers' data literacy competencies in five dimensions, namely, digital awareness, knowledge and skills of digital technology, digital application, digital social responsibility, and professional development. Although there are differences in terms of the division of different dimensions of teacher data literacy, in terms of specific content, most researchers focus on the process of data inquiry, focusing on how data can be used to enhance teaching and learning practices.

3. Analysis of the Current Situation of Data Literacy Competence of Teachers in Applied Universities

As technology empowers education, the traditional blackboard, chalk, and textbooks are transformed into electronic whiteboards, multimedia courseware, and tablet computers, especially with the epidemic lagging, online education is becoming more and more popular, and emerging technologies are coming into the classroom. Process data such as online learning hours, learning resource browsing, and discussion discourse are automatically collected, while data such as eye movements, expressions, and postures are applied to teaching, with the type and magnitude of data increasing. The informatization changes in education and the resulting big data in education have made it possible for teachers to teach better. However, there are still some dilemmas in specific teaching environments:

3.1. Data Awareness Needs to Be Improved

Teachers with a high level of data awareness can recognize the importance of data in educational decision-making and can collect, analyze, and utilize data proactively and effectively. However, some teachers may lack sensitivity to and attention to data, resulting in their inability to fully utilize the value of data in educational decision-making [13]. Although many teachers have realized the importance of data-driven teaching reform, they still follow the traditional experience-driven decision-making model in actual teaching, and are more lacking in the corresponding concept of data analysis, thus failing to fully utilize educational data in classroom teaching. Some teachers are afraid to try new technologies, and cannot effectively realize online and offline integrated teaching in teaching activities, while lacking reflection and summarization of the use of teaching data. Facing the double pressure of work and development of data literacy, teachers are psychologically burdened and have difficult tasks, and lack the time and energy to practice data literacy.

3.2. Inadequate Data Processing and Analyzing Skills

Under the information-based teaching environment, data processing and analy-

sis ability is one of the core qualities necessary for teachers. Still, some teachers lack professional knowledge and skills in processing and analyzing data. They do not know much about the basic concepts and methods of data analysis, as well as lack practical experience. When faced with a large amount of complex educational data, it is difficult to effectively extract valuable information, thus affecting the accuracy and scientific of teaching decisions. Due to the influence of low basic data knowledge skills and insufficient mastery of new theories, the application of data for scientific decision-making cannot be truly realized. In many schools, all kinds of online platforms, APPs, or software to assist teaching and learning have been introduced, and if the acquired data cannot be effectively analyzed and utilized, then these resources will be wasted.

3.3. Lack of Systematic and Prescriptive Training

In the existing teacher training, many schools have carried out relevant data literacy education. However, these trainings are often regarded as additional, non-core training content, lacking systematic planning and design, which makes it difficult for teachers to understand and master the core concepts and skills of data literacy, as well as to form a complete knowledge system, not to mention the process of transforming acquired data into actionable knowledge. In addition, few schools evaluate teachers' data literacy skills, which makes it impossible for teachers to accurately understand their learning progress and shortcomings, and difficult for them to achieve self-improvement. With the rapid development of big data, artificial intelligence, and other technologies, emerging data analytics techniques are emerging. Many teachers do not know enough about these emerging technologies to apply them to their teaching and research. This makes it even more important for schools to provide teachers with comprehensive training programs that are interdisciplinary and integrative.

4. Research on the Lifting Path of Data Literacy Ability of Applied University Teachers under the Perspective of Organizational Learning

Organizational learning refers to the process in which an organization continuously acquires, shares, and applies knowledge to improve its work and performance [14]. The core of organizational learning lies in the sharing and transfer of knowledge, not only the inheritance and application of existing knowledge, but also the exploration and innovation of new knowledge and ideas. Organizational learning often involves mutual learning among members within an organization, between organizations, and between organizations and the external environment. It emphasizes the learning of the entire organization, not just individual or team learning [15]. Organizational learning requires leaders and employees of the organization to have the awareness and ability of continuous learning, establish a comprehensive organizational learning system to adapt to constantly changing environments and needs, and ultimately improve teaching

quality. Figure 1 shows the organizational learning process of data literacy among applied university teachers.

4.1. Establishing a Data Culture

A data culture is a learning environment within a school or district that includes attitudes, values, goals, behavioral norms, and practices, and is wrapped in a clear vision of the leadership's use of data and the significant impact it is expected to bring to the decision-making process. It involves the collection, analysis, application, and sharing of data, as well as a focus on the value and quality of data. In a university with a good data culture, faculty will be more appreciative of the importance of data and will be more motivated to use data to support instructional decisions and innovation. To build a data culture, the university should first develop a long-term, systematic data literacy training program for faculty to ensure that they can acquire relevant knowledge and skills on an ongoing basis. Secondly, regular data literacy seminars or workshops can be organized to provide teachers with opportunities to share experiences, exchange ideas, and learn and progress together. For example, various forms of pilot classes on the integration of education and new technologies can be conducted to demonstrate the specific application of data in teaching and learning for teachers, so that they can have a close-up experience of the role of data. Through the contrast formed by the comparison of classroom teaching effects between those using data and those not using data to impact on teachers' solidified concepts and stimulate their endogenous motivation to use data, and through the establishment of a well-organized learning mechanism, teachers are made aware that data are available, data are useful, and they can use them.

4.2. Building a Data-Driven Teaching Environment

The existing teaching model is shifting to an innovative student-centered,

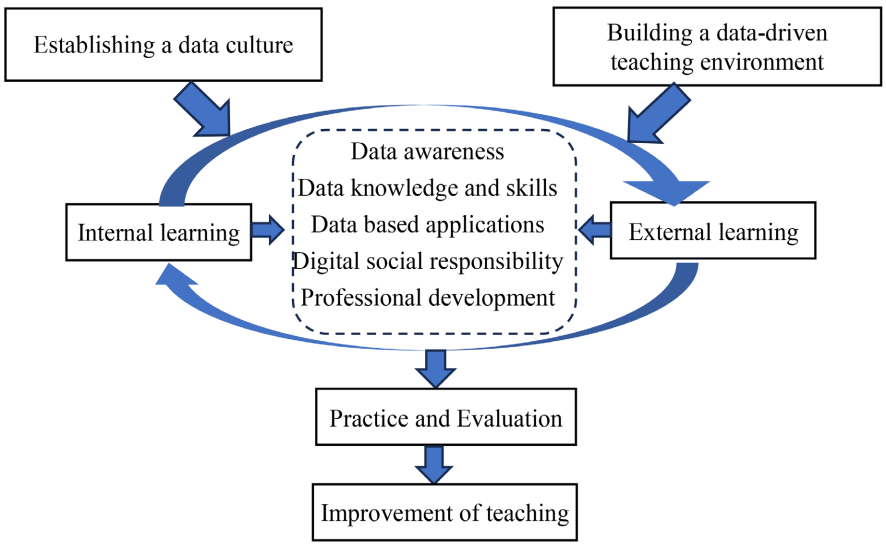

Figure 1. Organizational learning process of teacher data literacy.

media-rich environment, and educational data is evolving from single assessment data to multimodal learning data. Examples include image recognition (dot-matrix scanning, online marking, etc.), platform collection (log files, web crawlers, etc.), video monitoring (intelligent recording, expression recognition, etc.), and wearable (eye tracking, smart bracelets, etc.). A data-driven teaching and learning environment not only provides rich digital resources and allows teachers to access and utilize a variety of data; on the other hand, it also motivates teachers to continuously learn new technologies. For teachers to effectively utilize data-driven instructional environments, organizations need to provide the necessary technical support, including data analysis tools, data visualization tools, etc. These tools can help teachers better understand and analyze data and lay the foundation for teachers to apply data, thus solving the problem of having data available.

4.3. Utilizing Organizational Learning to Promote Internal and External Integration and Transformation

Organizational learning is the action taken by an organization around information and knowledge skills to achieve development goals and improve core competitiveness. Yujiro Noaka proposed the SECI knowledge spiral model for organizational learning, which emphasizes the driving role of knowledge creation in organizational development; On the other hand, the spiral of socialization, externalization, systematization, and internalization explains the transformation process between implicit and explicit knowledge. Therefore, in the process of improving the data literacy ability of teachers, it is necessary to strengthen the connection and transformation between internal and external learning, which is also the key to building continuous learning and innovation. Internal learning strengthens teachers' teaching methods and knowledge levels through professional development, peer learning, and reflective practice, while utilizing knowledge management strategies to organize and share teaching resources. External learning involves academic collaboration with other educational institutions and experts, participation in conferences and seminars, utilizing online learning resources, and international exchange programs to introduce new knowledge and technologies and broaden perspectives. This combination of internal and external learning methods not only improves the quality of education, but also further promotes applied and efficient adaptation to the rapidly changing global education environment.

4.4. Building Interdisciplinary Learning Communities

Teachers' learning community refers to the team of teachers who voluntarily form mutual learning and common development to strengthen individual teaching practice ability and improve teaching organization. The construction of a teacher learning community is an important mode of teacher training, which can effectively promote the professional development of teachers. Under the

common goal of improving teaching quality and promoting teachers' development, an interdisciplinary learning community can be built, consisting of teaching administrators, teachers of different disciplines, teaching supervisors, senior teachers, professional and technical experts, and so on. Young teachers, as a generation growing up in a digital environment, have a greater advantage in the use of digital media and digital products, which can be appropriately utilized in the team. Through exchanges and collaborations between different disciplines, teachers can gain a deeper understanding of the application of data in various disciplines and try to practice the application of data in all kinds of teaching and learning activities to improve their data literacy. In practice, they can rely on existing teaching resources and actively promote the deep integration of online and offline team learning. For example, in offline teachers' study camps and teachers' salons, teachers can put forward their own confusions and problems encountered in teaching and scientific research, discuss with each other, and offer advice, and at the same time strive to get more help from experts and senior people.

4.5. Provide Practice Opportunities and Follow-Up Services

By participating in actual data processing and analysis projects, teachers can apply the knowledge and skills learned in the training to practice, and continuously exercise and improve their data literacy skills. At the same time, practical experience can also provide teachers with more data resources and application scenarios to help them better understand and utilize data. At the same time, an assessment index system for teachers' data literacy competence can be established according to the characteristics of applied universities, and feedback and guidance can be given to teachers through the assessment results so that they can understand their learning progress and competence level. This helps teachers to find out their shortcomings and take corresponding measures for improvement.

5. Conclusion

Teachers, as organizers and leaders in teaching practice, improving their data literacy is a necessary condition for accelerating the process of digitalization in education, and is an indispensable part of teachers' professional development and self-improvement. In this process, universities need to play the role of organizational learning actively, and further promote the learning and application of internal and external data-driven theories and practices in organizations by building digital culture, data-driven teaching environment, and interdisciplinary learning communities, in order to better respond to the challenges in the information-based teaching environment.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Wang, D.W. and Lv, L.J. (2023) The Connotation, Development Dilemma and Enhancement Strategy of Teachers' Data Literacy. *Chinese Journal of Education*, **7**, 21-27.

[2] Gummer, E.S. and Mandinach, E.B. (2015) Building a Conceptual Framework for Data Literacy. *Teachers College Record*, **117**, 1-22. https://doi.org/10.1177/016146811511700401

[3] Liu, Y.X., Yang, X.M., Li, X. *et al.* (2018) Construction of Data Literacy Model for Teachers in the Era of Big Data. *Research on Electrochemical Education*, **39**, 109-116.

[4] Xu, Y.F., Peng, X., Cao, Y., *et al.* (2020) Connotation, Function and Development of Teachers' Digital Intelligence Literacy in the Perspective of Human-Computer Collaboration. *Journal of Distance Education*, **38**, 13-21.

[5] Ebbeler, J., Poortman, C.L., Schildkamp, K. and Pieters, J.M. (2017) The Effects of a Data Use Intervention on Educators' Satisfaction and Data Literacy. *Educational Assessment, Evaluation and Accountability*, **29**, 83-105. https://doi.org/10.1007/s11092-016-9251-z

[6] Kippers, W.B., Poortman, C.L., Schildkamp, K., *et al.* (2018) Data Literacy: What Do Educators Learn and Struggle with during a Data Use Intervention? *Studies in Educational Evaluation*, **56**, 21-31. https://doi.org/10.1016/j.stueduc.2017.11.001

[7] Cristina, S.C., Raúl, S.C. and Teresa, S.C. (2021) Teacher Digital Literacy: The Indisputable Challenge after COVID-19. *Sustainability*, **13**, 1-29. https://doi.org/10.3390/su13041858

[8] Li, Y. and Ye, M.M. (2022) Research on the Teaching Model of Teachers' Data Literacy and the Deep Integration of Smart Classroom. *Teaching and Management*, **18**, 77-80.

[9] Pan, Z.X. and Zhou, H.Y. (2023) Connotation Interpretation and Development Strategy of Data Literacy among College Teachers. *China Higher Education*, **6**, 53-56.

[10] Li, Q. and Zhao, H.H. (2018) Research on Teacher Data Literacy Evaluation Index System. *Research on Electrochemical Education*, **39**, 104-110.

[11] Ma, Y.Y. and Sun Q.P. (2021) Definition of Connotation and Construction of Cultivation Mode of Data Literacy of Teachers Oriented to Wisdom Education. *Henan Education* (*Higher Education*), **11**, 26-28.

[12] Zhang, X.B., Lin, S.B. and Zhu, Y. (2022) From Psychological Intervention to Competence Construction: A Systematic Framework and Practical Mechanism for Teachers' Data Literacy Cultivation. *China Electrified Education*, **6**, 105-111.

[13] Liu, G.P., Chen, Y. and Qi, Y.C. (2021) Cultivation Models and Strategies for Teachers' Data Literacy. *Journal of Teacher Education*, **8**, 21-30.

[14] Zhang, S. (2023) Teacher Rotation toward the Construction of High-Quality Education System: Based on the Perspective of Organizational Learning. *Journal of Edu-*

cation Studies, **19**, 114-128.

[15] Zhou, Y.L. (2022) How Does School-Based Teaching and Research Promote Teachers' Knowledge Development—Analysis Based on the Perspective of Organizational Learning. *Forum Contemporary Education*, **3**, 88-97.