

An Overview of Data Literacy Cultivation for Primary and Secondary School Teachers in the United States: History and Experience

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With the rapid advancement of technology, the role of educational technology in the field of education has become increasingly prominent. As a pioneer in the field of educational technology, the United States has taken the lead in exploring and practicing data literacy education for primary and secondary school teachers. This article, taking relevant policies for fostering teachers' data literacy as a clue, traces the various stages of data literacy cultivation for American primary and secondary school teachers, from the initial awakening of awareness at the government level, to the preliminary exploration through the combined efforts of the government and non-governmental organizations, then to the period of comprehensive development, and finally to the stage of standardization and maturity. It delves into the characteristics, measures, and achievements of each stage, ultimately summing up the experience of fostering teachers' data literacy.

Keywords: data literacy, primary and secondary school teachers, professional development

Introduction

Teachers' data literacy has been defined as "one's ability, or the broad knowledge and skills, needed to engage in data use or implement a data use inquiry process" (Abrams, Varier, & Mehdi, 2021, pp. 100, 868). In the field of education, enhancing teachers' data literacy holds significant importance for optimizing teaching processes and improving the quality of education. As a major country in the development of educational informatization, the United States possesses invaluable research value in systematically tracing the evolution of data literacy education for primary and secondary school teachers and summarizing its developmental experiences.

A Retrospective on the Development of Data Literacy Cultivation for Primary and Secondary School Teachers in the United States

The United States embarked on the journey of data literacy education for primary and secondary school teachers relatively early, and has gradually developed a relatively systematic cultivation mechanism through the support of a series of related policies and documents. Based on relevant information, the process of fostering data literacy among primary and secondary school teachers in the United States can be broadly divided into the following stages:

Stage of Awareness Awakening (1996-2004)

In 1996, the United States released its first National Educational Technology Plan titled “Getting America’s Students Ready for the 21st Century: Meeting the Technology Literacy Challenge”. This plan proposed adapting to the development needs of the digital age and called for increased investment in software development and teacher training, teaching teachers how to integrate technology into school curricula, and advocating for professional organizations to open easily accessible educational databases to support teacher instruction. Subsequently, the “No Child Left Behind” Act and the “Education Sciences Reform Act” were introduced, further emphasizing the role of data analysis in supporting educational decision-making. It was highlighted that the vast amount of data available to primary and secondary school teachers could enhance their teaching efficiency, and that timely and efficient online network databases should be provided for educators. These policies laid the foundation for data literacy education for primary and secondary school teachers in the United States. In 2004, the United States updated its National Educational Technology Plan and released “Toward a New Golden Age in American Education: How the Internet, the Law, and Today’s Students Are Revolutionizing Expectations” which mentioned that primary and secondary school teachers should integrate data and move towards digital teaching.

During this stage, as the process of educational informatization in the United States accelerated, relevant national legislation was enacted to actively encourage primary and secondary school teachers to integrate information technology into their daily teaching. However, it is noteworthy that despite this advocacy, there were no specific policies explicitly aimed at the dedicated cultivation and enhancement of data literacy among primary and secondary school teachers. Teacher training primarily focused on technology integration rather than specialized data literacy education.

Stage of Initial Exploration (2005-2008)

As the importance of data in educational decision-making became increasingly apparent, the US government and professional organizations began to intensify their support for data literacy education among primary and secondary school teachers. On one hand, non-profit organizations emerged from the civil sector to undertake the training of teachers’ data literacy. For instance, the non-profit Data Quality Campaign, initiated by the civil sector, aimed to enhance educators’ capabilities in data analysis and decision-making by fostering collaboration among various stakeholders in the education field. On the other hand, the United States enacted a series of laws to organize training for teachers’ data literacy. In 2007, the America Competes Act was enacted, proposing to organize teacher training to improve the ability of primary and secondary school teachers to use and integrate data. States were encouraged to create conditions to encourage and support teachers in effectively utilizing data resources, particularly academic achievement data, in classroom instruction, thereby enhancing their ability to interpret and apply data.

During this stage, the collaboration between the US government and civil professional organizations played a pivotal role in elevating the data literacy of primary and secondary school teachers. The federal government not only provided significant financial support but also worked towards establishing a robust data system, laying a solid foundation for teachers to access and use data more conveniently. At the state level, governments responded positively by organizing various forms of teacher data literacy training programs to help teachers improve their data processing and analysis skills.

Stage of Comprehensive Development (2009-2013)

With the advent of the Big Data era, the US Department of Education and its subordinate agencies began to focus on data-driven instructional practices and promoted the development of data literacy education for primary and secondary school teachers through a series of reports and policy documents. Starting in 2009, Arne Duncan, the then Secretary of Education, actively led and drove the in-depth development of data literacy education and training for primary and secondary school teachers. In the same year, the United States passed a far-reaching bill that clearly defined teachers' ability to interpret and use data as an integral part of their professional competencies. In 2012, the "Big Data Research and Development Initiative" proposed from a macro-perspective of national strategy marked the comprehensive layout and official launch of data literacy education. This strategy not only demonstrated the United States' profound insight and proactive response to the Big Data era but also clarified the critical mission of schools as the frontline of education.

During this stage, the cultivation of data literacy among primary and secondary school teachers in the United States entered a golden age of comprehensive development, with continuous optimization of the policy system and significant enhancement of financial and technical support. The national-level Big Data research and development strategy created a favorable social atmosphere for data literacy education among primary and secondary school teachers. Meanwhile, the release of a series of educational technology plans pointed out the direction for the development of data literacy education.

Stage of Normalization and Maturity (2014-Present)

As the data literacy education for primary and secondary school teachers continued to deepen, the US government and the education sector began to focus on its standardization and normalization. By formulating legally binding legislative documents and policy guidelines, teacher data literacy was officially incorporated into the teacher certification system, marking a milestone achievement that ushered in a phase of standardized and systematic development for data literacy education. Notably, in 2014, the United States introduced the "Data-Informed Decision Making Project", which not only emphasized data literacy as a vital component of teachers' professional competencies but also explicitly mandated its comprehensive assessment within the teacher certification process for primary and secondary schools. This measure was promptly embraced and implemented by various states; by February 2014, 19 states had already made teacher data literacy skills a necessary condition for obtaining teacher certification, further bolstering the nationwide enhancement of teachers' data literacy. In 2015, the Every Student Succeeds Act (ESSA) introduced the concept of "digital learning", mandating that the educational assessments of every state must evaluate educators' data literacy, such as assessing the abilities of educational administrators and teachers to use data to improve and differentiate instruction. The assessments also encompassed whether states provided resources and training to teachers and principals to facilitate their effective utilization of educational data. In 2016, the United States issued its fifth National Educational Technology Plan, "Learning for the Future: Reimagining the Role of Technology in Education", which emphasized the need for states, local educational agencies, and higher education organizations to collaborate in identifying cross-system, universally applicable key data elements (e.g., definitions, business rules, and technical specifications) to enhance the sharing of educational data.

During this phase, the data literacy education for primary and secondary school teachers in the United States entered a period of normative improvement, with the policy system, evaluation system, and standard system gradually being refined. Through measures such as legislative guarantees, evaluation system development, and

resource optimization, the goal was to elevate the level of data literacy among primary and secondary school teachers.

Summary of Experience in Cultivating Data Literacy Among Primary and Secondary School Teachers in the United States

Policy Leadership and Continuous Promotion

The development trajectory of data literacy education for primary and secondary school teachers in the United States clearly demonstrates the pivotal role of policy guidance, which serves as a vital driving force propelling the continuous advancement of data literacy education. From the introduction of national educational technology plans to the successive enactment of specific laws and regulations, each policy has emphatically underscored the central position of data in optimizing educational decision-making and fostering teachers' professional growth, laying a solid policy foundation for the implementation of data literacy education. Furthermore, these policies are not static but evolve dynamically, closely tracking the pace of educational needs and technological advancements, ensuring that data literacy education remains relevant and responsive to the demands of the times, thereby providing robust support for cultivating primary and secondary school teachers with a high level of data literacy.

Multi-stakeholder Engagement and Collaboration

Multi-stakeholder engagement and collaboration represent a crucial pathway to effectively foster teachers' data literacy. The government plays a leading role in this endeavor, establishing a legal framework through legislation, providing financial support, and setting policy directions, thereby offering a solid guarantee for the comprehensive promotion of data literacy education. Meanwhile, non-profit professional organizations are indispensable, as they initiate nationwide collaborative projects that significantly enhance educators' data-driven decision-making capabilities, injecting vitality into the deepening of data literacy education. Additionally, the close collaboration between schools and communities significantly contributes to the popularization and dissemination of data literacy education, fostering a favorable ecosystem conducive to its development through resource sharing and mutual support.

Teacher Training and Professional Development

The data literacy education for primary and secondary school teachers in the United States exhibits a high degree of targetedness and systematicity. The training content progresses from foundational technology integration skills to specialized data literacy education, with meticulously designed curricula ensuring that teachers acquire a comprehensive set of competencies spanning data acquisition, comprehension, analysis, evaluation, and application. To achieve this, the United States leverages policy support, financial investment, and technological backing to create diverse training modalities, including online courses, hands-on workshops, and intensive seminars, catering flexibly to the individual needs of different teachers. Notably, the United States views data literacy education as a long-term endeavor in teachers' professional development, establishing comprehensive evaluation and standard systems that not only measure current achievements but also incentivize teachers to continuously refine their data literacy skills throughout their careers, adapting to the rapid changes in the educational landscape.

Resource Optimization and Technological Support

The United States demonstrates forward-thinking strategies in the realm of data literacy education for

primary and secondary school teachers, with resource optimization and technological empowerment proceeding in parallel. Through generous funding and meticulous resource integration strategies, the country has crafted an abundant learning environment for teachers, encompassing valuable knowledge repositories such as open educational databases and public libraries. Additionally, leveraging cutting-edge achievements in modern information technology, including big data and cloud computing, teachers are equipped with efficient and convenient tools for data acquisition and analysis. This technological support not only significantly enhances the efficiency and quality of data literacy education but also fosters innovations in teaching methodologies, empowering teachers to confidently employ data-driven instructional decisions and propel the continuous progress of education.

Conclusion

The development of data literacy education for primary and secondary school teachers in the United States has undergone four stages, ranging from initial awareness to normative maturity. Each stage carries its unique policy context and primary measures. By examining the evolution of this education in the US, we can discern successful experiences in aspects such as the gradual improvement of the policy system, the enhancement of financial support, the optimization of technical assistance, and the robustness of the evaluation system. These experiences offer valuable insights and inspirations for countries worldwide in advancing data literacy education among primary and secondary school teachers.

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