Breaking Boundaries and Reconstruction: In-depth Reform of Data Literacy Education Models in University Libraries from a Multidimensional Perspective

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Abstract: *As an essential platform for knowledge dissemination in universities, the function of the library is not limited to traditional literature retrieval; it also bears the responsibility of enhancing students' data literacy. Especially with the accelerating digital transformation in the education sector, promoting the continuous innovation of data literacy education models in university libraries is highly beneficial for the long-term development of students. Based on this, this paper explores the innovative paths of data literacy education models in university libraries from a multidimensional perspective, aiming to provide valuable references for universities.*

Keywords: *University libraries; data literacy; education model*

Introduction

The demand for data analysis skills in modern society is increasing, and as a knowledge integration platform, libraries play a crucial role in fostering students' data application abilities, enabling them to adapt better in academic research. The innovation of data literacy education models can effectively promote the integration of interdisciplinary fields. As the boundaries between disciplines become blurred, university libraries, by integrating data resources from various disciplines, encourage students to form a more comprehensive cognitive structure in interdisciplinary learning. Currently, the data literacy education models in university libraries are relatively outdated, facing numerous limitations, especially in dealing with data processing, where depth is lacking, making it difficult to adapt to the trends of information development. Against this backdrop, universities must innovate data literacy education models, strengthen students' adaptability in complex information environments, and encourage management to innovate educational concepts and enhance the library's educational function. This will provide comprehensive support for students' academic development and meet the growing demands for data literacy education in the digital age, thereby improving the overall quality of education.

1. Definition of Data Literacy

Data literacy is a comprehensive capability that encompasses the entire process of data acquisition, analysis, processing, and application, reflecting an individual's cognitive level in modern information society. At its core, data literacy involves the ability to solve problems using data, mastering the fundamental properties of data, and performing logical reasoning based on scientific analysis methods. Data literacy requires a profound understanding of data, proficiency in various information retrieval tools and analysis software, and a high level of critical thinking to effectively assess the authenticity of data, avoiding blind reliance on incomplete data resources. The cultivation of data literacy integrates knowledge from fields such as statistics, forming a multidimensional capability framework. Whether dealing with structured or unstructured data, data literacy emphasizes interdisciplinary applications, encouraging learners to flexibly use data for innovation across different academic fields.[1]

2. Shortcomings in Data Literacy Education in University Libraries

2.1 Lack of Emphasis on Data Literacy Education in Universities

The lack of emphasis on data literacy education in universities is evident, reflecting insufficient attention to this field in many institutions. Although the demand for data analysis skills is growing rapidly in modern society, some university administrations still regard data literacy as a non-essential component of education. This attitude has resulted in data literacy education being marginalized within the overall curriculum, failing to become an integral part of subject teaching. The curriculum for data literacy education lacks systematic organization and is often scattered across other courses, preventing the formation of a complete and independent teaching module. In some universities, data literacy education is treated as supplementary content rather than a core part of subject education, leading to insufficient allocation of teaching resources to meet actual needs. Moreover, the low dissemination rate and limited coverage of relevant courses exacerbate the issue. In some institutions, data literacy courses are offered only to students in certain disciplines, failing to extend across the entire student body. This limitation means that many students go through their entire higher education experience without receiving in-depth training in data literacy, which hampers their future academic development.

2.2 Slow Update of Teaching Content

The teaching content of data literacy education is lagging behind the rapid advancements in information technology, resulting in noticeable delays in teaching quality. Technological progress has introduced numerous new methods for data processing, ranging from cloud computing and big data to the widespread application of artificial intelligence, with advanced data analysis tools emerging constantly. However, many university libraries continue to focus on traditional basic teaching, such as simple data retrieval, while neglecting the introduction of emerging technologies. This outdated and singular teaching content fails to equip students with skills that match the demands of modern work environments, particularly when dealing with large-scale data. As data processing tools rapidly evolve, library data literacy education has not kept pace with updating corresponding teaching materials, leaving the content stagnant. As a result, students are exposed to outdated methods and are unable to master the current widely-used technological tools. This lag in content diminishes students' learning outcomes and leaves them facing technical challenges in practical applications.

2.3 Lack of Diversity in Teaching Methods

For a long time, data literacy education has relied on traditional lecture-based teaching methods, lacking flexibility, which limits students' learning effectiveness. The course design is typically teacher-centered, with a focus on theoretical explanations, while practical operation components are often missing. Under such teaching methods, students' understanding of data processing technologies tends to remain superficial, preventing them from mastering complex data analysis tools in depth, thereby severely restricting the development of practical skills. Data literacy education, by nature, involves a significant amount of data analysis, which is highly practical. However, many university library courses lack sufficient interactive sessions, and the communication between students and teachers is limited, making it difficult for students to receive timely, targeted feedback during their learning process. This lack of interaction leads to a passive learning experience, with students missing out on the cultivation of creative thinking that is essential for data literacy education to achieve its goals. Traditional teaching methods overly emphasize fixed thinking patterns, with little focus on innovative teaching designs that encourage students to ask questions, resulting in ineffective development of students' innovation awareness.

2.4 Inconsistent Professional Abilities of Instructors

The professional abilities of instructors in library data literacy education vary greatly, which directly impacts students' learning outcomes. Modern data literacy education requires instructors to have a wealth of interdisciplinary knowledge, but some teachers lack a clear understanding of the practical applications of data science, and their teaching content lacks systematic organization. The rapid development of data processing technologies requires instructors to stay up to date with the latest advancements. However, some instructors fail to keep up with new technologies, resulting in a lack of practical guidance on contemporary data tools in the classroom. This leaves students without adequate hands-on training, and their learning experience remains confined to theoretical knowledge, with

insufficient practical skills. Additionally, weak mechanisms for teacher training contribute significantly to this issue. The lack of regular skills updates leads to outdated knowledge structures among some instructors, whose understanding of data literacy education remains at an outdated stage.[2]

3. Innovative Approaches to Data Literacy Education Models in University Libraries

3.1 Optimizing Teaching Resource Allocation and Enriching Practical Teaching Scenarios

The cultivation of data literacy is not only about theoretical learning but also requires students to master data analysis tools and apply them flexibly in complex practical scenarios. This strategy effectively compensates for the weak practical aspects of traditional classroom teaching, helping students deepen their understanding of data processing through hands-on experience. By reasonably allocating hardware resources, university libraries can provide students with real data experiment environments, allowing them to develop data sensitivity through practical operations. Constructing such practical teaching scenarios offers students a simulated environment resembling real-world data processing tasks, enhancing their ability to handle complex data tasks. These scenarios are not limited to physical equipment; virtual learning platforms should also be introduced, allowing students to participate in data projects online. Virtual platforms can provide rich datasets, enabling students to practice independently after class. Additionally, libraries should collaborate with data providers or industry organizations to obtain extensive real-world datasets, enriching students' practical experience in dealing with real problems. Practical teaching design should align closely with specific data literacy education goals, organizing activities in a task-driven manner based on students' learning progress. Libraries can create diverse practical projects to meet the needs of different course levels, guiding students step by step from basic data cleaning to complex data analysis, gradually mastering core data processing skills. Practical projects can be designed with staged tasks, allowing students to receive immediate feedback upon completion of each task, while teachers monitor student operations through a data analysis platform and provide timely guidance.[3]

3.2 Integrating Interdisciplinary Knowledge to Enhance Data Application Capabilities

The purpose of integrating interdisciplinary knowledge and enhancing data application capabilities is to equip students with the ability to tackle complex problems and apply data processing technologies efficiently in different academic contexts. Data literacy is not confined to a single discipline but requires flexible application across various fields. University libraries, as integrated centers of interdisciplinary resources, hold a unique advantage in promoting such integration. By designing interdisciplinary practice cases, students can understand the specificity of data in different fields, cultivating the ability to handle complex data situations. This interdisciplinary integration fosters knowledge transfer and skill enhancement, enabling students to better adapt to diverse academic and career demands. In practical implementation, diverse projects and course modules should be organized according to the characteristics of different disciplines. Each project should be designed with the unique data features of each field, ensuring that students are exposed to various data application scenarios. The projects can range from experimental data analysis in science and engineering to quantitative research in social sciences, helping students find commonalities among different data types and mastering how to apply appropriate technologies across disciplines. By setting interdisciplinary cases, students can discover the widespread application of data analysis technologies in different fields through hands-on practice, learning to adapt their thinking to solve various data problems. During course implementation, libraries should collaborate closely with departments, inviting experts from different fields to participate in course development, ensuring that data literacy education remains closely aligned with the forefront of academic disciplines. Interdisciplinary courses should not be limited to theoretical lectures but should immerse students in multi-dimensional learning environments through specific data cases, datasets, and application scenarios. For instance, in a financial data analysis project, students must understand the characteristics of financial market data, while in a medical data processing project, they need to master the methods of analyzing biological data. Different disciplines have unique data processing methods, and the design of interdisciplinary projects enables students to delve into these differences and develop the ability to use various analysis tools effectively.

3.3 Introducing Advanced Technological Means to Enhance the Intelligent Learning Experience

As the core platform of data resources, university libraries can leverage intelligent technologies to

create dynamic learning environments for students, helping them adjust their learning content flexibly according to their progress. Through adaptive learning systems, students can receive personalized learning suggestions, improving learning efficiency, while the platform provides real-time technical support to enhance their autonomy in data literacy learning. To implement this strategy, libraries need to build intelligent learning platforms based on AI technology, offering personalized learning plans for each student. The platform should integrate various adaptive learning tools, covering different modules such as data analysis, helping students adjust their learning paths according to their progress. This platform not only tracks students' learning progress in real-time but also analyzes their learning habits, providing targeted learning suggestions. The learning modules on the platform should be flexible, adjusting course content automatically based on students' feedback and learning outcomes to ensure continuity in learning. In terms of technical support, libraries should introduce cloud-based resource management systems, enabling students to access learning materials anytime and anywhere. The cloud platform can provide students with large-scale data processing capabilities, offering robust technical support during the learning process. Through this system, students can access vast datasets and use online data analysis tools provided by the library for hands-on practice. The introduction of cloud computing technology expands the accessibility of library resources and enhances the flexibility of students' data analysis operations.[4]

3.4 Strengthening Interactive Teaching Models to Stimulate Student Interest

The core of strengthening interactive teaching models lies in increasing student participation, thereby stimulating their interest in data literacy education. Traditional one-way teaching often overlooks students' independent thinking, while interactive teaching methods can effectively enhance classroom dynamics, enabling students to engage in deep discussions during collaboration and sparking their interest in data analysis. Task-driven approaches allow students to improve their data processing skills and teamwork capabilities by solving real-world problems. In practice, task-driven group discussions should be organized, with each task based on real-world cases involving actual data issues, allowing students to experience real data application scenarios during analysis. The tasks should be designed in accordance with the characteristics of different disciplines, guiding students step by step through the entire data analysis process, from data collection to cleaning and presenting analysis results. Through group collaboration, students can exchange views during discussions, identify problems, and propose diverse solutions. This discussion format encourages students to understand the logic behind data analysis more deeply while honing their communication skills. To further enhance interaction, libraries should design collaborative data projects where students can participate in interdisciplinary projects, with teachers from different disciplines providing guidance. The project content should be challenging, requiring students to use a variety of data analysis methods to solve complex data problems. Teachers act as facilitators, guiding students through difficulties encountered during the project, ensuring a high level of interaction throughout the learning process. The design of interactive teaching models should also include simulated operations, with libraries providing real industry data cases. By analyzing these cases, students can become familiar with the application of data in different fields.

3.5 Improving the Teacher Training System to Enhance Professional Teaching Levels

Teachers need to possess solid theoretical knowledge while continuously updating their understanding of data analysis tools to ensure the professional development of the teaching team and their ability to address complex data problems. This improves course quality and fosters comprehensive data literacy among students. In implementation, long-term teacher training plans should be developed, ensuring that teachers regularly receive training on cutting-edge technologies. Training content should be continuously adjusted according to the pace of data technology advancements and industry needs, enabling teachers to master advanced analysis tools and incorporate them into the classroom, helping students understand how to use the latest technologies for data processing. The training content should be designed hierarchically, covering both basic skills training and in-depth explanations of advanced analysis tools, meeting the diverse professional development needs of teachers. In addition to technical training, updating teaching methods is also an essential part of the teacher training system. Collaboration with industry experts can help organize regular teaching exchange activities to share the latest teaching methods. Through these exchanges, teachers can learn how to integrate emerging data technologies into their teaching and design more diverse teaching plans based on students' actual needs. To ensure widespread participation in training, a combination of online and offline methods should be used to expand the coverage of training programs.

3.6 Establishing a Multidimensional Evaluation System to Promote Learning Outcome Feedback

To improve students' learning outcomes in library-based data literacy education, a multidimensional evaluation system should be established to assess students' comprehensive abilities from different angles. Through a dynamic evaluation system, teachers can track students' learning progress in real-time and adjust teaching strategies flexibly based on their performance, optimizing the education model for greater effectiveness. In practice, university libraries should design comprehensive evaluation systems covering multiple learning dimensions. These systems should include various forms of assessment, such as regular tests, ensuring diversity in evaluation methods. Regular tests help teachers understand students' grasp of knowledge at different stages, allowing timely detection of knowledge gaps and adjustment of course content accordingly. Project presentations serve as practical evaluation methods, requiring students to apply their data analysis skills to real-world problems and demonstrate their comprehensive data processing abilities. During project presentations, the evaluation criteria should cover all aspects of data literacy, ensuring a thorough assessment of students' skills. Libraries should also introduce innovation and practicality as evaluation dimensions in data analysis outcomes, assessing students' technical application abilities and innovative thinking in solving real-world problems. Teachers can evaluate whether students apply learned techniques creatively to address challenges and offer unique insights in practice. Clear evaluation standards should be set for data analysis outcomes, allowing libraries to comprehensively assess students' practical data literacy skills and provide personalized feedback based on the evaluation results.

Conclusion

In conclusion, by exploring the optimization paths of data literacy education models in university libraries from a multidimensional perspective, university libraries can achieve comprehensive improvement. This systematic transformation provides students with a richer learning experience while effectively promoting the professional development of teachers. In the future, university libraries will continue to play a crucial role in data literacy education, further advancing data-driven learning models.

Fund Projects

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