A Study on the Integration and Implementation of Digital Literacy and Pedagogy Implementation in Educational Technology Programs: A Case Study Based on the Annotation Project of iFLYTEK's Educational Large Model

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ABSTRACT

As artificial intelligence (AI) technology profoundly reshapes the educational ecosystem, digital literacy has become a core element in talent development in education. Furthermore, continuous innovation in teaching methods is crucial for promoting the deep integration of digital technology and education. This article explores the "Educational Technology 'AI + Professional' Integrated Innovation Capacity Cultivation System," a project jointly launched by Qingdao Hengxing University and iFlytek's Large Language Model (LLM) Annotation Project in Education. As an exploratory practice aimed at connecting digital literacy and pedagogical innovation in educational technology, the project serves as an informative research object for understanding effective integration approaches. Using a case study approach, this article systematically analyzes the project's implementation process and practical outcomes, focusing on the cultivation of digital literacy, innovative teaching methods, and the application of technological tools. The project introduces a novel teaching model: "Educational Cognitive Map + LLM Training," which combines conceptual understanding of educational scenarios with hands-on large-scale language model training tasks. Furthermore, the project implements a "dual-teacher, three-stage" training mechanism, in which university faculty and industry experts jointly guide students through three stages: basic knowledge acquisition, practical application, and innovative design. The results demonstrate that these structured interventions significantly improve students' digital literacy, including their ability to use AI tools, analyze educational data, and design intelligent learning environments. Teaching quality has also improved, as reflected in student engagement, critical thinking, and project outcomes. This case provides a practical and replicable example for promoting the digital transformation of educational technology projects, highlighting the potential for collaborative development in curriculum design, teaching innovation, and industry collaboration in the era of artificial intelligence.

Keywords: Digital literacy; Pedagogy implementation; Educational big models; Industry-education integration; Intelligent teaching tools

INTRODUCTION

In the contemporary era, the exponential growth of artificial intelligence (AI) technology has triggered a profound transformation across various sectors, and the education domain is no exception. The education sector is currently undergoing a significant shift towards an intelligent and precise paradigm, driven by the rapid advancements in AI. At the heart of this transformation are educational large models, which have emerged as the central driving force revolutionizing teaching, management, and evaluation processes. These sophisticated models are not only reshaping the way education is delivered but also placing new and demanding requirements on the cultivation of talent.

The concept of digital literacy has gained increasing prominence in recent years. As early as 2018, the United Nations Educational, Scientific and Cultural Organization (UNESCO) recognized that digital literacy has evolved into the "new literacy" essential for future citizens. Digital literacy encompasses a wide range of multi-dimensional competencies. Information management is a crucial aspect, as in the digital age, vast amounts of information are available at our fingertips. Students need to be able to effectively search, filter, and organize this information to make informed decisions. Technology application skills are also vital, enabling individuals to utilize various digital tools and platforms in different educational and professional contexts. Ethical reasoning is another key component, ensuring that the use of digital technologies is carried out in a responsible and moral manner.

Building on UNESCO's framework, the European Union's DigComp 2.2 framework in 2022 further refined the concept of digital literacy by breaking it down into five core areas. Information and data literacy involve understanding, evaluating, and using digital information and data. In an educational setting, this could mean students being able to analyze educational data to improve their learning strategies. Communication and collaboration skills are essential for students to interact with their peers and teachers in the digital environment. With the increasing prevalence of online learning platforms, the ability to communicate effectively through digital means is becoming increasingly important. Digital content creation allows students to express their creativity and knowledge in digital forms, such as creating multimedia presentations or online courses. Security and safety are of utmost importance in the digital world, protecting students from cyber threats, privacy violations, and other digital risks. Problem-solving skills enable students to address various digital-related challenges, such as troubleshooting technical issues or finding solutions to complex digital problems.

However, traditional educational technology programs have faced significant limitations. For a long time, these programs have mainly focused on training students to be "technology users." They teach students how to operate existing educational software and tools, but they fall short in meeting the growing demand for "model developers" and "optimizers" in the field of educational large-scale models. As educational large models become more prevalent, there is a pressing need for professionals who can design, develop, and optimize these models to better serve the educational needs.

Against this backdrop, Qingdao Hengxing University has taken a proactive step by partnering with iFlytek to launch an educational large-scale model annotation project. This project uses real-world industrial practice as a platform to explore an innovative talent cultivation model that integrates "AI + professional disciplines." The project involves several key tasks. Firstly, the cleaning of massive amounts of educational text, speech, and image data is necessary. Educational text data may contain errors, such as spelling mistakes or inconsistent formatting. Speech data may be affected by background noise or unclear pronunciations. Image data may have low resolution or incorrect labels. By cleaning the data, we can ensure its quality and reliability for model training.

Secondly, annotation is a crucial process in this project. Annotators need to add labels or tags to the data to make it understandable for the educational large models. For example, in educational text data, annotators may need to identify key concepts, learning objectives, and knowledge points. In speech data, they may need to transcribe the speech accurately and annotate the intonation and emphasis. In image data, they may need to label objects, scenes, and educational elements.

Finally, quality inspection is carried out to ensure that the annotated data meets the high-quality standards required for training educational large models. This involves checking the accuracy, consistency, and completeness of the annotations. The project not only serves as the foundation for training high-quality educational large models but also provides an important platform for cultivating students' digital literacy and cross-disciplinary practical skills.

The training of educational large models heavily relies on high-quality annotated data. The special nature of educational data poses unique challenges and higher requirements on the educational professional competence of annotators. For instance, classroom conversations involve different cognitive levels of students and teachers. Annotators need to understand the context, the learning process, and the cognitive development of students to accurately annotate the data. Exam questions are also complex, as they are associated with specific knowledge points and learning outcomes. Annotators need to have a deep understanding of the educational curriculum and assessment criteria to annotate exam question data effectively.

This study is based on the practical experience of the educational large-scale model annotation project. It aims to systematically analyze the integration logic between digital literacy and pedagogy, providing valuable references for similar professional reforms. To ensure the scientific rigor and comparability of the research, the study combines the UNESCO Global Digital Literacy Framework, the EU DigComp model, and international industry-education integration practices to construct a multi-dimensional analytical framework.

METHOD

This study employs a case study approach, concentrating specifically on the educational large-scale model annotation project jointly executed by Qingdao Hengxing University and iFlytek. The central aim of this research is to thoroughly examine the integration of digital literacy and pedagogical methods within a real-world practical context. By focusing on this specific project, the study can gain in-depth insights into the challenges, strategies, and outcomes associated with such an integration.

The data for this research is primarily sourced from a variety of project documentation, each of which offers unique perspectives and valuable information.

Requirements analysis reports serve as a fundamental source of data. These reports are meticulously crafted to detail the initial goals, requirements, and expectations of the project. They are like a blueprint that outlines the project's scope, helping us understand the boundaries within which the integration of digital literacy skills and pedagogical methods is to take place. For example, they specify the target digital literacy skills, such as data analysis, programming, and digital communication, that are to be integrated into the educational process. They also define the pedagogical methods that are expected to be employed, such as project-based learning, flipped classrooms, or collaborative learning. Moreover, these reports clearly state the overall educational objectives, whether it is to improve students' academic performance, prepare them for future careers, or enhance their overall digital citizenship.

Technical development logs play a crucial role in understanding the technological aspects of the project. They record the entire journey of developing the annotation tools and algorithms. From the initial design phase to the final implementation, these logs document every step. They provide insights into the technological challenges that the project team faced. For instance, they might mention difficulties in handling large-scale data, ensuring the accuracy of annotation algorithms, or integrating different software components. The solutions adopted to overcome these challenges are also detailed in the logs. This could involve using new programming languages, optimizing existing algorithms, or collaborating with external technology partners. By analyzing these logs, we can understand the evolution of the technical aspects of the project over time and how it has adapted to the changing technological landscape.

Teaching practice records are another invaluable source of data. They document how the project is actually integrated into the teaching process. This includes a detailed description of the teaching methods used. For example, if a teacher is using a project-based learning approach, the records will show how the project is designed, how students are grouped, and what tasks they are assigned. The learning activities designed for the students are also recorded, such as online quizzes, group discussions, or hands-on experiments. Additionally, these records capture the interactions between teachers and students. They can show how teachers provide feedback to students, how students ask questions, and how the overall classroom atmosphere is. By analyzing these records, we can evaluate the effectiveness of the teaching methods and learning activities in promoting the integration of digital literacy and pedagogy.

Student competency assessment results are of utmost importance for evaluating the effectiveness of the project. These results are used to measure the progress of students in different aspects of digital literacy. Information management is one such aspect. Assessment results can show how well students can collect, organize, and analyze digital information. Technology application is another key area. They can indicate whether students can effectively use digital tools and software for various tasks. Problem-solving is also a critical skill, and the assessment results can reveal how well students can use their digital literacy skills to solve real-world problems. By comparing the assessment results before and after the implementation of the project, we can determine the impact of the project on cultivating students' digital literacy and cross-disciplinary skills.

Feedback from collaborating institutions, including iFlytek and other relevant partners, provides external perspectives on the project. These institutions have a deep understanding of the industry needs. Their feedback can tell us whether the digital literacy skills and pedagogical methods integrated in the project are in line with the current industry requirements. They can also offer insights into the practicality of the project. For example, they might comment on whether the annotation tools and algorithms developed are easy to use in a real-world educational setting. Moreover, they can suggest areas for improvement. This could involve enhancing the user-friendliness of the tools, adding more advanced features, or adjusting the teaching methods to better meet the industry needs. By considering this external feedback, the project can be further refined and optimized to achieve better results.

In conclusion, this comprehensive data collection from multiple sources allows for a detailed and in-depth analysis of the integration of digital literacy and pedagogical methods in the context of the educational large-scale model annotation project. It provides a solid foundation for drawing meaningful conclusions and making informed recommendations for future educational projects.

The research framework is centered around four core questions:

R1: How does the project define the core digital literacy required for students majoring in educational technology?

To answer this question, we need to closely examine the project's curriculum design, training materials, and assessment criteria. The curriculum should clearly outline the specific digital literacy skills that students are expected to acquire. For example, it may include courses on data analytics, programming for educational applications, and digital communication strategies. Training materials should provide detailed instructions, examples, and case studies to help students develop these skills. Assessment criteria should be well-defined and objective, measuring students' performance in different aspects of digital literacy. This could involve practical assignments, online tests, and project-based assessments.

RQ2: How does pedagogical innovation support the cultivation of digital literacy?

Pedagogical innovation plays a crucial role in the cultivation of digital literacy. New teaching methods, such as project-based learning, can be highly effective. In project-based learning, students work on real-world projects related to the educational large-scale model annotation. This allows them to apply their digital literacy skills in practical situations, enhancing their problem-solving and collaboration abilities. Flipped classrooms are another innovative approach. In a flipped classroom, students learn digital content independently at home through online resources, and then they come to class for discussions, group work, and hands-on activities. This approach can improve students' understanding and application of digital knowledge.

RQ3: What role do technological tools play in the cultivation of digital literacy and teaching practices?

Technological tools are essential in both the cultivation of digital literacy and teaching practices. Annotation software is a key tool in the project. It provides a user-friendly interface for students to annotate educational data accurately and efficiently. The software can also offer features such as data visualization, error checking, and collaboration tools, which can enhance the annotation process. Data analysis tools are also important. They allow students to analyze the annotated data, identify patterns, and draw meaningful conclusions. This can help them develop their data literacy skills. Online learning platforms provide a convenient and interactive environment for students to learn and practice digital skills. These platforms can offer courses, tutorials, and discussion forums, facilitating self-learning and peer-to-peer interaction.

RQ4: What specific impacts does technological optimization have on teaching outcomes?

Technological optimization can have significant impacts on teaching outcomes. Improving the performance of annotation tools can lead to more accurate and efficient data annotation. This can save time and resources, allowing students to focus more on the learning process. Enhancing the accuracy of data analysis algorithms can provide more valuable insights into the educational data, which can be used to improve teaching strategies and learning experiences. Optimizing the user experience of online learning platforms can increase student engagement and motivation. For example, a more intuitive interface, personalized learning paths, and real-time feedback can make the learning process more enjoyable and effective.

Through a layered analysis of these four core questions, combined with empirical data from the project, such as annotation accuracy rates and improvements in student performance, the study aims to identify the key elements and pathways for the integrated implementation of digital literacy and pedagogy.

The research follows Yin's (2018) case study methodology, which involves a standardized process of "case selection - data collection - data analysis - theory construction." In the case selection stage, the educational large-scale model annotation project between Qingdao Hengxing University and iFlytek is carefully chosen because it represents a real-world example of integrating digital literacy and pedagogy in an educational context. In the data collection stage, as mentioned above, various types of data are gathered from different sources. In the data analysis stage, appropriate statistical and qualitative analysis methods are used to analyze the data. For example, quantitative data such as annotation accuracy rates can be analyzed using statistical software, while qualitative data such as teaching practice records and feedback can be analyzed using content analysis and thematic analysis. In the theory construction stage, the key findings from the data analysis are summarized, and a theoretical framework for the integrated implementation of digital literacy and pedagogy is constructed. This framework can provide a basis for future research and practical applications in the field of educational technology.

III. Results and Discussion

Implementation of Digital Literacy and Teaching Methods

Core Dimensions and Implementation Pathways for Digital Literacy Development

The development of digital literacy for "Education AI Trainers" has been systematically structured into a three-tiered competency framework, validated through extensive research and practical implementation. At the foundational level, students acquire essential educational data processing skills, including data cleaning, annotation, and quality assurance. These competencies enable them to detect grammatical inaccuracies in textual materials, interpret emotional tones in classroom audio recordings, and extract pedagogically relevant information from instructional images. For instance, during essay annotation tasks, students perform not only surface-level grammar and spelling checks but also deeper linguistic analyses, such as identifying rhetorical devices (e.g., metaphor, personification) and assessing thematic coherence and depth—skills critical for training AI models to understand nuanced educational content. This layer establishes the baseline precision required for high-quality training datasets[8].

At the intermediate level, students develop AI technology application capabilities. They gain conceptual understanding of natural language processing (NLP) techniques and learn to apply semantic analysis models to evaluate teaching scripts for logical inconsistencies, incorrect mathematical formulations, or pedagogical gaps. Using specialized tools, they implement automated error correction protocols, thereby bridging theoretical knowledge with technical execution. This stage ensures that future AI trainers can actively contribute to refining AI-generated educational content, enhancing its accuracy and appropriateness for diverse learning contexts.

The advanced level focuses on cultivating model optimization thinking—a skill set traditionally absent in conventional educational technology programs. Students learn to conduct effect attribution analysis, diagnosing performance issues in large language models by evaluating annotated data quality. By identifying patterns of misannotation or bias, they can infer potential shortcomings in model training and propose targeted improvements. This analytical mindset empowers them to transition from passive data annotators to active contributors in AI model refinement, addressing a key gap identified in UNESCO's 2018 report on AI in education. To operationalize this framework, the project adopts a "theory-practice-reflection" pedagogical pathway. Theoretical instruction provides grounding in educational data characteristics and annotation standards; hands-on practice occurs through real-world projects at iFlytek; and reflective cycles utilize model performance feedback to refine annotation strategies, creating a continuous improvement loop that reinforces deep learning and professional readiness[3].

Innovative Teaching Methods

To move beyond traditional lecture-based instruction, the project introduces two transformative teaching methodologies. First, the "Educational Cognitive Map + Large Model Training" integrated approach aligns domain-specific knowledge structures—such as junior high school mathematics curricula—with AI model training workflows. This integration enables students to visualize how their annotations directly influence model behavior. For example, when annotating math problems, students reference curriculum-aligned knowledge maps to ensure content does not exceed prescribed learning levels, thus maintaining alignment between human-labeled data and AI training objectives. This method enhances both subject mastery and technical awareness, fostering interdisciplinary competence.

Second, the "Dual-Instructor Three-Stage" mechanism fosters collaboration between university faculty and industry mentors from iFlytek. In the Foundational Cognitive Stage, academic instructors deliver core pedagogical theories while corporate partners introduce real-world applications of educational AI. During the Project Practical Stage, students engage in live annotation projects under dual supervision: enterprise mentors guide tool usage and quality control, while university instructors assess theoretical application. Finally, in the Innovation Incubation Stage, joint teams design customized teaching scripts and model optimization strategies, promoting research-to-practice translation. This model effectively dissolves institutional silos, enhancing students' employability and adaptability—an outcome supported by Germany's Learning Factory 4.0 initiatives, which demonstrate significant gains in student competencies through university-industry partnerships (BMBF, 2023).

Implementation and Functions of Technology/Digital/Tools

Implementation Scenarios for Core Technical Tools

The technological infrastructure supports end-to-end processes in educational AI development. The Educational Data Annotation System features multi-layered annotation schemas tailored to the cognitive and contextual complexity of educational content. For example, classroom dialogues are tagged for question type (factual, inferential) and emotional tone (engaged, confused), enabling AI systems to better simulate responsive teaching behaviors. Similarly, exam questions are annotated for problem-solving strategy and knowledge linkage, ensuring rich, context-aware training inputs[5].

AI-driven error detection leverages subject-specific knowledge graphs to identify flaws in teaching scripts with over 95% accuracy. Research by Central China Normal University confirms its efficacy in improving content standardization (Liu et al., 2024). Meanwhile, the Script Customization System allows educators to generate adaptive lesson plans based on selected topics, difficulty levels, and textbook versions (e.g., People's Education Press), facilitating equitable access to high-quality instructional materials across regions.

Core Functions of the Technical Tool

The technical tool under consideration boasts a set of key functionalities that play a pivotal role in enhancing AI-augmented education. Firstly, data standardization is achieved through structured templates. These templates provide a consistent framework for organizing educational data, ensuring that information is presented in a uniform and easily understandable manner. By standardizing data, it becomes more accessible for both educators and learners, facilitating seamless integration into various educational systems.

Intelligent optimization is another crucial function. Through dynamic content updates, the tool can adapt to changes such as post-2024 curriculum reforms. This means that the educational materials are always up-to-date, reflecting the latest educational requirements and standards. For example, if there are new learning objectives or teaching methods introduced in the curriculum, the tool can quickly adjust the content to incorporate these changes, ensuring that learners receive the most relevant and accurate information.

Personalized adaptation to learner profiles is a significant feature. The tool can analyze the individual characteristics, learning styles, and progress of each learner. Based on this analysis, it can customize the learning experience, providing tailored content and activities that meet the specific needs of each student. This personalized approach not only enhances engagement but also improves learning outcomes by catering to the diverse needs of learners.

Interactive feedback mechanisms are also an integral part of the tool. Real-time quizzes allow learners to immediately test their knowledge and receive instant feedback on their performance. Drag-and-drop exercises provide a hands-on and engaging way for learners to interact with the content. These interactive elements encourage active participation and help learners better understand and retain the information.

Collectively, these features enhance engagement, efficiency, and equity in AI-augmented education. They align with EU DigComp standards, which emphasize the importance of digital competence in education. Moreover, they are in line with empirical findings on precision teaching, which highlight the effectiveness of personalized and targeted educational approaches. By leveraging these core functions, the technical tool can contribute to a more inclusive and effective educational environment (EU, 2022; Hattie, 2020; Prensky, 2019; Li et al., 2025)[6].

Results and Discussion

Interactivity and Communication Feedback of Technology/Digital Tools

Interactive Design

The integration of interactive features within the technological tools significantly enhances student engagement, knowledge retention, and active learning. Real-time interactive operations are central to this design, enabling learners to participate dynamically in the instructional process. For instance, online quizzes with immediate scoring and corrective feedback allow students to assess their understanding instantly, promoting metacognitive awareness. Drag-and-drop graphical interfaces are particularly effective in STEM subjects—during mathematics instruction, students manipulate formula components on-screen to complete derivations or solve equations. If an incorrect step is taken (e.g., misapplying a derivative rule), the system provides contextual prompts, guiding learners toward correct reasoning without giving away answers directly. This scaffolding approach supports cognitive load management and fosters deeper conceptual understanding[9].

Synchronized display interaction represents another critical advancement over traditional teaching methods. In conventional classrooms, discrepancies often arise between verbal explanations and visual aids—for example, teachers may verbally describe a concept while the projected diagram lags behind or vice versa. AI-driven synchronization ensures that multimedia content (animations, graphs, and text highlights) aligns precisely with spoken instruction, maintaining temporal coherence. This alignment reduces cognitive dissonance and improves information absorption, especially for visual and auditory learners. The use of timestamped narration linked to on-screen annotations allows for seamless navigation through complex topics, such as multi-step physics problems or historical timelines, enhancing overall instructional clarity and flow[2].

Communication and Feedback Mechanism

A robust communication framework underpins the effectiveness of these digital tools. The user feedback loop establishes a structured "student-teacher-technical team" chain that enables continuous improvement of educational content. Students can flag issues directly within the platform—for example, noting unclear problem-solving steps or ambiguous diagrams. Teachers aggregate these inputs, analyze recurring concerns, and relay them to the technical development team. Subsequently, the team revises scripts, updates error corrections, or refines interface designs based on empirical usage data. Once improvements are implemented, updated versions undergo application verification in real classrooms, forming a closed-loop cycle of "needs collection → technical iteration → classroom validation." This iterative mode ensures that educational tools evolve responsively to actual pedagogical demands rather than remaining static artifacts[6].

Additionally, the School-Enterprise Collaborative Feedback mechanism reinforces curriculum relevance and industry alignment. Within the "Dua-Instructor Three-Stage" training model, enterprise mentors from iFlytek conduct weekly reviews of students' performance in project-based learning tasks. They identify common challenges—such as inconsistencies in annotating multimodal data (text, audio, video)—and collaborate with academic instructors to adjust upcoming lessons accordingly. For example, if students struggle with emotional tone labeling in classroom recordings, additional exemplars and calibration exercises are introduced in the following week's session. This agile adaptation mirrors best practices in Germany's Industry 4.0 initiatives, where real-time feedback loops between education and industry have been shown to boost teaching efficiency by up to 30% (BMWi, 2024). Such collaboration not only sharpens students' technical competencies but also strengthens the practical applicability of their training[3].

Optimizing the Impact of Technology/Digital Tools

Improving Teaching Quality and Efficiency

The deployment of AI-powered tools has led to measurable gains in both content quality and instructional efficiency. Prior to implementation, manual script creation resulted in teaching materials with approximately 60% accuracy due to human oversight errors, particularly in formulaic disciplines like mathematics and science. With AI-driven error detection systems leveraging subject-specific knowledge graphs, accuracy has risen above 5%. For example, in junior high school math, frequent mistakes such as incorrect application of the vertex formula in quadratic functions or omission of domain restrictions in rational equations are now automatically flagged and corrected. As a result, students encounter fewer misleading explanations, which has improved their problem-solving accuracy by 25%, according to pilot studies conducted across partner schools[5].

Teaching efficiency has also seen dramatic improvements. Automated annotation and script generation functionalities have reduced manual workload by 70%, freeing educators to focus on higher-value activities such as personalized tutoring and lesson design. One participating teacher reported cutting preparation time by 40% while simultaneously increasing interactive elements in class, leading to a 30% rise in student participation rates. This shift reflects a broader transformation: from content delivery to facilitation of inquiry-based and collaborative learning environments supported by intelligent tools[8].

Improvements in Students' Digital Literacy and Academic Performance

Student outcomes demonstrate significant advancements in both digital literacy and academic achievement. Participants in the Education AI Trainer program showed an average increase of 35 points (on a 100-point scale) in assessments measuring core competencies, including data annotation standardization and model effect attribution analysis. Notably, 85% of students achieved proficiency in independently completing complex annotation tasks, indicating successful mastery of interdisciplinary skills. These gains reflect the efficacy of the integrated "theory-practice-reflection" pathway in building deep, transferable expertise[1].

Academically, students using personalized script systems demonstrated stronger performance gains compared to control groups. In mathematics, average test scores increased by 15-20 points, attributed to targeted practice on weak knowledge areas identified through AI analytics. In English language learning, grammar error rates declined by 32%, thanks to adaptive exercises that emphasize frequently misused structures (e.g., tense consistency, article usage). These results underscore the value of data-informed personalization in achieving precision education tailored to individual learner needs[7].

Promoting the Equitable Distribution of Educational Resources

One of the most transformative impacts of AI-driven educational initiatives is their significant contribution to advancing educational equity on a systemic level. By digitizing, standardizing, and automating high-quality instructional content, these projects enable the scalable dissemination of expert-level teaching practices across diverse geographic and socioeconomic contexts—including urban centers, rural villages, and historically underserved regions. This democratization of access ensures that students in remote or resource-constrained schools are no longer limited by the local availability of qualified teachers or advanced curricular materials. For instance, partner schools in rural Chongqing and Jiangsu provinces have successfully adopted localized versions of the AI-enhanced teaching script system, with adaptations aligned to regional textbooks such as those published by Suzhou Science and Technology Press[2], ensuring cultural and curricular relevance. These customized implementations maintain pedagogical rigor while accommodating regional learning needs, thereby increasing engagement and comprehension among diverse student populations. Notably, within just one academic year, standardized assessment data revealed an 18% reduction in the performance gap between these rural institutions and their urban counterparts—demonstrating measurable progress toward parity in learning outcomes. This narrowing of disparities underscores how AI-mediated replication of master teaching strategies can effectively compensate for imbalances in human and material resources. Moreover, platforms like the "National Primary and Secondary School Smart Education Platform" provide open access to thousands of high-quality lessons taught by distinguished educators, further leveling the playing field[2]. When combined with robust digital infrastructure—such as Chongqing's full coverage of multimedia classrooms across 9,177 schools—the potential for nationwide scalability becomes evident[2]. These efforts align closely with UNESCO's Sustainable Development Goal 4, which calls for inclusive and equitable quality education for all, regardless of location or background. By transforming expert pedagogy into reusable, adaptable, and widely distributable digital assets, AI not only preserves teaching excellence but also multiplies its impact, making equitable education not just an ideal but an achievable reality[6].

Evidence Screenshot Analysis

Educational Data Annotation Dimension Table

This screenshot displays a meticulously designed hierarchical matrix that defines multi-level annotation dimensions for diverse educational data types, serving as a foundational framework for training AI models in educational contexts. At the foundational layer, annotations focus on basic linguistic accuracy, including grammar, spelling, punctuation, and factual correctness—ensuring content reliability and clarity. These criteria are essential for maintaining high-quality instructional materials and are particularly critical when processing student-generated texts or automated content. Moving to the instructional layer, the framework introduces higher-order pedagogical dimensions. Cognitive level annotations are aligned with Bloom's Taxonomy, categorizing content or learner responses into memory, comprehension, application, analysis, evaluation, and creation. This enables educators and AI systems to assess not just what is learned, but how deeply it is understood. Emotional tone tagging—such as engaged, confused, frustrated, or curious—adds a socio-emotional dimension, allowing for the development of empathetic AI tutors capable of adapting to learners' affective states. For classroom dialogue datasets, each utterance is annotated across multiple axes: speaker role (teacher/student), discourse function (question, explanation, feedback), cognitive demand, and emotional valence. This rich metadata structure supports the training of socially aware, context-sensitive AI models that can simulate realistic teaching interactions. By standardizing these annotation practices, the framework fosters consistency, reproducibility, and scalability in educational AI development, directly contributing to the enhancement of trainees' digital literacy through structured engagement with real-world data[5].

Example of Correction in Junior High School Mathematics Problem Explanation

The side-by-side comparison vividly illustrates how AI-powered error correction significantly enhances the rigor and pedagogical quality of instructional content. In the uncorrected version, the mathematical explanation for a quadratic function problem misapplies the vertex formula $ y = ax^2 + bx + c $ without deriving it from completing the square, leading to conceptual ambiguity. Furthermore, when addressing rational equations, the solution fails to specify conditions under which denominators become zero—omitting crucial domain restrictions and extraneous root analysis. These oversights compromise both mathematical accuracy and student understanding. After AI intervention—guided by alignment with the official junior high mathematics knowledge map—the revised explanation demonstrates substantial improvements. It now includes a step-by-step derivation of the vertex formula, clearly linking algebraic manipulation to graphical interpretation. For rational equations, the corrected version systematically classifies solution cases, explicitly identifying restrictions on variables and verifying solutions against original equation constraints. Key steps are highlighted using color coding and annotated comments, improving readability and cognitive load management for learners. The AI system flags inconsistencies based on curriculum standards and suggests pedagogically sound revisions, ensuring curricular fidelity and conceptual coherence. This transformation exemplifies how AI error detection tools can act as intelligent co-editors, elevating the precision, completeness, and didactic effectiveness of educational materials[4]

Example of Teaching Script Structure

The teaching script structure presented here is a well-thought-out and standardized format that holds great potential for revolutionizing the educational experience. It begins with opening remarks, which serve as the gateway to the learning session. These opening remarks are not just a simple greeting; they are carefully crafted to capture the students' attention, set the tone for the lesson, and introduce the main topic. For instance, in a mathematics class, the opening remarks might start with a real-life problem related to the day's topic, like how to calculate the area of a garden when planning a landscaping project. This immediately makes the lesson relevant and engaging for the students.

Following the opening remarks is the problem breakdown section. Here, the main problem or concept of the lesson is dissected into smaller, more manageable parts. This step is crucial as it helps students understand the complexity of the problem gradually. In a science class, if the topic is about the water cycle, the problem breakdown could involve explaining the different stages of evaporation, condensation, and precipitation separately. Each part is explained in detail, with clear examples and visual aids if possible. This way, students can build a solid foundation of knowledge before moving on to more complex aspects.

The sub-question analysis with color-coded emphasis is a unique and effective feature of this script structure. Sub-questions are used to delve deeper into the main problem. The color-coding system helps students quickly identify the importance and type of each sub-question. For example, important key concepts could be highlighted in red, while supplementary or less critical questions could be in blue. This visual distinction makes it easier for students to focus on the most relevant information. During the analysis of these sub-questions, instructors can use various teaching methods, such as group discussions, individual thinking time, or demonstrations. This encourages active participation from the students and enhances their understanding.

Inserting an interactive quiz at this stage is a brilliant way to reinforce learning. The quiz can be designed to test the students' understanding of the sub-questions and the overall problem breakdown. It can include multiple-choice questions, fill-in-the-blanks, or short-answer questions. The interactive nature of the quiz allows students to immediately apply what they have learned. Moreover, it provides instant feedback to both the students and the instructor. If a large number of students get a particular question wrong, the instructor can go back and review the relevant concept.

After the interactive quiz, the summary section is essential for consolidating the knowledge. In this part, the instructor briefly reviews the main points of the lesson, emphasizing the key takeaways. It helps students organize their thoughts and see the big picture. For example, in a history class, the summary could recap the important events, causes, and effects of a particular historical period. This summary also serves as a reference for students when they are studying for exams or doing further research.

Finally, the closing statement is the last impression of the lesson. It can be used to encourage students to continue exploring the topic outside of the classroom, provide additional resources, or simply thank the students for their participation. A well-crafted closing statement leaves the students feeling satisfied and motivated to learn more.

This standardized teaching script structure ensures a logical progression of the lesson. It starts from an engaging introduction, moves through in-depth analysis, reinforces learning with a quiz, consolidates knowledge in the summary, and ends with a motivating closing. This structure also promotes consistency across different instructors and institutions. No matter who is teaching or where the lesson is taking place, students can expect a similar high-quality learning experience. It serves as a blueprint for replicable, high-quality instruction powered by digital tools, making it a valuable asset in the field of education. As more educators adopt this structure, it has the potential to improve the overall effectiveness of teaching and learning in various educational settings.

CONCLUSION

Qingdao Hengxing University, in collaboration with the iFLYTEK Education Large Model Annotation Project, has successfully developed a comprehensive system for integrating digital literacy and teaching methodology within its Educational Technology program. Through in-depth research and practical implementation, this initiative has demonstrated significant potential in enhancing students' digital capabilities and the quality of teaching practice.

The research findings suggest that by precisely defining the dimensions of digital literacy as "educational data processing—AI technology application—model optimization thinking," the university has created a clear roadmap for students' learning. This framework is not only based on theoretical knowledge but also closely aligned with real-world industrial requirements. It ensures that students are well-equipped with the skills needed to thrive in the digital age of education.

In terms of teaching methods, the innovation of the "educational cognitive map + large model training" and the "dual-teacher three-stage" approaches has been a key factor in the project's success. The educational cognitive map provides a structured way for students to understand complex educational concepts, while large-model training allows them to gain hands-on experience with advanced AI technologies. The dual-teacher three-stage model, which involves enterprise mentors and university instructors working together in different stages of the learning process, effectively bridges the gap between theoretical knowledge and practical skills.

The customized technical tools, including the annotation system, AI error correction system, and script customization system, play a crucial role in supporting the teaching and learning process. The annotation system helps students understand the nuances of educational data annotation, which is essential for developing digital literacy. The AI error correction system ensures the accuracy of teaching materials, improving the quality of instruction. The script customization system allows for personalized learning experiences, catering to the diverse needs of students.

The core experience of this project can be summarized in three main points. Firstly, defining the core dimensions of digital literacy based on real industrial needs is essential to avoid the common problem of a disconnect between training and practice. This approach ensures that students are learning skills that are directly applicable in the workplace. Secondly, through teaching method innovations in collaboration with enterprises, the project has achieved the transformation of theoretical knowledge into practical skills. The dual-teacher model, in particular, provides students with valuable insights from both academic and industry perspectives. Thirdly, optimizing technical tools to fit the unique characteristics of educational scenarios is crucial. Instead of simply applying generic technologies, the project has developed tools that are specifically tailored to the educational context, enhancing their effectiveness.

However, the project also faces several challenges. Technical competition is one of the major issues. For example, the "intelligent calibration-feedback" system may have an insufficient response speed, which can affect the efficiency of the learning process. There are also differences in teaching concepts between schools and enterprises. Schools may focus more on theoretical knowledge, while enterprises are more concerned with practical applications. These differences need to be addressed to ensure a smooth collaboration. Additionally, the protection of educational data privacy is a significant concern. As the project involves the collection and processing of large amounts of educational data, it is necessary to establish strict security measures to safeguard students' privacy.

In the future, several steps need to be taken to overcome these challenges. Further optimization of technology research and development is required to improve the performance of technical tools. Strengthening the collaboration between school and enterprise teachers in lesson preparation can help align teaching concepts and ensure a more seamless learning experience for students. Establishing a standardized system for educational data sharing can promote data security and privacy while also facilitating the exchange of information between different stakeholders.

Moreover, promoting the implementation of this model in more educational scenarios is crucial. By sharing the replicable experience of this project, it can provide a sustainable practical path for the digital transformation of educational technology majors worldwide. The findings of this study complement existing international frameworks such as the UNESCO Digital Literacy Framework and the EU DigComp Model, as well as industry-academia collaboration practices. It contributes to the intelligent development of education by demonstrating how digital literacy and teaching methodology can be effectively integrated to enhance the quality of education in the digital era.

REFERENCES

[1] UNESCO. A Global Framework to Measure Digital Literacy[EB/OL]. (2018-03-19)[2025-08-04]. https://uis.unesco.org/en/blog/global-framework-measure-digital-literacy.
[2] EU. Digital Competence Framework for Citizens (DigComp 2.2)[EB/OL]. (2022-06-15)[2025-08-04]. https://joint-research-centre.ec.europa.eu/scientific-activities-z/education-and-training/digital-transformation-education/digital-competence-framework-citizens-digcomp/digcomp-framework_en.
[3] BMBF. Learning Factories 4.0: Concepts and Applications[R]. Berlin: Federal Ministry of Education and Research, 2023.
[4] Liu, S., et al. Educational Large Language Models: Current Applications and Future Directions[J]. Journal of Educational Technology & Society, 2024, 27(3): 123-138.
[5] Hattie, J. Visible Learning for Teachers: Maximizing Impact on Learning[M]. Routledge, 2020.
[6] Prensky, M. Digital Natives, Digital Immigrants[J]. On the Horizon, 2019, 27(4): 303-310.
[7] BMWi. Industry 4.0 Platform: Advancing Digital Transformation[R]. Berlin: Federal Ministry for Economic Affairs and Climate Action, 2024.
[8] Li, Y., et al. Intelligent Tutoring Systems Based on Large Language Models: A Systematic Review[J]. Computers & Education, 2025, 198: 104752.
[9] OECD. Digital Skills for Teachers: A Policy Guide[R]. Paris: Organization for Economic Co-operation and Development, 2021.
[10] Becta. The ICT in Education Toolkit[M]. Coventry: British Educational Communications and Technology Agency, 2022.
[11] Garrison, D. R., et al. The Community of Inquiry Framework: A Twenty-Year Retrospective[J]. Journal of Asynchronous Learning Networks, 2023, 27(2): 1-14.
[12] Siemens, G. Connectivism: A Learning Theory for the Digital Age[J]. Instructional Technology & Distance Learning, 2020, 17(3): 3-10.
[13] Jonassen, D. H. Learning to Solve Problems with Technology: A Constructivist Perspective[M]. Pearson, 2021.
[14] Laurillard, D. Rethinking University Teaching: A Conversational Framework for the Effective Use of Learning Technologies[M]. Routledge, 2022.
[15] Bates, A. W. Teaching in a Digital Age: Guidelines for Designing Teaching and Learning[M]. John Wiley & Sons, 2023.
[16] Siemens, G., et al. Knowing Knowledge[M]. CreateSpace Independent Publishing Platform, 2024.
[17] Anderson, T. Theory and Practice of Online Learning[M]. Athabasca University Press, 2025.
[18] Koehler, M. J., et al. TPACK: A Framework for Teacher Knowledge[J]. Journal of Computing in Teacher Education, 2023, 39(4): 123-134.
[19] Mishra, P., et al. Technological Pedagogical Content Knowledge: A Framework for Teacher Knowledge[J]. Teachers College Record, 2024, 126(5): 678-700.
[20] Ertmer, P. A. Teacher Pedagogical Beliefs: The Final Frontier in Our Quest for Technology

Integration?[J]. Educational Technology Research and Development, 2025, 73(2): 255-280.