Research on the Composition and Cultivation of College Teachers' Literacy in the Digital-Intelligent Era

Lejia Kong

Editorial Department of Journal, Shandong University of Technology and Business, Yantai 264005, Shandong, China

Abstract: This paper aims to explore the new connotation, constituent elements, and systematic cultivation paths of college teachers' literacy in the digital-intelligent era. Firstly, it analyzes the macro background of education reform driven by technologies such as artificial intelligence and big data, and then sorts out the focus and gaps of current research through literature review. Based on theories such as the Iceberg Model, this paper constructs a teacher's digital-intelligent competence model covering implicit literacy and explicit abilities. Corresponding to this model, the paper proposes collaborative cultivation strategies from multiple dimensions including internal drive stimulation, external drive support, role transformation, and systematic construction. Finally, the future research directions and practical deepening are prospected, aiming to provide a reference for the construction of college teachers' teams and the high-quality development of education.

Keywords: Digital-intelligence; College teachers; Literacy composition; Teacher development; Cultivation path

1. Research background

Currently, we are in a digital-intelligent era defined by the rapid development of modern information technologies such as big data, cloud computing, and artificial intelligence. This wave has not only reshaped the operation mode of the social economy but also profoundly penetrated the field of education, bringing unprecedented opportunities and systematic challenges to higher education. Against this macro background, college teachers, as the direct leaders and key implementers of educational and teaching activities, their literacy level directly determines the depth and effectiveness of the integration of digital-intelligent technologies and educational practices. Teachers are the "key soft power" to promote the implementation of the educational digitalization strategy, and their teaching concepts, role positioning, and ability structure must keep pace with the times to achieve transformation and upgrading. However, the reality shows that the teachers' team is facing many difficulties in adapting to this historic change. On the one hand, the speed of technological iteration far exceeds the individual learning and updating cycle of teachers, leading to technical application barriers and a

"digital divide" among some teachers, especially older ones; on the other hand, the traditional assessment and evaluation mechanism insufficiently incentivizes digital teaching innovation, and the systematic and precise training system and resource sharing platform are not yet perfect, resulting in an obvious lack of external drive for teachers to improve their digital-intelligent literacy. In addition, how to balance technological application and humanistic care, prevent the risk of "technological dependence," and safeguard the main value and ethical bottom line of education is also a new topic that needs to be explored urgently.

Early research mostly regarded teachers' digital-intelligent literacy as the ability to use digital tools. With the deepening of understanding, scholars emphasize that its essence is the driving force for the reform of educational paradigms. Xu et al. [1] pointed out that teachers' digital-intelligent literacy is a key ability for teachers to adapt to and lead the development of the intelligent education ecosystem from the perspective of "human-machine collaboration," and its core lies in using digital-intelligent technologies to optimize, innovate, and even transform educational and teaching activities. Liu [2] further proposed that information literacy is an "adaptive ability" of people in the information society, which is holistic, developmental, hierarchical, and practical, and its connotation constantly evolves with technological iteration. This indicates that digital-intelligent literacy requires teachers to shift from passively adapting to technology to actively using technology to reconstruct the teaching and learning process. Although improving digital-intelligent literacy is imperative, college teachers still face multiple challenges in this process. An empirical study by Fan and Zhang [3] revealed that teachers lack high-level abilities to integrate digital-intelligent technologies in practical teaching. Scholars have proposed improvement paths from different perspectives. Li [4] put forward an integrated path of "training-practice-research-evaluation," where "training" emphasizes updating concepts and training basic skills. Xu et al. [5] suggested using big data to create "digital portraits" of teachers' abilities to achieve precise diagnosis and development planning.

However, existing research still has some deficiencies, lacking systematic research on the new connotation, scientific composition, and effective cultivation methods of college teachers' literacy in the digital-intelligent background. This is not only a positive response to the national strategy but also an urgent need to break through the current bottlenecks in teacher development and empower the high-quality development of higher education. This study aims to provide a forward-looking and operable reference framework for the construction of college teacher teams through theoretical construction and path exploration.

2. Composition of college teachers' literacy: Construction of the digital-intelligent competence model

This paper clearly defines the core literacy that college teachers should possess in the digital-intelligent background as "digital-intelligent competence." It refers to a comprehensive and developmental ability of teachers in the digital-intelligent educational environment to actively integrate digital tools such as artificial intelligence into ideological and political teaching and professional teaching based on big data, deep learning and other technologies and algorithm logic, efficiently acquire, process, manage, and evaluate digital information and resources to promote educational innovation and progress; at the same time, driven by a high sense of responsibility, ethical awareness, and innovative spirit, improve students' digital-intelligent literacy and comprehensive abilities through teaching practice and implement the fundamental task of fostering virtue through education. To clearly analyze this complex ability structure, referring to the Iceberg Model in existing literature [6], teachers' digital-intelligent competence is divided into two parts: "explicit layer" and "implicit layer," which are interdependent and mutually promoting.

2.1. Explicit layer: Digital-intelligent application literacy

The explicit layer is the part above the water surface of the iceberg, representing the knowledge, skills, and behavioral performance of teachers that can be directly observed, evaluated, and measured, collectively referred to as "digital-intelligent application literacy." It directly acts on teaching practice and is a key indicator to measure the effectiveness of teachers' digital-intelligent teaching. It mainly includes the following four core ability dimensions:

(1) Technology operation and integration innovation ability: Refers to the hard skills of teachers to proficiently operate various intelligent teaching software, platforms, and equipment (such as smart classroom systems, virtual simulation experiment platforms). More importantly, they can creatively select and integrate technical tools according to specific teaching goals and subject content to achieve the in-depth integration of technology, pedagogy, and subject content (i.e., TPACK framework), rather than simple superposition.

(2) Data-driven teaching decision-making and evaluation ability: In the digital-intelligent teaching environment, the teaching process will generate massive data. Teachers need to have a keen sense of data, be able to collect, process, and analyze students' learning behavior data, process evaluation data, etc., and based on this, conduct accurate diagnosis of learning situation, personalized learning path recommendation, dynamic adjustment of teaching strategies, and accurate evaluation of learning effects, realizing the transformation of teaching paradigm from experience-driven to data-driven.

(3) Intelligent teaching design and implementation ability: Refers to the ability of teachers to systematically design and effectively implement new teaching models such as blended teaching, flipped classroom, project-based learning, and immersive teaching based on virtual reality/augmented reality (VR/AR) using digital-intelligent thinking. This requires teachers to be not only users of technology but also architects of intelligent learning scenarios.

(4) Digital educational resource development and management ability: Teachers can use technologies such as AIGC to assist in developing or deeply processing digital teaching resources suitable for the characteristics of their own subjects, such as intelligent question banks, interactive courseware, micro-course videos, and digital textbooks, and can effectively classify, integrate, share, and iteratively manage resources.

2.2. Implicit layer: Digital-intelligent development literacy

The implicit layer is the part below the water surface of the iceberg. Although it is not easy to directly observe, it is fundamental to support explicit abilities and determine their development ceiling, called "digital-intelligent development literacy." It covers teachers' deep psychological traits, values, and role cognition.

(1) Digital-intelligent awareness and value ethics: This is the source of internal drive. Firstly, teachers need to have a deep recognition of the strategic significance of educational digital transformation, and have a strong willingness and firm will to actively embrace technology and continue learning. Secondly, they must establish a correct view of digital ethics and social responsibility, abide by norms such as information security, privacy protection, and intellectual property rights in teaching and scientific research, and guide students to view technology critically and prevent the risk of technology abuse.

(2) Innovative spirit and critical thinking: The digital-intelligent era requires teachers to be dissatisfied with the status quo and bravely explore new possibilities and boundaries of teaching. At the same time, facing a variety of technical tools and information, they need to maintain rational critical thinking, be

able to identify the applicability and limitations of technology, avoid falling into the misunderstanding of "technology omnipotence" or "digital dependence," and ensure that technology always serves the all-round development of people.

(3) Adaptability and personality leadership: Including an open mind when facing rapid changes, perseverance when dealing with challenges, and self-discipline for lifelong learning. In addition, in the human-machine collaborative teaching environment, teachers' personality charm, emotional care ability, and value leading role have become increasingly important, which is the "educational temperature" and leadership that machines cannot replace.

(4) Dynamic role cognition and transformation ability: Teachers need to clearly recognize that their roles must transform from traditional knowledge authorities and single lecturers to multiple roles: collaborators and guides for students' personalized learning, promoters of teaching reform and innovation, and practitioners of lifelong learning for their own professional continuous development. This change in role cognition is an internal prerequisite for driving behavioral changes.

The model reveals that the improvement of college teachers' digital-intelligent competence must not only stay at the "instrumental rationality" level of technical training but also go deep into the "value rationality" level of values shaping, thinking mode innovation, and role identity reconstruction, realizing the synchronous cultivation and collaborative development of explicit skills and implicit literacy.

3. Systematic paths for cultivating college teachers' literacy

Based on the above digital-intelligent competence model, improving college teachers' literacy is a systematic project that requires the collaboration of individuals, organizations, and society at multiple levels. It is necessary to build a three-dimensional cultivation system that stimulates internal drive, strengthens external drive, empowers role transformation, and forms a closed loop.

3.1. Stimulating internal drive: Laying the foundation for literacy improvement

Internal drive is the fundamental engine for teachers' continuous development. Colleges and universities need to take multiple measures to ignite the internal flame of teachers' self-renewal.

Firstly, deepen the cognitive understanding of the digital-intelligent education strategy and strengthen awareness. Through organizing thematic learning, policy interpretation, holding cutting-edge lectures, and displaying excellent digital-intelligent teaching cases, let teachers deeply understand the inevitability of educational digital transformation and its core value in improving teaching quality and talent training quality, changing from "being asked to learn" to "wanting to learn."

Secondly, create a cultural atmosphere encouraging innovation and stimulating initiative. Establish a teaching innovation fund to encourage teachers to boldly try projects such as AI-assisted teaching design and virtual simulation experiments; commend and publicize teachers who have made outstanding achievements in digital-intelligent teaching reform, set examples, and form an exploration atmosphere of "daring to be the first and tolerating failure."

Thirdly, establish learning communities and cultivate sustainability and reflective ability. Promote the formation of interdisciplinary and inter-departmental teachers' teaching and research communities, and regularly carry out activities such as teaching salons, observation and discussion, and experience sharing. Encourage teachers to conduct teaching reflection, and use methods such as teaching logs and action research to transform puzzles and gains in practice into materials for deepening cognition, forming a virtuous cycle of "practice-

reflection-improvement."

Finally, build a platform for displaying achievements and enhancing self-efficacy. Through holding teaching innovation competitions, digital teaching case evaluations, open classes, and other activities, let teachers' efforts and achievements be seen and recognized. Successful experiences can significantly enhance teachers' confidence and belief in using digital-intelligent technologies for teaching innovation, forming positive incentives.

3.2. Strengthening external support: Optimizing the cultivation ecosystem

Firstly, reform the evaluation and incentive mechanism and strengthen institutional guidance. It is necessary to scientifically and reasonably incorporate teachers' digital-intelligent teaching ability, resource construction contributions, and teaching innovation achievements into the evaluation system, such as performance appraisal, professional title evaluation, and selection of excellent teachers. Break the single evaluation of "only papers and projects," establish a multi-dimensional evaluation mechanism that emphasizes teaching, scientific research, social services, and digital-intelligent contributions, and affirm and incentivize teachers' investment in digital-intelligent teaching from the system.

Secondly, construct a hierarchical, classified, and precise training system. Training should not be "one-size-fits-all." Differentiated training content and forms should be designed according to teachers' different development stages (such as new recruits, growth period, backbone period, expert period) and different subject backgrounds. In terms of content, it should cover the complete chain from technical tool operation (TK), to subject-integrated pedagogy (TPACK) and then to digital ethics and leadership training. In terms of form, in addition to traditional lectures, workshops, practical training camps, famous teacher workshops, online adaptive learning courses, etc., they should be vigorously promoted to improve participation and effectiveness.

Thirdly, build an intelligent and integrated teacher development service platform. Integrate hardware and software resources to create a comprehensive online platform integrating "intelligent teaching environment support (such as smart classrooms, virtual laboratories), digital teaching resource library, teaching data analysis tools, online teaching and research communities, and expert consultation and guidance." The platform should be able to realize functions such as intelligent resource recommendation, accompanying collection and analysis of teaching data, and digital file recording of teachers' growth, providing full-process and personalized support services for teachers.

Fourthly, promote the co-construction and sharing of high-quality resources and bridge the digital divide. Encourage teachers in the university, and even joint brother universities and industry enterprises, to jointly develop and share high-quality digital teaching resources and case libraries. By establishing a UGC (User-Generated Content) resource co-creation and sharing mechanism and inter-university alliances, break resource barriers, enabling more teachers, especially those in regions with relatively scarce resources, to easily obtain high-quality digital-intelligent teaching materials and promote educational equity.

3.3. Empowering practical transformation: Promoting the innovation of teaching paradigms

The ultimate purpose of cultivation is application and innovation. It is necessary to create conditions for teachers to transform literacy into actual teaching productivity.

Firstly, implement the integrated development path of "training-practice-research-evaluation." Closely link the four links of training and learning, teaching practice innovation, teaching and research community activities, and multi-dimensional evaluation to form a closed loop. For example, after participating in the training of "AI-

assisted curriculum design," teachers immediately carry out practical projects in the courses they teach, then report and discuss in the teaching and research community, and finally, their practical process and achievements are subject to evidence-based, comprehensive evaluation. The evaluation results are fed back to optimize subsequent training and personal development plans.

Secondly, encourage data-driven teaching and academic research. Support teachers to take digital-intelligent teaching practice as the research object, use learning analysis technology to explore students' learning laws and effective teaching strategies in the technical environment, and elevate teaching experience into communicable and verifiable teaching academic achievements. Schools can set up a special project of "digital-intelligent empowerment education" in teaching reform projects to guide in-depth research.

Thirdly, deepen the intelligent transformation of curriculum and teaching models. Taking the construction of "golden courses" as the starting point, take the construction of knowledge graphs, intelligent question banks, application of AI teaching assistants, and development of virtual simulation experiments as important indicators of curriculum construction. Encourage teachers to carry out reforms such as blended teaching and flipped classroom, and reasonably calculate their teaching workload to relieve teachers' worries about trying innovation.

Finally, establish a human-machine collaborative multidimensional evaluation system. Reform summative evaluation and strengthen the assessment of students' learning processes. Use AI technology to assist in homework correction, learning behavior analysis, and formative evaluation feedback to improve evaluation efficiency and coverage. At the same time, combine multi-subject evaluations such as peer review, expert review, and student evaluation to comprehensively and objectively assess teachers' digital-intelligent teaching ability and effects, and use this as an important basis for teachers' professional development certification and honor incentives.

4. Conclusion and prospects

Based on literature review, this study constructs a composition model of college teachers' literacy in the digital-intelligent background and proposes a systematic cultivation method of internal and external collaboration and multidimensional drive. The conclusion shows that the improvement of teachers' literacy must adhere to "technology as a tool and education as the foundation," focusing not only on the training of explicit skills but also on the cultivation of implicit values and personality traits; it is necessary to stimulate teachers' internal drive for independent development and provide strong institutional, resource, and service support from schools. Looking forward to the future, the research and practice of college teachers' literacy cultivation can reflect on and construct human-machine collaborative educational ethics norms to ensure that technological application always serves the fundamental goal of fostering virtue through education. Through continuous exploration and improvement, the digital-intelligent transformation of the teacher team can be effectively promoted.

Funding

Disclosure statement

The author declares no conflict of interest.

References

[1] Xu Y, Peng X, Cao Y, et al., 2020, Connotation, Function and Development of Teachers' Digital-Intelligent Literacy from the Perspective of Human-Machine Collaboration. Journal of Distance Education, 38(06): 13–21.

[2] Liu W, 2023, Construction of the Formation Mechanism of College Teachers' Information Literacy in the Digital-Intelligent Background. China Modern Educational Equipment, (9): 13–15.

[3] Fan J, 2023, An Empirical Study on Primary and Secondary School Teachers' Digital-Intelligent Competence: Model Construction and Application, dissertation, Nanjing Normal University.

[4] Li R, 2025, Research on the Teaching Development Path of College Teachers in the Artificial Intelligence Era. Modern Business Trade Industry, (19): 125–127.

[5] Xu Z, Yang M, Zhang X, 2025, Generative Logic and Implementation Countermeasures of Digital-Intelligent Empowerment for the Improvement of College Teaching Quality. Higher Education Forum, (7): 35–40.

[6] Li L, Zhu Y, Cheng M, et al., 2025, Research on the Improvement of Digital-Intelligent Competence of College Ideological and Political Theory Teachers Based on the Iceberg Model. Journal of Zhaotong University, 47(2): 64–70.