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Artificial Intelligence-Enhanced Digital Educational Resources in Chinese Higher Education: From Resource Availability to Quality Governance

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Abstract: Digital educational resources have become a central component of Chinese higher education, but the policy and institutional focus is shifting from resource availability to quality, adaptability, and governance. This review article examines how artificial intelligence can support the development, organization, recommendation, classroom use and evaluation of digital educational resources in Chinese higher education. Drawing on policy documents, international guidance and studies on digital competence, learning analytics and artificial intelligence in education, the article uses a resource life-cycle perspective to analyze opportunities and risks. It argues that artificial intelligence can improve resource matching, formative feedback and inclusive access, but these benefits depend on human review, pedagogical alignment, transparent platform governance, data protection and student artificial intelligence literacy. The article proposes a quality governance framework covering resource standards, teacher professional support, student competence development, platform accountability and iterative evidence-based evaluation. The study provides a practical reference for universities seeking to transform digital resource systems from repositories of content into learning-centered, responsible and continuously improved educational infrastructures.

Keywords: Smart education; Learning analytics; Resource governance; Student digital competence; Teacher professional development; Platform accountability; Evidence-based evaluation

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1. Introduction

Digital educational resources have become a routine but strategically important part of higher education. In earlier stages of educational digitalization, universities mainly focused on network access, digital libraries, online course platforms, and the digitization of teaching materials. These efforts made learning content easier

to store, distribute and reuse. They also allowed teachers and students to extend learning beyond the physical classroom.

This access-oriented understanding is no longer sufficient. On a smart education platform, a learning resource may be a recorded lecture, but it may also be an interactive simulation, an adaptive quiz, a virtual laboratory, a knowledge graph, an analytics dashboard, a multimodal learning object or an artificial intelligence-supported tutor. The resource is therefore not only a piece of content. It is increasingly part of a learning service that links content, learner data, feedback, teacher intervention and institutional management.

China has developed a broad policy and platform foundation for educational digitalization. The national smart education public service platform was launched to integrate public services and resources across basic education, vocational education, higher education and employment services for college graduates [1]. More recently, the 2024–2035 master plan for building China into a leading country in education has placed high-quality education and educational modernization at the center of national development [2]. Official information on Smart Education of China also shows that the platform continues to gather large-scale digital educational resources and is increasingly connected with artificial intelligence-supported educational innovation [3].

Against this background, the key question is changing. Universities no longer need to ask only whether digital resources are available. They need to ask whether resources are accurate, pedagogically meaningful, inclusive, adaptable, well organized and responsibly governed. The rapid development of artificial intelligence makes this question more urgent. Generative artificial intelligence, intelligent recommendation, automatic tagging, learning analytics and natural language processing can help teachers and students use resources in more flexible ways. At the same time, these technologies can generate inaccurate content, reinforce bias, hide algorithmic decisions and create new risks for data protection and academic integrity [4,5].

International guidance stresses that artificial intelligence in education should be human-centered, transparent, inclusive and supportive of teachers rather than a replacement for them [6–8]. These principles are directly relevant to digital educational resources. If artificial intelligence is treated only as a production tool, universities may increase the amount of content without improving learning. If it is embedded in resource governance, however, it may help institutions connect resource design with learning objectives, student needs, teacher judgment, and continuous evaluation.

This article develops a review-based and conceptual analysis of artificial intelligence-enhanced digital educational resources in Chinese higher education. It does not report new experimental data or survey results. Instead, it synthesizes policy documents, international guidance, and academic literature to examine how artificial intelligence changes the resource life cycle and how universities can move from resource availability to quality governance.

2. Review approach and analytical framework

2.1. Review scope

This article adopts an integrative review approach. The purpose is not to conduct a statistical meta-analysis, but to connect different types of evidence and concepts around a practical problem: digital resources are expanding rapidly, while their educational usefulness, ethical reliability and long-term governance remain uneven.

The reviewed sources include three groups. The first group consists of policy documents and public reports related to educational digitalization, smart education, and artificial intelligence in education. The second group includes international guidance on artificial intelligence, digital competence, and teacher digital competence. The third group includes academic studies on learning analytics, artificial intelligence in higher education, digital learning and resource governance. This combination is appropriate because the topic concerns technology, pedagogy, institutional management and learner development rather than a single measurable variable. Recent reviews of artificial intelligence in higher education also show that evidence is growing rapidly but remains uneven across functions, disciplines and user groups [9].

2.2. Analytical lens: The resource life cycle

The article uses the resource life cycle as its analytical lens. Digital educational resources are examined through six connected stages: production, selection, organization, delivery, use and evaluation. Artificial intelligence may intervene in each stage. It may help teachers draft materials, assist departments in reviewing resource quality, classify resources through semantic tagging, recommend learning paths to students, provide feedback during resource use, and analyze evidence for resource improvement.

The life-cycle lens is useful because it prevents a narrow focus on tools. A chatbot, recommendation engine, or analytics dashboard cannot be evaluated only by its technical function. Its educational value depends on how it is designed, reviewed, interpreted and improved within a course or institution. Therefore, this article adopts a human-centered governance perspective: technology should support teacher agency, student development, educational equity and institutional responsibility.

2.3. Digital competence and educational quality

Digital competence frameworks also inform the analysis. DigComp 2.2 emphasizes information and data literacy, communication, digital content creation, safety and problem solving [10]. DigCompEdu highlights teachers' professional engagement, digital resources, teaching and learning, assessment, learner empowerment and support for learners' digital competence [11]. These frameworks suggest that digital resources should not be evaluated only by quantity, interface design or technical sophistication. They should be evaluated by whether they help learners search, judge, use, create and communicate responsibly in digital environments.

For artificial intelligence-enhanced resources, this competence perspective becomes more important. Students need to know how to question generated explanations, compare sources, protect personal information, and disclose artificial intelligence assistance when required. Teachers need to know how to verify generated content, redesign learning activities, and interpret platform data without reducing students to behavioral indicators. Recent competency frameworks further reinforce the need to treat teachers and students as active and responsible agents in artificial intelligence-mediated learning [12,13].

3. From resource availability to resource usefulness

Chinese higher education has made visible progress in resource availability. Universities have built digital libraries, course management systems, online learning spaces, virtual simulation platforms and campus information systems. National and institutional platforms allow students to access courses, lectures, learning materials and public services more easily than before. However, availability does not automatically produce

effective learning.

A student may have access to hundreds of videos but still lack a clear learning path. A teacher may upload many documents but receive little evidence about whether students understand them. A platform may record clicks and viewing time, but these data do not directly explain learning quality. In many courses, the central difficulty is not the absence of digital materials, but the weak connection among resource content, learner needs, teaching design and assessment.

For example, a video resource may be professionally produced but too long for pre-class learning. A quiz bank may cover many knowledge points but fail to diagnose the reason for a student's mistake. A discussion platform may increase participation records without improving the quality of collaboration. These problems show that digital resources should be evaluated in relation to actual learning activities rather than counted as platform assets.

As shown in **Table 1**, the shift from a quantity-oriented to a quality-oriented approach redefines the roles of resources, students, teachers, platform data, and quality standards.

Table 1. Two views of digital educational resources in higher education

Dimension	Quantity-oriented view	Quality-oriented view
Main concern	How many resources are available	Whether resources solve real learning and teaching problems
Resource design	Upload existing materials to a platform	Redesign materials according to learning objectives and learner needs
Student role	Receiver of online content	Active user, evaluator and co-creator of learning resources
Teacher role	Provider of digital materials	Designer, curator and interpreter of resource-supported learning
Platform data	Clicks, downloads and viewing time	Evidence for diagnosis, feedback, improvement and governance
Quality standard	Completeness and technical accessibility	Accuracy, relevance, usability, inclusiveness and learning impact

A quality-oriented view does not reject large-scale resource construction. Instead, it asks universities to connect scale with educational purpose. The value of a digital resource lies in whether it helps students understand concepts, solve problems, develop competence and participate responsibly in learning communities.

4. How artificial intelligence changes the digital resource life cycle

4.1. Resource production and verification

Artificial intelligence can support the production and updating of digital educational resources. Generative tools can help teachers draft explanations, create examples, design formative questions, produce bilingual materials, and adjust the difficulty of learning tasks. These functions may reduce repetitive preparation work and allow teachers to spend more time on learning design and student guidance.

However, generated resources must not be treated as automatically reliable. Artificial intelligence systems may produce inaccurate statements, fabricated references, biased examples, or content that does not fit course objectives. Therefore, teacher verification is not an optional step. It is the condition under which artificial intelligence-assisted production becomes educationally meaningful.

4.2. Resource selection and quality review

As resource supply increases, universities need clear mechanisms for selection and review. Artificial intelligence can help identify duplicated resources, outdated information, missing metadata, readability problems, and possible copyright risks. It can also assist departments in comparing resource versions and checking whether learning materials match stated outcomes.

Still, quality review must include disciplinary judgment. A resource may be grammatically fluent but conceptually weak. It may be visually attractive but pedagogically shallow. Review criteria should therefore include accuracy, relevance, learning objective alignment, accessibility, copyright compliance, cultural sensitivity and evidence of learning usefulness.

4.3. Resource organization and recommendation

A large resource platform often contains similar materials from different courses, disciplines or institutions. Without effective organization, students and teachers may find it hard to locate appropriate resources. Artificial intelligence-based tagging, semantic search and knowledge graphs can connect resources with concepts, prerequisite knowledge, difficulty levels, learning outcomes and assessment tasks.

Recommendation systems can then suggest videos, readings, exercises or peer examples according to learning history and current performance. Learning analytics has shown how educational data may support feedback and decision-making [14]. In resource recommendation, however, the key issue is not simply predictive accuracy. A recommendation should be explainable and pedagogically appropriate. Students should know why a resource is recommended, and teachers should be able to adjust or override platform suggestions.

4.4. Resource use in teaching and learning

Artificial intelligence-enhanced resources can be integrated into pre-class preparation, in-class discussion, after-class practice and project-based learning. For example, a teacher may ask students to compare an artificial intelligence-generated summary with original readings, identify missing arguments and revise the summary collaboratively. In this case, artificial intelligence is not only a content generator. It becomes a learning object that helps students practice evaluation and judgment.

This use-oriented perspective is important because the same resource may have different effects in different pedagogical designs. A chatbot used only to give answers may encourage dependence. The same chatbot used to ask follow-up questions, request evidence, and support reflection may promote deeper learning. Therefore, resource usefulness depends on the relationship among technology, task design, teacher guidance, and student agency.

4.5. Evaluation and continuous improvement

Artificial intelligence can help analyze which resources are frequently used, where students pause, which questions lead to repeated mistakes, and which materials are associated with better learning outcomes. These signals can support formative improvement. Teachers may shorten a video, revise an explanation, add a diagnostic activity, or provide additional examples when platform evidence shows persistent difficulty.

Yet data require interpretation. A resource with many clicks may be popular because it is useful, but it may also be repeatedly accessed because students are confused. Low resource use does not necessarily mean low motivation; students may have used alternative resources or faced technical barriers. Therefore, platform

data should be combined with assignment analysis, classroom observation, teacher reflection, and student feedback.

As summarized in **Table 2**, each artificial intelligence-supported function offers educational value only when it is paired with an explicit form of human review or control.

Table 2. Artificial intelligence functions and necessary human controls

Artificial intelligence-supported function	Possible educational value	Necessary human control
Drafting explanations and examples	Reduces repetitive preparation and provides alternative expressions	Teacher checks accuracy, level and alignment with course objectives
Automatic tagging and semantic search	Improves resource retrieval and cross-course connection	Department verifies labels, difficulty and prerequisite relations
Personalized recommendation	Matches resources with learner needs and progress	Teacher and student can understand and adjust recommendations
Learning analytics feedback	Identifies participation patterns and possible learning difficulties	Data are interpreted with assignments, observation, and student context
Accessibility adaptation	Provides subtitles, translations, summaries or multimodal versions	Generated outputs are reviewed for accuracy, fairness and usability

5. Challenges in artificial intelligence-enhanced resource development

5.1. Uneven resource quality and weak educational alignment

The first challenge is uneven resource quality. Research on artificial intelligence applications in higher education has noted that many studies emphasize technical systems while paying insufficient attention to the role of educators [15]. This warning is relevant to digital resource construction. If artificial intelligence tools are introduced mainly to increase production speed, universities may accumulate more materials without improving educational alignment.

Educational alignment means that objectives, content, activities, assessment, and feedback support one another. A resource that is accurate in isolation may still be unsuitable if it does not match the course level or assessment task. Therefore, universities need quality standards that are stronger than format checking.

5.2. Teacher readiness and workload redistribution

The second challenge concerns teachers. Artificial intelligence may reduce some repetitive work, but it also creates new tasks: checking generated content, designing artificial intelligence-supported activities, explaining data feedback, protecting students' information and updating academic integrity rules. Without professional support, teachers may either avoid the technology or use it superficially.

Teacher readiness should not be understood only as tool operation. It includes pedagogical design, data interpretation, ethical awareness, and the ability to guide students' responsible use. Professional development should therefore focus on course redesign and resource governance rather than one-time software training.

5.3. Student artificial intelligence literacy and learning autonomy

The third challenge is student artificial intelligence literacy. Intelligent resources may create a comfortable illusion that learning has become easier. Students can receive summaries, examples, and answers quickly, but quick access does not guarantee understanding. Without critical judgment, students may accept inaccurate explanations, rely on generated texts, or lose the habit of sustained reading.

Artificial intelligence literacy should include prompting, verification, citation, privacy protection, awareness of bias, and responsible disclosure. It should also include self-regulated learning. Students need to set goals, select resources according to their needs, monitor their progress and reflect on outcomes. Platform dashboards and artificial intelligence assistants can support this process, but they should not replace students' own planning and judgment.

5.4. Data protection, algorithmic bias, and academic integrity

The fourth challenge is governance risk. Learning analytics and recommendation systems depend on data. Ethical principles for learning analytics emphasize transparency, privacy, student agency, and responsible institutional use [16,17]. In resource platforms, these principles require clear rules about what data are collected, why they are collected, who can access them, how long they are stored, and how students can question decisions based on data.

Algorithmic bias is another risk. If recommendation systems are trained on incomplete or biased data, they may narrow students' learning opportunities, reinforce existing inequalities, or recommend easier materials to students who actually need challenging support. Academic integrity also becomes more complex when students use artificial intelligence to generate text, solve problems or summarize readings. Universities should respond with guidance and assessment redesign rather than only prohibition.

5.5. Over-reliance on automated systems

A final challenge is over-reliance on automation. Artificial intelligence may appear efficient, but educational decisions often require context, care and professional judgment. If teachers and students accept platform suggestions without questioning them, digital resource systems may become technically advanced but pedagogically thin. Critical scholars have warned against assuming that artificial intelligence will automatically improve education [18]. This warning should be taken seriously in resource governance.

The goal is not to slow down innovation. The goal is to ensure that innovation remains connected to learning. Artificial intelligence should make human educational work more informed and responsive, not less visible.

6. Practical strategies for quality governance

6.1. Establishing resource quality standards

Universities should establish clear quality standards for digital educational resources. These standards should cover accuracy, relevance, learning objective alignment, accessibility, copyright compliance, data safety, update frequency and evidence of learning usefulness. For artificial intelligence-generated or artificial intelligence-assisted resources, an additional review step should be required. Teachers and departments should not be asked to accept generated output automatically.

Quality standards should also distinguish different resource types. A virtual laboratory should be evaluated by simulation validity and feedback quality. A reading guide should be evaluated by conceptual clarity and source reliability. A recommendation system should be evaluated by explainability, fairness, and pedagogical relevance.

6.2. Supporting teachers as resource designers and reviewers

Professional development should help teachers move from platform use to resource design. Useful training may include how to write prompts for teaching materials, how to verify generated explanations, how to use platform data for formative feedback, how to design artificial intelligence-supported discussion tasks, and how to guide students' responsible use of artificial intelligence.

Universities can also create teacher communities for resource co-construction. Teachers who teach related courses can jointly develop resource banks, review generated materials, share classroom cases, and discuss problems in student use. Such collaboration may improve quality and reduce duplicated work.

6.3. Building student artificial intelligence literacy

Student artificial intelligence literacy should be treated as part of digital learning competence. Students need to learn how to ask better questions, compare sources, cite properly, identify hallucinated information, protect privacy, and use artificial intelligence as a thinking partner rather than a shortcut.

These skills can be integrated into general education courses, first-year learning guidance, library training, and discipline-specific assignments. For example, students may be asked to compare generated explanations with academic sources, identify errors and explain how they revised their understanding. Such tasks connect artificial intelligence use with critical reading and disciplinary learning.

6.4. Improving transparent platform governance

Universities should establish clear governance structures for artificial intelligence-enhanced resource platforms. Responsibilities should be distributed among teaching affairs departments, information technology offices, academic departments, ethics committees, teachers and students. Governance documents should specify data collection boundaries, data use purposes, access rights, retention periods, security measures and procedures for responding to errors or complaints.

Transparency is essential. Students and teachers should be informed when artificial intelligence is used for recommendation, assessment support or learning analytics. They should also have channels to report inaccurate labels, unsuitable recommendations or problematic resources. A human-in-the-loop mechanism is especially important when data-driven feedback may influence grading, warning or intervention.

6.5. Using iterative and evidence-based evaluation

The effectiveness of digital educational resources should be evaluated through multiple sources of evidence. Platform data can show patterns of use, but it should be combined with classroom observation, teacher reflection, student interviews, surveys and learning outcome analysis. Universities should avoid equating more clicks with better learning.

An iterative evaluation model can follow four steps: diagnose resource needs, design or select resources, implement them in courses, and revise them based on evidence. Artificial intelligence can support this cycle by detecting patterns, but educational interpretation remains essential. Research on learning analytics has similarly emphasized that data should be connected to learning theory and educational intervention rather than treated as an end in itself [19].

Broader reviews of educational data mining and learning analytics likewise show that analytical techniques are most useful when they are connected to learner support and evidence-based intervention [20,21].

As shown in **Table 3**, quality governance requires coordinated action across resource standards, teacher

support, student competence, platform governance and iterative evaluation.

Table 3. Strategy framework for artificial intelligence-enhanced digital resource governance

Strategy area	Key action	Expected effect
Resource standards	Set criteria for accuracy, relevance, accessibility, copyright, data safety and update frequency	Prevents resource expansion from becoming low-quality accumulation
Teacher support	Provide training on resource design, generated-content review and data interpretation	Improves meaningful use rather than formal platform use
Student competence	Teach verification, citation, privacy protection and responsible use	Strengthens independent judgment and learning autonomy
Platform governance	Clarify data use, recommendation logic, review procedures and complaint channels	Builds trust and reduces ethical risk
Iterative evaluation	Combine platform data with classroom evidence and learner feedback	Connects resources with actual learning improvement

7. Discussion

The analysis suggests that the next stage of digital resource development in Chinese higher education should be less platform-centered and more learning-centered. The early stage of digitalization had to solve access and infrastructure problems. The current stage needs to solve quality, governance, and competence problems. This shift is consistent with international discussions that emphasize human agency, teacher roles, transparency, and responsible use in artificial intelligence-supported education [6–8,22–24]. This transition also aligns with research emphasizing that the quality of online education in China depends on coordinated policy, institutional support, and continuous improvement [25].

For universities, the practical implication is clear: artificial intelligence should be introduced through teaching problems, not through technology slogans. If students cannot understand a difficult concept, artificial intelligence may help provide graded explanations and practice. If teachers cannot monitor progress in large classes, learning analytics may help identify risk signals. If resources are scattered across platforms, semantic search and knowledge graphs may help organize them. In each case, the educational problem should come first.

This article also highlights the need to protect the role of teachers. Teachers are not merely users of platforms. They are designers of learning experiences, interpreters of evidence, and guardians of academic quality. Artificial intelligence can support these roles, but it should not weaken them. Similarly, students should not be positioned as passive recipients of personalized content. They should become critical and responsible users who can evaluate, adapt, and co-create digital resources.

The proposed framework has several implications for future research. Empirical studies can examine how teachers review artificial intelligence-generated resources in different disciplines, how students respond to explainable recommendations, and how platform data can be combined with classroom evidence. Comparative studies between resource-rich and resource-limited institutions would also help explain how artificial intelligence can support equity rather than deepen inequality.

8. Conclusion

Artificial intelligence-enhanced digital educational resources are becoming an important part of the

modernization of Chinese higher education. China has already built a broad foundation through national platforms, institutional digital campuses, online courses and smart education policies. The next challenge is to improve the quality and governance of these resources.

This article argues that artificial intelligence can support resource production, selection, organization, recommendation, classroom use and evaluation. Yet artificial intelligence should be treated as a support mechanism, not as a substitute for pedagogical design. High-quality digital resources require teacher review, student competence, transparent governance and continuous evidence-based improvement.

The article is limited because it is a review-based and conceptual analysis rather than an empirical study. Future research can use interviews, classroom observation, platform data, expert review, or student surveys to examine how artificial intelligence-enhanced resources are actually used in different universities and disciplines. Such studies would help transform the proposed governance framework into more specific institutional models and measurable indicators.

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The authors declare no conflict of interest.

Author contributions

Hui Shi was responsible for conceptualization, framework construction, manuscript drafting, revision, and approval of the final manuscript. Xiaoyu Meng contributed to literature review, structural revision, language polishing, and final manuscript checking. Both authors have read and approved the final manuscript.

Declaration of generative AI

During the preparation of this manuscript, the authors used AI-assisted tools for language polishing and structural refinement. The authors reviewed, revised, and approved all content and take full responsibility for the accuracy, originality, and integrity of the manuscript.

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