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Teaching Reform Exploration of Information Retrieval Course in the Artificial Intelligence Era

Yu Sheng[1], Ying Wu[2]

[1,2]School of Artificial Intelligence and Law, Shanghai University of Political Science and Law, Shanghai, China
[1]shengyu@shupl.edu.cn, [2]wuying@shupl.edu.cn

Abstract: ***The development of artificial intelligence has brought about technological innovation in the field of information retrieval, which has also brought a series of problems such as non-transparency of the process, difficulty in recognizing misinformation and intellectual property rights while achieving convenience. Starting from the characteristics of information retrieval courses, this paper explores the intelligent reform of information retrieval courses from the three aspects of value dilemma, knowledge and technology dilemma and teaching method dilemma, based on the Artificial Intelligence Competency Framework for Teachers issued by UNESCO. The conclusions show that information retrieval teachers should clarify classroom ethical and legal responsibilities, critically evaluate and use search results and advocate green retrieval. In terms of course content, authoritative AI tools should be selected, AI retrieval cases should be increased, AI retrieval technology tracking should be maintained, and the whole process of information retrieval course should be reorganized by AI. Teaching methods should adopt AI to assist teachers in lesson preparation as well as AI participation in personalized teaching and classroom management. Finally, the school level and the legal level should be urged to generate a teaching environment that is conducive for the integration of AI and information retrieval courses.***

Keywords: Artificial intelligence, Information retrieval, Teaching reform, Curriculum reform**.**

1. Introduction

With the rapid development of artificial intelligence (AI), techniques and methods in the field of information retrieval are also being updated. Information Retrieval has a close relationship with Artificial Intelligence, especially Generative Artificial Intelligence, and the latter is the intelligent development of the former. Traditional information retrieval mainly presents search results based on indexing and sorting through query matching, with users actively selecting and refining key information, the process requires a lot of time and effort. The current artificial intelligence such as ChatGPT or DeepSeek brings a new interactive experience to the information retrieval and may become the development direction of the next generation of search engines [1]. Artificial intelligence also brings a series of problems such as non-transparent process, difficult to identify false information and intellectual property protection [2][3]. With the new opportunities and challenges, artificial intelligence empowers the information retrieval course has become an urgent problem to be solved.

UNESCO has successively issued guiding documents such as Artificial Intelligence in Education: Challenges and Opportunities for Sustainable Development, AI Competency Framework for Teachers, AI Competency Framework for Students, etc., provides a framework for the integration of Artificial Intelligence and education in the new era. Existing studies have used AI as a retrieval tool, set up various tasks such as factual, explanatory, exploratory, analyzed the differences in users' retrieval experience when using conversational search engines and traditional search engines, and summarized the factors that caused the differences [4].Students believe that these AI tools may be useful for future assignments [5]; explored the application of generative artificial intelligence (AIGC) in medical information retrieval teaching, and applied AIGC prompts design into the A Practical the Integration of Generative Artificial Intelligence into the Teaching of Medical Information Retrieval teaching content, through student feedback analysis to assess the teaching effectiveness, analyze the performance of AIGC in correcting homework [6][7]; Explore the academic use of generative AI in the context of the motivation, considerations, and results of the information retrieval process, while experiencing the convenience of AI searching, there are also concerns about its authority, timeliness, and contextualization [8]; Explored the gamification of artificial intelligence courses in teaching methods [9]. The research on AI literacy around the framework of AI put forward by UNESCO, which proposes the conceptualization framework of teachers' artificial literacy led by concepts, based on knowledge, core of competence, innovation is paramount, and value based; the factors influencing the AI literacy ability of college students were analyzed [10]. Various frameworks around AI literacy education have been proposed, including AI knowledge, AI use, AI assessment, AI ethics, AI cognition, AI application, future career development [11][12], interdisciplinary thinking, emotional connection [13] and other related contents have gained wide attention. At present, there are fewer studies on how to integrate the information retrieval course with AI, and the previous insufficiency has left a research space for us.

This paper is based on AI Competency Framework for Teachers proposed by UNESCO, combined with the characteristics of the information retrieval course, for the general education information retrieval course in colleges and universities, to explore the teaching reform of the information retrieval course in the era of artificial intelligence.

2. The AI Competency Framework for Teachers and the Information Retrieval Course

2.1 Characteristics of Information Retrieval Courses

(1) Instrumentality. Information retrieval as a tool course, the main purpose is to teach students to quickly and accurately find the information they need, which requires students to

master search engines, databases, data mining, natural language processing and the retrieval tools as well as analyzing and screening information. Instrumentality is also reflected in solving the problems of specific scenarios, such as in applications of search engine, students need to master the advanced search syntax of Google Scholar in order to accurately locate academic papers.

(2) Comprehensiveness. The course not only involves the basic theories and principles of information retrieval, but also involves computer science, information science, linguistics and other disciplines, interdisciplinary nature requires students to have cross-disciplinary knowledge structure and thinking ability, from different perspectives to understand the complexity and diversity of information retrieval. For example, for legal document retrieval, it is necessary to simultaneously master the keyword association function of the adjudication documents network, Westlaw's jurisprudence citation tracking tool, and the structured collection of public judicial data by Python crawler technology. This ability to integrate multidimensional tools enables learners to flexibly select search options according to their needs.

(3) Practicality. The core of information retrieval is to meet the needs of users, and the course focuses on cultivating students' practical application ability. Information retrieval technology is widely used in academic research, patent search, e-commerce, social media and other fields, with strong practicality. The information retrieval course pays great attention to practical training, students need to familiarize various retrieval tools, through which students can independently use information resources to solve practical problems, laying a foundation for learning and scientific research. Therefore, the course will also involve user requirements analysis, user behavior research and user experience design.

(4) Dynamism. With the great outbreak of artificial intelligence technology, information retrieval technology is also constantly updating and evolving, and the course needs to keep pace with the times and continuously introduce new technologies. Dynamism in the information retrieval course is mainly reflected in the continuous iteration of technical architecture, interaction methods and application scenarios. For example, in addition to the traditional Boolean retrieval model, generative artificial intelligence, multimodal retrieval, and other emerging retrieval technologies have emerged, dynamic feature forces the course content to be continuously updated, such as adding emerging modules such as large language models and vector databases, to cultivate the students' core competence in coping with the rapid iteration of technology.

2.2 AI Competency Framework for Teachers Guidance for Information Retrieval Courses

The explosive growth of AI may reduce teaching and learning processes to computational and automated tasks, thereby devaluing the role and influence of teachers and weakening their relationships with learners. AI competency framework for teachers, published by UNESCO in 2024.The Framework helps teachers adapt the new and changing landscape of AI in education by providing guidance and resources, enable teachers to confidently transition from previous generations of digital technologies to newer AI system, and helps teachers to become collaborative knowledge producers and guides to citizenship in the age of AI. The Framework serves as a reference path for teachers' progress by emphasizing and outlining the expected outcomes of each aspect at each level, rather than setting rigid, prescribed steps that teachers must go through. The Framework is instructive for information retrieval courses:

(1) Enhanced confidence of information retrieval teachers in embracing the artificial intelligence era. Teachers of information retrieval are mostly from information management major, artificial intelligence technology, especially the principles of artificial intelligence technology, is not their professional specialty, so that teachers are not confident enough when the explosion of artificial intelligence is coming. The Framework provides an authoritative guide, so that teachers have a clear understanding of the position and direction of development in the new era and embrace the new era with confidence.

(2) It provides a practical grip for the integration of information retrieval courses and artificial intelligence technology. The Framework puts forward five dimensions from the human-centered concept of AI, AI ethics, basic knowledge and application skills of AI, integration of AI with pedagogy and AI support for teachers' professional development, explains the competencies from the three competency levels of acquiring, deepening, and creating, which provides a practical way for the combination of information retrieval courses with AI technology in a very clear way. The information retrieval course can refer to these 15 dimensions for all-round teaching reform design.

(3) Provides an evaluation basis for the effectiveness of the combination of information retrieval courses and artificial intelligence technology. The 15 points of integration proposed in the Framework not only guide the design of course reforms, but also provide a basis for evaluating the effectiveness of the integration of information retrieval courses with artificial intelligence technologies. Acknowledging that competency development is a complex, context-dependent process, the Framework serves as a reference path for teachers' progress, emphasizing and outlining the expected outcomes at each level of each dimension, and how effectively information retrieval courses are integrated with AI can be examined according to the phases proposed in the Framework.

(4) The external support necessary for the integration of information retrieval courses with artificial intelligence techniques is presented. External support is essential for the effective integration of information retrieval courses with AI technology. Teachers are directly responsible for the classroom, and reasonable policies are essential to incentivize teachers to use AI. When introducing AI in information retrieval, it is important to establish legal protections to protect teachers' rights and provide financial support to ensure teachers' inclusive access to the technical environment and basic AI tools, and to provide a prior whitelist of trusted AI tools for education, that can reduce the burden on teachers of taking on ethical and legal responsibilities that are beyond

their roles.

3. The Teaching Dilemma of the Information Retrieval Course in the Artificial Intelligence Era

3.1 The Values Dilemma in Information Retrieval Courses

The functions of AI sometimes seem to be so powerful, for example, it can complete an academic paper in more than ten seconds, or give a beautiful PPT report, output more comprehensive and integrated information retrieval results than ever before, provide a synthesis of academic research and so on, and these have brought a great impact on the original concept of information retrieval, and the traditional information retrieval language and skills are in some ways no match for the functions of AI. Over-reliance on artificial intelligence will lead to the atrophy of the basic ability of teachers, artificial intelligence has the potential to usurp the autonomous decision-making ability of teachers, we need to pay more attention to the teacher's mobility and human-centered way of thinking, to ensure that the use of artificial intelligence is for the development service of human capabilities. In addition, information retrieval is widely used in reality, and AI tools that bring in data privacy, bias issues, and disinformation issues amplify the difficulty and degree of impact on the dialectical trade-offs of information retrieval results. In AI-enabled information retrieval systems, utility and ethical risks present a symbiotic relationship. In the face of the triple challenges of data privacy leakage, solidified algorithmic bias, and the proliferation of false information, the information retrieval course urgently needs to build a three-dimensional teaching content system that includes technical ethics, value judgment, and practical response, which has become a key breakthrough to enhance the practical value of the course.

3.2 Knowledge and Technology Dilemmas in Information Retrieval Courses

In the context of the Artificial Intelligence era, information retrieval tools have changed, the mastery degree of AI tools has become a challenge, not only to understand the tools, but also to understand the working principles. However, AI-enabled retrieval systems involve complex theories such as probabilistic graphical models, attention mechanisms, knowledge reasoning, etc., which poses a challenge to teachers, who need to have deep technical skills in AI in order to explain these contents, but teachers have failed to fully master emerging AI retrieval algorithms and technologies, and have difficulties in learning, thus affecting the quality of teaching. In addition, relevant AI teaching resources are relatively scarce and backward, a large number of AI online classes are currently emerging, these trainings tend to focus on profit-oriented platforms, athere are still gaps in introducing AI into education courses, and they also rarely address critical issues of AI. The construction of AI teaching resources suitable for information retrieval courses in colleges has not yet been carried out comprehensively, which makes it difficult for teachers to obtain suitable teaching materials and limits the improvement of teaching quality.

3.3 Dilemma of Teaching Methods in Information Retrieval Courses

The Framework sets out the competencies required for effective AI teaching and learning, including to select appropriate AI tools and integrating them with pedagogical approaches to support course preparation, teaching, learning, socialization and assessment for learning. The convenience brought by AI can improve work efficiency, teachers should think about how to use AI to improve the efficiency of teaching preparation; AI has a sharper ability to "capture" information, teachers should think about how to use it to manage information retrieval in the classroom; AI has the ability to analyze data, teachers should think about how to use it to provide personalized teaching strategies for information retrieval courses.

4. Teaching Reform Measures for the Information Retrieval Course in Artificial Intelligence Era

4.1 The New Perception of Information Retrieval Course in the Artificial Intelligence Era

The new understanding of the Information Retrievalcourse in the artificial intelligence era is centered on human-centeredness and the construction of a correct ethical view of artificial intelligence, which needs to be updated in the following aspects:

Table 1: Selected Provisions and Implications of Measures for the Management of Generative Artificial Intelligence Services

clause	Implications for Information Retrieval Courses
Take effective measures to prevent discrimination on the basis of ethnicity, belief, country, region, gender, age, occupation, health, etc., in the design of algorithms, selection of training data, generation and optimization of models, provision of services, etc.	Understand that information retrieval algorithms are not "value-neutral" and that discrimination may be implicit in the selection of training data, in the design of features (ethnicity, age, occupation, etc.).
Respect intellectual property rights, business ethics, keep business secrets, and do not take advantage of algorithms, data, platforms, etc., to implement monopoly and unfair competition behavior.	Integrate the concepts of antitrust, intellectual property and other rule of law into the design of search algorithms, the scope of search rights and the use of search results, and build a cognitive framework for integrating with information retrieval and business ethics.
Respecting the legitimate rights and interests of others, not jeopardizing their physical and mental health, and not infringing on their portrait, reputation, honor, privacy and personal information rights and interests.	Legal requirements such as privacy protection and respect for the reputation right are internalized as search principles, and the use of search results should take into account the protection of others' legitimate rights and interests.
Based on the characteristics of service types, take effective measures to enhance the transparency of generative artificial intelligence services and improve the accuracy and reliability of generated content.	Understand the concept of "algorithmic black box" to "transparent design", and understand that in addition to the traditional information retrieval standards of recall and accuracy, it is also necessary to add the interpretability and reliability of AI-generated content as the core indicators.

(1) Risk perception of AI retrieval tools. For infringement, privacy and personal data security, algorithmic fairness and other issues, information retrieval teachers should first familiarize with the legal knowledge related to AI risks and be able to identify the legal boundaries of the risks. For example, Measures for the Management of Generative Artificial Intelligence Services issued by China in 2023, some provisions of which are worthy of attention in information retrieval courses, as shown in Table 1. Information retrieval teachers should sort out their perception of the moral and ethical risks of AI in information retrieval courses, such as inclusiveness and interpretability. Again, instructors should clarify legal responsibilities of AI which are attributed to the individual. For example, instructors should be responsible for the development and review of materials for information retrieval courses to ensure that the content of the materials meets the requirements of AI ethics and legal responsibilities.

Table 2: Criteria for dividing the AI suitability in information retrieval courses

Evaluation dimension	Evaluation criteria	Clarification
Data sources and quality	1. Authority of data sources 2. Timeliness of data updating 3. Accuracy of data processing	Are the data sources from reliable, reputable organizations or databases? Are the data regularly updated to reflect the latest information? Are errors and biases avoided during data processing?
Transparency and interpretability	1. Transparency of algorithms and models 2. Interpretability of the decision-making process	Does the tool provide detailed information about the algorithms and models? Can users understand how the tool makes decisions?
Security and Privacy	1. Data security measures 2. Privacy protection policy	Does the tool have strict data security measures in place to protect user data? Does it have a clear privacy protection policy and follow relevant laws and regulations?
Customization and Scalability	1. Customization capabilities 2. Scalability and integration	Does the tool allow users to customize it for specific needs? Is it easy to integrate with other systems or tools?

(2) Critical evaluation and use of the query results. For the information retrieval course, the main purpose is to obtain the search results. Unlike traditional information retrieval, the search results given by AI are combined secondary and tertiary information, which is more likely to produce false "combined" information in the process, and requires teachers to treat the information retrieval results critically. Teachers can classify the applicability of AI tools, set indicators based on the characteristics of the information retrieval course as shown in Table 2, and prioritize the selection of tools with high applicability. In addition, the use of artificial intelligence retrieval results in academia should also guard against the risk of plagiarism. For the academic community, the attitude towards the application of artificial intelligence is from blocking to dredging, so it may involve the plagiarism of artificial intelligence, and some studies have proposed to establish a judgment index based on the author's "participation degree" [14], and some studies have based on the Content-Construction-Consolidation model, and based on the Moodle (open source learning) model, and based on the Moodle (open source learning) model. Based on the Content-Construction-Consolidation model, a study developed an "anti-plagiarism" literacy practice system based on Moodle (an open-source learning content management system) and presented it in the form of an independent and complete website, which consists of four customized modules, intelligent analysis of literature, support for writing, peer assessment, and intelligent analysis of plagiarism [15]. As a teacher, we need to select AI tools based on applicability criteria to reduce the risk of false information, as well as to understand the latest "anti-plagiarism" standards and detection tools to avoid the academic misconduct.

(3) Retrieval optimization and green environment. Teachers should recognize the environmental pollution problems caused by AI technology and promote green environmental protection when using AI retrieval. For example, recognizing the high power consumption of AI retrieval in information retrieval courses, large data centers require huge computational resources for training complex AI models, which leads to significant power consumption, especially if clean energy is not used for power supply, therefore AI retrieval algorithms should be constantly updated to reduce energy consumption. In addition, attention should also be paid to the problem of increasing e-waste, as AI technology continues to advance, AI hardware needs to be upgraded regularly, a large number of discarded electronic products leading to environmental pollution, therefore electronic materials that can be clean and environmentally friendly should be developed to maintain a green environment.

4.2 New Knowledge and Technologies in the Information Retrieval Course in Artificial Intelligence Era

In artificial intelligence era, the information retrieval course should be developed from the basic knowledge of artificial intelligence to the artificial intelligence creation. In order to achieve this goal, it is necessary to transform the content of the traditional information retrieval course, specifically, from the characteristics of the information retrieval course, the course is instrumental, so the teacher should choose the appropriate AI tools, and need to take into account the tool's functionality, ease of use, cost, reliability, educational value and student background, for example, as a general course of the information retrieval course, although the students come from different professional backgrounds, but all have the need to write a thesis. Therefore, it is a good choice to select academic AI tools, especially AI tools produced by authoritative vendors, such as Spark Research Assistant; information retrieval courses are dynamic, so teachers need to regularly update their own AI knowledge, which can be done by focusing on the "industry reports + academic databases + self-publishing media", through the formal and formalization of the AI tools [16]; The information retrieval course is practical, so it is necessary to design cases of AI search with applied value, such as how to use AI to broaden the idea of topic selection, or to organize the results of existing literature on a certain topic, and to complete the above case study by using MetaSo AI Search, KIMI, etc; Information retrieval course is comprehensive, teachers should think about integration of AI and traditional information retrieval course content, for example, the authenticity of AI-generated content need to use the traditional database search for evidence. The comprehensive is also reflected in the reconstruction of the information retrieval course system, and the whole process of information retrieval needs to be redesigned under the premise of considering AI tools, as shown in Figure 1.

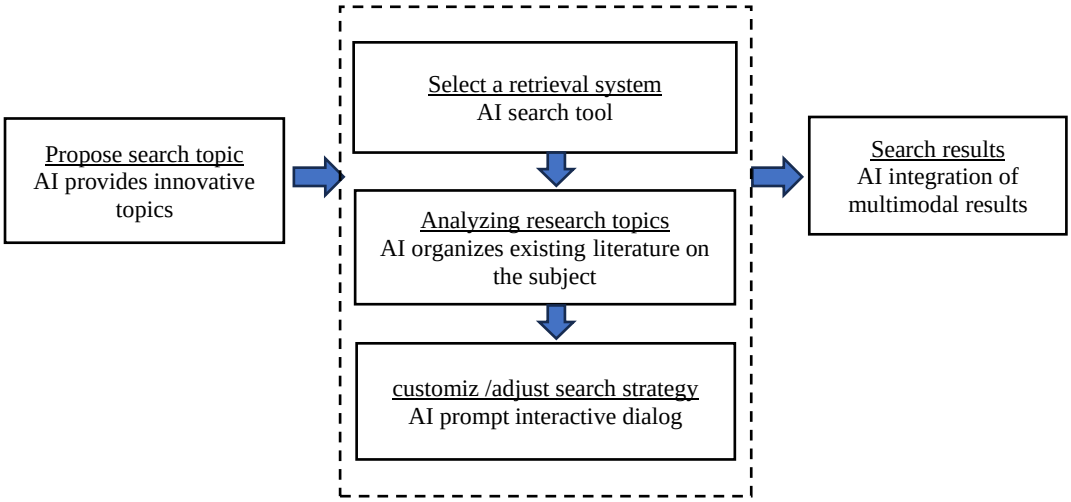

Figure 1: AI participation in the whole process of information retrieval

As shown in Figure 1, in terms of proposing topics, the traditional method of proposing new search topics requires reading a large amount of literature, and in the AI era, it is possible to generate multiple innovative topics at one time by AI tools; in terms of choosing a retrieval system, in addition to the traditional literature databases and network search engines, AI tools have become one of the most important choices; in terms of analyzing a research topic, the traditional method of is to analyze the keywords, while in the AI era, it is necessary to learn how to write AI prompts; in terms of customizing or adjusting the retrieval strategy, the traditional method is mainly through the adjustment of the search terms and Boolean logic, while in the AI era, it is necessary to learn how to adjust AI prompt and interact with AI tools.

4.3 Teaching Methods Reform of Information Retrieval Course in Artificial Intelligence Era

(1) Assisting teachers in lesson preparation. Intelligent content generation can liberate the repeated labor in the preparation of information retrieval, whether it is for various types of information retrieval materials or information retrieval cases, can be obtained through the form of man-machine dialogue, which enriches the content and form of information retrieval teaching and also saves the teacher's preparation time, in the past, teachers looking for suitable teaching resources is like looking for a needle in a haystack, the resources of different platforms are dispersed, and the quality is not uniform. With the help of AI technology, the system can automatically screen out the most matching courseware, exercises, cases from the massive resource database based on the course objectives, students' learning conditions, etc. AI can integrate different periodical databases, web pages, and self-media, and build a complete knowledge retrieval resource for teachers. In the educational innovation, AI can also help information retrieval teachers to break the information barriers and break through the boundaries of disciplines. AI is relying on its powerful knowledge association and expansion capabilities to become a powerful assistant for teachers to break through the limitations of thinking and generate innovative teaching content, connect the unthought knowledge, and collide with the sparks of wisdom.

(2) Personalized Teaching. AI has powerful data collection and integration capabilities, and can comprehensively and accurately record students' search keywords in the information retrieval system, so as to gain insights into the direction of students' demand, track clicking behaviors, understand the interest content of the students, count the length of time spent on the site, and determine the concentration degree of the students on different learning content. Through the integration of these massive data, we can build an information retrieval student's learning profile. For example, if a student frequently confuses "complete rate" and "accurate rate", AI will generate a personalized report to point out the problem and provide suggestions for improvement, and teachers can personalize the report to help students correct their mistakes and help them. Teachers can correct students' errors in a personalized way to help them improve their searching skills. On the tracking of learning progress, AI can record every step in the practical operation of information retrieval, such as the selection of keywords and the screening of search results. For students who frequently use fuzzy keywords resulting in low retrieval efficiency, the AI can point out the problems and provide suggestions for improvement, helping students to improve their retrieval ability.

(3) Intelligent classroom management. At the level of intelligent resource delivery, AI accurately delivers relevant learning resources according to students' classroom performance and learning progress, such as a student's weak ability to search in a specific field, AI will deliver high-quality search cases in the field, tutorials on the use of professional databases to meet the students' personalized learning needs; in terms of maintaining discipline in the classroom, AI monitors the classroom state of the students with the help of face recognition and gesture analysis technology in real time. If a student is found to be looking down for a long time, dozing off or frequently leaving his seat, the system will send a timely reminder to the teacher, who will be able to take measures, such as asking questions and interacting with the students to make them refocus their attention.

4.4 Beneficial Teaching and Learning Environment to the Integration of Artificial Intelligence and Information Retrieval Courses

(1) School Level Support. In the AI era, schools should

provide policy support and incentives for information retrieval courses that are closely related to AI applications. The first is financial security, such as setting up an innovation fund related to AI courses and supporting projects that integrate AI and disciplines. The second is a hardware update plan, such as the establishment of a three-year equipment iteration program to ensure that the experimental platform for implementing AI search is synchronized with industrial technology. The third is the incentive mechanism for teachers, the establishment of interdisciplinary title channels, and the setting of special evaluation indicators for teachers involved in the integration of AI courses, such as increasing the number of students' AI innovation achievements, the "AI Search Innovation Challenge" is organized, and the results are incorporated into the title promotion system of teachers. The fourth is dynamic teaching resource support, such as providing AI teaching resource libraries or building retrieval case libraries in the field of intelligence with enterprises.

(2) Legal Level Support. When introducing AI in education, legal must protect the rights of teachers, and long-term financial commitments are needed to ensure inclusive access to technological environments and essential AI tools as a critical resource for teachers to adapt to the AI era. Therefore, at the legislative level, consideration can be given to legislation to explicitly establish compliance thresholds for AI educational tools, requiring them to meet educational ethics and safety standards; rules for determining liability need to be established for teaching accidents caused by AI system failures, for example, if student data is compromised due to AI technical defects, the technology provider is legally liable, while the teacher is only liable for its use to a reasonable extent; AI Legislation should require AI-generated educational content (e.g., lesson plans, test questions) to be audited manually to ensure that it is in line with educational goals and values, and prohibit AI-generated teaching materials that contain discriminatory content or violate educational ethics; and legislation should make clear the government's responsibility to provide financial support for AI education, stipulate the percentage of AI-related inputs in the education budget, and establish a special fund for teacher training, equipment procurement, and technological upgrades.

5. Summary

The development of artificial intelligence has brought technological innovation to the information retrieval, but it has also caused problems such as opaque processes, difficulty in distinguishing false information, and intellectual property. In this context, how to transform the cognitive approach of information retrieval courses, integrate intelligent technology with traditional retrieval, and avoid legal and ethical risks has become the key. This article explores the intelligent reform of information retrieval courses from three aspects: values, knowledge and technology and teaching methods based on the AI Competency Framework for Teachers. The limitation of this article is that the research is mostly based on theoretical exploration, lacking long-term tracking and empirical analysis of actual teaching scenarios. In the future, further large-scale empirical research can be conducted to compare the learning effectiveness and ability improvement of students under different teaching modes, and construct a more comprehensive information retrieval curriculum system in the artificial intelligence era.

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