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Research on the Path of Empowering Professional Development of University Teachers by Generative Artificial Intelligence

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Abstract: The development of generative artificial intelligence offers significant opportunities for the professional growth of university teachers. This article analyzes the value of generative artificial intelligence in terms of university teachers' professional concepts, professional knowledge, professional abilities, and professional sentiments. However, in the process of empowering the professional development of university teachers with generative artificial intelligence, multiple practical challenges are faced: insufficient digital literacy and technical application capabilities of university teachers, making it difficult to efficiently leverage its potential; prominent ethical risks in education, with data security and privacy leaks and algorithmic biases affecting teaching fairness; over-reliance on technology may weaken teachers' professional judgment and critical thinking; and insufficient compatibility between technological tools and university teaching scenarios, leading to a mismatch between functions and needs. In response to these challenges, this article explores paths such as enhancing the digital literacy and technical application capabilities of university teachers, establishing ethical norms and risk prevention and control systems, strengthening the professional autonomy and critical thinking training of university teachers, and promoting the compatibility between technological tools and teaching scenarios, to facilitate the deep integration of generative artificial intelligence and the professional development of university teachers.

Keywords: Generative Artificial Intelligence, University Teachers, Professional Development.

1. Introduction

With the rapid development of generative artificial intelligence technology, its transformative impact on various social fields is increasingly prominent. Generative artificial intelligence refers to the automatic generation of various types of content such as text, images, videos, and audio through related artificial intelligence technologies [1].On November 30, 2022, ChatGPT, developed by the American company OpenAI, attracted global attention with its powerful content generation and interaction capabilities, further promoting the penetration and application of generative artificial intelligence in the field of education. However, the application of generative artificial intelligence in education not only shows great potential but also brings many challenges. On this basis, UNESCO released the "Guidelines for the Application of Generative Artificial Intelligence in Education and Research" in 2023, emphasizing the strengthening of human-centered artificial intelligence usage methods and the standardization of steps for using artificial intelligence in education to ensure that generative artificial intelligence becomes a tool that truly benefits teachers, learners, and researchers [2].At present, academic research on the empowerment of teachers' professional development by generative artificial intelligence mainly focuses on preschool and primary and secondary school teachers, while systematic studies on this aspect for university teachers are relatively scarce. Against this backdrop, this paper centers on the professional development of university teachers empowered by generative artificial intelligence, systematically exploring its value implications, practical challenges, and optimization paths, with the aim of providing theoretical references for the integration of technology in higher education.

2. The Value Implications of Generative Artificial Intelligence Empowering Professional Development of University Teachers

2.1. Promote the Reconstruction and Innovation of Professional Concepts

Professional concepts refer to the educational ideas and value concepts formed by teachers in educational practice, including educational views, teaching views, and learning views, etc [3].The rapid development of generative artificial intelligence is profoundly reshaping the educational ecosystem in higher education institutions, offering a fresh opportunity for the systematic reconstruction of professional concepts among university teachers. Its core value lies in the deep transformation of educational, teaching, and learning paradigms, forming an educational cognitive system suitable for the intelligent era. Firstly, in terms of the transformation of the educational paradigm, generative artificial intelligence, such as ChatGPT, is driving university teachers to shift from traditional "knowledge disseminators" to "innovation leaders" and "human-machine collaborators". In the traditional educational model, university teachers, as the core carriers of knowledge transmission, focused more on the systematic teaching of textbook content. However, with the massive data processing capabilities and real-time interaction functions of generative artificial intelligence tools, they can undertake basic tasks such as knowledge inquiry and information integration, allowing university teachers to redirect their efforts towards cultivating students' critical thinking, innovation capabilities, and values. This transformation does not diminish the educational subjectivity of university teachers but rather builds a new educational

ecosystem through human-machine collaboration, characterized by "technology-assisted and teacher-led". Secondly, regarding the optimization of the teaching paradigm, generative artificial intelligence provides technical support for university teachers to achieve personalized and precise teaching, promoting the upgrade of teaching concepts from "standardized supply" to "differentiated adaptation". The student body in higher education institutions is characterized by diverse knowledge backgrounds and stratified learning needs, making the traditional "one-size-fits-all" teaching model difficult to accommodate the development rhythms of different students. Generative artificial intelligence tools like ChatGPT, with their natural language interaction and data analysis capabilities, can assist university teachers in quickly identifying students' learning pain points. This technological empowerment enables university teachers to precisely grasp the cognitive characteristics, learning styles, and development demands of different students, thereby designing stratified teaching plans, such as providing targeted preparatory materials for students with weak foundations and offering extended research topics for those with more advanced capabilities, facilitating the implementation of the "teaching according to students' aptitudes" concept in large-scale teaching scenarios in higher education. Thirdly, in the renewal of the learning paradigm, generative artificial intelligence compels university teachers to embrace the professional growth concepts of "lifelong learning" and "cross-disciplinary integration". In the intelligent era, the trend of disciplinary intersections in higher education is prominent, and the pace of knowledge iteration is accelerating. A single-disciplinary knowledge reserve is no longer sufficient to meet the demands of cultivating compound talents. As an efficient knowledge tool, generative artificial intelligence can provide university teachers with information support on cross-disciplinary frontiers and research methods, and stimulate their active learning awareness through "human-machine dialogue" interaction. For instance, in course development, university teachers need to precisely question ChatGPT and other generative artificial intelligence tools to obtain valuable teaching resources. Before asking precise questions, they need to sort out their own knowledge and even proactively learn other professional knowledge. This process itself is a review and supplementation of their knowledge system.

2.2. Facilitate the Enrichment and Integration of Professional Knowledge

Teachers' professional knowledge encompasses theoretical knowledge, practical knowledge, and conditional knowledge. With its advantages in data processing and scene adaptation, generative artificial intelligence provides technical support for the systematic expansion and in-depth integration of teachers' professional knowledge in higher education institutions, promoting the formation of an organic system where theoretical knowledge, practical knowledge, and conditional knowledge are interconnected, and significantly enhancing the integrity and application efficiency of the knowledge structure. First, in terms of the expansion of theoretical knowledge, generative artificial intelligence breaks through the time and space limitations and disciplinary barriers of traditional knowledge acquisition, becoming an efficient tool for teachers in higher education institutions to track the latest developments and achieve cross-disciplinary integration. The disciplines in higher education institutions are highly specialized and the latest achievements evolve rapidly, making it difficult for teachers to keep up with the latest progress in their own fields and related disciplines. Generative artificial intelligence, such as ChatGPT, relies on large-scale pre-training data and real-time update mechanisms to quickly integrate core literature, academic disputes, and future trends in a specific research direction. For example, in the field of digital humanities, teachers in higher education institutions can obtain the integration of literary criticism theory and big data analysis methods through precise instructions, breaking the limitations of a single disciplinary perspective. Its cross-language processing capabilities can also simultaneously connect with international frontiers, avoiding delays in knowledge updates caused by translation lags. Second, in the accumulation of practical knowledge, generative artificial intelligence assists teachers in higher education institutions in transforming implicit experience into explicit wisdom through the simulation of teaching scenarios and case analysis. The teaching situations in higher education institutions are complex and individual differences are significant. Traditional experience accumulation relies on personal exploration and limited exchanges. Generative artificial intelligence can construct virtual teaching scenarios, allowing teachers to optimize their guidance strategies through interaction. At the same time, generative artificial intelligence such as ChatGPT can conduct structured analysis of teaching cases, extracting the common features of successful experiences. For example, through multiple rounds of course data, it can identify the "conditions for the adaptation of discussion-based teaching in different majors", transforming practical knowledge from "empiricism" to "data-driven rational summary". Third, in the improvement of conditional knowledge, generative artificial intelligence enhances teachers' judgment ability regarding "when to teach and how to teach" through precise student situation analysis and strategy matching. The student groups in higher education institutions are highly diverse, with significant differences in cognitive foundations between undergraduates and postgraduates, as well as students from different disciplines. Generative artificial intelligence such as ChatGPT can track students' classroom interactions, assignment quality, and research performance, constructing dynamic student situation portraits. For instance, it can recommend project-based teaching for students in science and engineering based on their logical thinking characteristics, and design debate-based classrooms for students in liberal arts based on their critical thinking needs. On this basis, it can generate strategy combinations suitable for different teaching goals, upgrading conditional knowledge from "empirical judgment" to "precise matching supported by data".

2.3. Promote the Improvement and Advancement of Professional Capabilities

Teachers' professional capabilities encompass "teaching ability, academic ability, management ability, and professional reflection ability" [4].Generative artificial intelligence, through technological empowerment and scenario reconstruction, promotes the leap of professional capabilities of university teachers from single skills to comprehensive qualities, forming a closed loop of capability advancement in core areas such as course development, teaching evaluation, and scientific research innovation, providing strong support for high-quality educational

practices. First, in terms of course development and teaching innovation capabilities, generative artificial intelligence breaks through the efficiency bottleneck and thinking limitations of the traditional lesson preparation model, enhancing the lesson preparation efficiency of university teachers. The university curriculum system is transforming from a single discipline to an interdisciplinary integration, and university teachers need to integrate knowledge from multiple fields to design modular courses. Generative artificial intelligence can quickly generate knowledge graphs, teaching module frameworks, and typical cases based on course objectives. For example, in the interdisciplinary course of "Artificial Intelligence and Social Ethics", it can assist in sorting out the history of technological development, ethical controversy focuses, and local case libraries, liberating university teachers from the complex task of integrating materials and allowing them to focus on the logical construction of the course and the design of teaching innovation points. Second, the strengthening of teaching evaluation and reflection capabilities is attributed to generative artificial intelligence converting data analysis into precise guidance for teaching improvement. Traditional teaching evaluation relies on final exams and subjective feedback, making it difficult to capture the dynamic changes in the learning process. However, ChatGPT and other generative artificial intelligence can integrate multi-dimensional information such as classroom interaction data, error patterns in homework, and student question focuses to generate visual assessment reports. For instance, by analyzing the high-frequency error types in a certain chapter, it can identify students' understanding deviations of core concepts. On this basis, it can further push targeted reflection directions, such as "How to optimize the visualization of abstract theories" and "How to design stratified exercises to consolidate weak links", transforming teaching reflection from "experience summary" to "data-driven precise improvement", forming a virtuous cycle of "evaluation - reflection - adjustment". Third, the enhancement of research and technology application capabilities is reflected in the empowerment of the entire research process by generative artificial intelligence, promoting the transformation of teachers from "technology users" to "innovative applicators". In the literature research stage, generative artificial intelligence can quickly extract core viewpoints, research gaps, and method evolution within the field, such as generating a comparison map of viewpoints from highly cited papers in the past five years for a certain research topic. In the data processing stage, ChatGPT and other generative artificial intelligence can assist in statistical analysis, model verification, and visual presentation, reducing the time cost of non-core technical operations. More importantly, this application of technology compels university teachers to enhance their digital literacy, such as optimizing question instructions to improve the accuracy of generated content and deepening their understanding of research methods through interaction with tools, ultimately achieving a dual improvement in research efficiency and innovation quality.

2.4. Realize the Nourishment and Elevation of Professional Sentiments.

Professional affect refers to the emotions, intentions, psychological tendencies and other aspects demonstrated by teachers in their teaching, and it serves as the endogenous driving force for professional development[5].While generative artificial intelligence is challenging the traditional education model, it also creates a dialectical development space for the in-depth cultivation of professional sentiments among university teachers. First, it strengthens the professional identity of university teachers and provides a new opportunity for role reconstruction. The popularization of generative artificial intelligence once triggered the anxiety of "teachers being replaced", especially posing a challenge to the "human teacher" role of university teachers. ChatGPT and other generative artificial intelligence can accurately answer professional questions and even generate standardized teaching plans, seemingly compressing the irreplaceable space of teachers. However, a deeper analysis reveals that the essence of education is "education of human beings", which includes humanistic attributes such as emotional resonance and value guidance that ChatGPT and other generative artificial intelligence cannot replicate. For example, in the cultivation of postgraduate students, university teachers interpret values in literature or art classes based on their own experiences. These educational scenarios based on "human interaction" are precisely the shortcomings of generative artificial intelligence. The impact of generative artificial intelligence has instead prompted university teachers to shed the superficial role of "knowledge carrier" and return to the core position of "spiritual mentor", deepening their recognition of the value of "human teacher". This role reconstruction is not a passive adaptation but a process in which university teachers actively discover their uniqueness: through collaboration with generative artificial intelligence tools, university teachers more clearly recognize that the ultimate goal of education is to cultivate complete individuals, and their roles in emotional support, thinking inspiration, and personality shaping are irreplaceable. This cognition will further consolidate professional confidence and elevate the sense of role identity. Second, it stimulates the initiative of professional development. In the traditional professional development model of university teachers, the training content is mostly preset by external institutions, and university teachers often remain in a "passive acceptance" state, with their internal growth motivation easily weakened. The emergence of generative artificial intelligence like ChatGPT has broken the unidirectionality of knowledge transmission. University teachers can interact with ChatGPT and other generative artificial intelligence to independently design their learning paths, such as using ChatGPT and other generative artificial intelligence to summarize the frontiers of disciplines and identify research gaps, or testing innovative teaching methods through simulated teaching scenarios. This "tool empowerment" process essentially liberates university teachers from mechanical tasks, enabling them to focus more on creative work and thereby activating their exploration and self-development awareness. At the same time, the disruptive impact of generative artificial intelligence on the education industry also prompts university teachers to re-examine their mission: when knowledge acquisition no longer relies on traditional classrooms, the core value of university teachers shifts to guiding students in critical thinking, ethical judgment, and personality shaping. This cognitive upgrade will strengthen the professional mission of university teachers, enabling them to proactively transform from "knowledge transmitters" to "lifelong learning guides".

3. The Practical Challenges of Empowering University Teachers' Professional Development with Generative Artificial Intelligence

3.1. Insufficient Digital Literacy and technical Application Capabilities of College Teachers Make it Difficult to Efficiently Leverage the Potential of Generative Artificial Intelligence

In the context of the deep integration of generative artificial intelligence and education, the digital literacy and technology application ability of university teachers have become the bottleneck restricting their performance. This deficiency is not only reflected in the operational skills but also permeates their technical cognition and application thinking, making it difficult to convert the potential of generative artificial intelligence into practical teaching value. First, there are limitations in technical cognition: some university teachers lack a systematic understanding of the core functions and applicable scenarios of generative artificial intelligence, merely viewing it as an "intelligent search tool", and failing to explore its deeper value in areas such as teaching design and data analysis. For instance, in course design, most university teachers only use generative artificial intelligence to generate summaries of key points, while ignoring its ability to optimize teaching logic by simulating students' cognitive paths. In research guidance, some university teachers only use generative artificial intelligence to search for literature, without attempting to utilize it for multi-dimensional analysis of research data to discover potential patterns. The root cause of this cognitive bias lies in the fact that universities' promotion of generative artificial intelligence mainly focuses on its "efficient tool attributes", lacking systematic training on its educational application logic. This makes it difficult for university teachers to establish a connection between technology and teaching, ultimately reducing generative artificial intelligence to a low-level auxiliary tool. Second, some university teachers have insufficient operational skills and learning motivation for generative artificial intelligence: older teachers or those in the social sciences may encounter obstacles in operating ChatGPT and other generative artificial intelligence tools. The rapid pace of continuous technological updates conflicts with the heavy teaching and research tasks of university teachers, weakening their willingness to actively learn generative artificial intelligence. From a skills perspective, some university teachers are not proficient in basic operations such as inputting instructions and adjusting parameters for ChatGPT and other generative artificial intelligence tools. For example, when using ChatGPT to generate cases, they may fail to accurately describe teaching objectives, resulting in outcomes that deviate from requirements. Teachers in the social sciences may also struggle to efficiently integrate cross-disciplinary content using generative artificial intelligence due to their unfamiliarity with technical terms. In terms of learning motivation, university teachers have to handle multiple tasks such as classroom teaching, thesis guidance, and research projects daily. The requirement for continuous time investment in learning the functions of generative artificial intelligence creates an imbalance between time cost and benefit, directly reducing their learning initiative. Additionally, some university teachers have a "fear of technology" mentality, worrying that operational errors may affect teaching outcomes, further suppressing their willingness to try generative artificial intelligence and creating a vicious cycle of "insufficient ability - reluctant to use - even less proficient".

3.2. The Risks of Educational Ethics Have Become Prominent, and Data Security and Privacy Leaks as Well As Algorithmic Bias Have an Impact on Teaching Fairness.

In the process of the deep integration of generative artificial intelligence and higher education teaching scenarios, the educational ethical risks hidden behind its technological empowerment effects are gradually emerging, mainly manifested as systemic vulnerabilities in data security management and the implicit erosion of educational equity by algorithmic bias. These two aspects together constitute the core ethical obstacles that restrict the benign application of the technology. First, in terms of data security management, when college teachers use generative artificial intelligence tools such as ChatGPT to handle the entire teaching process data, they face multiple risks of sensitive information leakage. On the one hand, as the direct operators of data processing, college teachers' cognitive biases and non-standard operation procedures may lead to the improper exposure of personal information in students' homework and confidential data in research projects during the upload and processing process. On the other hand, the non-transparency of the data storage mechanism and usage rules of generative artificial intelligence platforms further amplifies the risk exposure. In the user agreements of most commercial artificial intelligence tools, the ambiguous definition of data ownership and the expansive terms for data reuse make it possible for the teaching data uploaded by college teachers to be used for model training and other secondary developments, a process that often bypasses the data governance framework of colleges and universities, creating a "grey area" in data security supervision. This asynchrony between technology application and institutional norms makes it difficult for traditional data security management systems in colleges and universities to cope with the new risks in intelligent scenarios, urgently requiring the construction of an adaptive ethical regulatory framework. Second, the infiltration of algorithmic bias into the teaching process is more concealed and persistent, and its impact on educational equity is reflected in two dimensions: value transmission and resource allocation. From a technical perspective, the quality of the output content of generative artificial intelligence highly depends on the representativeness and neutrality of the training data. If the training corpus contains structural defects such as gender stereotypes and regional cultural biases, the generated teaching cases, assessment reference standards, and other contents will naturally carry such biases. When college teachers directly apply these pre-biased contents in classroom teaching, it may reinforce cognitive biases among student groups and exacerbate the inequality of opportunities in the educational process. A deeper risk lies in the shielding effect of the algorithmic black box. Under the cover of the algorithmic black box, trainers and programmers can feed the generative artificial intelligence large models with training corpora carrying subjective value colors or set algorithmic rules with personal preferences, resulting in the generated content not necessarily conforming to mainstream values and

even being contrary to them[6].This kind of value implantation at the technical level, through the transformation of teaching scenarios, may exert a subtle and misleading influence on students' value cognition.

3.3. Over-reliance on Technology May Weaken the Professional Judgment and Critical Thinking of University Teachers

While generative artificial intelligence provides efficient teaching support for college teachers, the risk of professional ability degradation caused by excessive reliance is gradually emerging, mainly manifested as the attenuation of teaching innovation momentum and the weakening of critical thinking quality. These two aspects jointly constitute a potential erosion of teachers' professional autonomy and become a hidden obstacle that cannot be ignored in the process of technology empowerment. First, regarding the degradation of teaching innovation ability, the high efficiency of generative artificial intelligence tools in teaching preparation stages such as lesson plan generation and courseware production may lead teachers into a vicious cycle of "technology dependence - ability idleness - innovation atrophy". When college teachers habitually apply the standardized teaching plans generated by generative artificial intelligence directly in the classroom, their initiative in independently deconstructing teaching objectives and designing teaching strategies will gradually weaken. The deeper harm of this dependence lies in the fact that it erodes the core ability of college teachers to conduct personalized teaching design based on student analysis. The content generated by generative artificial intelligence is often based on generalized training data and is difficult to precisely match the specific training orientation of a particular major, the cognitive characteristics of the student group, and the personalized teaching needs of the course. Long-term reliance on standardized content generated by technology will lead to a decline in college teachers' sensitivity to teaching situations, and their teaching innovation will be transformed from a creative transformation based on educational laws to a passive adjustment of technology output, ultimately weakening the differentiated and innovative characteristics that should be present in the higher education teaching process. More crucially, this ability degradation has a cumulative effect. Over time, college teachers may gradually lose the ability to independently construct a teaching logic system and become passive executors of technology output. Second, the blunting of critical thinking poses a more fundamental challenge to the academic rigor of teaching and research. The academic viewpoints and research conclusions generated by generative artificial intelligence are often presented in a highly structured form, and their superficial logical consistency can easily mask substantive defects, including factual errors, logical gaps, or insufficient evidence. When college teachers lack the awareness and ability to verify such technology output, direct citation or borrowing may lead to multiple academic risks. In teaching scenarios, unfiltered incorrect content may mislead students' knowledge construction and distort their cognitive systems; in research activities, excessive trust in technology-generated conclusions may lead to deviations in research design premises and reduce the originality and rigor of academic achievements. The deeper problem is that this dependence will gradually weaken the academic critical thinking ability of college teachers. When technology tools replace the process of independent thinking and logical reasoning, college teachers' critical awareness and reflective ability in knowledge production will gradually dull, which is precisely the core component of college teachers' professional qualities.

3.4. The Compatibility between Technical Tools and Teaching Scenarios in Colleges and Universities is Insufficient, and There is a Mismatch between Functions and Demands

The insufficient compatibility of generative artificial intelligence tools with the teaching scenarios in colleges and universities essentially reflects the structural contradiction between technology supply and teaching demand. This misalignment not only restricts the full play of technology's effectiveness but also increases the practical resistance for teachers to apply the technology. First, the functional design is divorced from the actual teaching situation and fails to cover the special scenarios in college teaching. Currently, the mainstream generative artificial intelligence tools are mainly oriented towards general scenarios, with core functions concentrated on text generation, information retrieval, and basic knowledge Q&A, which are universal tasks. They provide insufficient support for the discipline-specific and process-complex aspects of college teaching. From the perspective of teaching links, experimental courses, which are the core of science and engineering teaching, require tools to have specialized functions such as experimental scheme design guidance, real-time operation error correction, and data anomaly analysis. However, existing tools often only provide theoretical literature reviews and cannot connect with specific experimental equipment parameters or simulate operation scenarios, forcing college teachers to rely on traditional guidance methods in experimental teaching. Interdisciplinary project teaching involves the integration of knowledge from multiple disciplines and requires tools to have composite functions such as the construction of interdisciplinary knowledge graphs and the collaborative management of project progress. However, the knowledge boundaries of existing tools are mostly limited to a single discipline, making it difficult to meet the demands. From the perspective of teaching objects, college students have diverse learning needs: graduate students need tools to support the training of academic innovative thinking and guidance on research methods, while undergraduates need personalized learning path planning and explanations of knowledge points and difficulties. However, the functional design of existing tools often adopts a one-size-fits-all approach and lacks refined modules tailored to different academic stages and learning goals, making it difficult for college teachers to implement stratified teaching through technology. Second, the interaction experience is disconnected from the teaching process, further increasing the workload of college teachers. The teaching process in colleges and universities is systematic and standardized, relying on the coordinated operation of specialized tools such as educational management systems, learning platforms, and research databases. However, there are obvious compatibility shortcomings between generative artificial intelligence tools and these systems. The operation logic of some tools conflicts with the teaching habits of college teachers, and the interface design mostly adopts the interaction mode of internet products, emphasizing user self-exploration. College teachers, however, need linear operation

paths that conform to the teaching process, such as the seamless connection from lesson preparation material generation to classroom interaction design and post-class assignment grading. This logical difference forces college teachers to spend additional time learning the operation and even forces them to adjust the teaching process to adapt to the technical requirements. In addition, the response speed of some generative artificial intelligence tools does not match the teaching rhythm. In real-time classroom interaction, delayed feedback may disrupt the teaching process, reduce efficiency, and further dampen the enthusiasm of college teachers to apply the technology.

4. Optimal Paths for Empowering Professional Development of University Teachers through Generative Artificial Intelligencee

4.1. Enhance the Digital Literacy and Technology Application Capabilities of University Teachers, and Strengthen the Effectiveness Transformation of Generative Artificial Intelligence

In response to the insufficiency of digital literacy and technology application capabilities among university teachers, a systematic improvement path needs to be established to transform technological efficiency into teaching value. Firstly, it is necessary to carry out stratified and categorized generative artificial intelligence skills training, covering basic operations and advanced applications, to address skill deficiencies and cognitive limitations. The training should break away from the single model of promoting the tool's attributes and build a progressive content system of basic cognition, scenario application, and value exploration. Universities should design one-on-one practical guidance for older teachers or those in the social sciences to address obstacles in tool usage. For teachers in science and engineering, universities should strengthen training in multi-dimensional analysis of experimental data and construction of cross-disciplinary knowledge graphs, while for those in the humanities, focus on in-depth applications such as bibliometric analysis and optimization of argumentation logic, helping teachers transcend the cognitive limitations of intelligent search. Secondly, a practical platform should be established to encourage teachers to actively apply technology in teaching and research, and to enhance their capabilities and motivation through practice. Relying on the school's teaching management system, a generative artificial intelligence application test field should be built, embedding technology tools into daily processes such as lesson preparation, teaching, and research guidance: in the lesson preparation stage, provide a closed-loop tool chain for generating teaching objectives, content, and effect prediction, guiding university teachers to use generative artificial intelligence to create differentiated lesson plans and verify their suitability; in classroom interaction, set up a real-time feedback optimization module, allowing teachers to improve the accuracy of answering questions by adjusting instructions; in research guidance, develop auxiliary processes for literature analysis, data modeling, and conclusion verification, enabling teachers to master advanced functions while solving practical problems. At the same time, a mechanism should be established to link application achievements with workload recognition, incorporating technology application into teaching evaluation indicators, such as providing class hour subsidies to teachers who optimize teaching plans with generative artificial intelligence, and giving priority support for project applications to teams that achieve research breakthroughs with its help, balancing the time cost and benefits for university teachers and breaking the vicious cycle of heavy tasks and reluctance to learn. Thirdly, a community for university teachers to exchange technology application experiences should be established to share experiences and enhance understanding of generative artificial intelligence. Cross-disciplinary exchange communities should be formed at the department level through forms such as technology application workshops and achievement sharing sessions to promote the flow of experience. Universities should encourage young teachers to share instruction design skills and help older teachers lower the operational threshold. Universities should promote cross-disciplinary exchanges between science and engineering teachers and those in the humanities, such as physics teachers sharing data modeling experience to assist Chinese language teachers in conducting text quantification analysis, breaking down the barriers of technology application between disciplines. At the same time, universities should regularly push a case library of technology and teaching integration in university teacher exchange groups, including typical applications of generative artificial intelligence in stratified teaching and research innovation, strengthening teachers' understanding of the deep value of technology through peer practice cases, eliminating the fear of technology, and forming a virtuous cycle of active attempts, experience accumulation, and ability improvement.

4.2. Establish an Ethical Norms and Risk Prevention and Control System to Ensure the Safety and Legitimacy of Technology Application

In response to the ethical risks in the application of generative artificial intelligence in education, universities need to build a full-chain prevention and control system from three aspects: institutional norms, technical review, and ethical literacy cultivation, to ensure the safety and controllability of technology application and the legitimacy of its value. First, universities should formulate ethical guidelines for the application of generative artificial intelligence, clearly stipulating requirements for data usage and privacy protection, and filling the gap between institutional norms and technological application. These ethical guidelines should be tailored to the characteristics of university data governance, establishing a normative framework covering the entire data lifecycle: in the data collection stage, define the sensitivity levels of teaching data, specify the prohibited upload range for core data such as student assignments and confidential research information, and require university teachers to desensitize unnecessary data. In the data usage stage, universities should strictly limit the reuse boundaries of artificial intelligence tools for teaching data, prohibit the use of university data for model training and other secondary development, and clarify data ownership and usage periods through agreement terms. In the data supervision stage, establish a two-level data security responsibility system at the university and college levels, incorporate the application of artificial intelligence tools into the university's cybersecurity management system, conduct access evaluations for commercial platforms, and focus on

reviewing their data storage mechanisms and user agreements for compliance, eliminating regulatory gray areas. Second, establish a technical application review mechanism to ensure the accuracy and fairness of generated content through "human-in-the-loop" oversight, addressing the hidden risks of algorithmic bias. Universities should deploy bias detection tools at the technical level to automatically scan the teaching cases, assessment standards, and other content generated by generative artificial intelligence, identifying potential explicit biases such as gender stereotypes and regional cultural biases. Universities should form interdisciplinary review teams at the human level, composed of ethics experts, subject teachers, and student representatives, to conduct in-depth value verification of content that passes the initial technical screening, focusing on reviewing whether there are preset tendencies that conflict with mainstream social values, and avoiding value deviations caused by algorithmic black boxes. Universities should establish a traceability mechanism for generated content at the dynamic level, continuously tracking materials already applied in teaching scenarios, and using student feedback and teaching effectiveness evaluations to reverse-optimize review standards. Third, strengthen the ethical literacy cultivation of university teachers, enhancing their ability to identify and avoid risks such as algorithmic bias and technology abuse, and building a solid ethical defense line at the subject level. The ethical literacy cultivation system for university teachers should focus on the dual improvement of risk awareness and practical ability. At the theoretical level, universities should offer specialized courses on the ethics of generative artificial intelligence, explaining the impact mechanism of training data representativeness deficiencies on generated content, and elaborating on the technical paths for value implantation in algorithmic black boxes, helping teachers understand the root causes of ethical risks. At the practical level, universities should design scenario simulation training, providing teaching case materials containing implicit biases, guiding university teachers to identify biased content in algorithm outputs through comparative analysis, and mastering content correction methods based on disciplinary values. At the same time, universities should incorporate ethical literacy into the evaluation indicators for university teachers' professional development, making ethical considerations a necessary part of technology application decisions, and blocking the infiltration of ethical risks into teaching scenarios from the subject level.

4.3. Strengthening Professional Autonomy and Critical Thinking Training for College Teachers to Prevent the Degradation of Capabilities Caused by Technological Dependence.

In response to the potential weakening of professional judgment and the blunting of critical thinking caused by over-reliance on generative artificial intelligence, a counterbalance system should be established from three aspects: ability reconstruction, mechanism constraints, and cognitive cultivation to ensure the sustainable development of professional autonomy among university teachers. First, a mechanism for strengthening teaching innovation capabilities should be established to break the vicious cycle of technological dependence. Universities should leverage the distinctive features of teaching and establish a teaching design model that combines technological assistance with professional dominance: in the teaching preparation stage, university teachers should be required to use the standardized schemes generated by generative artificial intelligence as basic materials and, based on the disciplinary training orientation and students' cognitive characteristics, carry out secondary creation. By adding mandatory steps such as student situation adaptability analysis and personalized adjustment of teaching strategies, university teachers are compelled to deeply participate in the construction of teaching logic. Promote the interaction between generative artificial intelligence tools and the school's teaching resource library, incorporating school-specific course cases and outstanding teaching plans from previous years into the technical training data, making the technical output content more in line with the actual teaching situation of the university and reducing the passive reliance of university teachers on generalized content. At the same time, universities should establish an evaluation index system for teaching innovation, incorporating the original teaching design and contextualized teaching plan adjustments made by university teachers with the assistance of technology into the assessment dimensions. Through incentive mechanisms, guide university teachers to transform from executors of technology output to leaders of teaching innovation, avoiding the idleness and atrophy of independent design capabilities. Second, establish a system to guarantee academic rigor and prevent the blunting of critical thinking. In response to the potential flaws in the output of generative artificial intelligence, universities should establish a dual-track review process of technology generation and professional verification: in teaching scenarios, university teachers should be required to trace and verify the knowledge points, cases, and other contents generated by technology, confirming the accuracy of the information by comparing with authoritative textbooks and academic literature, and conducting logical consistency checks in line with teaching objectives; in research activities, implement a labeling system for technology-assisted achievements, clearly defining the scope of participation of generative artificial intelligence in research design and data processing, and requiring university teachers to conduct methodological rationality arguments for the conclusions generated by technology, including sample representativeness analysis and logical reasoning validity tests. Relying on the university's academic committee, establish academic norms for technology application, incorporate the critical verification of technology output into academic integrity assessment, and establish a responsibility mechanism for academic misconduct caused by unfiltered citation, strengthening the academic prudence awareness of university teachers from the institutional level. Third, deepen the cultivation of professional cognition among university teachers and reshape the subject consciousness in technology application. Through specialized training, enhance university teachers' awareness of professional autonomy. For example, universities should offer philosophical reflection courses on the integration of technology and teaching, analyzing the auxiliary nature of technological tools in knowledge production, explaining the core position of university teachers as decision-makers of teaching value, and guiding university teachers to establish a cognitive framework where technology serves professional goals.

4.4. Promote the Construction of Compatibility between Technological Tools and Teaching Scenarios to Achieve Precise Coupling of Functions and Demands.

To address the issue of insufficient compatibility between generative artificial intelligence tools and the teaching scenarios in universities, it is necessary to build an adaptation system from two aspects: modularized functional development and system integration, to eliminate the barriers of technology application in different scenarios. First, carry out modularized functional development oriented towards teaching scenarios to fill the gaps in support for special teaching links. Based on the disciplinary specificity and process complexity of university teaching, promote the professional upgrading of generative artificial intelligence tools. For experimental courses, develop functional modules integrating experimental equipment parameter libraries, operation simulation systems, and data anomaly diagnosis models to provide professional support such as experimental scheme optimization and real-time operation error correction for science and engineering university teachers. For interdisciplinary project teaching, universities should construct multi-disciplinary knowledge fusion algorithms and collaborative management modules to support university teachers in quickly integrating cross-disciplinary knowledge and regulating project progress. Universities should develop stratified functional modules based on the differences in student needs at different academic stages. For the postgraduate stage, configure academic innovation training and research method deduction tools; for the undergraduate stage, set up personalized learning path planning and difficulty analysis functions. Through meticulous design, meet the needs of stratified teaching. At the same time, universities should establish a dynamic feedback mechanism for teaching needs, with departments regularly summarizing functional demands in specific scenarios to prompt technology developers to carry out targeted iterations, achieving precise matching between functional supply and teaching needs. Second, strengthen the integration of technology tools and teaching systems to solve the problem of disconnection between interaction experience and processes. Based on the existing teaching management ecosystem in universities, build a compatibility framework for generative artificial intelligence tools. At the system level, universities should promote the development of data interfaces between technology tools and teaching management systems, learning platforms, and research databases to enable cross-platform flow of teaching resources, such as directly importing AI-generated teaching materials into course platforms. At the operational logic level, universities should reconstruct linearized interaction paths that conform to teaching processes, designing an integrated interface from lesson preparation material generation, classroom interaction design to post-class assignment correction, reducing the operational transition costs for university teachers. For real-time classroom interaction scenarios, universities should optimize the response algorithms of technology tools to improve processing speed and match teaching rhythms, avoiding delayed feedback that disrupts teaching progress. In addition, universities should establish a technology application process optimization team, with university teachers, technical specialists, and teaching administrators jointly sorting out the entire teaching process, embedding generative artificial intelligence tools at key nodes, and forming an application model of technology service processes to reduce the additional workload of university teachers.

5. Conclusion

The integration of generative artificial intelligence with higher education is an inevitable trend driven by technological revolution to transform education. Its empowering value for the professional development of university teachers has begun to emerge, but it also faces multiple challenges such as insufficient digital literacy, ethical risks, technological dependence, and scenario adaptation. The essence of these challenges lies in the tension between technological innovation and educational laws, as well as between instrumental rationality and value rationality.Future research could further expand to areas such as the differences in the application of generative artificial intelligence by university teachers in different disciplines and the long-term assessment of the empowerment effects of technology. Only by achieving a deep coupling of technological tools and educational values can the empowering potential of generative artificial intelligence be truly unleashed, and the professional development of university teachers be advanced towards a higher quality path.

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