



Exploration of Course Resources and Modes under Generative Artificial Intelligence

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Abstract

To find an approach that combines standardization and personalization, the course resources and teaching modes are explored by generative artificial intelligence. By researching and summarizing the problems and solutions in the course teaching process, it is proposed to set up an assessment way based on key nodes. Then, targeted analysis action of students who did not pass the assessment will be assisted with the effective linkage of generative artificial intelligence technology, teacher and students to achieve the expected goals. Research has shown that with the effective linkage, it can provide advanced assistance for multi-level and personalized teaching in terms of broadening horizons, inspiring ideas, and case demonstrations. In addition, the integrated application framework of course resources proposed in the study can provide reference and guidance for the construction of other engineering courses in the future.

Keywords: generative AI, course resources, course modes, automatic control theory.

1 Introduction

At the end of 2022, ChatGPT emerged, and generative artificial intelligence represented by it has received widespread attention both domestically and internationally. The current consensus among people is that it will ignite a new round of artificial intelligence revolution, accelerate the arrival of the intelligent era, trigger a dramatic change in social structure, especially in the future industry, education ecology, and people's production and lifestyle.

To what extent and depth will the phased generative artificial intelligence achievements represented by ChatGPT affect education? What will the future of education be like? How we will meet challenges, adapt to changes, build a strong education country, and promote modernization of education are all topics of great concern to higher education workers.

This article takes the course of automatic control theory as an example to explore the transformation, exploration, and implementation of science and engineering course resources and teaching modes driven by generative artificial intelligence.

2 The Power of Generative Artificial Intelligence in Digitizing Education

In recent years, China has emphasized the need to "promote the digitization of education to build a



Submitted: 10 December 2024

Accepted: 10 February 2025

Published: 26 February 2025

Vol. 1, No. 1, 2025.

10.62762/FEIR.2024.649562

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Citation

Zhang, H., Jin, X., & Cui, X. (2025). Exploration of Course Resources and Modes under Generative Artificial Intelligence. *Frontiers in Educational Innovation and Research*, 1(1), 4–9.



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learning society and a learning country with lifelong learning for all" [1]. In addition, the 2023 National Education Work Conference was held in Beijing, which proposed the "Deepening the Digital Education Strategy Action". This also indicates that digitalization of education is an important breakthrough for China to open up a new track for educational development and shape new advantages in educational development. Empowering high-quality development of education with digitalization is a strategic choice and necessary path for the new era.

2.1 The Possibility of Teaching Application

The essence of digitalization in education is the transformation of the development mode of education. It faces the challenge of how to break through the multiple limitations of time and space on the basis of inheriting traditional educational elements, and carry out boundaryless learning, in order to truly achieve flexible education that allows students to learn whenever they want, at any time, and with personalized learning [2]. It can be seen that the digitization of education cannot be separated from the sharing and co construction of educational resources. In the digital transformation of education, it is necessary to pay attention to both the transformation of education itself and the development of digital technology, especially artificial intelligence. A guidance and standardized management system for artificial intelligence education should be established to form an educational model assisted by artificial intelligence.

At present, generative artificial intelligence represented by ChatGPT, with its powerful natural language processing capabilities, can easily complete complex tasks such as information retrieval, question answering, creation of some video and audio content, and code generation through open dialogue, which has had a great impact on the education field [3]. The rapid development of generative artificial intelligence is fundamentally driven by the availability and diversity of data, the improvement of computing power provided by computers, the active open-source environment, and the continuous optimization of multimodal large models. From an educational perspective, the development of artificial intelligence, training large models, and educating students are isomorphic. Cultivating students is similar to continuously inputting information into a large model. Generative artificial intelligence as a humanoid intelligent learning technology,

can be effectively embedded in classroom activity design to assist teachers in achieving teaching objectives [4]. Generative artificial intelligence technology is a process path and important driving force in deepening the digital transformation of education. By accompanying and guiding students to complete courses and other educational processes, it can interact, provide knowledge, technology, and even emotional support. Providing possible channels and tools for building a teaching model centered on individualized instruction. Can effectively support teachers in carrying out teaching preparation, including the supply of learning resources, rapid generation of lesson plans, providing suggestions for teaching design prototypes, creating teaching scaffolds, answering and interacting with general questions, designing and implementing student performance assessments, etc.

Therefore, keeping pace with the times, researching the transformation of curriculum resources and modes by generative artificial intelligence technology, and exploring the use of generative artificial intelligence technology can promote teaching innovation, enhance teachers' professional abilities, enrich teaching resources, and reduce the burden of conventional teaching [5]. On the other hand, it can meet the personalized learning needs of students, provide personalized resource provision and demonstration, accelerate learning efficiency, and break through the temporal and spatial limitations of classroom teaching. This will greatly benefit the comprehensive growth of college students.

2.2 Construction of Course Resources

Curriculum resources, especially digital resources, have made outstanding contributions to flexible education and lifelong education. At present, various units attach great importance to the construction of curriculum resources, and aim to provide rich, convenient, and high-quality opportunities for educational reform and innovation by absorbing new technologies to assist in the accelerated transformation of existing education and teaching innovation [6]. At present, there is an urgent need to utilize generative artificial intelligence technology to integrate high-quality course resources from the past, share digital information usage standards and optimize operational experience, and improve the quality and efficiency of resource construction plans. Therefore, studying the ways and approaches to improve the assistance mode and effectiveness of

teachers and students by incorporating generative artificial intelligence is of great significance for enhancing the efficiency of curriculum resource construction and utilization.

As a compulsory course in the field of automation, "Automatic Control Theory" is also an important foundational course in the discipline of control engineering. It is of great significance for cultivating students' abstract thinking ability, reasoning and deductive ability, and ability to analyze engineering systems. Due to the extensive mathematical foundation required for this course and its close connection with engineering practice, there are typical problems such as difficulty in getting started, difficulty in delving deeper, and difficulty in practice and experimentation. In previous teaching activities, some course resources have also been constructed and accumulated, forming some teaching experience for pre class, in class, and post class education. However, in the current situation where there are fewer classes and more personalized needs of students, how to achieve high satisfaction has long been an unresolved issue.

Generative artificial intelligence technology has unique advantages of "responsive agility, efficient question answering, and multimodal data analysis". Through question answering interaction, it greatly reduces the threshold for knowledge acquisition. On the premise that explicit knowledge can be quickly transmitted to learners, convenient implementation can also achieve efficient supply of implicit knowledge, greatly enriching learners' personal knowledge graph [4]. Based on this, as shown in Figure 1, this study divides the key nodes of the promotion stage according to the characteristics of the automatic control theory course, and explores the use of generative artificial intelligence for the construction and integration of course resources in each stage to meet the standardized and personalized needs of teachers and students in the course teaching process.

A basic knowledge assessment is required at the beginning of the course, as the automatic control theory course requires a significant amount of advanced mathematics, university physics knowledge, and hands-on programming skills. However, students' relevant foundations vary and need to be tailored to their individual needs. In the past, some typical resources have been accumulated, such as Laplace transform derivation documents, circuit analysis videos, virtual simulation experiment examples, etc.

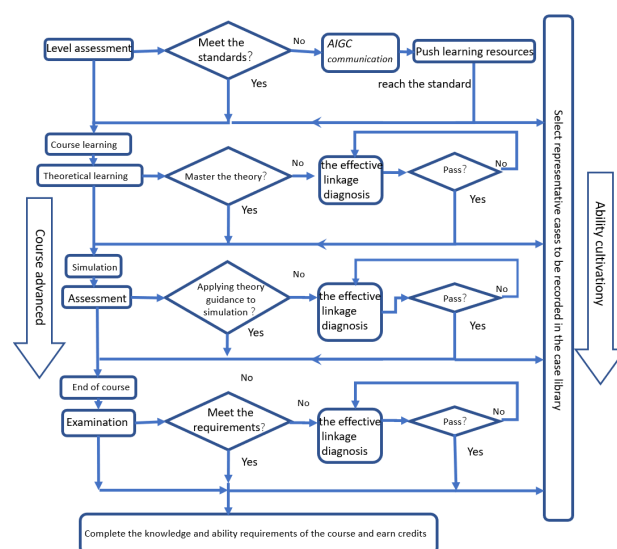


Figure 1. Schematic diagram of course integration driven by AIGC.

However, parallel push has the disadvantage of poor targeting and may even lead to students' disinterest in learning. Here, by setting up an "assessment" node, teachers assign assessment tasks and evaluate them themselves or use generative artificial intelligence assistants to assist in assessment. Students complete the assessment tasks and provide feedback, achieving the goal of discovering and clarifying student status and identifying existing problems. For those who fail to pass the assessment, as shown in Figure 2, they need to form a solution to the problem through the "teacher machine student" communication and interaction, and then select the corresponding resources from the existing resource pool to push and help students, or even give a solution directly or indirectly through the guidance given by ERNIE Bot, etc.

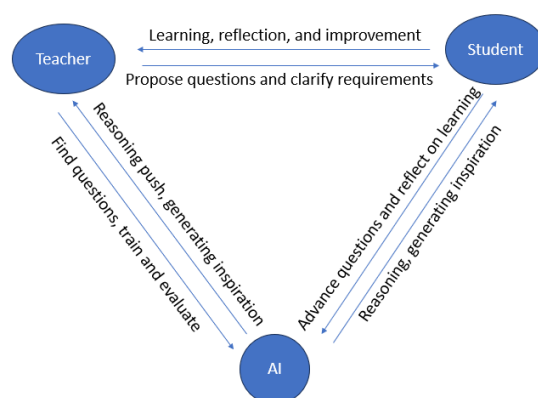


Figure 2. Three agents effective linkage of treatment issues.

The course of automatic control theory includes two

important components: theory and practice. In the process of course promotion, the theoretical learning part has the characteristics of multiple concepts, complex and abstract interconnections. At present, our school has recorded course resources such as video courses on automatic control theory and micro courses on key content. In addition, due to the selection of national level planning textbooks, there are corresponding high-quality courseware, post class exercise answers and explanations, and other traditional accumulated resources. After long-term use and positive feedback from students, this part of the resources needs to be inherited.

The current problem is limited classroom time and student time, so selecting suitable course resources and improving learning efficiency are the first issues that need to be addressed. With the help of generative artificial intelligence technology, personalized auxiliary teaching resources can be determined through the linkage of "teacher -AI-student", which can achieve the goals of saving time, improving efficiency, and being flexible and convenient.

In addition, the practical or experimental part of the course on automatic control theory includes two parts: virtual simulation experiments and physical experiments. This is because automatic control theory itself is a fundamental course for studying and transforming the world. Therefore, as a comprehensive course closely related to practice, the combination of theory and practice must be emphasized in the process of promotion. In the past, students were encouraged to preview, think, and even practice online by setting up virtual simulation experiments in advance, and then proceed to conduct physical experiments after becoming familiar with them. Although the overall effect is good, there is indeed a certain problem of time repetition for some excellent students. With the help of generative artificial intelligence technology, it is recommended to use the preview materials provided by virtual simulation experiments for self-learning by setting up an "assessments" module, and then directly conduct physical experiments. Only for those who have not passed the diagnosis, decide whether to supplement practical and experimental skills or review theoretical knowledge before making an appointment for virtual simulation experiments? Or it is better to conduct physical experiments again to supplement and improve practical skills in a targeted manner, in order to achieve standard evaluation.

Finally, a course assistant management software

developed based on generative artificial intelligence is used to organize the process records of the course (including both theoretical and practical parts), and evaluate them comprehensively based on the final exam scores. Determine whether students have completed the knowledge and ability objectives set in the course of automatic control theory, evaluate their grades, and obtain corresponding credits.

3 The transformation of teaching mode

Teaching mode can be defined as a relatively stable teaching activity structure framework and activity program established under the guidance of certain teaching ideas or theories. The transformation of teaching mode is closely related to the requirements of the times, technological development, and student status. In recent years, the concepts of supporting personalized learning and lifelong learning have gradually become deeply rooted in people's hearts with the promotion of digital education. The emergence of generative artificial intelligence has further accelerated the gradual implementation of the "people-oriented" education concept, providing a simple, fast, and efficient teaching model for it [7]. With the help of generative artificial intelligence technology, theoretically, it can assist in changing teaching modes, solve the dilemma of traditional teaching standardization requirements and individualized teaching, while also promoting educational equity and improving educational quality, and promoting better teaching and learning between teachers and students in the teaching process.

Due to the current shift in educational philosophy from imparting knowledge to cultivating abilities. This objective requirement constrains other factors that make up the teaching mode, determining the operational procedures of the teaching mode and the combination relationship between teachers and students in teaching activities. Therefore, researching the construction of teaching models in new forms is of great significance for strengthening students' deep understanding of concepts, proficient processing of knowledge, and the improvement of knowledge systems. This can lay a solid foundation for students to ultimately develop the ability to solve complex problems. As shown in Figure 2, during the teaching of automatic control theory courses, generative artificial intelligence technology integrates online and offline teaching environments, course resources, interactive methods, teaching evaluation methods, and other teaching elements of "teacher", "student", and "AI" to

form a new teaching mode.

Driven by digital education or generative artificial intelligence technology, universities have made beneficial explorations in the transformation of teaching modes, such as proposing efficient retrieval and fusion of online information while inheriting and optimizing previous evaluations and feedback, and achieving multi scenario analysis through multiple rounds of dialogue and virtual role-playing; Propose to adopt a hybrid teaching method of online and offline, forming a learning path before, during, and after class. Therefore, how to integrate and construct various resources, expand the temporal and spatial scope of education and teaching, and achieve the cultivation of students' higher-order abilities is the key to educational innovation.

4 Conclusion

Through practical feedback, this study found that the "basic assessment" in the early stage of the course, which adopts self-testing and generative AI-assisted guidance, demonstrates good practicality. This is because at the beginning of the course, the trust between teachers and students has not yet been established, and students are unwilling to showcase their own abilities to others. In this way, the assessment nodes at the beginning of the course can distribute assessment questionnaires through a mobile app, and after students submit them, the program will automatically score and evaluate them. In addition, this way can also guide students who are not familiar with the basic knowledge of automatic control theory to communicate and exchange through ERNIE Bot and other generative AI platforms, obtain help, review and master relevant knowledge, and then conduct evaluation. It should be emphasized that sufficient attention should be paid to the "practical simulation" module, as it is an important part to assist students in understanding the guiding role of theory in practice. Only when students can truly apply theory to guide and explain practice, achieve experimental goals, and analyze the consistency and differences between theory and practice or experiment, and discover the shortcomings of theory or practice, can they efficiently stimulate higher-order cognition, promote deep learning, and have the possibility of innovation.

Data Availability Statement

Data will be made available on request.

Funding

This work was supported in part by the Key Project of Education and Teaching Reform Research at Beijing Technology and Business University in 2023; in part by the Exploration, Planning, and Implementation of Personalized Teaching Resources Driven by Generative Artificial Intelligence under Grant jg235120.

Conflicts of Interest

The authors declare no conflicts of interest.

Ethical Approval and Consent to Participate

Not applicable.

References

- [1] Huai, J. (2022). To contribute a strong educational force to the comprehensive construction of a socialist modernized country. *Guang Ming Daily*, November 30, 2022 (4).
- [2] Xue, E. (2024). Empowering the Construction of a Strong Basic Education Country with Digitalization. *Educational Science Research*, (02), 1.
- [3] Wang, X., & Li, Y. (2024). Artificial Intelligence and Educational Transformation. *e-Education Research*, 45(08), 13-21.
- [4] Shan, J., & Liu, Y. (2024). Research on Learning Design Empowered by Generative Artificial Intelligence. *e-Education Research*, 45(07), 73-80.
- [5] Li, H., & Xue, L. (2024). Enhancing Risk Management in Higher Education for Generative Artificial Intelligence: Basic Framework and Key Measures. *Journal of Higher Education*, 45(02), 31-38.
- [6] Li, J., Xing, Y., Han, B., & Zhang, J. (2024). Research and Practice of Diversified Blended Teaching Mode Based on Digital Resources. *Industry and Information Technology Education*, (08), 15-20.
- [7] Tao, Y. (2024). Action Research on Double-line Blending Teaching to Promote Deep Learning under the Perspective of Embodied Cognition. *Modern Educational Technology*, 33(01), 66-73.



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