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An Exploratory Study on the Integration of AI Technology into the Training of Graduate Students in Engineering Thermophysics

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Abstract: Against the backdrop of the in-depth integration of the new round of technological revolution and industrial transformation, artificial intelligence (AI) technology has become an important driving force for innovative development in the energy and power sector, and also provides a brand-new opportunity for the reform of the training model of graduate students in Engineering Thermophysics at colleges and universities. Combining the existing problems in the training of graduate students in Engineering Thermophysics and the adaptability of AI technology in this training process, this paper systematically explores the practical paths of integrating AI technology into the entire process of graduate curriculum teaching, scientific research innovation, practical training, and quality evaluation. It aims to provide a theoretical reference for cultivating compound Engineering Thermophysics talents with solid theoretical foundations, innovative capabilities, and engineering literacy.

Keywords: AI technology; Engineering Thermophysics; Graduate training

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1. Introduction

Engineering Thermophysics is a discipline that studies the laws of energy transfer and conversion and solves key issues in energy utilization. It plays an irreplaceable role in new energy development, energy conservation and emission reduction, high-end equipment manufacturing, etc. Graduate education is the training base for innovative talents in the field of Engineering Thermophysics, and the quality of graduate training directly affects China's core competitiveness and sustainable development capabilities in the energy technology sector. Therefore, when cultivating graduate students in Engineering Thermophysics, colleges and universities should keep pace with the times and apply artificial intelligence (AI) technology to address the pain points in the training process, such as the disconnect between theory and practice, the difficulty in visualizing complex problems, and low scientific research efficiency. By organically integrating AI technology with the training of graduate students in Engineering Thermophysics, universities should continuously explore scientific and feasible practical paths.

2. Existing problems in the training of graduate students in Engineering Thermophysics at colleges and universities

2.1. Poor integration of theory and practice in curriculum teaching

The curriculum teaching of graduate students in Engineering Thermophysics in some colleges and universities still mainly adopts the traditional "classroom lecture" model. The curriculum content emphasizes the transmission of theoretical knowledge, but has no close connection with engineering practice and industrial needs. The theoretical system of Engineering Thermophysics is complex and abstract, covering the application of thermodynamic laws and the analysis of heat and mass transfer processes. The traditional teaching model is difficult to materialize abstract theoretical knowledge, leading some graduate students to struggle to accurately and quickly understand complex principles and concepts, and apply them to solving practical engineering problems [1]. At the same time, the graduate courses in Engineering Thermophysics at colleges and universities usually fail to timely integrate the latest research results of advanced technologies such as artificial intelligence and new energy, resulting in a loose connection between graduate students' knowledge systems and industrial development needs [2]. In addition, traditional curriculum teaching often lacks personalized guidance, making it difficult to meet the learning needs of graduate students with different foundations and research directions.

2.2. Room for improvement in cultivating students' scientific research capabilities

Scientific research capability is an important training goal of graduate education in Engineering Thermophysics. However, there is still great room for improvement in the cultivation of graduate students' scientific research capabilities in many colleges and universities. On the one hand, graduate students encounter problems such as difficult data processing, complex model modeling, and long experimental cycles in scientific research. For example, in numerical simulation of thermal systems and experimental research on heat transfer processes, the traditional scientific research methods are inefficient and cannot achieve rapid scientific research breakthroughs [3]. On the other hand, graduate students' interdisciplinary and innovative thinking is relatively weak. They are accustomed to solving problems with traditional scientific research ideas and methods, and fail to connect cutting-edge technologies, such as AI technology, with Engineering Thermophysics research, resulting in insufficient innovation and practicality of scientific research results. In addition, some supervisors' scientific research guidance methods are relatively traditional, lacking the cultivation of graduate students' interdisciplinary comprehensive application capabilities and innovative thinking awareness, which, to a certain extent, affects the improvement of graduate students' scientific research capabilities.

3. Adaptability analysis of AI technology in the training of graduate students in Engineering Thermophysics at colleges and universities

3.1. Adaptability of AI technology to curriculum teaching

AI technology has the characteristics of virtual simulation, intelligent tutoring, and personalized learning, which can well solve the problems of abstract theories and backward teaching models in the curriculum teaching of graduate students in Engineering Thermophysics. For example, virtual simulation technology can transform abstract theoretical knowledge such as thermodynamics and heat and mass transfer into specific virtual scenarios, making complex thermal processes "tangible and perceptible" and helping graduate students better understand theoretical knowledge. Using online teaching platforms to integrate and analyze data such as graduate students' learning foundations and progress, personalized learning resources, and tutoring plans can be generated to meet the learning needs of different graduate students [4]. For instance, the online platform can

automatically push learning resources such as basic concept explanations, typical heat transfer problem cases, and micro-course videos to graduate students with relatively weak theoretical knowledge; and push advanced content such as cutting-edge research literature and complex engineering heat transfer model construction methods to graduate students with solid professional knowledge systems.

3.2. Adaptability of AI technology to scientific research innovation

The application of AI technology in the training of graduate students in Engineering Thermophysics is also highly beneficial for cultivating graduate students' scientific research capabilities and innovative thinking. Graduate students can use machine learning, deep learning, and other methods to quickly process and analyze a large amount of thermal experimental data and numerical simulation data, find patterns from them, and provide support for scientific research innovation. At the same time, using AI technology to establish intelligent models of thermal systems can also accurately predict and optimize thermal processes, shorten scientific research time, and reduce scientific research costs [5]. For example, an Engineering Thermophysics research institute of a university optimized the structure of microchannel heat sinks through machine learning methods and optimization algorithms, which greatly improved research efficiency and result quality, fully reflecting the integration of AI technology and scientific research innovation.

3.3. Adaptability of AI technology to practical training

In the training of graduate students in Engineering Thermophysics at colleges and universities, using virtual simulation technology to create virtual thermal experimental platforms and thermal system scenarios can replace some high-risk, high-cost, and high-difficulty physical experiments, allowing graduate students to conduct comprehensive and innovative practical training in a virtual environment and improve their practical capabilities. Colleges and universities should also strengthen cooperation with enterprises, build intelligent practical training platforms with the help of AI technology, integrate practical problems and cutting-edge technological achievements in the Engineering Thermophysics industry into practical training, allow graduate students to access first-hand information from the industry, and strengthen their engineering literacy and industrial adaptability [6]. In addition, the application of AI technology is also conducive to better intelligent monitoring and evaluation of the Engineering Thermophysics practical training process, so as to accurately grasp the practical situation of graduate students, identify problems in a timely manner and provide guidance, and optimize the practical education effect.

3.4. Adaptability of AI technology to quality evaluation

The big data analysis and intelligent evaluation characteristics of AI technology can improve the quality evaluation system of graduate training in Engineering Thermophysics, and enhance the comprehensiveness, objectivity, and fairness of evaluation. Adopting big data analysis technology can comprehensively collect and analyze data on graduate students' learning processes, scientific research achievements, and practical performance, so as to achieve dynamic evaluation and tracking of the graduate training process; using AI technology to create intelligent evaluation models can comprehensively evaluate graduate students' comprehensive literacy, break away from a single evaluation standard, and consider various qualities such as scientific research capabilities, practical capabilities, and innovative capabilities; introducing third-party evaluation subjects and using AI technology to realize the sharing and analysis of evaluation data can improve the objectivity and fairness of evaluation results [7].

4. Practical paths of integrating AI technology into the training of graduate students in Engineering Thermophysics at colleges and universities

4.1. Constructing an intelligent curriculum system and teaching model

In the graduate education of Engineering Thermophysics, supervisors need to optimize the graduate curriculum system in combination with the characteristics of the Engineering Thermophysics discipline and industrial development needs, and integrate AI technology-related content into core courses and elective courses. In core courses, integrate application cases of AI technology in the field of Engineering Thermophysics, such as the application of machine learning in thermal system optimization and the application of deep learning in heat and mass transfer process analysis, so that graduate students can understand the integration points of AI technology and Engineering Thermophysics; according to the actual learning situation and school conditions, appropriately add elective courses such as "Machine Learning and Thermal Engineering Applications," "Intelligent Thermal System Design," and "Big Data Analysis in Energy Fields" to systematically teach graduate students AI technology-related theoretical knowledge and application methods, and enrich their interdisciplinary knowledge reserves [8]. At the same time, timely update the curriculum content, introduce the latest research results in fields such as AI technology and new energy technology into curriculum teaching, and ensure that graduate students' knowledge systems are synchronized with industrial development needs. For example, in the course "Engineering Thermodynamics," expand AI-driven cases of dynamic characteristic prediction and optimization of thermal systems for students, such as the latest research progress in variable working condition optimization control of gas turbine combined cycle systems using reinforcement learning algorithms.

Graduate supervisors should also break the traditional classroom lecture model and innovate an online-offline mixed teaching model based on AI technology. Upload course videos, learning materials, AI-assisted learning tools, etc., to the online teaching platform to guide graduate students to independently learn AI technology and Engineering Thermophysics-related knowledge. In offline classrooms, teaching activities such as key and difficult point analysis, case discussions, and interactive exchanges enable graduate students to have a deeper understanding of the application issues of AI technology in the field of Engineering Thermophysics [9].

4.2. Strengthening the cultivation of graduate students' scientific research and innovation capabilities

First of all, colleges and universities should increase investment to establish a scientific research and innovation platform integrating AI and Engineering Thermophysics, equipped with advanced artificial intelligence technology equipment, software tools, and data resources to provide technical support for graduate students' scientific research and innovation. The platform should integrate AI technology resources such as machine learning, deep learning, and big data analysis with experimental data and numerical simulation data in the field of Engineering Thermophysics to facilitate graduate students' scientific research work [10]. Encourage graduate students to use the platform to carry out scientific research combining AI technology and Engineering Thermophysics, that is, using AI technology to optimize thermal system design, intelligently predict and control thermal processes, and intelligently analyze heat and mass transfer processes.

Secondly, supervisors of graduate students in Engineering Thermophysics at colleges and universities should change traditional scientific research guidance methods and use AI technology to guide graduate students in interdisciplinary scientific research and innovation. In the scientific research topic selection stage, lead graduate students to select innovative and practical topics in combination with practical problems in the field of Engineering Thermophysics and the application prospects of AI technology [11]; during the scientific research process, guide graduate students to use AI technology for data processing, model construction, experimental

simulation and other tasks, improve their AI technology application capabilities and scientific research innovation capabilities, and strengthen cooperation and exchanges with AI field supervisors and enterprise technical personnel during the scientific research process to broaden students' scientific research horizons and cultivate their interdisciplinary thinking.

4.3. Innovating practical training activities integrating AI technology

The Engineering Thermophysics virtual simulation training platform constructed based on AI technology can simulate professional practical scenarios such as thermal experiments, thermal system operation, and fault diagnosis, replacing some high-risk, high-cost, and high-difficulty physical experiments. The virtual simulation platform has the characteristics of intelligence, interactivity, and authenticity. Students can carry out comprehensive practice, design practice, innovation practice, and other activities in a virtual environment, such as the design and optimization of thermal systems and the fault diagnosis and maintenance of thermal equipment, to improve graduate students' practical capabilities [12]. At the same time, the platform also supports graduate students to independently design experimental schemes, adjust experimental parameters, and analyze experimental results, cultivating their innovative awareness and ability to solve complex engineering problems.

Colleges and universities should continuously strengthen cooperation with enterprises and scientific research institutions, use AI technology to create intelligent practical training bases, and integrate practical problems and cutting-edge technologies in the industry into practical training. Invite enterprise technical personnel to participate in practical training guidance, teach graduate students cases and experiences of AI technology application in the industry, enable graduate students to contact industrial reality, and improve their engineering literacy and industrial adaptability [13]. Carry out enterprise internships, project cooperation, etc., allow graduate students to participate in the actual engineering of enterprises, use artificial intelligence technology to solve problems encountered in engineering practice, and improve their practical capabilities and teamwork capabilities.

4.4. Improving the talent evaluation system integrating AI technology

First of all, in accordance with the core training goals of graduate students in Engineering Thermophysics, supervisors should include AI technology application capabilities, scientific research innovation capabilities, engineering practice capabilities, and interdisciplinary thinking capabilities into the evaluation indicators. For example, AI technology application capabilities can be measured by the achievements of graduate students using AI technology for scientific research and practice; scientific research innovation capabilities can be measured by graduate students' scientific research papers, patents, scientific research projects, and other achievements; engineering practice capabilities can be measured by graduate students' practical training performance and enterprise evaluations [14]. Secondly, pay attention to the organic combination of process evaluation and result evaluation in teaching evaluation. Supervisors use AI technology to implement dynamic tracking and evaluation of the entire training process of graduate students, and adopt a combination of process evaluation and result evaluation. Process evaluation mainly focuses on the learning process, scientific research process, and practical process of graduate students. Use AI technology to collect graduate students' learning data, scientific research data, and practical data for real-time analysis and evaluation, and timely discover and guide problems; result evaluation focuses on the training achievements of graduate students, that is, paper publication, patent application, practical reports, etc., to comprehensively evaluate their comprehensive literacy. Through the organic combination of the two, an all-round and objective evaluation of graduate students' learning effects and

comprehensive literacy can be achieved.

Finally, introduce third-party evaluation subjects, use AI technology to share and analyze evaluation data, and improve the objectivity and fairness of evaluation results [15]. Enterprises can evaluate graduate students' engineering practice capabilities and industrial adaptability, and scientific research institutions can evaluate their scientific research innovation capabilities and academic levels. Use a multi-subject evaluation to overcome the drawbacks of a single supervisor evaluation and reflect graduate students' comprehensive literacy and core competitiveness from various aspects.

5. Conclusion

In summary, with the rapid development of AI technology and the continuous advancement of the Engineering Thermophysics discipline, the integration of AI technology and the training of graduate students in Engineering Thermophysics will become more in-depth and diversified. In the future, colleges and universities should actively explore the innovative application of AI technology in the training of graduate students in Engineering Thermophysics, develop AI teaching aids and scientific research auxiliary tools that meet the training needs of graduate students in Engineering Thermophysics, improve their learning and scientific research efficiency, and provide more powerful talent support for China's energy transformation and sustainable development.

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