

Research and Application Demonstration of AI-Based Online-Offline Tutorial Agent in Vocational Education

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Abstract: Under the dual background of the advancement of the Education Informatization 2.0 Strategy and the high-quality development of vocational education, the in-depth integration of AI technology and vocational education has become a key path to solve the problem of personalized teaching and improve teaching quality. This paper focuses on the online-offline blended teaching scenario in vocational education, carrying out research and application exploration of tutorial agents. Firstly, it sorts out the research status and development trends of domestic AI in the field of vocational education, clarifies the core value of tutorial agents; secondly, defines the research objectives and main contents, and analyzes the core difficulties of the construction logic of AI tutorial agents, the online-offline integrated application mode, and the intelligent teaching evaluation system; then proposes research methods and technical routes; finally, designs the application scheme framework and looks forward to future directions. The research aims to construct a theoretical framework and application ideas of AI tutorial agents adapting to the characteristics of vocational education, provide theoretical reference for the high-quality development of vocational education informatization, and help cultivate high-quality technical and skilled talents.

Keywords: Artificial intelligence; vocational education; online-offline blended teaching; tutorial agent; teaching mode innovation

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1. Introduction

At present, digital technology is reshaping the educational ecosystem and promoting transformation. The “Education Informatization 2. 0 Action Plan” proposes the goal of “accelerating the modernization of education”, emphasizing the integrated application of technology and constructing a new form of smart education^[1]. Vocational education plays an important role, but it faces challenges such as large differences in students’ basic levels. The traditional teaching mode is difficult to match individual differences^[2]. Although the online-offline blended teaching mode has advantages, it has shortcomings such as insufficient personalized tutoring. AI technology can solve the above problems. Higher vocational colleges promote the integration of information technology and general AI courses, providing an application carrier and demand for AI tutorial agent^s [3-5]. Carrying out research on AI-based tutorial agents in vocational education is not only a response to national strategic requirements but also an inherent demand for promoting vocational education reform, adapting to curriculum reform, and improving teaching quality.

2. Domestic research status and development trends

Although the research on the integration of artificial intelligence and vocational education in China started late, it has developed rapidly under the promotion of policies^[6]. The “Education Informatization 2.0 Action Plan” has clarified the integration direction, and a number of local achievements have been formed in China, such as the application of Chaoxing Huiya large model in vocational colleges, and the development of AI tutorial system prototypes for majors such as information technology and automobile maintenance. However, there are still deficiencies in the research: first, insufficient pertinence. Most tutorial agents lack in-depth adaptation to the practical and skill-oriented characteristics of vocational education courses and students’ cognitive laws; second, insufficient integration depth. They mostly focus on online learning scenarios and fail to effectively collaborate with offline teaching. Data fragmentation leads to the inability to form a complete teaching closed loop; third, insufficient technical adaptability. Core technical indicators such as emotional interaction and decision-making accuracy have a gap with the advanced international level.

Combined with the development needs of domestic vocational education, AI applications show three major trends: first, “personalization + precision”, realizing precise learning support and teaching intervention through data analysis; second, “collaboration + integration”, building a collaborative teaching ecosystem of teachers, AI, and students; third, “intelligence + diversification”, promoting the innovation of teaching evaluation methods^[7-9].

3. Research objectives, main contents and core difficulties

3.1. Research objectives

Guided by the demand for personalized training in vocational education, this study focuses on the online-offline blended teaching scenario, aiming to construct a theoretical framework and application ideas of AI tutorial agents adapting to the characteristics of vocational education, explore its application mode in the blended teaching scenario, and achieve the following core objectives: first, clarify the core positioning and functional framework of AI tutorial agents, and construct a theoretical system of tutorial agents adapting to the characteristics of vocational education courses; second, form a framework of online-offline integrated collaborative teaching mode between teachers and AI, providing support for improving teaching efficiency and students’ learning experience; third, establish a framework of diversified, intelligent, and dynamic teaching evaluation system to achieve the goal of precise training; fourth, design a feasible application scheme framework, providing theoretical guidance for subsequent practical applications and promoting the high-quality development of vocational education informatization.

3.2. Main research contents

3.2.1. Construction of the core framework of ai tutorial agents

Based on the characteristics and teaching objectives of vocational education courses, combined with the advantages of domestic mainstream large language models, the core framework of AI tutorial agents is constructed: the core positioning is “teacher assistant” and “student guide”; the functional modules include a knowledge base support module docking with higher vocational integrated course textbooks, a personalized learning support module focusing on individual differences, and a learning situation analysis module monitoring learning status; the operation logic is a closed loop of “data collection - analysis and processing - service output - feedback optimization”.

3.2.2. Construction of ai collaborative teaching mode integrating online and offline

In online scenarios, the agent undertakes functions such as resource push, progress monitoring, and basic Q&A; in offline scenarios, teachers carry out targeted teaching based on learning situation analysis, and the agent assists in interaction organization and real-time feedback; clarify the online-offline data sharing mechanism to achieve a balance between “large-scale teaching + personalized tutoring”.

3.2.3. Construction of an intelligent teaching evaluation system framework

Centering on the goal of “knowledge mastery + skill improvement + literacy development”, three evaluation dimensions are designed: knowledge, skills, and learning attitude; set quantifiable indicators for online (learning progress, answer accuracy rate, etc.) and offline (classroom interaction, skill operation, etc.); establish a dynamic evaluation mechanism to realize the combination of process evaluation and result evaluation.

3.2.4. Design and feasibility analysis of application scheme framework

Taking the higher vocational integrated course “Information Technology + General AI” as the adaptation object, the application scheme framework of AI tutorial agents is designed^[10]. The scheme is synchronously adapted to the knowledge system and teaching objectives of the newly revised textbooks, clarifying the core elements of implementation: adaptation standards for teaching objects, hierarchical design for the cognitive level and professional needs of higher vocational students; adaptation requirements for teaching scenarios, covering the whole process of pre-class preview, in-class interaction, and after-class consolidation; key points of teaching process design, embedding links such as knowledge point analysis, skill training, and case operation^[11]. Feasibility analysis is carried out from three aspects: technical feasibility, evaluating algorithm support and hardware environment combined with existing AI technology and the current situation of higher vocational informatization infrastructure; teaching feasibility, conforming to the practice-oriented cognitive laws of higher vocational students according to the interdisciplinary characteristics of integrated courses; resource guarantee feasibility, analyzing the teacher AI literacy training mechanism, teaching resource co-construction and sharing mode, and long-term fund investment mechanism, providing a complete implementation blueprint and scientific decision-making basis for the implementation of the scheme.

3.2.5. Core difficulties

There are three core difficulties in this study: first, improving teaching adaptability, which requires constructing an agent framework adapting to different majors, students with different foundations, and practical courses; second, online-offline collaborative integration, realizing seamless connection and data integration of agents across scenarios, and balancing the roles of AI and teachers; third, ensuring evaluation scientificity, realizing accurate quantification of implicit indicators such as skills and literacy, and comprehensive and accurate collection of evaluation data.

4. Research methods and technical routes

4.1. Research methods

4.1.1. Literature research method

By systematically sorting out research literature, policy documents, and practical reports on AI in vocational education, online-offline blended teaching, intelligent tutoring systems, etc. , at home and abroad, the research status, core technologies, application modes, and development trends of AI tutorial agents are clarified; at the same time, relevant educational theories such as constructivist learning theory and personalized learning theory are sorted out to provide theoretical support and direction guidance for the research.

4.1.2. Comparative research method

By comparing relevant research results and application cases of AI tutorial agents at home and abroad, the core ideas, technical routes, and application effects of different studies are analyzed, and the advantages and disadvantages of different modes are summarized; at the same time, the teaching characteristics and learning needs of different majors and types of vocational education courses are compared, and the adaptability requirements of tutorial agents are clarified, providing reference for the construction of AI tutorial agent framework and the design of application modes.

4.1.3. Logical analysis method

Based on the results of literature research and comparative research, logical analysis method is used to sort out the core logic of the integration of AI technology and online-offline blended teaching in vocational education, clarify the construction logic, functional positioning, and operation mechanism of AI tutorial agents; at the same time, construct the framework of online-offline integrated collaborative teaching mode and intelligent teaching evaluation system through logical reasoning, ensuring the scientificity and rationality of the research framework.

4.2. Technical routes

This study follows the technical route of “theoretical combing - framework construction - difficulty analysis - scheme design - summary and prospect”, with specific steps as follows:

Step 1: Theoretical and current situation combing. Through literature research method, systematically sort out the domestic and foreign research status, policy documents, and theoretical foundations, clarify the research objectives, core contents, and core difficulties; at the same time, clarify the adaptability requirements of AI tutorial agents by sorting out the teaching characteristics of vocational education courses in different majors, providing demand basis for framework construction.

Step 2: Core framework construction. Based on the results of theoretical combing and combined with the teaching needs of vocational education, construct the core framework of AI tutorial agents, clarify the functional modules and operation logic; at the same time, construct the framework of online-offline integrated collaborative teaching mode and intelligent teaching evaluation system, forming a preliminary research framework system.

Step 3: Difficulty analysis and optimization. Aiming at the core difficulties of the research, optimize and adjust the constructed AI tutorial agent framework, collaborative teaching mode framework, and teaching evaluation system framework combined with the results of comparative research method.

Step 4: Application scheme design. Taking information technology professional courses as the adaptation object, design the application scheme framework of AI tutorial agents, clarify the core elements of scheme implementation; carry out feasibility analysis from technical, teaching, and resource guarantee dimensions to form a complete application scheme.

Step 5: Summary and prospect. Systematically summarize the research results, clarify the research conclusions; analyze the deficiencies of the research, and look forward to future research directions combined with the development trends of AI technology and the development needs of vocational education.

5. Design and feasibility analysis of application scheme framework

5.1. Adaptation objects and core scenarios of the scheme

The scheme is adapted to learners of the higher vocational integrated course “Information Technology + General AI”, and synchronously serves the needs of textbook revision^[12,13]. It covers three core scenarios: online focusing on independent learning and basic Q&A, providing personalized resources and guidance adapting to the curriculum system; offline focusing on skill guidance and interactive teaching, realizing teacher-student collaboration; after-class strengthening review and consolidation and expansion and improvement, pushing targeted resources and suggestions, connecting online and offline teaching.

5.2. Design of scheme implementation framework

5.2.1. Preliminary preparation framework

The preliminary preparation framework includes three core tasks: sorting out the curriculum knowledge system, docking the textbook framework, systematically sorting out core knowledge points and skill requirements such as information technology operation and AI concept principles, and constructing a structured system to support the agent; analyzing teaching needs, clarifying needs such as personalized support and learning situation analysis combined with curriculum

objectives, student characteristics, and teacher pain points, and optimizing the functional framework; integrating teaching resources, establishing a standardized resource library including videos, courseware, exercises, etc. , adapting to the needs of collaborative teaching^[14].

5.2.2. Design of teaching implementation process

In the online link, after students log in, the agent pushes personalized plans and resources, provides real-time Q&A during independent learning, and synchronously collects and analyzes learning behavior data^[15]; in the offline link, teachers carry out targeted teaching with reference to the agent's learning situation report, and the agent assists in real-time feedback during training; in the after-class link, the agent pushes review resources and exercises, assists in homework correction, focuses on centralized explanation of common problems and personalized guidance for individual problems, forming a teaching closed loop.

5.2.3. Design of effect evaluation framework

The effect evaluation adopts a multi-dimensional framework: evaluation subjects include teachers, students, and teaching experts; dimensions cover teaching effect (knowledge mastery and skill improvement), learning experience (satisfaction with personalized services), and resource adaptability (matching degree between resources and needs); methods combine qualitative methods such as questionnaires and reviews with quantitative data such as scores and progress to comprehensively evaluate application value.

5.3. Feasibility analysis of the scheme

Technically, mainstream large models are mature, and higher vocational informatization infrastructure is improved; teaching-wise, it adapts to curriculum characteristics and cognitive laws, and conforms to teaching norms; resource-wise, there are sufficient teachers, policy and fund support; in terms of benefits, it can improve personalized learning and teaching efficiency, and has promotion value.

6. Conclusion and prospect

6.1. Research conclusions

Targeting the online-offline blended teaching scenario in vocational education, this study conducts systematic research on AI tutorial agents. By sorting out the domestic status quo, constructing core frameworks and application modes, and designing implementation schemes, the following conclusions are formed: first, the in-depth integration of AI technology and vocational education is the key to solving the problem of personalized teaching. As the core carrier, tutorial agents have functions such as personalized learning support, learning situation analysis, and teaching assistance, which can effectively improve the effectiveness of blended teaching. Second, the constructed core framework of AI tutorial agents includes three modules: knowledge base support, personalized learning support, and learning situation analysis, with clear operation logic, which can adapt to the characteristics of vocational education courses and students' learning needs. Third, the proposed framework of collaborative teaching mode between teachers and AI clarifies the functional division of labor and collaborative mechanism in online and offline scenarios, realizes the balance between "large-scale teaching + personalized tutoring", and provides support for improving teaching efficiency. Fourth, the designed application scheme framework and feasibility analysis system accurately adapt to the reform needs of higher vocational information technology courses, covering elements such as adaptation objects, implementation processes, and effect evaluation. The technical, teaching, and resource guarantee conditions are sufficient, and it has a landing foundation. It can provide theoretical support and application ideas for personalized teaching in higher vocational education, and has practical value and promotion prospects.

6.2. Research deficiencies and prospects

The research has three deficiencies: first, it focuses on theoretical framework and scheme design, lacking practical verification; second, the discussion on the technical implementation details of the agent is insufficient. Future research will proceed from four aspects: first, carry out practical verification to optimize the framework scheme; second, expand the research scope to improve universality; third, deepen technical adaptation research to optimize the implementation path; fourth, explore the application of emotional computing technology to improve the agent's emotional perception ability.

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Disclosure statement

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