Research on the Application of Humanoid Robots in Tax Law Course Teaching

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Abstract: **The rapid development of artificial intelligence (AI) technology has opened up new possibilities for the application of humanoid robots in the field of education. Tax law courses, characterized by their complex knowledge system, frequent updates, and strong practical orientation, impose higher demands on teaching mode innovation. This paper focuses on the application potential and practical challenges of humanoid robots in tertiary-level tax law course teaching. Through literature analysis, case comparison, and needs assessment, it outlines the main current application scenarios (such as explanation of tax law provisions, case simulation, interactive Q&A) and their preliminary outcomes (enhancing learning interest, providing personalized tutoring). The study finds that insufficient technological maturity (naturalness of interaction, depth of knowledge base), high costs, barriers to acceptance by teachers and students, ethical and privacy risks, and difficulties in interdisciplinary integration are key issues constraining deeper application. Accordingly, this paper proposes countermeasures including a tiered application promotion strategy, constructing a "human-machine collaboration" teaching model, developing specialized tax law knowledge and scenario databases, strengthening interdisciplinary team building, and formulating ethical guidelines alongside enhanced training.**

Keywords: Humanoid Robot; Tax Law Teaching; Artificial Intelligence in Education; Teaching Reform; Human-Machine Collaboration

1. Introduction

In the digital economy era, tax systems are becoming increasingly complex and dynamically updated, posing unprecedented challenges to tax law course teaching in higher education institutions. Traditional classrooms, predominantly teacher-centric, suffer from structural difficulties such as challenges in understanding abstract legal provisions, lack of practical scenarios, low student engagement, and delayed teaching feedback, making it difficult to cultivate interdisciplinary tax talents meeting contemporary demands. Simultaneously, artificial intelligence technology, particularly the rapid development of humanoid robots, has injected strong momentum into educational innovation. Humanoid robots integrate cutting-edge technologies like natural language processing, computer vision, and motion control, possessing highly anthropomorphic appearances and interaction capabilities. They can break through the limitations of traditional virtual assistants and participate in the teaching process in a more natural and immersive way within physical spaces[1]. This study focuses on the characteristics of tax law courses, exploring potential pathways and practical value for the deep integration of humanoid robots throughout the teaching process, aiming to address teaching pain points, enhance teaching quality, and provide intelligent solutions for cultivating tax law talent in the new era.

2. Current Situation and Problems in Tax Law Course Teaching

"Tax Law" is a course that studies the basic theories, procedures, and methods of tax laws and regulations, and explores the practical application of tax law. It is characterized by strong rule-based content, frequent updates, rigorous logic, and a pronounced practical orientation. Current teaching primarily faces the following problems:

Firstly, the knowledge system of "Tax Law" is vast and abstract. The multitude of tax types, detailed and rigorous legal provisions with strong logicality make comprehension difficult for students. Secondly, tax law policies update frequently. Tax laws and regulations constantly

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change with economic conditions and national policy adjustments, with revisions or supplements occurring annually. However, the lengthy cycle of textbook compilation and publication leads to classroom content lagging behind the latest policies. Teachers, burdened by heavy research and teaching duties, also find it difficult to track policy dynamics promptly, resulting in insufficient depth in policy interpretation. Thirdly, the cultivation of students' practical abilities is inadequate. Traditional lecture-based teaching struggles to effectively simulate complex real-world scenarios such as tax consultation, tax filing, and dispute resolution. Due to the course structure prioritizing theory, practical components are often delayed; case studies are mostly based on simplified scenarios, detached from the complexities of real business operations. The classroom primarily follows a "lecture + exercise training" model, lacking hands-on training in crucial links like tax filing, tax planning, and dispute resolution. Finally, student learning motivation is insufficient. Students have diverse foundations and comprehension abilities, making a unified teaching model unsuitable for all needs. Teacher-centric lectures and case analyses often limited to a "teacher questions - student answers" pattern deprive students of deep engagement.

3. Current Application Status of Humanoid Robots in Tax Law Teaching

Currently, although the application of humanoid robots in education is still in its early stages, it has shown potential in specific scenarios. Explorations in tax law teaching mainly focus on the following aspects:

3.1 Intelligent Teaching Assistant and Knowledge Explanation

Humanoid robots can undertake some basic, repetitive teaching tasks in the tax law teaching process. Specific applications include: reading and interpreting tax law provisions—the robot can read provisions clearly and accurately, offering basic explanations in more accessible language based on a pre-set knowledge base, particularly suitable for teaching fundamental concepts of core taxes like Value-Added Tax (VAT) and Corporate Income Tax. Or interacting with students for Q&A on knowledge points—students can ask the robot questions via voice or touchscreen, and the robot provides instant responses based on its built-in tax law knowledge base, offering standardized basic information [2].

3.2 Case Simulation and Scenario Practice

Humanoid robots can guide students through practical operations and decision-making by creating virtual tax scenarios.

First, Tax Consultation Simulation. The robot and student role-play as taxpayer and tax consultant respectively, simulating consultation scenarios (e.g., inquiring about the applicable tax rate for a specific business, application process for preferential policies). The robot can respond based on pre-set rules and databases, training students' communication skills and professional judgment.

Second, Basic Tax Filing Practice. Assisted by a simulated interface, the robot guides students step-by-step through the filing procedures for specific taxes (e.g., simulating Personal Income Tax app filing), highlighting key points and common errors.

Third, Basic Simulation of Tax Audit/Dispute Response. The robot plays the role of a tax officer raising basic questions or requests, and the student must explain or provide documentation according to tax regulations, cultivating their ability to handle pressure and apply laws.

Introducing humanoid robots into practical training allows for the construction of small-scale simulated tax service halls or corporate finance office scenarios for basic interactive exercises with students.

3.3 Interactive Q&A and Learning Companion

Humanoid robots can also provide students with extended after-class learning support and some degree of emotional companionship, mainly useful in three areas: First, After-class Q&A. During self-study or review, students can ask the robot about unresolved class questions or homework difficulties, receiving immediate feedback (within the limits of the knowledge base). Second, Learning Progress Reminders. The robot can remind students to complete assignments, review key points, or pay attention to the latest policy changes based on a pre-set study plan. Third, Emotional Companionship and Motivation. Through expressions, gestures, and encouraging language, the robot can provide

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positive feedback on student learning behaviors, enhancing their motivation [3].

3.4 Preliminary Effectiveness

Overall, the use of humanoid robots in "Tax Law" course teaching has achieved the following effects. Firstly, the novelty and interactivity of humanoid robots significantly attract student attention, making dull tax law learning more interesting, thereby better enhancing learning interest and motivation. Secondly, robots can provide targeted information based on student queries, meeting some differentiated needs and offering a personalized learning experience. Finally, humanoid robots can create simulated situations, providing students with preliminary, low-risk practical experience opportunities. Of course, users should also be clearly aware that current applications are mostly in the pilot and exploration stage, with limited depth and breadth, primarily serving as a supplement to traditional teaching rather than its core [4].

4. Challenges Facing the Application of Humanoid Robots in Tax Law Teaching

Despite promising prospects, the deep integration of humanoid robots into tax law teaching faces a series of severe challenges.

4.1 Insufficient Technological Maturity and Functional Limitations

On one hand, current technology often struggles with understanding complex professional terminology, long-sentence logic, and the implied intent behind policies in the tax law domain, showing deficiencies in natural language understanding. Responses can tend to be superficial or formulaic, making it difficult to handle in-depth, open-ended tax law discussions and case analyses; generated professional explanations also lack the flexibility and depth of human teachers. On the other hand, the situational awareness and adaptive interaction capabilities of current humanoid robots are weak. They cannot precisely perceive the overall classroom atmosphere or students' subtle emotional changes like human teachers do, and dynamically adjust teaching pace and strategies. Consequently, their expressiveness is insufficient when simulating complex and volatile real tax scenarios (e.g., multi-party negotiations, interpreting sudden policy changes). Limited by current technology, while robots can access accurately and timely updated tax law knowledge bases, they struggle with deep reasoning and providing forward-looking strategic advice like experienced tax experts. The movement fluency, precision (e.g., simulating signing documents, operating complex interfaces), and adaptability to diverse teaching physical environments (different classroom layouts, practical training equipment) of existing commercial robots still need improvement.

4.2 High Usage Costs and Significant Maintenance Burden

Firstly, the acquisition cost is high. Humanoid robots with advanced interaction capabilities are expensive, creating procurement pressure for schools, especially posing significant financial strain for large-scale deployment in educational institutions. Secondly, daily maintenance and operational costs are substantial. Operational costs mainly include routine maintenance, software upgrades, knowledge base updates, hardware repair for wear and tear, and the need for specialized technical personnel, constituting a continuous investment. Finally, the Return on Investment (ROI) is unclear. Compared to their high cost, evidence of clearly quantifiable improvements in teaching effectiveness is still insufficient, affecting the willingness of school decision-makers to invest.

4.3 Potential Low Acceptance by Teachers and Students

Firstly, teachers may experience anxiety regarding role transformation, apprehension towards using new technology, and a lack of skills and confidence in effectively integrating robots into teaching designs. Secondly, some students might feel discomfort towards robots whose appearance is very close to humans but whose behavior is different [5]. More importantly, robots cannot fully replace the deep interpersonal interaction based on emotional resonance, experience sharing, and value transmission between teacher and student, and among students themselves, which is crucial in cultivating tax ethics and professional judgment[6]. Finally, poor interaction experiences are likely. When robots frequently make understanding errors, respond slowly, or give overly mechanical answers, it quickly reduces users' willingness to use them and erodes trust.

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4.4 Interdisciplinary Integration and Instructional Design Challenges

Communication barriers exist between tax law teaching experts and technical personnel. Tax law experts have limited understanding of technical implementation details, while technicians have a shallow understanding of the core needs and difficulties of tax law teaching. This can easily lead to a disconnect between the developed robot functions and actual teaching needs. Furthermore, mature instructional design models are lacking. There is a absence of systematic, validated instructional design frameworks and methodologies for effectively designing teaching activities that deeply integrate "human-robot-content-environment" and maximize the teaching value of humanoid robots. Integrating humanoid robot applications seamlessly into curriculum standards, teaching plans, and evaluation systems remains an area requiring much discussion. If design biases exist in the robot's knowledge base or algorithms, it could lead to the dissemination of incorrect knowledge or discriminatory feedback. Determining liability becomes difficult if a robot provides erroneous tax advice leading to student misunderstandings or errors in simulated operations.

4.5 Privacy and Security Risks

The vast amount of sensitive data collected during robot interactions (student voice, images, learning behaviors) poses risks of misuse or leakage, potentially harming students. On the other hand, over-reliance on robots for answers might weaken students' ability to actively inquire, think independently, and critically analyze complex tax law issues. Balancing the use of advanced technology without impairing students' independent thinking and creativity is also an issue requiring consideration and trade-offs.

5. Countermeasures for Challenges Facing Humanoid Robots in Tax Law Teaching

To address the problems mentioned above, the following strategies can be considered.

5.1 Set Different Goals and Promote Application in Tiers

Given insufficient technological maturity, consider setting short-term, medium-term, and long-term goals, progressing step by step, with each tier focusing on different core value scenarios. For instance, short-term goals could prioritize deepening application in repetitive basic tasks, specific scenario simulations, and post-class personalized Q&A and companionship, ensuring system stability and reliability. Medium-term goals could involve developing more complex interactive case simulations, exploring robot collaboration with student groups to complete tasks; utilizing robots for learning process data collection and analysis to provide teachers with learning analytics reports. Long-term goals could aim for deep AI integration, achieving deep semantic understanding and reasoning to support open-ended complex case discussions. By setting goals at different levels, preset functions can be realized step by step, ultimately achieving perfect integration with the teaching process [7].

5.2 Explore Diversified Investment and Sharing Models

The production cost of robots is directly related to the scale of manufacturing. On one hand, product promotion can be conducted in institutions nationwide with relevant majors, increasing production volume to reduce the unit production cost. On the other hand, seeking government special funds, educational informatization allocations, or partnerships with relevant enterprises can be pursued. Encourage companies to develop more economical, durable, dexterous, and sensor-rich educational specialized humanoid robot platforms. Introduce the latest corporate robot technology into the classroom, promoting the development of courses in new AI education technologies and directions. Integrate these courses throughout the entire process of professional basic education and professional innovation education, holistically enhancing students' hands-on ability and innovation creativity [8]. Additionally, establishing robot teaching resource sharing centers within regions or university consortia can improve equipment utilization rates and reduce per-use costs.

5.3 Construct an "Human-Machine Collaboration" Intelligent Teaching Model

To alleviate teacher resistance, first clarify the role positioning: the robot is an intelligent assistant for the teacher and a learning partner for the student, not a replacement. Secondly, the

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use of robots should help teachers optimize instructional design. For example, before class, the robot pushes preview materials and conducts small quizzes to assess baseline knowledge. During class, the teacher explains core theories and difficult points, while the robot assists students with basic case simulation exercises. After class, the robot assists in providing personalized exercises, Q&A, and policy update notifications; the teacher answers deep questions online that the robot cannot handle. Strengthen teacher training to enhance their ability to use robots for instructional design, classroom management, data analysis, and solving problems beyond the robot's capabilities. Strive to achieve the effect of students conducting independent and innovative learning under teacher guidance [9].

5.4 Build Interdisciplinary Teams and Improve Support Mechanisms

The problem of disconnection between robot functions and actual teaching needs can be addressed by forming interdisciplinary teams. Project teams should deeply integrate tax law faculty, educational technology experts, AI engineers, robotics engineers, and instructional design experts to ensure technology serves real teaching needs. Simultaneously, enhance user (teacher) training and support, providing systematic training covering robot operation, human-machine collaborative instructional design concepts and methods, data interpretation, and basic troubleshooting. Through in-depth communication with teaching staff, design standardized, configurable simulation scenario scripts and digital resource packages covering different tax types, business types, and complexity levels for the robot to use.

5.5 Establish Sound Ethical Norms and Privacy Protection Systems

Strengthen transparency and informed consent. Clearly inform teachers and students about the scope of data collection and its purpose, obtain explicit informed consent, allow users to opt-out of certain data collection features, and establish clear accountability mechanisms[10]. Within school management systems, pre-define principles for liability attribution in case of teaching accidents or erroneous guidance during robot use.

6. Conclusion

The application prospects demonstrated by humanoid robots in tax law course teaching are exciting. Their anthropomorphic interaction capabilities offer a new path to alleviate the tedium of learning tax law provisions. Their potential for scenario simulation bridges the gap between classroom theory and complex tax practice. Their personalized service characteristic opens possibilities for meeting students' differentiated learning needs. These values align with the core goals of enhancing teaching efficiency, optimizing learning experiences, and promoting educational equity.

With continuous breakthroughs in AI technology, gradually decreasing costs, and evolving teaching philosophies, humanoid robots are expected to play a deeper and more flexible role in tax law teaching, evolving from assistants in knowledge transmission to wise partners inspiring thinking and empowering practice. The success of this process will ultimately depend on our ability to be guided by the essential needs of education, oriented towards solving real-world problems, achieving deep integration of technological innovation and humanistic care, and jointly shaping a new paradigm for tax law education in the intelligent era.

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