International Journal of Education and Humanities
ISSN: 2770-6702 | Vol. 17, No. 1, 2024

Research on Virtual Simulation Experiment Course for Enterprise Decision-Making based on Multilateral Dynamic Game

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Abstract: Virtual simulation experiment serves as a bridge that organically connects innovation and entrepreneurship classes with professional quality education, fostering a talent cultivation ecosystem that supports high-quality economic development and exerts significant social influence. Currently, there are many shortcomings and bottlenecks in both virtual simulation experiment and the teaching process. This paper discusses the necessity and objectives of the virtual simulation experiment course for enterprise decision-making based on multilateral dynamic game, experimental principles, experimental characteristics, and experimental steps under the principle of "being real and not fictitious, simulating reality with virtuality, and grounding in reality". The experimental platform utilizes real business case that participants can freely choose. Through online human-computer interaction and interaction, as well as offline team discussions, participants are empowered to make independent decisions throughout the experiment. With the assistance of system prompts and task-driven guidance, participants can autonomously complete the experiment. This paper aims to promote the establishment of a virtual simulation experiment platform for enterprise decision-making based on multilateral dynamic game, specifically designed for business students, contributing to the construction of a strong higher education nation.

Keywords: Multilateral Dynamic Game; Enterprise Decision-making; Virtual Simulation Experiment; Course Research.

1. Introduction

The "China Education Modernization 2035" plan focuses on promoting the extensive integration of education with virtual reality and information technology, supporting the construction of a strong education nation. Virtual simulation technology has been widely applied in fields such as medicine, architecture, and mechanics[1, 2, 3]. However, there has been relatively little attention given to its integration with courses related to accounting and financial management. Currently, it is difficult to conduct such entity experiment in undergraduate teaching. Therefore, it is crucial to integrate the actual conditions of accounting and financial management courses to help students experience the internalization of ethics and decision-making behavior of economic contract thinking, business rules, legal awareness, and corporate social responsibility in their professional education. Using virtual simulation experiment can address high costs and irreversibility issues caused by inaccessible real decision-making scenarios, errors in actual decisions, and moral hazards. Additionally, it can ensure a larger scale of students benefiting from comprehensive training.

Simultaneously, enterprise decision-making experimentation is an important experimental project for core courses in management-related majors, such as "Professional Innovation Spirit and Practice" "Financial Decision Support Systems," and "Auditing". The effective implementation of this experiment can significantly stimulate the enthusiasm of management students for learning, enhance their professional passion, and promote their overall understanding of the disciplinary knowledge and systematic thinking in the discipline.

2. Necessity of the Virtual Simulation Experiment Course for Enterprise Decision-Making Based on Multilateral Dynamic Game

(1) Inaccessibility of Real Scenarios for Multilateral Dynamic Game Based Enterprise Decision-Making.

There are few experimental opportunities for social entities, and the limitations of physical spaces make it difficult to have personal experiences. Core decisions in actual enterprises are hard to entrust to students, and traditional experimental teaching cannot fully create an environment of multilateral dynamic game between enterprises and external. Virtual simulation technology combines real cases with real data into the classroom, allowing students to engage in virtual training activities anytime and anywhere using personal computers and other terminal devices, solving the issues of limited practical opportunities and inability to train professional skills.

(2) High Trial-and-Error Costs in Social Entity Experiment.

The decision-making results of enterprises based on multilateral dynamic game are irreversible and the consequences of decision-making errors are serious. Social entity enterprises vary in quality, and experiment may face problems such as limited ability of enterprise management personnel, inadequate financial management systems, weak risk resilience, high operational risks, and insufficient funds. Non-professional decision-making is prone to trial-and-error costs, which could cause great losses to the country and enterprises. Conversely, virtual simulation experiment has well-defined error tolerance mechanism, allowing students to repeatedly conduct experiment in the virtual environment, discover and summarize errors. Through the accumulation of

experience in virtual simulation experiment, they will greatly improve their business decision-making ability in practical work in the future, thereby reducing trial-and-error costs.

(3) Long Cycle of Entity Experiment.

The manifestation cycle of enterprise decision-making effects is long, often taking several months or even more than a year. The short-term and long-term effects of decision-making have a large span, and it is difficult to form an overall evaluation of the decision-making effect in the short term and conduct a comprehensive and systematic learning practice for students. The virtual reality technology of human-computer interaction compresses the experimental process, thereby significantly enhancing learning efficiency and effectively solving the problem of long entity experiment cycle.

(4) Complexity of Influencing Factors in Multilateral Dynamic Game.

Due to the complexity of society, economy, and dynamic game, traditional teaching experiment is difficult to cover the various factors involved. The virtual simulation experiment course can visualize abstract and difficult-to-implement steps, creat concrete decision-making scenarios, effectively address the "pain points" in professional education, stimulate students' initiative and enthusiasm for decision-making exploration, and improve the quality of talent cultivation.

Using information technology solve the problem of students' "unknowable" through enterprise business environment simulation, solve the problem of students' "impossible" through process simulation, and solve the problem of students' "unreachable" through decision game simulation. Integrating multidisciplinary knowledge and skills into virtual simulation education to improve students' practical and innovative abilities. Therefore, it is necessary to conduct virtual simulation experiment course for enterprise decision-making based on multilateral dynamic game.

3. Objectives of the Virtual Simulation Experiment Course for Enterprise Decision-Making based on Multilateral Dynamic Game

(1) Value Shaping Goal

The virtual simulation experiment course for enterprise decision-making based on multilateral dynamic game simulates the scenario of Chinese enterprises going global by firmly believing in cultural confidence and mission responsibility, demonstrating the strength of Chinese enterprises in international competition, and enhancing the patriotism and mission responsibility of the younger generation; The virtual simulation experiment course for enterprise decision-making based on multilateral dynamic game enhances the awareness to adhere to the risk management mindset, reproduces the complex environment and risk crisis faced by enterprises in multilateral dynamic game (Ren et al., 2022)[4], strengthens students' risk management mindset, improves risk prediction and prevention awareness, and enhances their awareness of "sense of crisis in times of safety" (Yan and Pourdavood, 2024)[5]; The virtual simulation experiment course for enterprise decision-making based on multilateral dynamic game highlights the professional spirit, entrepreneurial spirit, and humanistic care awareness, cultivates students' use of scientific analysis methods for risk prevention and rational decision-making, enhances their professional ethics, moral responsibility, and humanistic care awareness, and achieves high levels.

(2) Knowledge Exploration Goal

Virtual simulation technology creates vivid and realistic management scenarios and processes, achieving a design of "real enterprise, real data, real tools, real positions, and real scenarios" through diversified interface expressions. It guides students to independently learn about corporate governance structure, organizational structure setting and division of rights and responsibilities, corporate culture, business management, and auditing practices, etc. Through role-playing and integrating theory with practice, students form original solutions, analyze and solve practical operational issues, improve their decision-making ability in multilateral dynamic game in complex environments, and achieve innovation.

(3) Ability Improvement Goal

The virtual simulation experiment course for enterprise decision-making based on multilateral dynamic game guides students to use mature theoretical models to assist decision-making, cultivates students to use a combination of qualitative and quantitative methods, and improves their ability to make scientific decisions; The experiment sets up complex case scenarios and provides open real data, requiring students to complete decision-making problems that are close to reality (Jung and Jeong, 2018)[6], practically apply what they have learned, independently design and explore reasonable solutions innovatively, and improve their ability to explore independently; The experiment set up team cooperation tasks which requires team members to independently choose case scenarios, stages, and content, make scientific strategic decisions based on collective wisdom, discuss reasonable risk prevention and response plans to train their decision-making ability and internalize risk methods, and improve team collaboration ability, and has a certain level of challenges.

4. Principles of the Virtual Simulation Experiment for Enterprise Decision-Making based on Multilateral Dynamic Game

The experimental course is based on the market environment of virtual enterprise operation, utilizing virtual simulation to simulate enterprise decision-making and improve students' comprehensive practical abilities.

(1) Game Simulation Integrated with Economic Game Theory

Students are assigned to several enterprise-like operating entities, taking on different roles within enterprises, including general managers, marketing managers, financial managers, etc., engaging in games within various market environments, and receiving comprehensive evaluation of their performance. The ever-changing market demands allow competitors more space for thought and decision-making.

(2) Process Design Integrated with Industry Chain Thinking

In the virtual simulation experiment for enterprise decision-making based on multilateral dynamic game, both upstream and downstream organizations reference the business processes of mainstream domestic enterprises. Key tasks and daily work tasks extracted for various positions are designed to closely resemble actual organizational operations, achieving process simulation.

Enterprise Operating Environment Integration with

Experimental Economics Theory

The virtual simulation experiment for enterprise decision-making based on multilateral dynamic game encompasses all aspects of the complete supply chain of enterprise operations, as well as various forms of simulation organizations such as related service industries and administrative management institutions (Richards and Taylor, 2015)[7], such as virtual enterprises, tax management departments, industrial and commercial administrative departments, consulting agencies, banks, etc. Students are required to conduct policy analysis, market forecasting, product production, sales, after-sales service, and internal management of enterprises in a virtual operating environment (Silva et al., 2012)[8]. The key functional departments and major job positions of the enterprise have been distilled and simulated, achieving a comprehensive virtual environment setup.

5. Characteristics of Virtual Simulation Experiment for Enterprise Decision-Making based on Multilateral Dynamic Game

(1) Focus on Cultivating Students' Comprehensive Abilities in Solving Complex Problems and High-Level of Abstract Thinking.

Based on the research achievements accumulated by university faculty, the virtual simulation experiment for enterprise decision-making based on multilateral dynamic game implements scenario-based simulations, by big data support, advanced hardware infrastructure and technical and software systems support, comprehensive case experiments from interdisciplinary courses, innovation in teaching and research, multidisciplinary collaborative innovation, sharing of case resources information, data openness and interoperability, and a fully open and shared professional integrated virtual simulation new experimental ecosystem, aimed at cultivating high-level professional talent.

Firstly, the experimental teaching process reflects the cultivation of high-level thinking, covering content related to analysis, synthesis, problem solving, critical thinking, rational thinking, critical questioning or daring exploration, reflecting diligently, application of technology, creativity, and evaluation, etc. Secondly, The experiment implements a tripartite management talent cultivation philosophy of "thought leadership, knowledge impartation, and capability development", ensuring a balance in the cultivation of knowledge, ability, and quality throughout the process, with clear teaching trajectory of integrating the three aspects. Thirdly, to develop students' comprehensive abilities to solve complex problems, the experimental teaching presents issues involved in multiple factors, layers, and changes, thereby encouraging students to utilize their multifaceted abilities for problem-solving.

(2) Innovation in Experimental Course Content, Teaching Formats, and Learning Segments.

The course content reflects cutting-edge and contemporary themes, while the teaching formats demonstrate advancement and interactivity, and the learning segments emphasize inquiry and personalization. Inspiring teaching condenses course content and cases, making up for the lack of existing courses where students, as participants, do not express their own voices, share their insights, expectations, and suggestions. Firstly, the experimental teaching methods adopt a multidimensional perspective, aligning with students' learning needs and motivational characteristics, as well as the characteristics of the curriculum content, effectively stimulating students' motivation to learn and providing more learning opportunities while avoiding irreversible issues of real operational losses. Secondly, the experimental teaching content keeps pace with the forefront of the times, disciplinary research and technological applications, presenting content complies with relevant regulations, and the evaluation system that balances "process" "results" and "capabilities" can differentiate between different types of students, achieving "teaching according to students' aptitude". At the same time, the design of repeated experimental functions can instantaneously provide students with assessment feedback on their performance, thereby driving proactive learning and improvement through guiding mechanism. Thirdly, experimental teaching can effectively organize each teaching segment according to the onsite teaching scene, take measures to promote effective communication, sharing, and meaning construction among teachers and students, as well as between students themselves in terms of knowledge, experience, and other aspects. Real time tracking of the "process" and systematic intelligent scoring can be carried out, thereby leveraging the intelligent and dynamic advantages of machine evaluation and obtaining objective evaluation. Fourthly, the teaching process reflects inquiry, focusing on the presentation of problems and problem-solving scenarios to inspire students' independent learning and collaborative exploration. Fifthly, the experimental teaching process reflects the consideration of personalized needs of students, including but not limited to learning tasks and content, requirements for questioning and answering methods, homework, praise, evaluation and feedback, etc., allowing differentiation based on students' personalized learning characteristics.

(3) The Challenge of Experimental Teaching Design and Processes.

Experimental teaching broadens the breadth of knowledge systems or deepens its construction, breaking away from original frameworks and mainlines, allowing students to attain a higher perspective. Instructors possess the abilities to refine knowledge, constantly reflecting and summarizing, adjusting, and optimizing (Scherer et al., 2021)[9]. Examples and applications of knowledge points reflect frontiers and contemporary characteristics, as instructors timely introduce academic research and frontier achievements of technological developments into the course, incorporating research-oriented, innovative, and comprehensive content to enhance student engagement, scientifically "increasing the load", and allowing students to experience the learning challenge of "jumping one step to obtain" in teaching design and teaching process. Firstly, prior to experimental teaching, instructors familiarize the psychological characteristics of students' learning and the gap between existing development levels and the ideal objectives of the experimental course. Secondly, during the experimental teaching, it is important to reasonably select and supplement teaching content, assign homework, and provide extracurricular reading materials based on students' psychological characteristics and their existing development levels. Thirdly, after experimental teaching, the assessment of course grades reflects a unified approach of formative and summative evaluations. The overview of the characteristics of experimental teaching is illustrated in Figure 1.

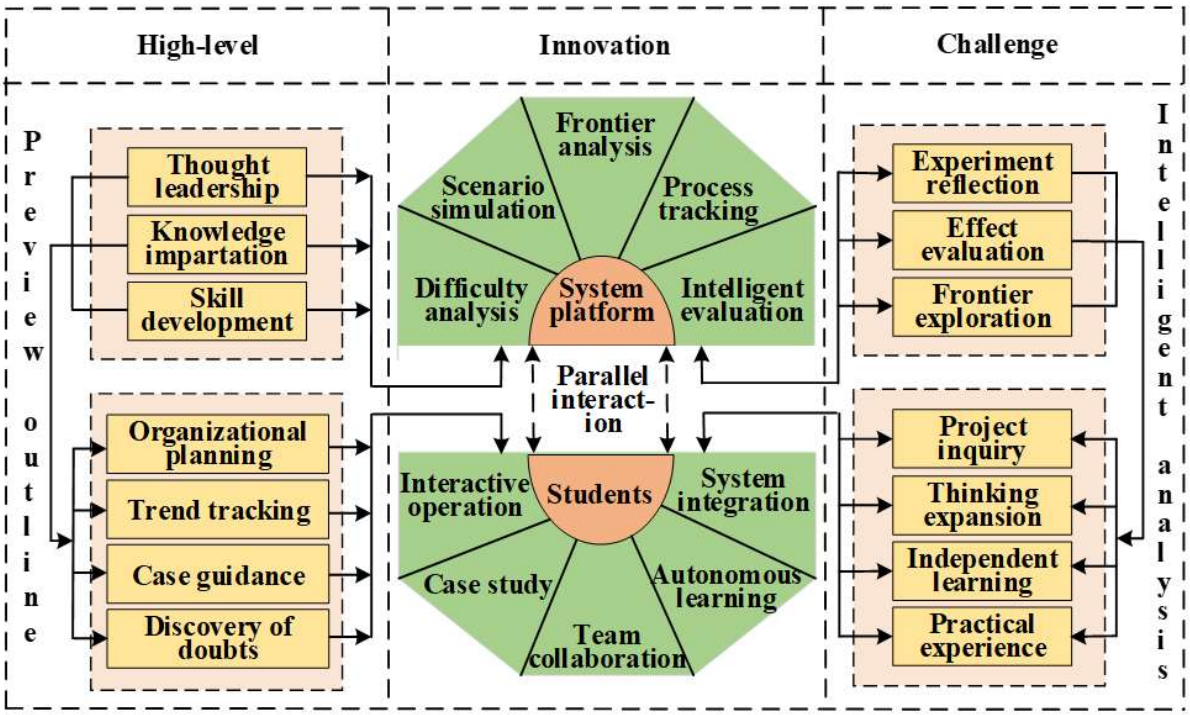

Figure 1. Overview of the Characteristics of Experimental Teaching

6. Steps for Virtual Simulation Experiment of Enterprise Decision-Making based on Multilateral Dynamic Game

In the decision-making preparation stage, multiple learning resources are embedded, and students can first enter this stage to learn about relevant experimental content and understand the decision-making background information. On this basis, a one hour offline course is set up first, where the instructors concentrate on explaining the decision-making rules and guiding students to carry out the preliminary construction of experimental projects and the first operational decision, and allowing students to familiarize themselves with the decision-making rules independently.

In the operational decision-making stage, students can complete the decision game process according to the operational guidelines. After students complete the input of decision variables, the system automatically calculates and assigns orders, presenting sales revenue and operational results. Once the game results are available, the system completes the display and evaluation of the first decision business results. The remaining two consecutive decisions are made by students as the main body, and they are trained independently according to the basic experimental process prompts within the limited completion time period. During this process, online and offline teacher-student interactions and Q & A can be conducted. After the final overall operational ranking is released, teachers can review and comment on the process through a one hour offline class.

In the comprehensive evaluation stage, students can choose either the online pairwise PK mode (randomly matching opponents) or the single person online question-answer mode to complete random question-and-answer tasks and confirm submission, and the system provides feedback on their scores. Multiple answers are allowed, and the highest score achieved will be taken as the final grade for this stage.

In the experimental report stage, students independently review the gains and losses of the decision-making process during the experiment, reflect on methods for optimizing decisions, and promote their disciplinary thinking from their summaries.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this paper.

Acknowledgments

This study was supported by Jiangsu Provincial Science and Technology Plan Project (Innovation Support Plan Soft Science Research) "Collaborative Mechanism and Implementation Path of Low Carbon Governance in Intelligent Agriculture Driven by Digital Economy" (BR2023020-3); Sichuan Provincial Philosophy and Social Science Foundation Project "Research on Audit Governance of ESG Greening Behavior in Enterprises and Its Economic Consequences" (SCJJ23ND176); Special Funding for Postdoctoral Research Projects in Sichuan Province "Research on ESG Assurance Empowering Sustainable Development of Enterprises" (TB2023089); Yangzhou 2024 Municipal Social Science Research Project (Audit Special) “Management and Audit Optimization Mechanism for Local Government Special Bonds” (3); Research Project of Yangzhou University on Teaching Reform "Research on Virtual Simulation Technology and Innovation and Entrepreneurship Ethics Literacy Education of Accounting Majors" (YZUJX2022-C18); Research Project of Yangzhou University on Teaching Reform (Undergraduate Discipline Competition Special) "National Undergraduate Tax Risk Management Case Competition" (44).

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