Journal of Education and Educational Research
ISSN: 2957-9465 | Vol. 16, No. 1, 2025

Innovation and Reform Pathways in Game Theory Education for Graduate Students

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Abstract: This paper focuses on the innovation and reform of teaching models for graduate-level courses in Game Theory. In response to the challenges of talent cultivation in the new era, the study aims to enhance teaching quality by introducing diversified instructional methods, optimizing course content, integrating teaching resources, and establishing a systematic evaluation mechanism. The project seeks to break through the constraints of traditional teaching models, stimulate students' interest, and improve both theoretical understanding and practical application of Game Theory. Through the implementation of this reform, students are expected to develop solid theoretical foundations, strategic thinking, and innovative capabilities, which will benefit their future academic research and professional development. Moreover, the outcomes of this project can serve as a valuable reference for the reform of related courses, thereby promoting the overall quality of graduate education.

Keywords: Graduate Education; Game Theory; Teaching Reform; Innovation.

1. Introduction

Game Theory, as a fundamental analytical framework in modern economics, management, political science, and related disciplines, has been widely applied in areas such as market competition, organizational cooperation, public policy, international relations, and artificial intelligence [1]. With the ongoing digital transformation and the advancement of complex systems research, Game Theory has played an increasingly critical role in strategic decision-making and resource allocation. It has become a core course for cultivating graduate students' logical reasoning, modeling competence, and research innovation skills [2]. At the graduate level, Game Theory is not only responsible for systematically delivering theoretical knowledge but also for fostering academic thinking, interdisciplinary perspectives, and practical problem-solving abilities [3].

However, in current graduate education practice, the teaching of Game Theory still faces several challenges. On one hand, many curricula overemphasize mathematical deduction and theoretical derivation while neglecting interdisciplinary and real-world cases. As a result, students often fail to connect abstract theory with practical issues, leading to insufficient learning motivation and weak awareness of application [4]. On the other hand, teaching methods remain largely lecture-based, with limited classroom interaction and opportunities for independent exploration, making it difficult to cultivate students' critical thinking and teamwork skills effectively [5]. Moreover, assessment approaches tend to focus on final examinations and theoretical mastery, lacking a comprehensive evaluation of research capability, practical application, and creativity, which undermines the potential of Game Theory courses in talent development [6].

In the context of improving graduate education quality and advancing the "New Business" initiative in China, balancing theoretical rigor and practical relevance in Game Theory teaching has become an urgent issue [7]. In recent years, case-based learning, problem-based learning (PBL), flipped classrooms, and digital–intelligent teaching platforms have provided new ideas and tools for pedagogical reform in this field [8]. Through systematic innovation in curriculum design, teaching methods, interactive mechanisms, and assessment systems, it is possible to enhance students' strategic thinking and research competence, strengthen the connection between theoretical learning and real-world analysis, and cultivate interdisciplinary, high-level professionals capable of addressing complex strategic challenges [9].

Based on this perspective, this paper takes graduate education in Game Theory as its focus. It systematically reviews the current teaching situation and existing problems, integrates trends in educational digitalization, case-driven instruction, and interdisciplinary collaboration, and explores innovative models and reform paths suitable for graduate training objectives. The aim is to provide theoretical insights and practical references for Game Theory curriculum development and for improving the overall quality of graduate education.

2. Current Situation and Major Challenges in Graduate Game Theory Teaching

As a core course in graduate education, Game Theory has played an important role in higher education systems both in China and abroad [3,6,10]. However, in current practice, a number of shortcomings still exist in the teaching of this course in China. The main problems and challenges can be summarized as follows.

(1) Outdated course content and weak linkage between theory and practice.

Most graduate-level Game Theory courses remain focused on classical theoretical models and basic equilibrium analysis. The curriculum often emphasizes mathematical deduction and logical reasoning while paying limited attention to recent academic advances and frontier applications [2,9]. For example, the applications of Game Theory in fields such as the digital economy, international competition, and environmental governance are not adequately integrated into teaching. This limits students' understanding of the real-world

relevance of theoretical models and their ability to apply such knowledge to practical problem-solving.

(2) Monotonous teaching methods and low student engagement.

At present, classroom instruction is still dominated by teacher-centered lecturing, with students mainly acquiring knowledge through listening and completing assignments [2]. This "transmission-oriented" approach lacks interactivity and student participation, offering few opportunities for questioning, discussion, or independent inquiry. As a result, students' initiative and creativity are insufficiently stimulated [5]. This is particularly problematic at the graduate level, where emphasis should be placed on academic inquiry and research training—areas that current methods fail to adequately support [3,10].

(3) Insufficient practical teaching components.

As an application-oriented discipline, the essence of Game Theory lies in applying models and methods to real-world problems. Yet, practical elements in the current curriculum remain weak. Students rarely have opportunities to conduct simulation experiments, case analyses, or strategic decision exercises using game-theoretic models [2. 4, 6, 9]. Consequently, their ability to apply theoretical knowledge and engage in research-based problem-solving is undermined, and the educational function of the course is not fully realized.

(4) Limited and unbalanced evaluation mechanisms.

In most universities, final examinations remain the primary basis for assessment, emphasizing theoretical mastery while neglecting process-based learning and comprehensive ability development [6,8]. Students' performance in areas such as case studies, group discussions, academic writing, and innovative thinking is often excluded from systematic evaluation. This outcome-oriented approach fails to reflect students' real competence and overall quality, thereby dampening their learning motivation and creativity.

(5) Inadequate support for teaching innovation and resource sharing.

On the one hand, in terms of pedagogy, training systems designed to improve modern instructional skills—such as case-based teaching, simulation experiment design, and the use of digital–intelligent tools—remain underdeveloped. Teachers' practical competence and confidence in implementing innovative teaching approaches require systematic enhancement [2,8]. On the other hand, at the resource level, mechanisms for cross-disciplinary and inter-departmental collaboration are still weak. The absence of an open, shared case database and simulation platform for Game Theory restricts the advancement, practicality, and interdisciplinary nature of course content, thus hindering the cultivation of high-level, integrative talents.

In response to these challenges, this study aims to optimize course content, innovate teaching methods, improve assessment systems, strengthen practical components, and enhance faculty development. Through these efforts, the project seeks to improve the overall quality and effectiveness of Game Theory teaching, cultivating graduate students with solid theoretical foundations and strong practical and analytical abilities.

3. Overall Reform Framework and Innovation Design

3.1. Reform Objectives

In response to the current challenges in graduate-level game theory education—including the gap between theory and practice, limited teaching methods, weak practical components, incomplete evaluation systems, and insufficient teaching innovation capacity—this study aims to construct an ability-oriented and innovative teaching system through systematic reform. The core objectives of the reform include:

(1) Achieving dynamic updates of teaching content and alignment with the latest academic frontiers, while strengthening the application of game theory in areas such as economics and management, artificial intelligence, and public policy.

(2) Transforming teaching methods from a "knowledge transmission" model to an "interactive inquiry-based" model to enhance student engagement and learning initiative.

(3) Establishing a multi-level practical teaching system to develop students' abilities in model building, experimental simulation, and decision analysis.

(4) Improving a diversified evaluation mechanism that integrates formative and summative assessment, thereby promoting students' comprehensive competence and innovative capacity.

(5) Enhancing teachers' awareness of pedagogical innovation and their digital teaching capabilities, while encouraging high-quality resource sharing and collaborative teaching development.

3.2. Reform Principles

To ensure the systematicity and effectiveness of the reform, the study adheres to the following key principles:

(1) Student-centered approach: Focus on graduate students' learning needs and developmental characteristics, emphasizing self-directed inquiry and collaborative learning.

(2) Competence-oriented principle: Center on cultivating strategic thinking, logical reasoning, and innovative decision-making skills, highlighting the principle of "learning for application."

(3) Integration of education and practice: Strengthen collaboration between universities, research institutions, and enterprises to facilitate the application of game theory in real-world decision-making contexts.

(4) Digital empowerment principle: Utilize simulation platforms, data analysis tools, and intelligent teaching technologies to enhance classroom interaction and instructional precision.

(5) Interdisciplinary collaboration: Promote the integration of game theory with disciplines such as economics, management, computer science, and public policy, broadening students' perspectives on application and research.

3.3. Overall Approach

This study follows the reform logic of "competence cultivation—process guidance—practice innovation," and builds a comprehensive teaching framework centered on content renewal, pedagogical innovation, enhanced practical components, and optimized evaluation mechanisms.

The overall approach includes:

(1) Competence-centered objectives: Defining the game theory curriculum as a platform for developing graduate students' analytical, research, and innovative abilities.

(2) Pedagogical innovation: Introducing case discussions, simulation experiments, and flipped classrooms to improve students' participation and depth of reasoning.

(3) Practice-oriented design: Strengthening experimental simulation, interdisciplinary project research, and industry

cooperation to enable students to apply theoretical models to real-world problems.

(4) Evidence-based evaluation: Establishing a multidimensional assessment system covering learning processes, practical performance, and research outcomes.

3.4. Innovation Framework

Based on the reform objectives and overall approach, this study constructs an innovative teaching framework consisting of four key dimensions: goal, content, method, and evaluation.

(1) Goal dimension. Cultivate high-level, interdisciplinary talents with strong theoretical grounding, applied competence, and innovative thinking.

(2) Content dimension. Expand course content from classical theory to frontier applications by incorporating cases from the digital economy, artificial intelligence, and public management.

(3) Method dimension. Implement a blended teaching model combining lectures, case studies, experiments, and seminars to strengthen interactivity and inquiry-based learning.

(4) Evaluation dimension. Develop a comprehensive assessment system integrating three dimensions—knowledge mastery, ability application, and innovation performance—to promote students' holistic development.

4. Pathways for Innovating Graduate Game Theory Teaching Models

To address the current challenges in graduate-level game theory education—namely outdated content, limited teaching methods, insufficient practical components, delayed evaluation mechanisms, and weak faculty support—this study proposes innovative pathways across five dimensions: curriculum content, teaching methods, practical components, evaluation systems, and faculty development. The goal is to construct a systematic, open, and high-performing teaching model.

(1) Optimizing Curriculum Content: Enhancing Frontier Orientation and Interdisciplinary Integration

In curriculum design, it is essential to retain the classical theoretical framework of game theory while introducing the latest research findings and interdisciplinary applications. For example, integrating game theory with fields such as artificial intelligence, blockchain, the digital economy, and public governance can help connect theory with real-world issues. By drawing on cutting-edge academic papers, experimental results, and contemporary social cases, students can better understand the relevance of game theory to complex problems, thereby enhancing both the timeliness and practical value of the course.

(2) Innovating Teaching Methods: Strengthening Interaction and Inquiry

To improve classroom engagement, a variety of learner-centered approaches—such as flipped classrooms, seminar-based instruction, case-driven learning, and situational simulations—should be employed. For instance, students can be organized into groups to perform role-playing and strategy design exercises around cases such as business competition, international negotiation, or platform-based games. Beyond the classroom, students may be encouraged to explore open-ended research questions using mathematical derivation and computational experimentation, which helps cultivate independent thinking, research competence, and teamwork.

(3) Reinforcing Practical Components: Emphasizing Application and Experimentation

Practical and experimental learning components should be strengthened within the curriculum. A dedicated game theory laboratory platform can be established, where simulation software and computational experiments create virtual game environments for students to test strategies and analyze outcomes. Moreover, collaboration with enterprises and research institutions should be expanded to design practice-oriented projects. Such integration of academia, research, and industry will enable students to apply game-theoretic tools in real-world decision-making contexts, thereby improving their analytical and problem-solving capabilities.

(4) Improving the Evaluation System: Promoting Process Orientation and Diversity

The evaluation mechanism should shift from a single "result-oriented" model to a comprehensive framework that values both process and outcomes. In addition to final examinations, assessments should incorporate class participation, group case studies, experimental simulations, and course papers. A balanced combination of quantitative and qualitative assessment, as well as individual and team performance, can more accurately reflect students' depth of learning, practical application ability, and creative potential.

(5) Strengthening Faculty Development and Resource Sharing: Enhancing Instructional Support

Faculty development plays a vital role in ensuring the sustainability of teaching innovation. Instructors should be encouraged to update their knowledge structures continuously, engage in frontier research in game theory, and participate in interdisciplinary projects. Training programs on pedagogy, digital teaching tools, and case-based instruction should be strengthened to enhance teaching effectiveness. At the same time, an inter-university and interdisciplinary resource-sharing network should be established, providing open access to teaching cases, simulation platforms, and instructional outcomes, thereby fostering a collaborative and co-evolving teaching ecosystem.

The innovation of graduate-level game theory teaching requires systematic planning and phased implementation. Through coordinated efforts in content renewal, pedagogical innovation, practical enhancement, evaluation reform, and faculty development, a comprehensive educational system integrating theory, practice, and innovation can be gradually established. This system will provide strong support for cultivating high-caliber, interdisciplinary talents with both theoretical depth and practical competence.

5. Conclusion

This study examines the current state of graduate-level game theory education and identifies key challenges, including outdated course content, limited teaching methods, insufficient practical components, inadequate evaluation systems, and weak faculty support. In response, it proposes targeted reform pathways in five areas: optimizing curriculum content, innovating teaching methods, strengthening practical components, improving evaluation mechanisms, and enhancing faculty development.

These reform initiatives aim to shift the focus of graduate game theory education from knowledge transmission to competence cultivation, thereby building an innovative teaching model that integrates both theoretical depth and practical relevance. The innovation of teaching models for graduate game theory is a long-term and systematic endeavor

that requires continuous exploration and dynamic improvement.

With the ongoing renewal of educational philosophies and the enhancement of teaching resources, the reform framework proposed in this study offers valuable insights for improving the quality of graduate education. Moreover, it contributes to the broader goal of fostering innovative talent cultivation models capable of meeting the evolving demands of high-level education and research.

Acknowledgments

The authors are grateful to the editors and anonymous reviewers for their insightful comments which have lead to an improved version of this paper. This work was supported by Sichuan University of Science & Engineering Postgraduate Educational Reform Project (Nos. JG202409, JG202407), Yibin Federation of Social Sciences (No. YB25ND036), the System Science and Enterprise Development Research Center Project (No. Xq21B07), Sichuan University of Science & Engineering Educational Reform Project (JG-24007), and the Humanities and Social Sciences of Ministry of Education of China (No.23YJA630126).

References

[1] Zhang Weiying. Game theory and information economics. New 1st Edition [M]. Truth & Wisdom Press, 2012.

[2] Ji Chunyi. Research on the teaching reform of "Game Theory" under the background of "Internet+" [J]. Journal of Science & Education, 2023(18): 114-116.

[3] Zhao Zhouhua, Mei Lei. Cultivating research competence in graduate course reform under "Double First-Class": A case study of "Game Theory" course [J]. Coal Higher Education, 2019, 37(3): 121-126.

[4] Jian Xiaoyou. Application of case-based teaching methods in game theory courses [J]. Innovation and Entrepreneurship Theory and Practice, 2021, 4(14): 10-14.

[5] Xiang Lijing. Heuristic teaching model research in finance-related game theory courses [J]. Journal of Inner Mongolia University of Finance and Economics, 2018, 16(1): 123-125.

[6] Wang Dan, Li Jiayang. Teaching reform of graduate-level foundational and applied game theory courses [J]. Modern Communication: Academic Edition, 2016(14): 253-254.

[7] Li Zhi, Zhou Weizhi. Exploration of teaching reform in undergraduate management major "Game Theory" courses [J]. Education and Teaching Forum, 2016(3): 74-75.

[8] Peng Ziran, Meng Shuangwu. Cultivation of higher education teaching and research reform projects from the perspective of graduate education [J]. China Multimedia and Network Teaching Journal, 2025(1): 57-60.

[9] Li Baocheng, Yan Tao, Fan Jinhua. Teaching reform of public mathematics courses to enhance graduate innovation ability: A case study of Advanced Engineering Mathematics at Nanjing University of Science and Technology [J]. Journal of Science & Education, 2024(36): 59-61.

[10] Zhang Changqing, Geng Zhengrong. Teaching reform of game theory courses from the perspective of general education [J]. Business Economics, 2019, 12: 184-186.