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Research on the Strategies for Enhancing the Innovative Quality of Undergraduate Business Administration Students in the Digital Intelligence Era

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Abstract: Addressing the challenges of traditional, applied undergraduate business administration programs in innovative entrepreneurship education and interdisciplinary integration, such as overly monotonous course content and a lack of interactive teaching methods, this paper introduces the concepts of information technology and personalized teaching, integrating modern technologies such as big data and artificial intelligence with the business administration discipline to enhance students' innovative literacy and entrepreneurial capabilities. Specifically, by building an intelligent learning platform and deeply integrating it into practical activities, this approach stimulates students' innovative thinking and optimizes their entrepreneurial project design and teamwork skills. The experimental results showed that the experimental group's mean score for after-class practical projects is 85, with a standard deviation of 5.2, and their mean final score is 88, with a standard deviation of 4.7. In contrast, the control group's mean score for after-class practical projects is 75, with a standard deviation of 6.3, and their mean final score is 78, with a standard deviation of 6.1. The experimental group's scores are significantly higher than those of the control group in terms of innovation, entrepreneurship, teamwork, and practical application. The experimental group showed a particularly significant advantage in improving innovation and entrepreneurship, demonstrating the effectiveness of information-based teaching and interdisciplinary integration in improving college students' innovative literacy.

1. Introduction

With the rapid development of information technology in the new era, university student management models face an opportunity for transformation. The adoption of digital technologies offers a new path for university student management. This study explores how universities can leverage data mining and intelligent analysis to improve management efficiency and service quality in the current digital era. The article also reviews the current status of university student management. This study aims to explore and verify how a new educational model based on the digital era can enhance the innovative qualities of business administration students. Through

empirical analysis, it compares the effectiveness of different teaching strategies, hoping to provide useful reference for optimizing future educational models.

This paper first introduces the background and purpose of the study, explores the challenges and opportunities that the digital age brings to the teaching of applied undergraduate business administration, and clarifies the necessity of improving students' innovative literacy. Then, through a literature review, it reviews relevant research, analyzes the shortcomings of the existing education model and the current application status of innovative teaching methods. The research method section elaborates on the experimental design, including how to evaluate the effectiveness of the innovation literacy improvement strategy through comparative analysis of the experimental group and the control group. Next, the paper presents the experimental results through data analysis, verifying the positive impact of the new teaching model on students' innovative thinking, entrepreneurial ability and academic performance. Finally, the article summarizes the main findings of the study, discusses the limitations of the study, and proposes directions and room for improvement for future research.

2. Related Work

To benefit the teaching process of the Bachelor of Business Administration by implementing innovative educational practices, Rubio-Parodi and López-Jácome used a very qualitative approach and used methods such as document review and analytical synthesis. The results showed that innovative educational practices were conducive to the construction of teaching processes and the development of competencies of management students based on cooperation, leadership and business competitiveness [1]. To illustrate the effectiveness of online learning on the quality of education during the COVID-19 pandemic, Al-Quran et al. based their research design on quantitative data collected from students at various universities in Jordan. The results showed that the online education system of Jordanian universities during the COVID-19 pandemic depended on a variety of factors [2]. Szegedi et al. conducted a questionnaire survey on 1,188 business school students and conducted univariate and multivariate analyses using SPSS version 28 and AMOS version 28. The results showed that the most important factors affecting the quality of life of business school students were physical state, psychological state and family relationships [3]. Minh and Tien used exploratory factor analysis (EFA) and binary logistic regression models to measure and identify factors that affect job-seeking ability. The results showed that the factors affecting the employment opportunities of business school students abroad include two categories: internal factors and external factors. Internal factors mainly include skills and foreign language proficiency, while external factors include competition and economic conditions [4]. Ěal et al. concentrated on generative cognitive ability, a unique type of artificial intelligence that can produce a variety of content, including text, graphics, videos, audio, and software codes. People are very aware of and interested in developing content models, according to the data [5]. Berkery and Ryan first examined gender role stereotypes and required management traits among Irish business school students over a ten-year period using the Schein Descriptive Index. Specific descriptive items were tested using factor analysis, using Duncan's multiple range test. The results showed that the degree of gender role stereotypes in management roles varied among the male population studied [6]. To study educational technology adoption in the Indian context, Ravichandran and Shanmugam developed a conceptual structure based on qualitative data using an expanded version of a technology adoption model. The findings demonstrated that by emphasizing the critical elements influencing college students' adoption of educational technology products in educational institutions, the course enhanced the body of knowledge already in existence [7]. Abbas et al. examined the effects of public higher education institutions' quality management systems in London, UK, on the

employability among pupils majoring in managerial accounting, computer science, and engineering using a probabilistic convenience sample technique. According to structural analysis, industry-university collaboration somewhat mediated the relationship between the quality system for management and students' employability [8]. The OECD International Student Assessment Program's three main themes—creative expression, knowledge generation, and innovative problem solving—were the basis for Karunarathne and Calma's assessment of creativity. According to their investigation, pupils lack the capacity for creative thought, and evaluation assignments can help them develop these abilities [9]. During the height of the COVID-19 pandemic, Garcia et al. innovatively used collaborative online international learning experiences and transitioned to online learning to internationalize their undergraduate business courses. Comments from students in both nations on their end-of-course evaluations attested to the effectiveness of the educational process and the benefits of collaborating virtually with teachers and other students [10]. By investigating the mediating function of knowledge management skills and the regulating mechanism of collaborative culture, Le et al. will also expand their comprehension of the proper methods and conditions for enhancing particular facets of frugal innovation. The study's findings demonstrate that the influence of transformational leadership on particular facets of frugal innovation in businesses—such as frugal ecosystems, frugal costs, and frugal functionality—is considerably mediated by knowledge management capabilities [11]. Existing research generally focuses on the impact of a single factor on educational effects. It lacks a systematic analysis of educational model innovation and its long-term effects under the combined effects of multiple factors.

3. Method

3.1 Promoting Innovation, Entrepreneurship and Interdisciplinary Integration

3.1.1 Deep Integration of Innovation and Entrepreneurship Education with Business Administration Majors

To cultivate high-caliber individuals with innovative spirit and entrepreneurial capabilities, the teaching model of business administration programs needs to undergo a profound transformation, integrating innovation and entrepreneurship education with the curriculum and achieving an organic union of theory and practice.To effectively integrate the two, teaching activities should place greater emphasis on practical application and the cultivation of innovative thinking. For example, business courses on human resource management,marketing and electronic commerce could incorporate the latest entrepreneurial case studies. Students should not only understand theoretical knowledge but also apply it to real-world cases. Through team projects and business plans, this can stimulate their innovative thinking and enhance their ability to solve practical problems.

3.1.2 Breaking the Traditional Teaching Model and Promoting the Cross-Development of Innovation, Entrepreneurship and Subject Content

Currently, business administration curriculum is gradually showing a trend of integrating "theory and technology." By introducing modern technology courses such as Python programming, data mining, and business intelligence, this not only expands the depth of the curriculum but also enables students to better understand how to make business decisions in a data-driven environment.

(1) Promote the integration of disciplines, especially the design of the "Big Data + Management" co-construction course, which further promotes the intersection of management and technology disciplines.

Newly designed courses, such as "Big Data Human Resource Management" and "Big Data

Marketing," not only strengthen the technical foundation of management knowledge but also cultivate students' ability to comprehensively apply big data tools to analyze market and organizational behavior. Through this integration, students not only learn traditional management theory but also master how to use big data technology for more accurate market forecasting, decision support, and strategy optimization.

(2) In course design, it is necessary to ensure that "theory + practice" are given equal importance and emphasize the teaching concept of student-centeredness.

The course content aims not only to provide students with a solid theoretical foundation but also to encourage them to apply what they have learned to solve practical problems. Through case analysis, corporate collaboration projects, and real-world exercises, students will be able to continuously strengthen their ability to apply big data and management knowledge in practice and enhance their innovative ability to solve real-world problems.

3.2 Promoting the Reform of the Innovation and Entrepreneurship Curriculum System

3.2.1 Informatization Construction and Curriculum Reform

Informatization has driven the updating of curriculum content and innovation in its models. For example, the financial management course incorporates content on financial data analysis and risk early warning models, while the human resources management course introduces talent data modeling and forecasting techniques. These updates not only help students understand the practical application of traditional management theories but also equip them with the ability to apply modern technology to solve real-world business problems.

Informatization has also driven a transformation in curriculum models. Through online education platforms and intelligent learning systems, students can flexibly select learning content based on their individual needs and receive real-time feedback. This approach breaks the limitations of traditional classrooms, making teaching more flexible and interactive. Curriculum design is gradually shifting from solely theoretical learning to a comprehensive "theory + practice" approach. Students can use digital tools to participate in activities such as business simulations and case studies, enhancing their practical skills and innovative awareness.

3.2.2 Personalized Teaching and Differentiated Training

Driven by information technology, the reform of innovation and entrepreneurship curriculum systems should also focus on personalized teaching and differentiated training. This is not only a response to students' individual needs, but also a key measure to improve teaching effectiveness and stimulate students' potential.

(1) Information technology, especially big data technology, can provide students with customized learning paths

By analyzing student learning data, teachers can understand each student's learning progress, knowledge mastery, and interests, allowing them to develop personalized teaching plans. This data-driven teaching model allows for differentiated training tailored to the needs of individual students, enabling them to develop better along the most appropriate learning path. For example, if a student is particularly interested in or excels in a particular field, teachers can use the intelligent teaching platform to recommend relevant in-depth courses or practical projects to help students further develop in that area.

(2) Personalized teaching is also reflected in the adjustment of teaching content

Through big data analysis, teachers can assess students' learning difficulties and bottlenecks in real time, adjusting teaching content to ensure more targeted courses that meet students' individual

learning needs. For example, some students may show greater interest and aptitude in technical courses like digital marketing and data analysis. Teachers can provide more advanced course resources to further enhance their technical application skills. Other students, on the other hand, can choose courses related to management theory to cultivate their management decision-making and innovation capabilities based on their individual circumstances.

4. Results and Discussion

4.1 Experimental Group and Control Group

The experimental group will participate in a revamped innovation and entrepreneurship curriculum system, including interactive teaching, an information platform, case studies, and business simulations.

The control group will maintain the traditional business administration curriculum system, primarily teaching traditional management theory with limited practical activities.

Experiment Duration and Duration

Cycle: One semester (approximately 15 weeks)

Phase Division:

Preliminary Preparation (Weeks 1-2): Course arrangement, information platform development, and selection of the experimental and control groups.

Course Implementation (Weeks 3-12): The experimental and control groups will be taught according to different curriculum systems.

Post-Evaluation and Analysis (Weeks 13-15): The effectiveness of the experiment will be evaluated through various assessment methods (tests, questionnaires, and interviews).

4.2 Course Design and Teaching Arrangement

The experimental group integrates innovation and entrepreneurship education into the business administration curriculum, utilizing big data technology, artificial intelligence tools, business case analysis, and entrepreneurial project design, emphasizing the integration of theory and practice. After each module, students are given relevant practical activities (such as business plan development, market research, and business simulations).

The control group uses a traditional business administration curriculum, focusing primarily on theoretical knowledge, supplemented by case studies and classroom discussions.

4.3 Information Platform Construction

Providing students in the experimental group with an intelligent learning platform that can automatically push personalized learning content, case analysis, and project tasks based on learning progress, interests, grades, and other data.

The control group uses a traditional learning model, utilizing textbooks, classroom lectures, and paper-based assignments.

Practical Activity Design

Students in the experimental group participate in various practical activities (such as simulated business operations, entrepreneurial project design, and business competitions) and submit project plans or case studies online. Teachers provide feedback and guidance on these activities.

Students in the control group also participate in practical activities, but through traditional business case analysis and classroom discussions.

4.4 Data Collection

Initial Data (Week 1): Questionnaires and interviews are used to assess students' foundational levels of innovative literacy (e.g., innovative thinking and problem-solving skills).

Later Data (Weeks 13-15): Final exams, extracurricular practical assignments, student project results, and feedback questionnaires are used to assess students' improvement in innovative literacy and entrepreneurial skills. Observations focus on student performance in teamwork, project design, problem-solving, and entrepreneurial decision-making.

Using the quantitative assessment results of innovative and entrepreneurial skills, a before-and-after analysis is conducted between the experimental and control groups.

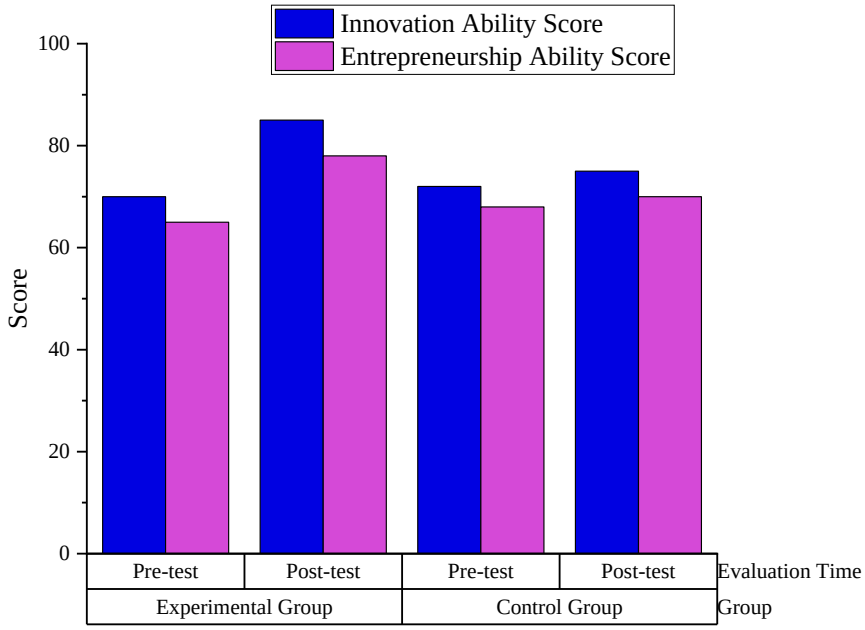

Figure 1. Quantitative evaluation of innovation and entrepreneurship capabilities

The experimental group's pre-test scores for innovation and entrepreneurship are 70 and 65, respectively. In the post-test, these scores rose to 85 and 78, respectively, representing significant improvements of 15 and 13 points, respectively. This change indicates that the experimental group experiences significant improvements in both abilities after the intervention of the innovation literacy enhancement strategy, reflecting the effectiveness of the strategy in enhancing students' innovative thinking and entrepreneurial practice (Figure 1).

In contrast, the control group's scores show a more gradual change. Their innovation ability score is 72 and their entrepreneurship ability score is 68 in the pre-test. By the post-test, their innovation ability score has only risen to 75 and their entrepreneurship ability score has only risen to 70, an increase of 3 points and 2 points, respectively. While the control group also shows some improvement, the magnitude of the increase is significantly smaller, failing to demonstrate the dramatic short-term progress seen in the experimental group.

Conduct statistical analysis on the evaluation of learning outcomes (such as after-class practical projects and final grades), using methods such as t-tests or analysis of variance to determine the significant differences between the experimental group and the control group.

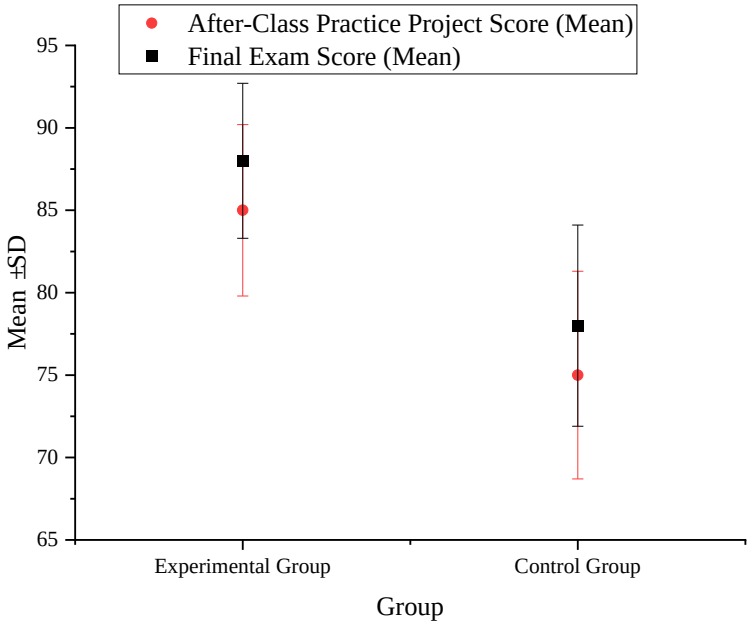

Figure 2. t-test

Figure 2 shows a t-test conducted on the after-class practical project scores and final exam grades of the experimental and control groups to examine the significant differences in learning outcomes between the two groups. The experimental group's mean after-class practical project score is 85, with a standard deviation of 5.2, and its mean final exam grade is 88, with a standard deviation of 4.7. In contrast, the control group's mean after-class practical project score is 75, with a standard deviation of 6.3, and its mean final exam grade is 78, with a standard deviation of 6.1. Analysis of the t-test results shows that the experimental group demonstrated significant advantages in both assessment dimensions.

Open-ended student feedback (e.g., through questionnaires and interviews) is collected and analyzed regarding the new teaching model, information platform, and practical activities.

Table 1. Analysis of students' open feedback

Feedback Topic	Experimental Group Student Feedback (Count)	Control Group Student Feedback (Count)	Rating (1-5)	Feedback Type
New Teaching Model	20	15	4.2	Positive Feedback: 70%; Neutral Feedback: 20%; Negative Feedback: 10%
Information Platform	18	12	4	Positive Feedback: 60%; Neutral Feedback: 30%; Negative Feedback: 10%
Practical Activities	22	16	4.5	Positive Feedback: 80%; Neutral Feedback: 15%; Negative Feedback: 5%
Overall Satisfaction	21	14	4.3	Positive Feedback: 75%; Neutral Feedback: 20%; Negative Feedback: 5%

In the analysis of students' open-ended feedback in Table 1, the experimental group's average

response to the new teaching model is 4.2. 70% of the students gave positive feedback, indicating that the model is widely accepted. Although 20% of students held neutral views and 10% offered negative feedback, the overall feedback remained positive.

The experimental group received a 4.0 rating for the information platform, with 60% of students providing positive feedback. This indicates that the use of the information platform received relatively positive reviews, although some students still offered suggestions for improvement. The experimental group received a 4.5 rating for the practical activities, with 80% of students providing positive feedback and only 5% providing negative feedback. This indicates that most students are very satisfied with the practical activities and believe that they effectively improved their practical application skills and innovative thinking. In contrast, the control group's feedback is relatively conservative, particularly regarding the information platform and practical activities, where satisfaction is lower than that of the experimental group. Therefore, the experimental group's high ratings and positive attitudes across all feedback categories demonstrate that the implementation of the innovative teaching model and information platform has significantly improved students' learning experience and satisfaction.

Conducting a qualitative analysis of the changes in students' innovative thinking and evaluating their practical problem-solving ability and entrepreneurial thinking demonstrated during the project implementation.

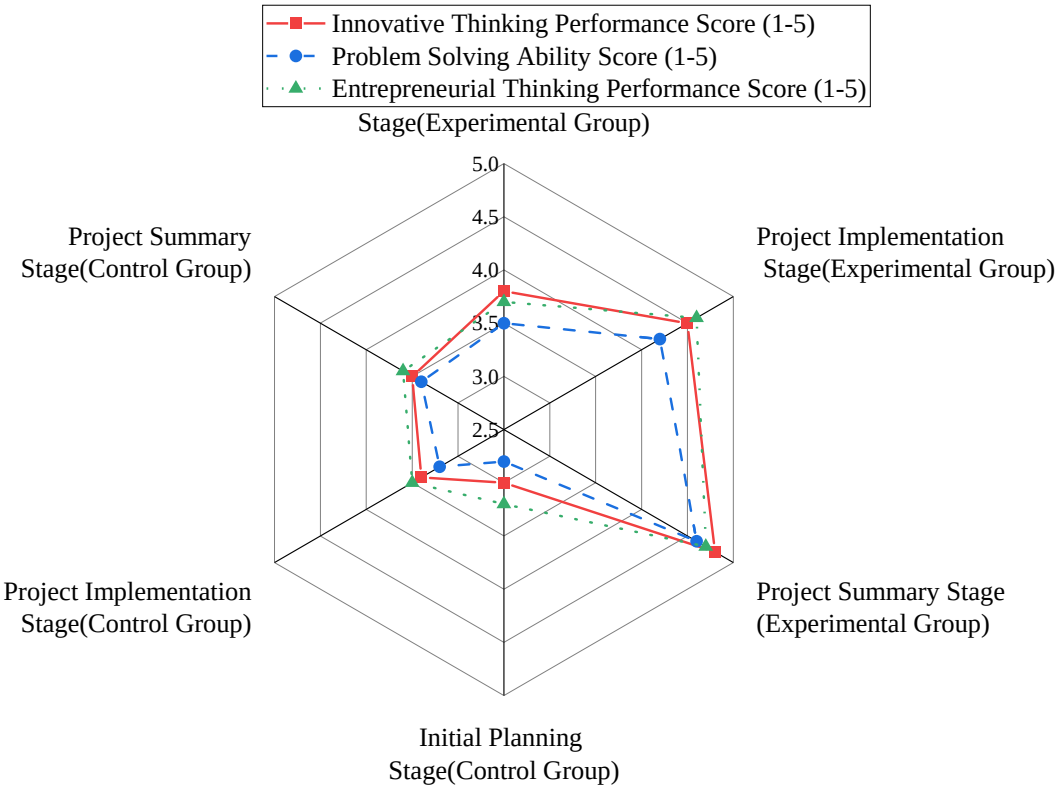

Figure 3. Assessment of students' innovative thinking and problem-solving abilities

During the initial planning phase, the experimental group's scores for innovative thinking are 3.8, problem-solving skills are 3.5, and entrepreneurial thinking skills are 3.7, demonstrating considerable innovative potential and entrepreneurial awareness. However, as the project progressed, the experimental group's scores significantly improved during the implementation phase, reaching 4.5 for innovative thinking, 4.2 for problem-solving skills, and 4.6 for entrepreneurial thinking skills, indicating that students' thinking skills are significantly enhanced through practical experience. During the project summary phase, the experimental group's scores in all three

categories rose further, reaching 4.8 (innovative thinking), 4.6 (problem-solving skills), and 4.7 (entrepreneurial thinking). These improvements reflect that the experimental group students are able to comprehensively summarize and reflect on the innovation process at the end of the project, demonstrating strong comprehensive problem-solving skills and entrepreneurial thinking, as shown in Figure 3.

5. Conclusion

This study explores strategies for enhancing the innovative literacy of applied business administration undergraduates in the digital age and proposes a comprehensive educational model based on an information platform, project-based learning, and interactive instruction. A before-and-after comparison of the experimental and control groups in innovative thinking, problem-solving skills, and entrepreneurial thinking, using t-tests, shows that the experimental group significantly outperforms the control group in both after-class practical projects and final grades, further validating the role of innovative educational practices in promoting learning outcomes. The study's sample size is relatively small and limited to students from a select number of universities. Future work could expand the sample to encompass more regions and institutions to enhance the generalizability of the findings.

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