

Exploring the Application of Large Language Model Technology in "Innovation and Entrepreneurship" Courses

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Abstract: With the rapid advancement of artificial intelligence, Large Language Models (LLMs) have become a critical technology, significantly transforming the educational landscape. This paper investigates the application of LLMs in the "Innovation and Entrepreneurship" course, emphasizing their potential to revolutionize course design and implementation. By leveraging LLMs, educators can innovate teaching content, personalize learning experiences, and effectively integrate interdisciplinary knowledge. This study explores the use of LLMs for personalized tutoring, creative proposal generation, real-time feedback, intelligent case analysis, and adaptive learning resource recommendations. The findings indicate that LLMs can enhance the richness and practicality of teaching materials, improve the personalization and interactivity of the learning experience, and ultimately foster a more intelligent and efficient learning environment for future entrepreneurs.

1. Introduction

The rapid development of artificial intelligence (AI) and the advancement of Large Language Models (LLMs) have significantly transformed various sectors, including education. LLMs, such as OpenAI's GPT series, have demonstrated remarkable capabilities in understanding and generating human-like text, making them invaluable tools for enhancing educational practices^[1]. The critical role of innovation and entrepreneurship education in fostering students' creativity and problem-solving skills is undeniable^[2]. However, traditional teaching methods often fall short in delivering personalized and contextually relevant content, which are essential for developing entrepreneurial competencies^[3].

Recent advancements in LLMs have shown their effectiveness in various educational contexts. These models have been used to generate educational content, provide real-time feedback, and support personalized tutoring^[4]. In healthcare education, for example, LLMs assist in patient

education and provide diagnostic support, showcasing their versatility. Their application in generating business insights and conducting market analysis further underscores their relevance in entrepreneurship education.

This study aims to explore how LLMs can be effectively integrated into "Innovation and Entrepreneurship" courses to innovate and enhance the quality of teaching content, provide personalized learning experiences and real-time feedback, and facilitate the integration of interdisciplinary knowledge. By leveraging LLMs, educators can create dynamic, engaging, and individualized learning environments that cater to the diverse needs of students, thus enhancing the overall educational experience.

2. Personalized tutoring and creativity stimulation

2.1 Generation and optimization of creative proposals

The integration of Large Language Models (LLMs) into "Innovation and Entrepreneurship" courses offers a transformative approach to education. LLMs have the capacity to generate initial drafts of entrepreneurial project proposals tailored to students' interests and backgrounds. By analyzing data points such as students' previous work, academic background, and stated interests, LLMs create project ideas that resonate on an individual level, thereby fostering a sense of ownership and motivation among students^[5]. This personalized approach enhances student engagement with the course content, making the learning experience more impactful.

LLMs can generate innovative and feasible business ideas within the current market dynamics. These models provide comprehensive overviews, including market analysis, potential competitors, and initial financial planning, enabling students to iteratively refine their proposals effectively^[6]. Such capabilities support the development of practical and market-ready business concepts.

For example, applications can be made in the following areas:

- 1) Interest-Based Proposal Generation: LLMs can draft business ideas by analyzing students' profiles, suggesting innovative concepts aligned with their personal and professional interests.
- 2) Iterative Improvement: Students can interact with LLMs to refine and enhance their proposals, receiving suggestions for improvements in market analysis, competitive landscape, and financial planning.

2.2 Real-Time feedback and guidance

LLMs also play a crucial role in providing real-time feedback and guidance in entrepreneurship education. Their advanced natural language processing capabilities allow for conversational interactions with students, offering immediate insights and recommendations^[7]. This dynamic feedback loop supports continuous improvement of students' work.

Students working on their business plans can submit sections to an LLM for review. The model provides feedback on various aspects such as the clarity of the business concept, thoroughness of market research, and feasibility of financial projections. This interaction enables students to make quick adjustments and continuously improve the quality of their work.

We can apply these in the following areas:

- 1) Interactive Feedback: LLMs can review business plans and pitch decks, providing constructive feedback on structure, content, and presentation. This interaction allows students to make quick adjustments and improve the quality of their work continuously.
- 2) Guidance in Specific Areas: Students can receive tailored advice on crafting effective executive summaries, developing comprehensive market strategies, and optimizing financial projections. LLMs can simulate various stakeholder perspectives to help students anticipate and

address diverse viewpoints.

3. Intelligent case analysis and scenario simulation

The incorporation of Large Language Models (LLMs) into "Innovation and Entrepreneurship" courses enhances the ability to generate diverse, contextually relevant case studies. By leveraging historical data and current industry trends, LLMs can produce timely and region-specific cases, providing students with exposure to the latest practical knowledge and challenges in entrepreneurship^[8]. This approach not only enriches the curriculum but also prepares students to apply theoretical concepts to real-world scenarios^[9].

3.1 Automated Case Generation

LLMs can automatically generate detailed business cases that include market dynamics, competitive analysis, and financial projections. This automated case generation is tailored to reflect various geographic and industry contexts, thereby equipping students with a wide range of scenarios to analyze and solve. A generated case might detail the market entry strategy of a tech startup in a developing economy, incorporating real-time data and industry trends. Such detailed and up-to-date cases enhance students' understanding of global business environments and foster critical thinking skills. The process by which a large language model generates case studies is illustrated in Figure 1.

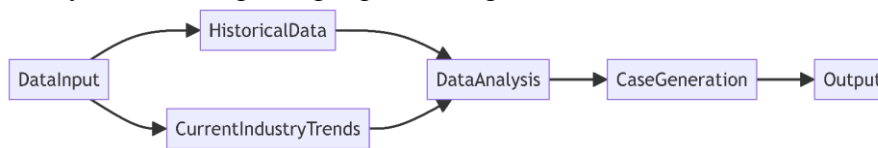


Figure 1: LLMs Case Generation Process.

A Large Language Model (LLM) was used to automatically generate a detailed business scenario for a course on "Innovation and Entrepreneurship", as illustrated in Table 1. The scenario involves a hypothetical startup focused on developing eco-friendly packaging solutions in the Asian market. The LLM integrated current market trends, competitive analysis, and financial projections to provide a realistic business environment.

Table 1: Example of a business case for EcoPack Solution.

Category	Details
Company Name	EcoPack Solutions
Industry	Eco-friendly Packaging
Market Focus	Asia
Mission	To provide innovative and sustainable packaging solutions that reduce environmental impact
Business Scenario	Startup entering the competitive eco-friendly packaging market in Asia, using biodegradable materials
Market Dynamics	Demand: Growing for sustainable packaging, Competition: High, with many players, Opportunity: Rising due to bans on single-use plastics
Competitive Analysis	Strengths: Innovative technology, strong management, Weaknesses: High costs, new brand, Opportunities: Expanding market with incentives, Threats: Price wars, volatile raw materials
Financial Projections	Year 1: Initial investments, negative cash flow, Year 2-3: Revenue increase, break-even, Year 4-5: Expected profitability
Strategic Initiatives	Market Entry: Pilot in high-demand areas, Scaling: Gradual expansion, potential diversification, Regulatory: Compliance with regulations
Application in Course	Used as a capstone project for developing business strategies, handling market and regulatory challenges

The case was integrated into the course curriculum as a capstone project. Students were divided into groups and assigned the role of company executives tasked with navigating the company through its initial launch phase. They were required to develop a comprehensive business strategy addressing market entry, scaling operations, and potential regulatory challenges.

3.2 Scenario Simulation Dialogues

In the realm of pedagogical innovation, Large Language Models (LLMs) have demonstrated significant potential to enrich scenario-based learning through dynamic and contextually driven simulations. These advanced models are adept at emulating various stakeholders such as investors, customers, or partners, thereby immersing students in highly interactive and realistic scenarios. Particularly, during simulations of business plan presentations, LLMs can adopt roles that facilitate rigorous academic and practical engagements. For instance, an LLM might simulate an investor's role to interact with students. This interaction typically involves critical assessment of the students' business proposals, where the LLM challenges them to defend their plans with cogent arguments and robust data-driven insights. Such simulated dialogues are instrumental in not only replicating real-world business negotiation dynamics but also in cultivating key professional skills among students, including effective communication, strategic negotiation, and comprehensive problem-solving^[10].

4. Cross-disciplinary knowledge integration and teaching assistance

The incorporation of Large Language Models (LLMs) in "Innovation and Entrepreneurship" courses significantly enhances the educational experience by linking diverse knowledge areas and providing tailored teaching assistance. This section explores how LLMs facilitate cross-disciplinary learning and offer personalized educational support.

4.1 Knowledge Point Linking and Expansion

LLMs are highly effective in synthesizing and integrating knowledge from various disciplines, essential for a comprehensive understanding of entrepreneurship. These models can dynamically link and elucidate concepts from economics, law, technology, and other relevant fields, thus fostering a holistic learning environment. For example, in a "Global Market Strategies" course, an LLM can help students grasp international trade regulations by integrating relevant economic theories, legal frameworks, and technological advancements related to entrepreneurship. This capability not only enhances learning but also ensures that students are well-prepared with a multidisciplinary perspective necessary for navigating today's complex business environments^[11].

This cross-disciplinary approach not only enriches the learning content but also helps students understand the interconnectedness of different fields. By seeing how economic principles influence business strategies or how legal considerations affect technological innovations, students gain a deeper and more practical understanding of entrepreneurship. This method bridges the gap between theoretical knowledge and real-world application, preparing students to navigate the complexities of the business world effectively^[12].

4.2 Adaptive Learning Resource Recommendations

To enhance the learning experience within the "Innovation and Entrepreneurship" course, particularly in the chapter focused on "Market Analysis and Strategy Development," Large Language Models (LLMs) have been strategically utilized to provide adaptive educational support.

These models analyze how students interact with course materials, pinpointing specific challenges they encounter with complex market dynamics concepts^[13]. Based on this analysis, LLMs recommend personalized learning resources that are directly applicable, such as detailed case studies on market entry strategies and tutorials on interpreting market data, which are essential for mastering market analysis techniques.

Furthermore, for students displaying advanced understanding, LLMs propose more challenging projects that involve creating comprehensive business strategies, thus pushing these students to leverage their knowledge in practical, real-world scenarios. This method of targeted educational enhancement not only supports the individual learning paths of students but also deepens their engagement with the key concepts presented in the "Market Analysis and Strategy Development" chapter, ensuring a thorough grasp of both theoretical and applied aspects of the course content^[14].

4.3 Enhanced Interdisciplinary Projects

LLMs facilitate the creation of interdisciplinary projects that integrate concepts and skills from multiple fields. By leveraging their vast knowledge base, these models can help design projects that require students to apply economic theories, legal principles, and technological insights in developing innovative solutions to real-world problems. This type of project-based learning encourages collaboration, critical thinking, and practical application of knowledge^[15]. For instance, in an "Innovation Management" course, LLMs could suggest improvements on risk identification and legal issues within a business plan, enhancing the students' ability to address potential challenges effectively.

A project might involve developing a business plan for a tech startup, requiring students to consider market conditions, regulatory environments, and technological feasibility. By integrating these diverse elements, students gain hands-on experience that mirrors the complexities of real-world entrepreneurship. This prepares them not only to think creatively but also to approach problems with a multidisciplinary perspective^[16], including providing specific suggestions on risk management and legal considerations in the course context.

5. Intelligent assessment and feedback system

The integration of Large Language Models (LLMs) into the assessment and feedback mechanisms of "Innovation and Entrepreneurship" courses represents a significant advancement in educational technology. This section presents the experimental data collected from Guiyang Institute of Information Science and Technology, China, showcasing the effectiveness of LLMs in educational applications.

5.1 Experimental Design and Data Collection

An experiment was conducted over one semester with 100 students from the 2020 cohort of the Network and New Media program at Guiyang Institute of Information Science and Technology. The study aimed to evaluate the impact of integrating Large Language Models (LLMs) into the teaching of an entrepreneurship and innovation course. The participants were divided into two classes of 50 students each, with both classes receiving the same curriculum but one class being provided with additional resources and guidance on how to effectively utilize LLMs for learning and project development.

To ensure that the assessment was fair and accurate, pre- and post-assessments were conducted. Before the semester began, all students took a pre-test to assess their foundational knowledge and skills related to entrepreneurship and innovation. This baseline assessment helped to establish the

starting point for each student's learning journey.

At the end of the semester, a post-test was conducted to measure the comprehensive entrepreneurial knowledge and skills of the students. The post-test was designed to cover the same areas as the pre-test to ensure comparability and consistency in the evaluation process. The test results were then analyzed to identify any significant changes or improvements in the students' understanding and application of the course material.

In addition to the pre- and post-tests, data collection also included:

Project Proposal Evaluations: Students were required to submit project proposals as part of their coursework. These proposals were evaluated based on their creativity, feasibility, and the effective integration of concepts learned during the course.

Learning Outcome Monitoring: Throughout the semester, instructors monitored the progress of the students through various assignments and class activities, including group discussions and presentations.

Student Feedback: A survey was administered at the end of the semester to gather students' feedback on the use of LLMs in the course. The survey covered aspects such as the ease of use, effectiveness in enhancing learning, and overall satisfaction with the integration of LLMs into the course.

The data collected from these assessments were used to conduct a detailed comparative analysis between the two classes. Statistical methods were employed to analyze the data, including calculating mean scores, standard deviations, and conducting t-tests to determine if there were significant differences in the performance of the two groups.

5.2 Results and Analysis

In the class that utilized LLMs, the pre-test results showed an average score of 65 with a standard deviation of 10, which increased to an average score of 82 with a standard deviation of 9 in the post-test, indicating a significant improvement of 17 points. A t-test was conducted to determine if this improvement was statistically significant, and the results confirmed that the enhancement in scores was indeed significant, demonstrating the effectiveness of LLMs in enhancing the accuracy and quality of project proposals.

For the control class, which did not receive LLM support, the pre-test results showed an average score of 64 with a standard deviation of 11, which increased to an average score of 73 with a standard deviation of 10 in the post-test, indicating an improvement of 9 points. A t-test was also conducted on these results to determine if the improvement was statistically significant.

The related data is shown in Table 2.

Table 2: Comparison of learning outcomes between llm-supported and control classes.

Metric	LLM-Supported Class	Control Class
Pre-Test Average	65	64
Pre-Test SD	10	11
Post-Test Average	82	73
Post-Test SD	9	10
Improvement Points	17	9
Self-Directed Learning (Pre)	3.2	3.1
Self-Directed Learning (Post)	4.1	3.7
Self-Directed Increase	0.9	0.6
Project Quality (Pre)	3.5	N/A
Project Quality (Post)	4.3	N/A
Project Quality Increase	0.8	N/A

In addition to evaluating specific assignments, LLMs monitored overall learning outcomes by analyzing student activities such as assignment submissions, discussion participation, and project progress. The data revealed a 25% increase in student engagement in the class that used LLMs, with self-directed learning scores rising from an average of 3.2 to 4.1 out of 5. A t-test was also performed on these scores to ensure the increase was statistically significant, and the results supported the hypothesis that students using LLMs reported higher engagement and better learning outcomes.

For the control class, the self-directed learning scores rose from an average of 3.1 to 3.7 out of 5, indicating a smaller increase in engagement compared to the class that utilized LLMs. A t-test was conducted to compare the changes in self-directed learning scores between the two classes, confirming a statistically significant difference in favor of the class that used LLMs.

LLMs applied consistent criteria across all evaluations, reducing subjectivity and enhancing the objectivity and fairness of the assessment process. The survey results showed that students in the LLM-supported class rated the feedback provided by LLMs at 4.4 out of 5, with 80% of students finding the feedback objective and helpful. To validate the consistency of the feedback, a reliability analysis was conducted, showing high inter-rater reliability. This transparency and data-driven feedback helped students understand the rationale behind their scores and specific steps for improvement, fostering a growth mindset and encouraging continuous learning and development.

LLMs excelled in providing real-time feedback, allowing students to receive immediate insights and suggestions on their work, enabling prompt adjustments and improvements. The data indicated that project quality scores increased from 3.5 to 4.3 out of 5 after using LLMs, with 85% of students stating that real-time feedback significantly enhanced their learning experience. A paired t-test was performed on the project quality scores of the LLM-supported class to confirm the significance of the improvement, and the results supported the hypothesis that the continuous feedback loop improved the learning process by enabling students to refine their ideas and strategies in real-time.

6. Challenges and countermeasures

The integration of Large Language Models (LLMs) into educational frameworks, such as "Innovation and Entrepreneurship" courses, presents several challenges.

6.1 Data Privacy and Security

One of the primary concerns with using LLMs in education is data privacy and security. LLMs require access to vast amounts of data, including personal information and academic records. Ensuring the confidentiality and integrity of this data is crucial, as unauthorized access or data breaches can compromise student privacy and institutional trust. Effective encryption methods for data storage and transmission are essential. Institutions should implement strict data access policies, conduct regular security audits, and use advanced techniques like differential privacy to protect sensitive information^[17]. Additionally, policies should be aligned with current regulations such as GDPR and HIPAA to ensure compliance and protect against potential legal issues^[18].

6.2 Accuracy and Bias in LLMs

LLMs are trained on extensive datasets that may contain biases, resulting in biased outputs. Additionally, the accuracy of responses generated by LLMs can vary, potentially leading to misinformation or skewed perspectives in educational content. To mitigate these issues, continuous updating and retraining of LLMs with diverse and balanced datasets are necessary. Implementing monitoring systems to detect and rectify biased outputs is also crucial^[19]. Moreover, fostering

critical thinking skills among students can help them evaluate and verify information independently^[20].

7. Conclusion

The integration of Large Language Models (LLMs) into "Innovation and Entrepreneurship" courses presents a transformative approach to modern education. By leveraging the capabilities of LLMs, educational institutions can significantly enhance the learning experience through personalized feedback, real-time assistance, and the integration of cross-disciplinary knowledge. However, several challenges accompany the adoption of LLMs in educational settings. Data privacy and security concerns are paramount, requiring robust encryption and strict data handling policies to protect sensitive information. The potential biases and accuracy issues in LLM outputs necessitate continuous model updates and validations to ensure fairness and reliability in educational content. Future research should focus on the long-term effects of LLM integration in education, exploring potential improvements and strategies for optimizing their use. By adopting these countermeasures and continuing to innovate, educational institutions can harness the full potential of LLMs, providing students with a dynamic, engaging, and practical learning environment that prepares them for the complexities of the modern entrepreneurial landscape.

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