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The impact of innovation and entrepreneurship competition participation and its team roles on undergraduate students' leadership

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Abstract

Purpose – Innovation and entrepreneurship competitions are employed as an important policy tool by the Chinese government and universities to promote entrepreneurship education and training. However, its effect has seldom been verified by empirical studies, especially in students' leadership development, one of the core objectives of innovative talent cultivation. This study aims to test how undergraduate students' participation and different team roles in innovation and entrepreneurship competitions can impact their leadership development.

Design/methodology/approach – Based on a questionnaire survey of 1,431 undergraduate students, this study used independent sample *t*-tests to verify the effect of whether to participate or not in innovation and entrepreneurship competitions on their self-reported leadership competence, and furthermore, to verify the effect of different team roles in the competitions on leadership improvement. Then, the propensity score matching method was used to verify whether team role was the most critical factor contributing to differences in leadership improvement.

Findings – The study found that undergraduate students who participated in the innovation and entrepreneurship competitions had significantly higher leadership value-added than non-participants. Among the students who participated in the competition, those who took the role of team leader were significantly better than team members in seven leadership dimensions, including sense of adventure, planning, information processing, problem solving and teamwork. They also differed in some individual educational experiences, family backgrounds and personal traits (especially vigor). The study verified that being a leader was a key factor in the difference of leadership improvement among undergraduate students.

Originality/value – On the one hand, the introduction of the vigor factor into the field of undergraduate student development expands the application space of the theory while verifying the role of vigor traits in students' leadership behavior. On the other hand, it confirms the nurturing effect of innovation and entrepreneurship competitions in leadership and points out the direction of optimizing the quality of innovation and entrepreneurship education.

Keywords Innovation and entrepreneurship competition, Leadership, Team roles, Vigor

Paper type Research paper

1. Introduction

Innovative entrepreneurship is now globally recognized as a prominent force for economic growth and mobilization of talent (Audretsch & Belitski, 2017). Innovation and entrepreneurship education serves as a crucial lever for higher education institutions to

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cultivate innovative talents. The participation of students in innovation and entrepreneurship projects, widely implemented through competitions or training, is a powerful measure. Publications with an education focus show that innovation competitions are a great tool for encouraging and motivating students and, hence, for developing their technical, design, teamwork, communication and leadership skills (Adamczyk, Bullinger, & Möslein, 2012). The majority of innovation and entrepreneurship competitions are conducted in a team format, with participants divided into two main roles: leader and participant. However, there is a paucity of studies that have conducted a comparative analysis of these two roles and their impact on competence improvement.

In the context of China's efforts to build an innovative nation, realize the national innovation-driven strategy and enhance the quality and efficiency of economic development, the government has placed urgent demands on universities to deepen reforms in innovation and entrepreneurship education and improve the cultivation of innovative talents. In 2015, the General Office of the State Council issued the "Implementation Opinions on Deepening the Reform of Innovation and Entrepreneurship Education in Higher Education", which proposed building an innovation and entrepreneurship education system with distinct Chinese characteristics. This document emphasized a competency-based innovation education model. Among the policy tools employed to promote entrepreneurship education in higher education institutions, innovation and entrepreneurship competitions have been given particular importance, because they have demonstrated various positive impacts, including strong incentives both before and during the competition, favorable spillovers in specified industry sectors after the events, and significant contributions to participants' education and entrepreneurial awareness (Liotard & Revest, 2018). For example, China International "Internet+" Innovation and Entrepreneurship Competition for University Students, the largest and most influential competition of its kind in China, attracted participants from 4,554 institutions across 111 countries and regions, both domestic and international. A total of 3.4 million projects were submitted, with 14.5 million students registering, marking the first time the number of participants exceeded 10 million in 2022 (Ministry of Education of the People's Republic of China, 2023).

In the environment of multitudes of entrepreneurship, talents with leadership potential are more capable of generating competitive advantages and thus successful entrepreneurship. Previous studies focus more on the impact of entrepreneurship education in secondary or elementary schools on students' leadership and other entrepreneurial competencies, with a very limited focus on undergraduate students (Brüne and Lutz, 2020). Cultivating undergraduate students' leadership not only meets the real needs of dealing with the uncertain, complex and risky world in their individual development, but also serves the strategic goal of national innovative and entrepreneurial talents. Therefore, we intend to assess the relationship between entrepreneurship competitions and students' competencies, especially leadership skills. Our research questions are as follows: (1) Does participation in innovation and entrepreneurship competitions contribute to significant differences in leadership competence compared to non-participating students? (2) What factors influence students' propensity to take on leadership roles in innovation and entrepreneurship competitions, and what distinct characteristics do these students exhibit? It offers insights into how institutions can better design educational programs, allocate resources, and create supportive environments that cultivate entrepreneurial leaders.

2. Literature review

This section aims to construct an analytical framework for the study, by examining the connotations of undergraduate students' leadership, assessing the impact of innovation and entrepreneurship education on leadership development of students, and exploring additional factors that contribute to the leadership development of undergraduate students.

2.1 Theory of undergraduate student leadership development

For the development of undergraduate students' leadership, scholars proposed several explanatory theories or models based on different understandings of the connotation of leadership, and the research is mainly based on the theoretical constructs of leadership trait theory, the behavioral model of undergraduate students' leadership practices, the relational leadership development model, and the social change model of undergraduate students' leadership. The following section will detail the insights contributed by each of these theories or models to the present study.

The trait theory of leadership suggests that leaders have certain specific personalities, dispositions, motivations, cognitive abilities, skills and expertise that can distinguish them from non-leaders. Leaders usually have high personality qualities such as energy, achievement, resilience, initiative, loyalty, self-confidence and cognitive abilities (Kirkpatrick & Locke, 1991). Among them, due to the rise of positive psychology in recent years, vigor, as an important dimension of positive personality traits, has become an important research component in personality psychology. In this study, we try to introduce the factor of vigor to test for the first time whether it can be used as an observable indicator of physical, emotional and cognitive states of college student participants in innovation and entrepreneurship competitions, in order to help design educational practices to stimulate vigor to enhance undergraduate students' leadership in innovation and entrepreneurship education.

Unlike trait theory, the students' leadership practice inventory considers leadership as an observable and cultivable external behavior (Posner, 2004). The model assumes that leadership is not a character unique to a few charismatic people, but can be understood and learned by all. It arises between the words and actions of the leader and the perceptions of the followers, and is the ability to influence others and make them behave in accordance with the leader's wishes (Kouzes & Posner, 2018). Innovative entrepreneurship competitions can certainly identify and nurture them. It is because of the awareness of the plasticity of undergraduate students' leadership that American colleges and universities pay much attention to the cultivation and development of undergraduate students' leadership. Numerous universities such as the University of California-Lavin, Southern Illinois University, and Yale University have taken various organizational approaches to leadership education, such as establishing institutionalized training programs, promoting leadership exam certificates, and infiltrating through extracurricular activities (Zimmerman-Oster & Burkhardt, 2001).

The relational leadership development model views leadership as a process in which relationships and values interact (Kouzes & Posner, 2017). It attempts to integrate individual values, traits, and actions, emphasizing the differences in how and why leaders and followers see things differently, and the differences in qualities such as inclusiveness, openness, and mutuality, as well as how to engage in group actions in a responsible manner. The concept of relational leadership posits that leaders must always be aware of their role in the context of relationships with others and must accept responsibility for the actions of those they lead. It is therefore essential that leaders maintain a dialogue with their subordinates (Cunliffe & Eriksen, 2011). The theory assists leaders in recognizing the significance of their relationships. Furthermore, it highlights the potential of informal activities in the workplace, such as interactions with colleagues and the seemingly inconsequential events that occur, to contribute to more effective leadership behaviors.

2.2 Innovation and entrepreneurship education and student leadership

Leadership is an important component of innovation and entrepreneurship. Research on innovation and entrepreneurship worldwide has gradually found that leadership plays an important role in it and academics consider leadership as an important component of the core competencies of university students' entrepreneurship (Barba-Sánchez & Atienza-Sahuquillo, 2016). Martin and Staines (1994) listed leadership as one of the core qualities of entrepreneurs. Previous studies have indicated that entrepreneurial capability encompasses six dimensions,

one of which is organizational capability. This encompasses the ability to organize and utilize a range of resources, including human, material, financial and technological resources, as well as the capacity to build and lead teams (Man, Lau, & Chan, 2002). Rasmussen, Mosey, and Wright (2011) employed a case study approach to categorize entrepreneurial capabilities into three distinct categories: opportunity, resource, and human. The core responsibility of an entrepreneur is to identify opportunities, create them, and put them into action to commercialize them and meet social needs and social will (Audretsch & Tamvada, 2023). In light of this, some foreign universities have attempted to develop entrepreneurial leadership in undergraduate students through innovative entrepreneurship programs.

There is a general agreement that leadership can be learned (Watt, 2003). Existing studies posit that innovation and entrepreneurship are teachable skills and that innovation and entrepreneurship education programs and training are essential for the development of creative and innovative managerial and employee capabilities within business firms (Mattare, 2008). Innovation and entrepreneurship education may facilitate the development of leadership skills. It has been demonstrated that the comprehension and creativity levels achieved in entrepreneurship education have a significant impact on self-reward in self-leadership, which in turn has a notable influence on entrepreneurial activity (Kim & Noh, 2012).Through interviews with undergraduate students and university entrepreneurship program coordinators, Bagheri and Lope Pihie (2013) found that entrepreneurship education programs bring students into the world of real entrepreneurship, create excellent leadership learning opportunities, and enhance students' leadership self-awareness, self-efficacy, and leadership identity. A sample of 43 countries was subjected to a series of studies, utilizing data from the Global Entrepreneurship Monitor and the Global Leadership and Organizational Behavior Effectiveness. The findings of these studies indicate that participatory leadership and higher education are the most significant explanatory factors for the observed differences in the rates of innovation and entrepreneurship across the countries in question (Van Hemmen, Alvarez, Peris-Ortiz, & Urbano, 2015).

Some scholars assert that leadership is central to the human condition—timeless and current, not a passing fad—and that leadership should be understood and practiced by all (In Wren, 1995). How we can find the people who are the best or potential leaders and help them prepare for careers that will allow them to have an impact is a key issue. Therefore, it is reasonable to investigate the development of undergraduate leadership skills in a variety of roles within a team as part of entrepreneurship education programs. It makes sense to establish a closer relationship between entrepreneurship research and leadership research (Harrison & Leitch, 1994).

Existing studies show that an innovation contest meets many of the education objectives and provides a range of benefits to participants, the most significant being the development of entrepreneurial skills, including team-building and leadership. (Jones & Iredale, 2010; Russell, Atchison, & Brooks, 2008) With the rapid development of innovation and entrepreneurship competitions supported by Chinese governments and universities, innovation and entrepreneurship competition, mainly "Challenge Cup" and "China International College Students' 'Internet' Innovation and Entrepreneurship Competition", have become the most important platforms to support the cultivation of leadership and other innovative qualities of undergraduate students and yet their actual effects need to be verified through empirical studies.

2.3 Other factors influencing undergraduate students' leadership

In terms of the factors influencing the differences in leadership among undergraduate students, studies have shown that among the dimensions of individual factors, student organization, social participation and leadership learning, there are significant differences in the level of leadership development among Chinese undergraduate students, except for the individual family structure (whether or not they are only children).

Analyzing from the perspective of educational experience, it was found that undergraduate students' experience in entrepreneurship, whether they had received innovation and entrepreneurship courses, whether they had participated in innovation and entrepreneurship competitions, whether they were student leaders, and their academic achievement level all reflected significant differences in leadership (Li *et al.*, 2022). The innovation and entrepreneurship competition is now mainly in the form of teams, and team leadership behavior plays a moderating role between team innovation atmosphere and team innovation, and between team background and innovation level (West & Hirst, 2005). According to the nearest developmental zone theory, important others such as the captain of the student innovation and entrepreneurship team play a particularly important role as "scaffolding" (Chaiklin, 2003). A leader's vision, self-efficacy, collaborative organization and management skills, and outstanding personality can attract the best people to the team, and lead the team to success (Martin & Staines, 1994). Different roles have different responsibilities, and it is logical to presume that the ultimate level of leadership should also vary.

In addition, family factors also contribute to the differences in undergraduate students' leadership levels, including the presence of leader role models among family members (Kouzes & Posner, 2017), household income level, the only child or not, urban or rural household registration in the Chinese context.

In addition to the education and family levels, this study examines the differences in the personal vigor traits of different team roles in the innovation and entrepreneurship competition with the help of vigor theory, and dissects the mechanism of leader vigor in the process of participation. Due to the inherent difficulty of the innovation and entrepreneurship competition and the long selection cycle, undergraduate students inevitably experience negative emotions such as burnout and stress. How to overcome negative emotions, maintain sufficient cognitive and emotional vigor, and boost team morale becomes the key to gaining successful experience in the competition and promoting leadership value-added. In the fields of positive psychology and positive organizational behavior, research on positive emotions is gradually increasing, including research on vigor as a positive emotion in the workplace. Although vigor research is making its debut in the field of management, research in academic performance and the development of innovative and entrepreneurial literacy among undergraduate students is still limited.

Based on the above previous research on leadership and innovation and entrepreneurship competition of undergraduate students, this paper argues that future outstanding undergraduate students should not only have the sense of innovation and innovation ability, but also exercise the leadership ability of shouldering social responsibility, leading social progress, and uniting and driving others forward together. In this study leadership is regarded both innate and nurtured, which can be acquired not only from the classroom, but more importantly from rehearsal and practice. As an important practice platform for innovation and entrepreneurship in China, the innovation and entrepreneurship competition has a large room for development in cultivating undergraduate students' leadership, which can provide more practice opportunities and expand the radiation of leadership education due to the wide number of participants. However, current research has focused more on the characteristics of the participants (McKenzie & Sansone, 2019) and the process of organizing the competitions (Liotard & Revest, 2018). Few micro-level empirical tests have been conducted to examine the impact of competition participation on student competency enhancement. Meanwhile, how to identify the influencing factors of undergraduate students' leadership and then take precise measures to cultivate them is also an urgent question to improve the innovation and entrepreneurship education system. Hence, the analytical framework shown in Figure 1 is constructed, and an empirical analysis is attempted to investigate whether there are differences in the enhancement of leadership among undergraduate students through participation in competitions. In this way, we respond to the extent to whether innovation and entrepreneurship competition can play a practical role in nurturing undergraduate students' leadership and thus high-level innovative talents.

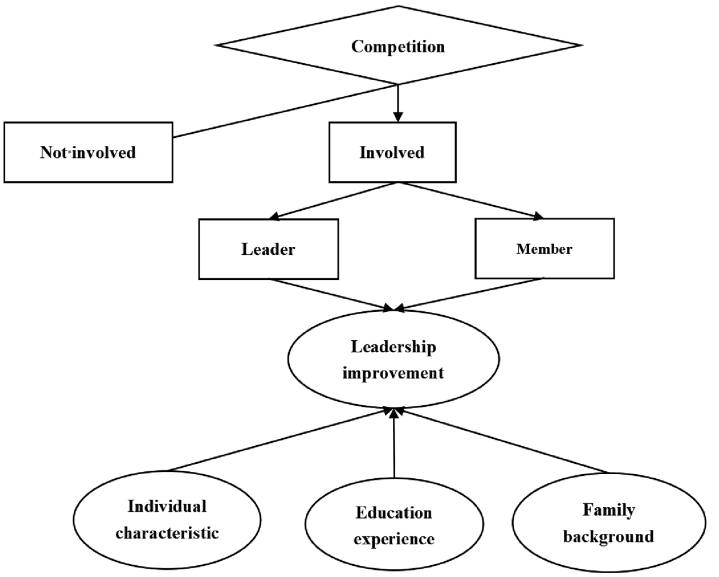

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Figure 1. Analytical framework

3. Methodology

3.1 Participants

In April 2023, the research group conducted an online questionnaire survey on the participation and satisfaction of innovation and entrepreneurship education of undergraduate students in a Chinese research university. Based on the number of undergraduate students in each faculty or department and the number of innovation and entrepreneurship projects announced on the official website of the Academic Affairs Office of the University, the questionnaire was distributed to students in a purposeful manner with the assistance of the staff in charge of innovation and entrepreneurship education in the university level as well as the faculty or department level as an attempt to ensure the maximum coverage of the participants in innovation and entrepreneurship education with the matching of grade, gender and discipline. A total of 1,460 questionnaires were distributed. 1,431 valid questionnaires were obtained after the screening of polygraph questions and the cleaning of invalid questionnaires, with an effective rate of 98.0%. Among the valid samples, 551 students had participated in innovation and entrepreneurship events, accounting for 38.5% of the whole sample. And among the 551 students who had participated in the event, 231 students had served as team leader role, accounting for 41.9%, and 320 students as team members, accounting for 58.1%.

3.2 Measurement

3.2.1 Leadership. Brodsky Barbara used the leadership practices inventory to measure undergraduate students and developed the student leadership practices inventory. It consisted of five dimensions, including modeling the way, inspiring a shared vision, challenging the process, enabling others to act and encouraging the heart (Posner, 2004). This study also integrates references to the conceptual definition of entrepreneurial leadership (Fernald, Solomon, & Tarabishy, 2005). Seven questions were developed to measure the undergraduate students' leadership skills on 5-point Likert scale, including "planning and process management skills" and "leadership and organizational skills", "problem solving skills"

and so on, ranging from "no improvement" to "very much improvement". The higher the value, the higher the value-added leadership. The Cronbach's alpha for all questions was 0.937, indicating that the scale has good reliability.

3.2.2 Individual characteristics. In addition to general characteristics such as gender, only child, and place of birth, this study defined vigor, with reference to Shirom's definition, as the positive affective response that an individual had when interacting with some significant people in the work environment, including feelings of physical strength, emotional energy, and cognitive vigor that were intrinsically linked (Shirom, 2007).

The vigor questionnaire was mainly derived from Shirom's scales applied in organizational research (Shirom, 2004). Reference was also made to international scholars' survey scales on undergraduate vigor (Pulido-Martos, Cortés-Denia, de la Rosa-Blanca, & Lopez-Zafra, 2020) and revised it in the context of this study. The questionnaire included three dimensions: physical vigor, cognitive vigor, and emotional vigor. The questions in each dimension include "I feel physically energetic", "I think I am responsive", "I give my classmates a warm and enthusiastic feeling", for a total of 13 items on a 7-point Likert scale. The recovered data showed that the Cronbach's α of each dimension was 0.953, 0.933, and 0.901 respectively, which indicated that the scale could be applied to measure the vigor of undergraduate students in China, and had good cross-cultural and reliability validity.

3.2.3 Education and innovation competition experience. Educational experiences include grades, academic achievement, student cadre experience, club experience, innovation and entrepreneurship competition team role, participation motivation, and entrepreneurial intention. Motivation for participation was divided into internal motivation (e.g. to improve overall ability) and external motivation (e.g. for award and merit), and the intensity of their motivation was assessed by a 5-point Likert scale, with higher values indicating stronger motivation. Grade level, student cadre experience, club experience, and entrepreneurial intention were treated as dummy variables. In addition, whether or not to take on the role of a leader was investigated by the single-choice question "Is your general role in the competition or project you are participating in a leader or a member of the group", in order to further investigate whether different roles affect the value-added of students' leadership.

3.2.4 Family background. In terms of family background, students' parents' education level was transformed into a continuous variable of the length of education. The measure of parents' occupational status was assigned according to 11 levels of occupational social status, with higher values indicating higher occupational social status and more economic, social and cultural capital possession. Family economic status was students' self-reported family economic affluence, which was assigned using 1–5, with higher values indicating better economic status. Meanwhile, Posner (2004) suggests that leadership might be affected by a range of demographic variables (e.g. gender, ethnicity, year in school, age, GPA, academic major). In this study, we took GPA and grade into consideration. GPA rankings are categorized into six bands, with higher scores being associated with better academic performance.

4. Result

4.1 Difference analysis of the impact of competition participation and its role type on leadership

In order to answer the question of heterogeneity in the influence of whether or not to participate in the innovation and entrepreneurship competition and different team roles on the value-added leadership of undergraduate students, an independent sample *t*-test was initially used for the analysis and the results were shown in Table 1. The results found that the mean value of leadership improvement of students who participated in the innovation and entrepreneurship competition was 26.32, which was significantly higher than the score of 23.89 of non-participating students. When it comes to all participating groups, the mean value of leadership value-added of undergraduate students who served as leaders was 27.14, and the leadership score of students who served as team members' roles was only 25.73, with the former being

Table 1. Heterogeneity analysis of competition participation and team role leadership enhancement

Group	*N*	M	SD	*F*	*T*-test
Involved	551	26.32	4.35	31.148***	9.223
Not involved	880	23.89	5.56		
Leader	231	27.14	4.46	0.027***	3.811
Member	320	25.73	4.17		

Note(s): *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$
Source(s): Table by authors

significantly higher than the latter. Further analysis revealed that team leaders performed significantly better than team members in each sub-dimension of leadership value-added, as shown in Table 2, i.e. planning and process management skills, information sensitivity, information retrieval and processing skills, problem solving skills, presentation skills, social skills, teamwork skills, and leadership and organizational skills. To sum up, participation in the innovation and entrepreneurship competition has a significant positive effect on the improvement of students' leadership. Further, the role of team leaders has a greater effect on the improvement of leadership than that of team members.

4.2 Characterization of participants

To portray the characteristics of the participants in the innovation and entrepreneurship competition, the study compared the differences in the characteristics of team leaders and group members in terms of individual characteristics, educational experiences, and family background.

In terms of individual characteristics, especially vigor traits, leaders outperformed group members in terms of physical, cognitive and emotional vigor, as shown in Table 3. Continuously leading a team in preparation for a race in a high-intensity and high-stress environment poses a significant challenge to the vigor of team leaders. This study confirms Kouzes and Posner's (2017) findings that leaders typically exhibit higher levels of passion, energy, stamina, and vigor compared to non-leaders, and have the physical energy to maintain a steady pace of work. From the gender perspective, women accounted for more than 70% of

Table 2. Differences between leaders and members of leadership enhancement

Items	Role(leader/ member)	M	SD	*F*	*T*-test
Planning and process management skills	L	3.84	0.80	0.641***	2.384
	M	3.68	0.78		
Information sensitivity, information retrieval and processing skills	L	3.81	0.82	0.027***	1.962
	M	3.68	0.75		
Problem solving skills	L	3.89	0.73	5.343***	2.613
	M	3.73	0.72		
Presentation skills	L	3.90	0.76	2.779***	3.471
	M	3.68	0.73		
Social skills	L	3.82	0.77	1.677***	2.439
	M	3.66	0.78		
Teamwork skills	L	3.96	0.75	2.923***	2.133
	M	3.82	0.76		
Leadership and organizational skills	L	3.90	0.77	12.080***	6.314
	M	3.48	0.82		

Source(s): Table by authors

Table 3. Difference of leaders and group members in terms of individual characteristics, educational experiences and family background

Variables	Dimensions	Role (leader/ member)	M(SD)/%	*F*	*T*-test
Vigor traits	Physical vigor	L	24.85 (6.42)	0.124***	2.781
		M	23.36 (6.07)		
	Cognitive vigor	L	20.06 (0.99)	0.500***	3.072
		M	18.82 (4.55)		
	Emotional vigor	L	21.57 (4.20)	3.239***	2.051
		M	20.87 (3.76)		
Other individual characteristics	Gender (dummy)	L	28.6/71.4	–	–
		M	22.2/77.8		
	Only child or not (dummy)	L	62.3/37.3	–	–
		M	57.2/42.8		
	Household registration (dummy)	L	8.7/91.3	–	–
		M	15.3/84.7		
Education experience	Grade	L	3.04 (0.99)	5.694***	4.571
		M	2.64 (1.04)		
	GPA	L	4.28 (1.35)	0.368***	5.031
		M	3.69 (1.35)		
	Internal motivation	L	7.87 (1.38)	0.011***	3.125
		M	7.52 (1.29)		
	External motivation	L	7.70 (1.59)	0.122	1.340
		M	7.52 (1.50)		
	Entrepreneurship intention (dummy)	L	4.8/95.2	–	–
		M	2.8/97.2		
	Student cadre experience (dummy)	L	85.3/14.7	–	–
		M	75.3/24.7		
	Club experience (dummy)	L	82.7/17.3	–	–
		M	82.5/17.5		
Family background	Father's education level	L	13.66 (3.67)	1.171***	2.303
		M	12.96 (3.41)		
	Mother's education level	L	13.07 (4.02)	1.178	1.932
		M	12.42 (3.89)		
	Father's occupation	L	7.29 (2.94)	1.988***	3.938
		M	6.26 (3.08)		
	Mother's occupation	L	6.35 (3.14)	0.329***	2.295
		M	5.74 (2.99)		
	Economic status	L	3.03 (0.89)	0.008***	2.205
		M	2.87 (0.82)		

Source(s): Table by authors

both leaders and team members, indicating that female students were an important group in the survey sample, although this should be due to the fact that the surveyed universities are dominated by basic disciplines and the ratio of men to women is about 1:2. Among the team leaders and team members, the proportion of only children was around 60%, and there was no significant difference between the two. However, in terms of student household registration, the proportion of leaders from urban areas was 91.3%, and the corresponding proportion of team members was 84.7%, and the chi-square test showed that there was a significant difference between the two.

As for education experience, there was a significant difference in the distribution of team leaders and team members in terms of grade level. The team leaders were mainly senior students, among whom 37.7% were third-year students and 26.8% were fourth-year students, while the group members were especially second-year students, accounting for 40.3%, because the innovation and entrepreneurship competition had certain threshold requirements

for students' professional knowledge, innovation ability and team management skills so this grade distribution was reasonable. In addition, team leaders had significantly better academic performance than team members, and more experience as student leaders than team members. However, there was no significant difference between them in terms of club experience. In terms of motivation, team leaders had stronger internal motivation to participate in the competition, while there was no significant difference between the two in terms of external motivation to participate in the competition. Although the overall entrepreneurial intention of the participating students was lower, which to some extent reflected that students did not participate in entrepreneurship competitions as a preparation for entrepreneurship, but as a way to improve their ability or gain recognition from the external evaluation system.

In terms of family background, nearly half of the participants in the innovation and entrepreneurship competition had parents who had earned a university degree or higher. However, further analysis showed that team leaders had an obvious advantage in three variables that measured the abundance of family socioeconomic capital, i.e. parents' professional status, fathers' education level, and economic status.

4.3 Robustness test of the results of the effect of team roles on the leadership improvement

There may be an endogeneity problem in estimating the effect of being a leader or not on students' leadership value-added due to the fact that being a leader is not a random event, and the results of data analysis in Table 3 also present that it may be confounded by some factors such as educational experience, individual characteristics, and family background. Therefore, the propensity score matching (PSM) method was further used to overcome the estimation bias due to sample selectivity bias. First, with whether or not to be a leader as the dependent variable, covariates confounding the relationship between the independent and dependent variables were included in the model, and the probability of whether or not an individual is a leader (i.e. propensity score, or PS value) was predicted by logistic regression. Factors outside the team role were matched according to PS values to verify the role of the leader in adding value to students' leadership after controlling for other factors.

4.3.1 Propensity score matching results. This study examined the matching effect by comparing the PS values and the main explanatory variables before and after matching. Figure 2 shows the kernel density functions of PS values before and after matching for the experimental group (serving as leader) and the control group (group members). Figure 3 shows the differences in the mean values of the main explanatory variables before and after matching. Before matching, there were significant differences in the mean values of variables such as probability distribution, learning experience, personal vigor trait and family background of PS values between the two groups, while the PS values of the two samples were already closer

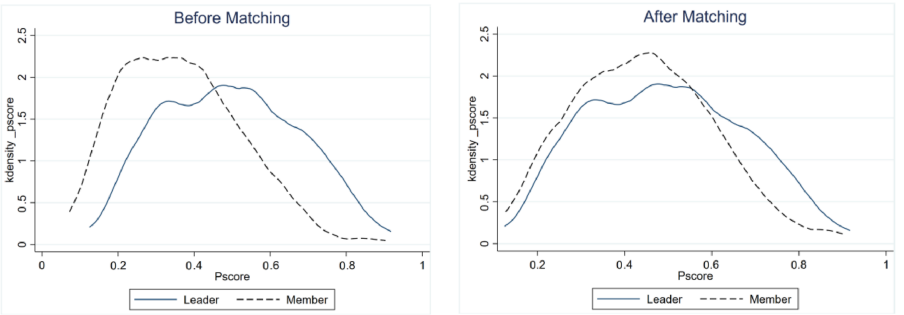

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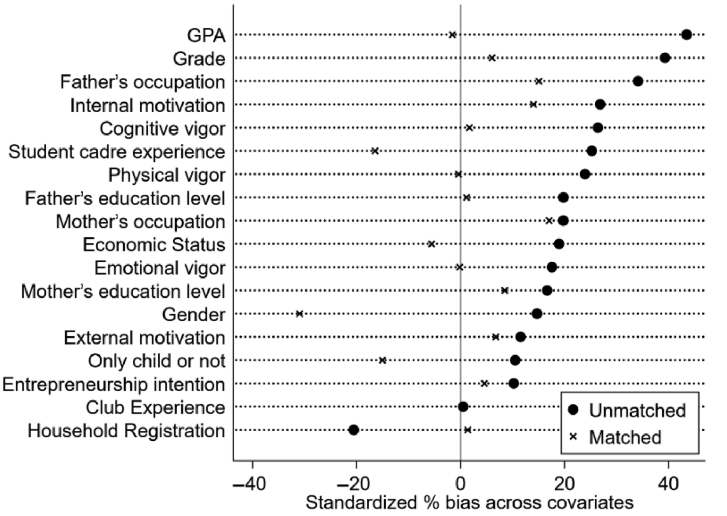
Figure 2. Kernel density function before and after matching



Source(s): Figure by authors

Figure 3. Comparison of differences in explanatory variables before and after matching

after matching, and none of the explanatory variables were significantly different between the two groups, indicating that the matching effect was good.

The average treatment effect (ATT) for the leader group was examined by nearest-neighbor matching and compared directly with pre-match, as shown in Table 4. The study showed that leaders had an overall leadership value-added of 3.81 points higher than group members before matching ($p < 0.001$). After matching, the ATT estimated by PSM was 2.13 points ($p < 0.001$), which means that the leadership enhancement of leaders after matching remained 2.13 points higher than the group members. Thus, this study confirms that after controlling for endogeneity issues to some extent, the effect of serving as a team leader of an innovation and entrepreneurship competition on leadership improvement is still significantly more effective than that of group members.

5. Discussion

Undergraduate student leadership has long become an important grip for western universities to cultivate future social elites and leaders in various industries. With the rise of innovation and entrepreneurship activities in countries all over the world, the necessity of innovation and entrepreneurship education in enhancing students' leadership has gradually become a consensus. The development of international higher education has shown a new trend of cultivating university students' leadership through innovation and entrepreneurship education

Table 4. Differences in leadership improvement in different roles

Variables	Sample	Leader vs member B (SE)
Leadership improvement	Pre-match *t*-test	3.81^{***} (0.37)
	PSM estimation (ATT)	2.13^{***} (0.58)

Source(s): Table by authors

(Mattare, 2008). However, empirical studies regarding the effectiveness of these programs in the innovation and entrepreneurship of university students, especially in leadership enhancement, were scarce (Bagheri & Lope Pihie, 2013). This study used an empirical investigation of a Chinese research university to reveal the impact of innovation and entrepreneurship competition participation and its team roles on the improvement leadership of undergraduate students. The findings of the study are as follows.

5.1 Factors influencing leadership

Most of the leaders of the innovation and entrepreneurship competition teams are students with high professional status and education levels and student cadre experience. Specifically, student cadre experience enriches students' experiences related to activity organization and team coordination, further enhancing their leadership skills. It in turn strengthens the achievement motivation of student leaders, making them more actively involved in social practice, research projects and innovative entrepreneurial activities. In terms of family socioeconomic status, when fathers have higher cultural and social capital, students are more likely to acquire interpersonal skills, to be comfortable reproducing cultural and social capital, to show greater inspiration and leadership in team management, and thus to successfully navigate leadership roles in the team. Besides, the good family economic status that usually accompanies cultural and social capital reduces students' concerns about the financial commitment required to participate in competitions and gives students a contextual economic resource advantage in running for and playing team leadership roles.

It is also worth noting that, in terms of gender in individual characteristics, female leaders accounted for more than two-thirds of this sample. There is a disagreement about whether women are qualified leaders, as evidenced by empirical studies (Adams, 2016). Female leaders are not weaker in innovation and entrepreneurship performance because the leadership characteristics needed for innovation and entrepreneurship teams are a better match for women's gender characteristics. Female leaders are more transformative than male leaders, they also engage in more power-rewarding behaviors, support and encourage their subordinates more than men (Eagly, Johannesen-Schmidt, & van Engen, 2003). In other words, women are in a better position to use their flexibility to strengthen team cohesion. Most of the innovation and entrepreneurship teams are peer-to-peer cooperation, their knowledge and ability levels are not too disparate, and there is no strict hierarchical relationship. The relationship between the leader and the group members is a "spider web" rather than a "pyramid".

Notably, the resonance phenomenon of whether or not to be a leader and the level of leadership improvement with the strengths of individual characteristics is mainly reflected in the differences of motivation to participate and vigor traits. For the motivation of participation, there was no significant difference between leaders and members in terms of extrinsic motivation such as obtaining awards and merit rewards, but the significant characteristic of leaders was that internal motivation such as improving overall ability was the main driver for participation. This indicates that although students have a certain utilitarian tendency in their motivation to participate the competition, leaders prefer to achieve value-added in all aspects of ability through innovation and entrepreneurship practice. At present, there is an incentive mechanism of "emphasizing results but not process" in the form of innovation and entrepreneurship competitions in China, in terms of evaluation, students' competition experience is a necessary indicator for their merit evaluation and further education, which leads to utilitarian motivation of students to participate in competitions. However, it is undeniable that the innovation and entrepreneurship competition has played an effective role in promoting the number of practical achievements and the cultivation of innovation quality.

For the personal vigor trait, leaders outperformed group members on physical vigor, cognitive vigor, and emotional vigor. Vigor is difficult to classify in absolute terms as a trait that leaders previously possess, a trait that is enhanced through program practice, or both. This

study tends to consider it as an independent variable that influences leadership, meaning that students who are leaders may themselves be more energetic. Leaders who are energetic or possess positive emotions also make members feel energized. To cope with the stressful environment of a competition, leaders need to lead by example when tackling project challenges, demonstrate high energy and active thinking skills, shape team dependencies, pay close attention to changes in group members' emotional attitudes. Especially when group members slack off, leaders can boost group morale by empathizing and portraying a good vision. From a communication perspective, leadership is human communication that changes the attitudes and behaviors of others in order to meet common group goals and requirements (Fairhurst & Connaughton, 2014). Leaders need to communicate to their superiors, subordinates and their colleagues. Interacting with different audiences can lead to more heterogeneous information and practice communication skills. Leaders who use their emotional energy to give their group members a sense of warmth and enthusiasm will communicate more frequently and effectively with each other. Emotional intelligence is at the core of positive leadership, and emotions influence individual leadership by influencing individual thoughts, decisions and behaviors (Allen, Shankman, & Miguel, 2012). Overall, a leader's emotional vigor is a core expression of emotional intelligence, and the higher the emotional vigor, the better the leadership performance.

5.2 Serving as a leader is a significant predictor of leadership improvement

Both leaders and group members can improve the leadership skills by participating in dual competitions. Social exchange theory suggests that individuals exchange social activities not only at the level of extrinsic rewards, but also at the level of intrinsic rewards such as feelings of support, trust, self-esteem, and social approval (Blau, 1964). Students tend to give positive behaviors and emotions to group members due to the need of project benefit distribution and resource exchange, and group members will contribute positively and show their talents to the project in return so that leadership will be enhanced in the process of promoting the project together.

Team leaders in innovation and entrepreneurship competitions have a higher level of improvement leadership than their group members. The leader leadership enhancement comes first from the position itself, the authority given by the innovation and entrepreneurship team as an organization, which requires the leader to be able to coordinate all resources. Secondly, it comes from professionalism and values. Leaders tend to excel academically as well, and professionalism is an important factor in motivating group members to take action and present a more visionary and convincing view. Actually, the most important psychological source of leadership should be the leader's emotional vigor. According to expansion-construction theory, positive emotions have two main functions: to expand the "thinking-action" sphere and to construct lasting physical, cognitive and social resources (Fredrickson & Losada, 2005). When leaders have a high level of emotional vigor, they provide sustainable resources for their own growth and the development of their teams. When students are leaders, they need to be motivated, active and quick to think about the competition, to attract well-qualified team members, to empathize with the feelings and situations of the team members, and to mobilize the team's intelligence to overcome the competition challenges. The leader-member exchange theory suggests that the division of tasks and the quality of exchange between the leader and the members determine the outcome of leadership. It indicates that leader identifies the "inner circle" of the team based on the compatibility of the members' personalities and abilities and works more closely with these members (Robbins, Judge, & Breward, 1993). When leaders take full advantage of the complementary strengths of their members' abilities, it helps to improve team performance as well as the degree of individual leadership value-added. In short, the leadership behaviors of students in these competitions are a core factor in their leadership breakthrough.

6. Policy recommendations

Based on this study's findings on the positive effect of participation in innovation and entrepreneurship competitions on student leadership, this study explores how to promote student leadership from the perspective of creating innovation and entrepreneurship opportunities and stimulating dynamism as proposed at the school level. First, integrating leadership development into curriculum design. Universities should redesign their curricula to incorporate leadership training as a fundamental element of talent development, aligning educational content with the evolving needs of an entrepreneurial and innovation-driven economy. This includes embedding leadership-related competencies such as strategic thinking, team collaboration, and problem-solving into both general education and specialized programs. Universities could form interdisciplinary curriculum committees to identify key leadership competencies relevant to different fields of study and implement these competencies across a variety of course offerings. Pilot programs and elective leadership courses should be tested and refined based on student feedback and learning outcomes.

Second, creating structured leadership practice platforms. Practical training allows students to navigate complex scenarios, manage teams, and make strategic decisions skills that are crucial for both entrepreneurship and leadership development. Such experiences are essential in bridging the gap between theory and practice and ensuring that students are well-prepared for leadership roles in various professional contexts. Universities allocate resources to establish student-led innovation teams, entrepreneurship labs, and project incubators where students can engage in interdisciplinary projects. In parallel, mentorship programs should be formalized, pairing students with faculty or industry professionals who can provide ongoing support and feedback.

Third, building a supportive institutional ecosystem. A supportive ecosystem encourages student engagement, provides necessary resources, and promotes leadership as a key component of personal and professional development. Establishing a centralized leadership development office responsible for coordinating leadership initiatives, providing guidance, and managing funding for student-led projects are beneficial. University could create a university-wide leadership forum to connect students with industry leaders and successful alumni, fostering a vibrant community of aspiring leaders.

7. Contributions and limitations

On the one hand, the introduction of the personal vigor factor into the field of development for undergraduate students expands the application space of the theory, while verifying the role of vigor traits in students' leadership behavior; on the other hand, it confirms the nurturing effect of innovation and entrepreneurship competitions in leadership and points out the direction of optimizing the quality of innovation and entrepreneurship education.

This study has several limitations that warrant consideration. First, the data were collected from a single research university in China, which may limit the generalizability of the findings to institutions with different educational practices or in different cultural contexts. Future research should replicate this study in diverse educational settings to validate the observed patterns. Second, the reliance on self-reported data for leadership outcomes introduces the risk of social desirability bias, potentially inflating the perceived leadership gains. Employing alternative measurement strategies, such as peer assessments or performance-based evaluations, would provide a more comprehensive picture of leadership development.

References

Adamczyk, S., Bullinger, A. C., & Möslein, K. M. (2012). Innovation contests: A review, classification and outlook. *Creativity and Innovation Management, 21*(4), 335–360. doi: 10.1111/caim.12003.

Adams, R. B. (2016). Women on boards: The superheroes of tomorrow?. *The Leadership Quarterly, 27* (3), 371–386. doi: 10.1016/j.leaqua.2015.11.001.

Allen, S., Shankman, M., & Miguel, R. (2012). Emotionally intelligent leadership: An integrative, process-oriented theory of student leadership. *International Journal of Leadership in Education*, *11*(1), 177–203. doi: 10.12806/V11/I1/TF1.

Audretsch, D. B., & Belitski, M. (2017). Entrepreneurial ecosystems in cities: Establishing the framework conditions. *The Journal of Technology Transfer*, *42*(5), 1030–1051. doi: 10.1007/s10961-016-9473-8.

Audretsch, D. B., & Tamvada, J. P. (2023). From entrepreneurship to leadership. *The Journal of Technology Transfer*, *48*(2), 814–820. doi: 10.1007/s10961-022-09956-8.

Bagheri, A., & Lope Pihie, Z. A. (2013). Role of university entrepreneurship programs in developing students' entrepreneurial leadership competencies: Perspectives from Malaysian undergraduate students. *The Journal of Education for Business*, *88*(1), 51–61. doi: 10.1080/08832323.2011.638681.

Barba-Sánchez, V., & Atienza-Sahuquillo, C. (2016). The development of entrepreneurship at school: The Spanish experience. *Education + Training*, *58*(7/8), 783–796. doi: 10.1108/ET-01-2016-0021.

Blau, P. M. (1964). *Exchange and power in social life*. New York: Routledge.

Brüne, N., & Lutz, E. (2020). The effect of entrepreneurship education in schools on entrepreneurial outcomes: A systematic review. *Management Review Quarterly*, *70*(2), 275–305. doi: 10.1007/s11301-019-00168-3.

Chaiklin, S. (2003). The zone of proximal development in Vygotsky's analysis of learning and instruction. In A. Kozulin, B. Gindis, V. S. Ageyev, & S. M. Miller (Eds), *Vygotsky's educational theory in cultural context* (pp. 39–64). Cambridge University Press.

Cunliffe, A. L., & Eriksen, M. (2011). *Relational leadership. Human Relations*, *64*(11), 1425–1449. doi: 10.1177/0018726711418388.

Eagly, A. H., Johannesen-Schmidt, M. C., & van Engen, M. L. (2003). Transformational, transactional, and laissez-faire leadership styles: A meta-analysis comparing women and men. *Psychological Bulletin*, *129*(4), 569–591. doi: 10.1037/0033-2909.129.4.569.

Fairhurst, G. T., & Connaughton, S. L. (2014). Leadership: A communicative perspective. *Leadership*, *10*(1), 7–35. doi: 10.1177/1742715013509396.

Fernald, L. W., Solomon, G. T., & Tarabishy, A. (2005). A new paradigm: Entrepreneurial leadership. *Southern Business Review*, *30*(2), 1–10. Available from: https://digitalcommons.georgiasouthern.edu/sbr/vol30/iss2/3.

Fredrickson, B. L., & Losada, M. F. (2005). Positive affect and the complex dynamics of human flourishing. *American Psychologist*, *60*(7), 678–686. doi: 10.1037/0003-066X.60.7.678.

Jones, B., & Iredale, N. (2010). Enterprise education as pedagogy. *Education + Training*, *52*(1), 7–19. doi: 10.1108/00400911011017654.

Harrison, R. T., & Leitch, C. M. (1994). Entrepreneurship and leadership: The implications for education and development. *Entrepreneurship & Regional Development*, *6*(2), 111–125. doi: 10.1080/08985629400000007.

Kim, Y. J., & Noh, B. S. (2012). A study of entrepreneurship education effect on self-leadership and entrepreneurship. *Journal of Digital Policy & Management*, *10*(6), 23–31.

Kirkpatrick, S. A., & Locke, E. A. (1991). Leadership: Do traits matter?. *Academy of Management Perspectives*, *5*(2), 48–60. doi: 10.5465/ame.1991.4274679.

Kouzes, J. M., & Posner, B. Z. (2017). *The leadership challenge: How to get extraordinary things done in organizations* (6th ed.). New Jersey: John Wiley & Sons.

Kouzes, J. M., & Posner, B. Z. (2018). *The student leadership challenge: Five practices for becoming an exemplary leader*. John Wiley & Sons.

Li, G., Long, Z., Jiang, Y., Huang, Y., Wang, P., & Huang, Z. (2022). Entrepreneurship education, entrepreneurship policy and entrepreneurial competence: Mediating effect of entrepreneurship competition in China. *Education + Training*, *65*(4), 607–629, doi: 10.1108/ET-06-2021-0218.

Liotard, I., & Revest, V. (2018). Contests as innovation policy instruments: Lessons from the US federal agencies' experience. *Technological Forecasting and Social Change*, *127*, 57–69. doi: 10.1016/j.techfore.2017.07.008.

Man, T. W. Y., Lau, T., & Chan, K. F. (2002). The competitiveness of small and medium enterprises: A conceptualization with focus on entrepreneurial competencies. *Journal of Business Venturing, 17* (2), 123–142. doi: 10.1016/S0883-9026(00)00058-6.

Martin, G., & Staines, H. (1994). Managerial competences in small firms. *The Journal of Management Development, 13*(7), 23–34. doi: 10.1108/02621719410063396.

Mattare, M. (2008). Teaching entrepreneurship: The case for an entrepreneurial leadership course. *Paper presented at USASBE*, San Antonio, TX.

McKenzie, D., & Sansone, D. (2019). Predicting entrepreneurial success is hard: Evidence from a business plan competition in Nigeria. *Journal of Development Economics, 141*, 102369. doi: 10.1016/j.jdeveco.2019.07.002.

Ministry of Education of the People's Republic of China (2023). Running on the track of endeavour - 8 Years of China international 'Internet+' innovation and entrepreneurship competition for students. Available from: http://www.moe.gov.cn/jyb_xwfb/s5147/202304/t20230410_1055016.html

Posner, B. Z. (2004). A leadership development instrument for students: Updated. *Journal of College Student Development, 45*(4), 443–456. doi: 10.1353/csd.2004.0051.

Pulido-Martos, M., Cortés-Denia, D., de la Rosa-Blanca, J. J., & Lopez-Zafra, E. (2020). The Shirom-Melamed Vigor Measure for students: Factorial analysis and construct validity in Spanish undergraduate university students. *International Journal of Environmental Research and Public Health, 17*(24), 9590. doi: 10.3390/ijerph17249590.

Rasmussen, E., Mosey, S., & Wright, M. (2011). The evolution of entrepreneurial competencies: A longitudinal study of university spin-off venture emergence. *Journal of Management Studies, 48* (6), 1314–1345. doi: 10.1111/j.1467-6486.2010.00995.x.

Robbins, S. P., Judge, T., & Breward, K. (1993). *Essentials of organizational behavior.* New Jersey: Pearson US.

Russell, R., Atchison, M., & Brooks, R. (2008). Business plan competitions in tertiary institutions: Encouraging entrepreneurship education. *Journal of Higher Education Policy and Management, 30*(2), 123–138. doi: 10.1080/13600800801938739.

Shirom, A. (2004). A feeling vigorous at work? The construct of vigor and the study of positive affect in organizations. In P. L. Perrewé, & D. C. Ganster (Eds), *Research in occupational stress and well-being* (Vol. 3, pp. 135–164). Elsevier. doi: 10.1016/S1479-3555(03)03004-X.

Shirom, A. (2007). Explaining vigor: On the antecedents and consequences of vigor as a positive affect at work. In C. L. Cooper, & J. Barling (Eds), *Positive organizational behavior* (pp. 86–100). SAGE Publications. doi: 10.4135/9781446212752.n7.

Van Hemmen, S., Alvarez, C., Peris-Ortiz, M., & Urbano, D. (2015). Leadership styles and innovative entrepreneurship: An international study. *Cybernetics & Systems, 46*(3-4), 271–286. doi: 10.1080/01969722.2015.1012896.

Watt, W. M. (2003). Effective leadership education: Developing a core curriculum for leadership studies. *Journal of Leadership Education, 2*(1), 13–26. doi: 10.12806/V2/I1/RF1.

West, M. A., & Hirst, G. (2005). Cooperation and teamwork for innovation. In M. A. West, D. Tjosvold, & K. G. Smith (Eds), *International handbook of organizational teamwork and cooperative working* (pp. 297–319). John Wiley & Sons.

Wren, J. T. (Ed.) (1995). *The leader's companion: Insights on leadership through the ages.* Free Press.

Zimmerman-Oster, K., & Burkhardt, J. C. (2001). Leadership in the making: Impact and insights from leadership development programs in U.S. Colleges and universities. Available from: http://www.wkkf.org/Pubs/CCT/Leadership/Pub3165.pdf

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