Exploring the relationship between failure-learning-based entrepreneurship education and youth entrepreneurial resilience: A mediated moderation model

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Abstract: *Entrepreneurial failure exists objectively in the process of entrepreneurship, and the fear of entrepreneurship failure inhibits youth entrepreneurship activities to a certain extent. Thus, failure-learning-based entrepreneurship education is critical to cultivating youth entrepreneurial literacy. However, previous research on this topic has not provided a clear answer to how to improve youth entrepreneurial resilience. To explore the relationship between failure-learning-based entrepreneurship education and youth entrepreneurial resilience, using the questionnaire data of 399 youth recruited from China in October 2021 via the Credamo platform, the multiple regression analysis, and the Bootstrap method, we empirically analyzed the impact of failure-learning-based entrepreneurship education on youth entrepreneurial resilience, as well as the mediating effect of entrepreneurial cognition and the moderating effect of the fault-tolerant environment on the above relationship. The results show that failure-learning-based entrepreneurship education has a significant positive impact on youth entrepreneurial resilience. The two dimensions of willingness cognition and ability cognition in entrepreneurial cognition have a complete mediating effect on the impact of failure-learning-based entrepreneurship education on youth entrepreneurial resilience while the mediating effect of arrangements cognition is not significant. The fault-tolerant environment positively moderates the impact of failure-learning-based entrepreneurship education on entrepreneurial resilience, and its moderating effect is transmitted through the mediating effect of willingness cognition and ability cognition. A strong fault-tolerant environment enhances the impact of failure-learning-based entrepreneurship education on the formation of youth rational cognition, through the mediating effect of willing cognition and ability cognition, which further strengthens the positive impact on youth entrepreneurial resilience. The findings enrich the body of knowledge on entrepreneurship education and can improve youth entrepreneurial resilience.*

Keywords: *Failure learning, entrepreneurship education, entrepreneurial resilience, entrepreneurial cognition, fault-tolerant environment.*

JEL Classification: *I21, L26.*

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Introduction

Youth entrepreneurship is an important way to realize the ideals and self-worth of youth groups, and also an important measure to alleviate the pressure of social employment (Corrales-Herrero & Rodriguez-Prado, 2021). Youth can promote their entrepreneurial ability through entrepreneurship education. Therefore, entrepreneurship education is an increasingly valued and important part of the youth education system in countries around the world. Youth entrepreneurial intention and entrepreneurial quality have been significantly improved as a result. In addition, in recent years, governments around the world have issued policies to encourage youth entrepreneurship activities, which have become the new driver of innovation and entrepreneurship groups (Aftab et al., 2022). However, owing to anti-failure bias, existing entrepreneurship education pays more attention to entrepreneurial success, focuses on conveying the experiences of successful entrepreneurs to learners, and avoids entrepreneurial failure (Liu et al., 2019). Relevant data indicate that if viewed from the perspective of expected investment returns, the failure rate of startups worldwide ranges from 70% to 80% (Olaison & Sørensen, 2014), and the success rate of entrepreneurship among youth from China is less than 5% and that entrepreneurial failure is an objective, high-frequency event in the process of youth entrepreneurship (Wang, 2019). Therefore, more entrepreneurship education for youth has begun to focus on teaching content about entrepreneurial failure and improving the entrepreneurship education system from the perspective of failure learning (Hameed & Irfan, 2019; Yu et al., 2012).

Failure-learning-based entrepreneurship education emphasizes summarizing and reflecting on cases of entrepreneurial failure, refining and absorbing knowledge of entrepreneurial failure, and improving youth entrepreneurial literacy when facing entrepreneurial challenges (Mohamed & Ali, 2021; Testa & Frascheri, 2015). It is critical to help youth correctly understand entrepreneurial failure, enhance entrepreneurial risk awareness, and improve the ability to recover from entrepreneurial failure (Bandera et al., 2021). Entrepreneurship resilience is the ability of entrepreneurs to self-adjust and actively respond to entrepreneurial challenges, and failure-learning-based entrepreneurship education has a significant impact on entrepreneurship resilience. By learning from previous entrepreneurial failures, entrepreneurs' entrepreneurial resilience will significantly improve and their probability of success will be higher (Santoro et al., 2020). In the context of the current global economic recession and post-COVID-19 pandemic, the difficulty of entrepreneurship has increased dramatically. Entrepreneurship resilience has become a key factor affecting the success of youth entrepreneurship (Li et al., 2022), and it is also an important aspect of cultivating youth entrepreneurial ability.

Existing studies on entrepreneurship education have focused more on how to improve youth entrepreneurial willingness (Jena, 2020; Zhang et al., 2014) and promote youth entrepreneurial success (Boldureanu et al., 2020; Welsh et al., 2016). Especially influenced by the anti-failure bias, existing discussions on entrepreneurship education mostly guide and stimulate youth entrepreneurial behavior from the perspective of entrepreneurial success. Li et al. (2023) used qualitative comparative analysis to explore the specific path of stimulating students' entrepreneurial intention through entrepreneurship education. Martínez-Gregorio et al. (2021) used meta-analysis to find that the duration of entrepreneurship education has a more significant effect on enhancing entrepreneurship intention. However, the above literature does not consider the important role of failure learning in entrepreneurship education. Meanwhile, considering the positive impact of entrepreneurial resilience on entrepreneurial success and the ability to start a new business after failure, there has been no systematic discussion in the existing literature on how to cultivate youth entrepreneurial resilience. Therefore, this study analyzed the relationship between failure-learning-based entrepreneurship education and youth entrepreneurial resilience and discussed the possible effects of entrepreneurial cognition and fault-tolerant environment in the above relationship. The aim was to provide a certain theoretical reference and decision support for improving youth entrepreneurial resilience and further solving the practical problem of the low entrepreneurial success rate of youth.

The rest of this paper is organized as follows: Section 1 reviews existing literature on the relationship between entrepreneurship education and entrepreneurial resilience, the mediating effect of entrepreneurial cognition,

and the moderating effect of the fault-tolerant environment, and it develops the research hypotheses of this study through theoretical analysis. Section 2 introduces the methodology of this study, including data sources and measurement of variables. Section 3 describes the results of a reliability and validity analysis of the scale, a common method biases test, and a correlation analysis, and it tests the hypotheses. Last section discusses the research findings, managerial implications, limitations, and future research directions.

1. Theoretical analysis and hypothesis development

This section conducts a theoretical analysis of the relationship between failure-learning-based entrepreneurship education and entrepreneurship resilience, further explores the mediating effect of entrepreneurial cognition, and the modeling effect of the fault-tolerant environment in the above relationship. On this basis, the research hypotheses of this study are developed.

1.1 Failure-learning-based entrepreneurship education and entrepreneurship resilience

Entrepreneurship education should deliver entrepreneurial knowledge to youth, including cultivating the individual ability to identify opportunities and forming strong entrepreneurial awareness, teaching individual entrepreneurial skills to enable youth to explore entrepreneurial resources, and developing individual creativity and critical thinking (Zeng et al., 2017). Moreover, the dimensions of entrepreneurship education also include theoretical and practical guidance (Bell & Bell, 2020). Specifically, theory-oriented entrepreneurship education aims to deliver knowledge about entrepreneurship opportunities, elements, and teams to youth in the form of lectures. Practice-oriented entrepreneurship education emphasizes "learning by doing," performs entrepreneurial activities in real situations, and further develops youth entrepreneurial skills through the practical guidance of entrepreneurial tutors (Hynes et al., 2011; Ollila & Williams-Maddleton, 2011). Failure-learning-based entrepreneurship education is ideal in an education environment related to entrepreneurial failure; it includes knowledge discovery in the case of entrepreneurial failure (Gartner & Vesper, 1994), failure scenario simulation in entrepreneurial practice training (Funken et al., 2020), and a help system for youth to recover from their entrepreneurial failures (Chen et al., 2022).

Entrepreneurial resilience is a further extension of psychological resilience in the field of entrepreneurship, and it refers to the dynamic adaptability of entrepreneurs to self-adjust and actively respond to challenges in highly uncertain entrepreneurial environments. Moreover, the interpretation of entrepreneurial resilience also explains to some extent why some entrepreneurs can better cope with setbacks and challenges and later achieve entrepreneurial success (Zhang & Li, 2020). From the perspective of the youth self-concept of ability development, the positive role of failure-learning-based entrepreneurship education in the development and cultivation of youth psychological resilience can be predicted (González-López et al., 2019). The introduction of cases of entrepreneurial failure in the process of entrepreneurship education, the learning of failure experience, and the guidance of youth to actively face setbacks, challenges, and even failures in practice can effectively inhibit the generation of negative emotions. Therefore, the following research hypothesis is proposed:

H1: Failure-learning-based entrepreneurship education has a positive impact on entrepreneurial resilience.

1.2 Mediating effect of entrepreneurial cognition

The theory of entrepreneurial cognition emphasizes that entrepreneurial activity is a unique cognitive way of thinking and information processing formed by entrepreneurs in highly uncertain entrepreneurial environments (Hu et al., 2019; Mitchell et al., 2007). Entrepreneurial cognition is a unique knowledge structure of entrepreneurs, and the cognitive style of entrepreneurs can be acquired through childhood learning. The key to the formation of entrepreneurial cognition lies in the acquisition of entrepreneurial experience and previous knowledge, and entrepreneurial education is an important way for youth to acquire such entrepreneurial knowledge (Zhou & Xu, 2012). Through the teaching of theoretical knowledge and the development of practical skills, youth can form a new knowledge structure about entrepreneurship. Therefore, entrepreneurship education can not only transfer entrepreneurial knowledge but also have a positive impact on youth entrepreneurial cognition.

At the same time, according to the entrepreneurial cognition model proposed by Mitchell et al. (2002), the entrepreneurial cognition of individuals is categorized into three types: entrepreneurial arrangements cognition, willingness cognition, and ability cognition. Among these, arrangements cognition is a unique knowledge structure configuration wherein individuals need to perform and complete entrepreneurial activities. Before forming entrepreneurial decisions, individuals need to form good entrepreneurial cognitive scripts (memory structures established through repeated experience) in terms of entrepreneurial thinking, entrepreneurial networks, entrepreneurial knowledge, and entrepreneurial skills (Liñán et al., 2011), and with continuous enrichment of script content, arrangements cognition will be further expanded. From the perspective of impact and consequence, the expansion of arrangements cognition can psychologically prepare youth to cope with entrepreneurial challenges, thus improving their entrepreneurial resilience (Korber & McNaughton, 2017). Accordingly, the following research hypothesis is proposed:

H2a: Arrangements cognition plays a mediating role between entrepreneurship education and entrepreneurship resilience.

Entrepreneurial willingness cognition refers to the knowledge structure wherein entrepreneurs must guarantee the realization of their commitment to entrepreneurial activities. Based on the script content of willingness cognition, this type of cognition includes individuals' search, trade-offs and recognition of entrepreneurial opportunities, and tolerance of entrepreneurial commitment (Mitchell et al., 2004). Clearly, through certain entrepreneurship education, youth can gain the ability to deal with information resources so that they can identify entrepreneurial opportunities more keenly. Meanwhile, in the process of entrepreneurship, youth can enhance their risk awareness, take corresponding measures in advance, and reduce entrepreneurial risks. Especially in the face of entrepreneurial dilemmas, they can gain a more sensitive ability to identify opportunities, which can help them find solutions to entrepreneurial problems more quickly and thus effectively improve their entrepreneurial resilience. Accordingly, the following research hypothesis is proposed:

H2b: Willingness cognition plays a mediating role between entrepreneurial education and entrepreneurial resilience.

Entrepreneurial ability cognition is a knowledge structure that emphasizes that entrepreneurs can mobilize entrepreneurial knowledge and skills to complete entrepreneurial activities. Its script content includes entrepreneurial diagnostic ability, situational knowledge, and opportunity discovery ability (Mitchell et al., 2004). Ability cognition can stimulate individual entrepreneurial knowledge and entrepreneurial skills and help entrepreneurs identify key information in the entrepreneurial process. Especially in the face of entrepreneurial challenges, entrepreneurs can diagnose previous entrepreneurial decisions, obtain feedback about entrepreneurial setbacks and self-adjust, and form the ability to actively respond to entrepreneurial challenges, which can significantly improve their entrepreneurial resilience. Accordingly, the following research hypothesis is proposed:

H2c: Ability cognition plays a mediating role between entrepreneurial education and entrepreneurial resilience.

1.3 Moderating effect of the fault-tolerant environment

As society becomes better equipped to face entrepreneurial failure objectively, its tolerance for the failure of innovation and entrepreneurship and for the fault-tolerant environment also changes significantly (Cardon et al., 2011; Tian & Wang, 2014). A fault-tolerant environment is an abstract environmental variable. When entrepreneurs face entrepreneurial failure, the scientific fault-tolerant environment can help them correctly attribute their entrepreneurial failure, which can not only reduce the failure-induced doubt and negation of their ability by the external environment but also inhibit the phenomenon of entrepreneurial failure stigma. Even after entrepreneurial failure, entrepreneurs can receive some social support to stimulate subsequent entrepreneurial behavior (He & Zhang, 2020). It can be seen that the degree of friendliness to entrepreneurial failure reflected by the fault-tolerant environment can help youth cope with entrepreneurial setbacks and challenges more actively, and such a supportive external environment is important for youth to shape entrepreneurial resilience. Therefore, it can be predicted that in the process of entrepreneurship education for youth, the higher the degree of fault tolerance of the external environment, the stronger the effect of failure-learning-based entrepreneurship education

on improving youth entrepreneurial resilience. Based on the above analysis, the following research hypothesis is proposed:

H3a: The fault-tolerant environment has a significant positive moderating effect on the relationship between entrepreneurship education and entrepreneurship resilience.

In addition, according to the cognitive-effective personality system (CAPS) theory, the individual's response system can perform cognitive processing on external environmental stimuli, thus showing more rational behavioral responses (Kell, 2018). If individuals need to form effective behavioral regulation, the key lies in the transition from emotional processing to cognitive processing (Hu et al., 2019). As a positive entrepreneurial support situation, the fault-tolerant environment can stimulate youth to form rational cognition of entrepreneurial challenges and frustrations according to the friendliness of the external fault-tolerant environment, which can help them perform in-depth processing of entrepreneurial cognition in terms of different scripts of entrepreneurial arrangements cognition, willingness cognition, and ability cognition. Finally, in the process of entrepreneurship education, youth can realize self-regulation and control of their cognition and behavior, and they can improve their dynamic adaptability to entrepreneurial dilemmas.

H3b: The interaction effect between entrepreneurship education and the fault-tolerant environment affects youth entrepreneurial resilience through the mediating effect of entrepreneurial cognition.

In sum, the conceptual framework of this study is shown in Fig. 1.

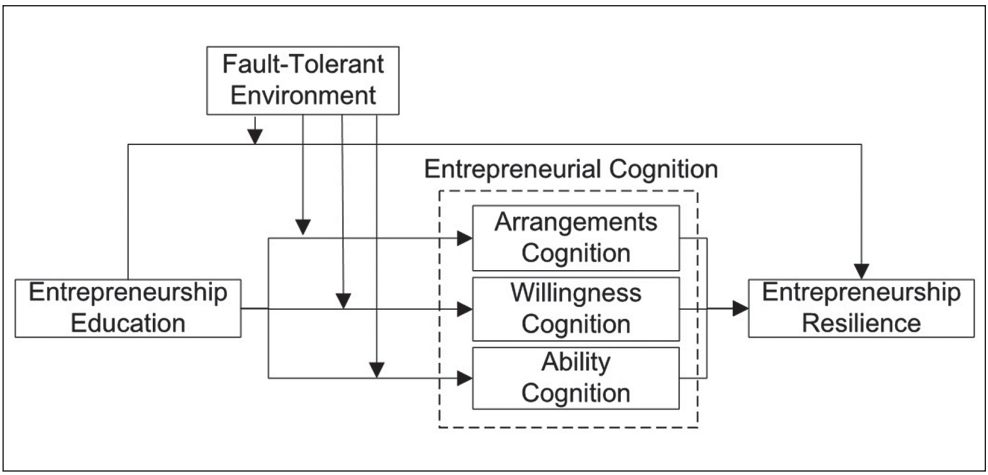

Fig. 1: The conceptual framework of this study

Source: own

2. Methodology

2.1 Data sources

To ensure the diversity of research samples, 421 questionnaires were randomly distributed to youth from Chinese universities in October 2021 via the Data Mart of Credamo platform, a platform that can provide professional solutions for data collection. A total of 421 questionnaires were collected, with a return rate of 100%. Strict identity and quality control were adopted for the subjects. The questionnaires with incorrect answers to filtered item ("I am not a university student") were removed, and 399 valid questionnaires were recovered, yielding an effective rate of 94.8%.

Among the subjects, 31.8% were male, and 68.2% were female. In terms of grades, all samples belong to university-level students,

freshmen accounted for 1.8%, sophomores accounted for 19.0%, juniors accounted for 38.6%, and seniors accounted for 40.6%. In terms of majors, engineering majors accounted for 23.1%, science majors accounted for 29.8%, business majors accounted for 25.3%, and humanities and arts majors accounted for 21.8% of subjects. Moreover, 46.9% of subjects came from rural areas, while 53.1% came from urban areas. Only children accounted for 40.9%, and non-only children accounted for 59.1%. In addition, subjects were recruited from Anhui, Beijing, Fujian, Gansu, Guangdong, Guangxi, Guizhou, Hainan, Hebei, Henan, Heilongjiang, Hubei, Hunan, Jilin, Jiangsu, Jiangxi, Liaoning, Inner Mongolia, Qinghai, Shandong, Shanxi, Shaanxi, Shanghai, Sichuan, Tianjin, Yunnan, Zhejiang, and Chongqing.

2.2 Measurement of variables

The research variables included failure-learning-based entrepreneurship education (*EE*), entrepreneurial resilience (*ER*), entrepreneurial cognition (*EC*), and the fault-tolerant environment (*FTE*). To ensure the reliability and validity of the scale, we used mature scales in the existing literature to measure the above variables, and we modified some items of the scale according to the research context.

EE was measured referring to the entrepreneurship education scale compiled by Lüthje and Franke (2002) and Zhang et al. (2018). On this basis, the contents of the questions enriched the expression of failure-learning-based entrepreneurship education, which was divided into six items. For example, "Failure-learning-based entrepreneurship education encourages me to cultivate creative ideas to become a resilient entrepreneur," "Failure-learning-based entrepreneurship education provides me with the necessary knowledge to cope with setbacks," and "Failure-learning-based entrepreneurship education develops my entrepreneurial skills and abilities to solve difficulties."

ER was measured using Zhang and Li's (2020) adapted scale based on the Chinese context, which included 10 items in total. For example, "I can overcome difficulties to achieve goals," "I am not easily discouraged by failure," and "I think I am a person of iron will."

EC referred to the measurement method of Mitchell et al. (2000) and Ni and Li (2017) on entrepreneurial cognition, which was divided into three dimensions: arrangements cognition (*ARC*), willingness cognition (*WC*), and ability cognition (*ABC*). Among these dimensions, *ARC* mainly examined the youth cognition level of resource preparation required for entrepreneurial activities, such as "I have entrepreneurial resources," and "I have corresponding technology patent protection," including six items. *WC* examined the cognition of youth willingness to perform entrepreneurial activities, such as "I can quickly adapt to the new environment," and "I do things with great vigor," including five items. *ABC* examined the youth cognition of the degree of ability required for entrepreneurial activities, such as "I can quickly judge the problem," and "I have good knowledge reserves," including six items.

FTE was measured following the approach of Cox et al. (2012) and Zhang and Long (2016), and it was revised according to the research context, including six items in total. For example, "I am in an environment that will not resent entrepreneurs because of entrepreneurial failure," and "I am in an environment that will forgive the failure of entrepreneurs."

The above scales were measured on a five-point Likert scale, from 5 (strongly agree) to 1 (strongly disagree).

Control variables

Gender, grade, major, hometown, and only-child status were measured as dummy variables. Gender was coded 0 = male and 1 = female. Grade was coded as 1 = freshmen, 2 = sophomores, 3 = junior, and 4 = senior. Major was coded as 1 = engineering major, 2 = science major, 3 = business major, and 4 = humanities and arts major. Hometown was coded as 0 = rural areas and 1 = urban areas. Only-child status was coded as 0 = only children and 1 = non-only children.

3. Results and discussion

3.1 Reliability and validity analysis

The results of the reliability and validity test show that Cronbach's α values of the entrepreneurship education, fault-tolerant environment, entrepreneurial resilience, and entrepreneurial cognition scales were 0.867, 0.832, 0.895, and 0.932, respectively. Moreover, three internal dimensions of arrangements cognition, willingness cognition, and ability cognition showed Cronbach's α values of 0.918, 0.829, and 0.845, respectively, indicating that each scale has a good internal consistency and high reliability.

The exploratory factor analysis (EFA) was used to test the structural validity of each scale. The results show that the five items in the entrepreneurship education scale converged to a common factor and that the cumulative explained variance ratio was 60.528%. The six items in the fault-tolerant environment scale converged to a common factor, and the cumulative explained variance ratio was 53.349%. The 17 items in the entrepreneurial cognition scale converged to three common factors: the Kaiser-Meyer-Olkin (KMO) value was 0.929, the cumulative explained variance ratio was 64.062%, and the factor loadings for the items on each of the factors exceeded 0.5. The cumulative explanatory variance ratios of the above variables all reach over 50%, which is acceptable and satisfactory, indicating that the common factors can reflect the content expressed by the item more effectively. The distribution of items conformed to the expectation of the dimensions of arrangements cognition, willingness cognition, and ability cognition. At the same time, in the results of the confirmatory factor analysis of entrepreneurial cognition, the fit statistics were RMR = 0.059, RMSEA = 0.096, GFI = 0.865, TLI = 0.879, CFI = 0.896, NFI = 0.872, χ^2 = 538.583, and df = 116, indicating that the measurement model of entrepreneurial cognition was accepted as adequate. The 10 items in the entrepreneurial resilience scale converged to a common factor, and the cumulative explained variance ratio was 52.008%.

3.2 Common method bias test

A Harman one-factor test was used to examine the possible common method biases. The results of the exploratory factor analysis show that five common factors were extracted in variables and that the highest variance explained by a single factor was 37.880%, which was less than the critical standard of 40%, indicating that there was no single factor in this study that could explain the covariance in variables. Hence, there were no significant issues with common method bias in the data.

3.3 Correlation analysis

Tab. 1 presents the average value, standard deviation, and correlation between the main variables in this study. From the results, entrepreneurship education is significantly and positively correlated with arrangements cognition, willingness cognition, ability cognition, and entrepreneurial resilience (r = 0.538–0.580, p < 0.01). In addition, the fault-tolerant environment is positively correlated with entrepreneurship education, arrangements cognition, willingness cognition, and ability cognition (r = 0.404–0.505, p < 0.01). Overall, the correlations do not cause multicollinearity issues. The above correlation results are consistent with the predicted direction of the hypothesis, which is also a preliminary verification of the hypothesis. In addition, the variance inflation factor was used to further test the multicollinearity in all regression models. Its value is less than 10, indicating that there is no multicollinearity.

3.4 Test of hypotheses

Test of main effect and mediating effect

To verify the proposed hypotheses, we first tested the main effects between dependent and independent variables. It can be seen from

Tab. 1: Correlation analysis

	Mean	SD	*FTE*	*ARC*	*WC*	*ABC*	*ER*
EE	3.720	0.744	0.485**	0.556**	0.538**	0.580**	0.528**
FTE	3.585	0.644	1	0.505**	0.404**	0.441**	0.439**
ARC	2.512	1.020		1	0.599**	0.635**	0.525**
WC	3.582	0.775			1	0.744**	0.749**
ABC	3.666	0.668				1	0.735**
ER	3.827	0.613					1

Note: **p < 0.01.

Source: own

Models (1–2) in Tab. 2 that failure-learning-based entrepreneurship education has a significant positive impact on entrepreneurship resilience (β = 0.463, p < 0.001), indicating that learning about entrepreneurial failure in entrepreneurship courses can improve youth entrepreneurial resilience. Hypothesis *H1* is thus verified. Moreover, the gender of youth in the control variables has a significant negative impact on entrepreneurial resilience (β = −0.216, p < 0.001), indicating that young men have more entrepreneurship resilience than young women.

Referring to the method of Wen and Ye (2014) about the mediating effect test, Models (3–6) of Tab. 2 present the results of the mediating effect of entrepreneurial cognition. From the results, failure-learning-based entrepreneurship education has a significant positive effect on the three dimensions of entrepreneurial cognition: arrangements cognition (β = 0.521, p < 0.001), willingness cognition (β = 0.488, p < 0.001), and ability cognition (β = 0.555, p < 0.001). In Model (6) of Tab. 2, the impact coefficient of entrepreneurship education is 0.065, but it is not significant; only the coefficients of willingness cognition (β = 0.419, p < 0.001) and ability cognition (β = 0.379, p < 0.001) are significantly positive. The above results indicate that the two dimensions of willingness cognition and ability cognition in entrepreneurial cognition have a complete mediating effect on the relationship between entrepreneurship education and entrepreneurial resilience. That is, there are two influence paths: "entrepreneurial education → willing cognition → entrepreneurial resilience" and "entrepreneurial education → ability cognition → entrepreneurial resilience," but the mediating effect of arrangements cognition is not significant. Hypotheses *H2b* and *H2c* are verified, and hypothesis *H2a* is not verified. This finding further reveals that strengthening failure-learning-based entrepreneurship education can promote youth cognition of their willingness to perform entrepreneurial activities, as well as their cognition of individual

Tab. 2: Results of the mediating effect test

	ER	*ER*	*ARC*	*WC*	*ABC*	*ER*
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**
Control variables						
Gender	−0.336***	−0.216***	−0.117*	−0.223***	−0.161***	−0.066
Grade	0.002	0.044	−0.020	0.071	0.053	−0.007
Major	−0.061	−0.026	−0.068	0.015	0.018	−0.041
Hometown	0.017	0.044	0.118*	0.050	0.079	−0.003
Only-child or not	0.102	0.065	0.001	0.031	−0.016	0.058
Independent variable						
EE		0.463***	0.521***	0.488***	0.555***	0.065
Mediating variables						
ARC						−0.031
WC						0.419***
ABC						0.379***
R^2	0.139	0.327	0.343	0.336	0.369	0.647
ΔR^2	0.128	0.317	0.333	0.326	0.359	0.639
F	12.639***	31.741***	34.144***	33.086***	38.136***	79.156***

Note: ***p < 0.001, *p < 0.05.

Source: own

entrepreneurial ability, thus enhancing their entrepreneurial resilience.

In addition, the Bootstrap method was used to test the above mediating effects. From the results in Tab. 3, the direct effect "entrepreneurial education → entrepreneurial resilience" (BootLLCI = −0.012, BootULCI = 0.119) shows that the confidence intervals include zero. The indirect effect "entrepreneurial education → arrangements cognition → entrepreneurial resilience" (BootLLCI = −0.045, BootULCI = 0.020) shows that the confidence intervals include zero. However, the indirect effects "entrepreneurial education → willing cognition → entrepreneurial resilience" (BootLLCI = 0.056, BootULCI = 0.145) and "entrepreneurial education → ability cognition → entrepreneurial resilience" (BootLLCI = = 0.031, BootULCI = 0.097) show that the confidence intervals do not include zero. This indicates the existence of the mediating effect of willingness cognition and ability cognition on the positive impact of failure-learning-based entrepreneurship education on entrepreneurial resilience, and we see a complete mediating effect. In contrast, the mediating effect of arrangements cognition is not significant, which is consistent with the results of the regression analysis.

Tab. 3: Bootstrap analysis results of the mediating effect

Effects	Estimated	BootSE	95% CI	
			BootLLCI	BootULCI
Direct effect				
Entrepreneurial education → entrepreneurial resilience	0.056	0.033	−0.012	0.119
Indirect effect				
Entrepreneurial education → arrangements cognition → entrepreneurial resilience	−0.014	0.016	−0.045	0.020
Entrepreneurial education → willing cognition → entrepreneurial resilience	0.094	0.023	0.056	0.145
Entrepreneurial education → ability cognition → entrepreneurial resilience	0.060	0.017	0.031	0.097

Source: own

Test of moderating effect

To test the possible moderating effect of the fault-tolerant environment, we introduced the interaction term of failure-learning-based entrepreneurship education and the fault-tolerant environment (*EE*FTE*) into the regression analysis after the standardization of variables. From the results in Model (3) of Tab. 4, the fault-tolerant environment has a significant positive impact on entrepreneurial resilience ($\beta = 0.230$, $p < 0.001$), indicating that the higher the degree of tolerance of the external environment for entrepreneurial failure, the higher the youth entrepreneurial resilience. Moreover, the coefficient of the interactive item *EE*FTE* is significantly positive ($\beta = 0.116$, $p < 0.01$), indicating that the fault-tolerant environment has a significant positive moderating effect on the relationship between failure-learning-based entrepreneurship education and entrepreneurship resilience. Hypothesis *H3a* is thus verified. The higher the degree of fault tolerance of the external environment in which youths live, the more they can improve their entrepreneurial resilience through failure-learning-based entrepreneurship education.

In addition, this study relied on Wen et al.'s (2006) methods to test the mediated moderation effect of hypothesis *H3b*. Based on the test of the moderating effect of the fault-tolerant environment, the mediating variables such as arrangements cognition, willingness cognition, and ability cognition were introduced into the regression analysis. From the results in Models (4–6) of Tab. 4, we can see that mediating variables have a significant impact on interaction items (*EE*FTE*). However, in Model (7), when the mediating variables are

Tab. 4: Results of the moderating effect test

	ER			*ARC*	*WC*	*ABC*	*ER*
	Model (1)	**Model (2)**	**Model (3)**	**Model (4)**	**Model (5)**	**Model (6)**	**Model (7)**
Control variables							
Gender	−0.336***	−0.216***	−0.201***	−0.097*	−0.207***	−0.144**	−0.069*
Grade	0.002	0.044	0.032	−0.035	0.059	0.040	−0.009
Major	−0.061	−0.026	−0.039	−0.086*	0.001	0.003	−0.046
Hometown	0.017	0.044	0.015	0.081	0.026	0.052	−0.009
Only-child or not	0.102	0.065	0.045	−0.024	0.013	−0.037	0.051
Independent variable							
EE		0.463***	0.374***	0.407***	0.429***	0.489***	0.043
Moderating variable							
FTE			0.230***	0.292***	0.174***	0.194***	0.106**
Interaction term							
*EE*FTE*			0.116**	0.148***	0.130**	0.142***	0.019
Mediating variables							
ARC							−0.066
WC							0.414***
ABC							0.368***
R^2	0.139	0.327	0.382	0.432	0.377	0.418	0.655
ΔR^2	0.128	0.317	0.369	0.420	0.364	0.406	0.645
F	12.639***	31.741***	30.085***	37.037***	29.448***	34.991***	66.686***

Note: ***$p < 0.001$, **$p < 0.01$, *$p < 0.05$.

Source: own

Tab. 5: Bootstrap analysis results of the mediated moderation effect

Mediating variables	**Estimated**	**BootSE**	**95% CI**	
			BootLLCI	**BootULCI**
Arrangements cognition	−0.011	0.008	−0.030	0.002
Willingness cognition	0.063	0.030	0.056	0.124
Ability cognition	0.061	0.027	0.014	0.121

Source: own

introduced, the coefficient of the interaction term (*EE*FTE*) is not significant; only willingness cognition ($\beta = 0.414$, $p < 0.001$) and ability cognition ($\beta = 0.368$, $p < 0.001$) are significantly positive. This indicates that the moderating effect of the fault-tolerant environment is entirely exhibited through the mediating effect of willingness cognition and ability cognition; hypothesis *H3b* is thus verified. We used the Bootstrap method to test the mediated moderation effect of hypothesis *H3b*. The results in Tab. 5 show that the confidence intervals

of willingness cognition (BootLLCI = 0.056, BootULCI = 0.124) and ability cognition (BootLLCI = 0.014, BootULCI = 0.121) do not include zero, indicating that the moderating effect of the fault-tolerant environment is influenced by willingness cognition and ability cognition, which also confirms the results of the regression analysis.

3.5 Discussion

First, we found that failure-learning-based entrepreneurship education had a significant positive impact on youth entrepreneurial resilience. Through the introduction of entrepreneurial failure learning in entrepreneurship education, youth entrepreneurial resilience could be effectively improved. This finding is different from those of previous studies, which paid more attention to the impact of entrepreneurship education on entrepreneurial intention. This study analyzed the impact of entrepreneurship education on youth psychological resilience in the entrepreneurship process from the perspective of entrepreneurial failure learning. While promoting youth entrepreneurial intentions (Karimi et al., 2016; Zhang et al., 2014), failure-learning-based entrepreneurship education could also help young entrepreneurs correctly examine the failure phenomenon in the entrepreneurial process, improve the ability to cope with entrepreneurial challenges and setbacks, enhance youth entrepreneurial resilience. The formation of entrepreneurial resilience was particularly critical for youth to perform entrepreneurial activities in the context of the current global economic recession and post-COVID-19 pandemic (Zhang & Huang, 2021). In addition, we also found that young men have more entrepreneurship resilience than young women, which may also be due to the higher stress tolerance of males compared to females (Rudman et al., 2012).

Second, different dimensions of entrepreneurial cognition played different mediating effects on the relationship between entrepreneurial failure learning and entrepreneurial resilience. In the test of the mediating effect, the two dimensions of willingness cognition and ability cognition in entrepreneurial cognition had a complete mediating effect on the relationship between entrepreneurial education and entrepreneurial resilience, while the mediating effect of arrangements cognition was not significant. The possible reason is that the formation of entrepreneurial resilience, as an individual's performance of entrepreneurial ability, follows the cognition-behavior process (Pryor et al., 2016). Unlike arrangements cognition, which emphasizes that individuals need to be prepared for the cognitive script of entrepreneurial thinking, knowledge, and skills before the formation of entrepreneurial decisions, willingness cognition and ability cognition may have a more significant impact on entrepreneurial resilience. Entrepreneurial resilience refers to the dynamic adaptability of individuals to self-adjust and actively cope with entrepreneurial challenges in the entrepreneurship process (Korber & McNaughton, 2017). When facing risks in the entrepreneurial process, youth can learn from failure, prepare corresponding risk response plans in advance, and avoid not knowing how to solve risks when they arise. Entrepreneurial education that emphasizes failure learning enhances youth entrepreneurial resilience through the effects of willingness cognition and ability cognition.

Third, the fault-tolerant environment positively moderated the positive impact of failure-learning-based entrepreneurship education on entrepreneurial resilience, and its moderating effect was transmitted through the mediating effect of entrepreneurial willingness cognition and ability cognition. This is an interesting finding. It indicates that a strong fault-tolerant environment can create a positive entrepreneurial support situation for entrepreneurship education. This positive external factor stimulus further enhances the impact of entrepreneurship education on the formation of their rational cognition, especially the entrepreneurial cognition script of the willing cognition and ability cognition, through the mediating effect of willing cognition and ability cognition, which further strengthens the positive impact on youth entrepreneurial resilience. However, in a poor fault-tolerant environment, the public's not very friendly attitude towards entrepreneurial failure may weaken the positive effect of failure-learning-based entrepreneurship education, thereby affecting the growth of youth cognition of entrepreneurial willingness and ability, which is not conducive to the formation of their entrepreneurial resilience.

Conclusions

Main findings

The relationship between failure-learning-based entrepreneurship education and youth entrepreneurial resilience was explored through

an empirical test of the hypotheses, and the following conclusions were obtained based on the results: i) Failure-learning-based entrepreneurship education positively affects youth entrepreneurial resilience; ii) The willingness cognition and ability cognition in entrepreneurial cognition play a completely mediating role in the relationship between failure-learning-based entrepreneurship education and youth entrepreneurial resilience; iii) The fault-tolerant environment has a positive moderating effect on the relationship between entrepreneurshipeducation and entrepreneurial resilience. Furthermore, willingness cognition and ability cognition effectively transmit the moderating effect of the fault-tolerant environment in the process of the entrepreneurial education's impact on entrepreneurial resilience.

Managerial implications

Based on the results, we can make some recommendations to those in the entrepreneurship education system. First, increase the proportion of entrepreneurial failure learning in the entrepreneurship education system. At the theoretical teaching level, the entrepreneurship education system needs to provide entrepreneurship risk management, crisis management, adversity psychology, and other related courses; compile a case library of entrepreneurial failure; and guide youth to correctly understand the objective existence of entrepreneurial failure through case teaching. At the practical teaching level, entrepreneurial tutors with entrepreneurial failure experience are invited to help youth correctly cope with entrepreneurial challenges and setbacks in entrepreneurial practice. At the same time, psychological counseling programs can be further set up to ease the fear of entrepreneurial failure of youth.

Second, actively guide youth entrepreneurs to correctly understand the objective existence of entrepreneurial failure. Compared with external education, individual cognition can better cultivate youth entrepreneurial resilience. Thus, youth should actively overcome psychological fears, expand social networks to obtain support, understand the relevant entrepreneurial support policies, summarize the experience in failure, identify the value of failure, and then improve their ability to evaluate entrepreneurial opportunities.

Third, create a fault-tolerant entrepreneurial atmosphere among youth. Youth entrepreneurs are the new force in entrepreneurial activities. They inevitably encounter failure in entrepreneurship, and they make more mistakes than other entrepreneurs owing to their inexperience. Therefore, it is necessary to form a fault-tolerant entrepreneurial atmosphere among youth entrepreneurial groups to urge youth entrepreneurs to overcome the fear of entrepreneurial failure. The entrepreneurship education system should guide youth to change the traditional concept of "the victor becomes a king and the loser a bandit," and it should strengthen the consciousness of "failure is the mother of success." When publicizing entrepreneurial deeds, the media should report the deeds of entrepreneurial failure but also realize the inherent value of all entrepreneurial efforts, not just praise successful entrepreneurs. Moreover, the government and business incubation platforms should actively provide youth with financial support, establish fault-tolerant mechanisms in innovation and entrepreneurship, and guide society to become a more fault-tolerant entrepreneurial atmosphere.

Limitations and future directions

This study had some limitations that need further discussion in future research. First, failure-learning-based entrepreneurship education is different in specific teaching contents and methods. Future research can further analyze the effect of different types of entrepreneurship education on youth entrepreneurial resilience. Second, in terms of the impact of failure-learning-based entrepreneurship education on entrepreneurial resilience, this study only considered the effects of entrepreneurial cognition and the fault-tolerant environment. In future research, more boundary conditions can be further explored, such as risk orientation, self-efficacy, and other individual-level characteristic variables of youth, to better identify the internal relationship between failure-learning-based entrepreneurship education and entrepreneurial resilience.

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