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Exploring The Mediating Role of Intrinsic Motivation Between Innovation Support and Innovative Behavior: An Empirical Study Based on a Design Thinking Course

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Abstract. Establishing a culture of innovation is complex and demands more than simply urging students to be creative. It requires a comprehensive support system encompassing resources, leadership, training, and an environment that fosters and sustains innovative behavior. The purpose of this research is to investigate the way in which innovation support impacts the innovative behavior of university students. Additionally, it aims to explore the role of intrinsic motivation in mediating the relationship between innovation support (including emotional, interpersonal, and resource support) and innovative behavior within the context of a design thinking course. The study presents a conceptual model that examines the causal link between innovation support and innovative behavior, as well as the mediating role of intrinsic motivation, to test hypotheses regarding the connections among innovation support, innovative behavior, and intrinsic motivation. The research was conducted using an online survey and snowball sampling technique, which resulted in the collection of 234 questionnaires from four universities in China. The collected data were analyzed using structural equation modelling. The results indicate that all three types of innovation support have a significant impact on students' innovative behavior. Furthermore, the research reveals that intrinsic motivation plays a mediating role between the three types of innovation support and innovative behavior. These findings have both theoretical and practical

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implications for universities seeking to foster students' creative thinking and innovative behavior. Additionally, future research can further explore ways in which universities can effectively cultivate a culture of innovation through strong support systems and by harnessing intrinsic motivation.

Keywords: innovation support; innovative behavior; intrinsic motivation; mediator

1. Introduction

In the current economic landscape, creativity is considered to be one of the most important characteristics among the workforce. Design thinking is not merely a new educational concept but also a way in which to innovate and solve problems (Henriksen et al., 2017; Razzouk & Shute, 2012). It emphasizes a process of empathy, ideation, prototyping, and iteration, providing students with a systematic methodology for solving problems. This methodology can be implemented not only in the design field but also in various other industries. The design thinking course aims to develop students' design thinking skills and foster their capability to solve intricate problems and create innovative solutions (Henriksen et al., 2017; Koh et al., 2015; Razzouk & Shute, 2012; Retna, 2016). By studying theory, analyzing case studies, and working on practical projects, students can master the fundamental principles of design thinking, creative stimulation techniques, prototyping methods, and the concepts of user experience and sustainable development.

In design thinking courses, students' innovative behavior is affected by many factors, among which the level of educational support is crucial. Teachers, peers, and institutional resources play essential roles in providing the necessary support. Teachers need to stimulate students' creative potential and instill them with confidence (Reeve et al., 1999; Roffeei et al., 2017). Peer interaction and support promotes growth and development, leading to the exchange of ideas and a culture of innovation (Budge et al., 2013; Dai & Zhang, 2019; Kamaşak & Bulutlar, 2010; King, 1990). Sufficient institutional resources can encourage students to explore and innovate (Gumusluoğlu & Ilsev, 2009; Titova et al., 2021). Meanwhile, motivation is crucial in fostering students' innovative behavior. According to self-determination theory, people are inherently inclined towards activities that meet their psychological requirements of autonomy, competence, and relatedness (Deci & Ryan, 2008). Depending on the extent of autonomy, motivation can be categorized as intrinsic or extrinsic motivation, depending on whether an individual's behavior is motivated by their interest and enjoyment of the activity or by the desire to obtain a reward, respectively. The social cognitive theoretical framework suggests that students are active information processors, and that motivation is not a fixed trait but is dynamic and situation-dependent (Duncan & McKeachie, 2005). Therefore, it is critical to comprehend the way in which students' intrinsic motivations interact with innovation support to impact their innovative behaviors.

Budge (2013) studied the development of students' creativity and the conditions

that support it, while Gao aimed to identify the relationships between school climate, proactive personality, achievement motivation, and the creativity trait of primary school students by using a path model (Budge et al., 2013; Gao et al., 2020). Moreover, Zaitouni's study sought a deeper understanding of the ways in which leadership support and coworker support influence creativity (Zaitouni et al., 2018). Bawuro explored the relationship between intrinsic motivations, innovative work behavior and psychological mechanism (Bawuro et al., 2019). However, there remains a lack of in-depth exploration regarding the relationship between the internal factors of innovation support and intrinsic motivation, which can play a critical role in promoting innovative behavior among individuals. Internal factors of innovation support may include organizational culture, leadership style, team climate, and similar factors that can significantly influence an individual's intrinsic motivation (Ryan & Deci, 2000; Xu et al., 2022). Moreover, there has been limited research on the specific effects of the interplay between intrinsic motivation and innovation support on innovative behavior among university students. It is essential to understand the impact of intrinsic motivation, as it is considered a critical component of innovative behavior, leading to the generation of new ideas and solutions. Therefore, further research is needed to explore the relationship between intrinsic motivation and innovation support in order to effectively promote innovative behavior among university students.

In this study, innovation support is defined as college students' subjective feelings about the innovation environment in universities as well as various practices and measures that may be conducive to innovation (Amabile, 1983). The purpose of this research is to investigate the way in which innovation support affects students' innovative behavior in design thinking courses. The study focuses on various forms of support, including emotional, interpersonal, and resource support, and the ways in which they impact students' engagement with innovation. Furthermore, the research examines the mediating role of students' intrinsic motivation in this relationship. By analyzing these connections, the study aims to gain a deeper understanding of the mechanisms that drive students' involvement in innovation.

Such findings would not only enrich the theoretical research on the relationship between innovation support and innovative behavior but also provide practical guidance for universities seeking to enhance students' creative thinking and innovative behavior. By strengthening students' emotional, interpersonal, and resource support, universities can stimulate students' intrinsic motivation, thereby effectively improving their innovation capacity and behavior. Thus, this study has important implications for cultivating innovative talent, promoting social progress, and driving economic development.

2. Literature Review

2.1 Innovative Behavior

Innovation is an essential aspect of any individual's endeavors. It involves not only thinking but also practical efforts to transform innovative ideas into actions. Researchers suggest that innovative behavior is a process whereby employees generate new ideas and implement them while working in an organization (Li &

Zheng, 2014). Some scholars divide individual innovative behavior into three stages; the first stage is idea generation, which is followed by seeking support and assistance, and finally, implementation (Bani-Melhem et al., 2018). In this article, we primarily focus on university students' innovative behavior, which refers to their personal tendencies to apply their newfound knowledge and perspectives to their studies and daily lives. While innovative behavior may not always yield positive results, it can deliver a vast array of benefits. Design thinking, a methodology that seeks to develop students' capacity to solve intricate problems, offers a practical approach to promoting innovative behavior (Razzouk & Shute, 2012). It is a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success (Brown, 2008). Within the context of higher education, such courses typically involve a combination of lectures, practical projects, and collaborative activities that encourage students to empathize with users, define problems, ideate solutions, prototype, and test their ideas. By engaging in design thinking, students learn to navigate complex problems, work collaboratively, and develop solutions that are not only novel but also practical and user-centric (Guaman-Quintanilla et al., 2023). Thus, design thinking courses can promote students' innovative behavior by encouraging them to actively participate in the course, deepen their learning, and improve their skill sets, laying the groundwork for their future development.

Given the increasing popularity of design thinking as a tool for enabling innovative educational reform in colleges and universities (Matthews et al., 2023), the data in this study were drawn entirely from design thinking courses to explore the potential of innovation support in fostering innovative behavior.

2.2 The Relationship Between Innovation Support and Innovative Behavior

Extensive research has been conducted on the relationship between innovation support and innovative behavior (Scott, 1994; Siegel & Kaemmerer, 1978). The findings suggest that the presence of innovation support can have a positive impact on innovative behavior. For example, researchers have discovered that when team members perceive an atmosphere that encourages innovation, they are more likely to display individual innovative behavior within the team (Gilson & Shalley, 2004). Similarly, students who feel that they have support for their creativity have been shown to perform better in innovative tasks (Lee et al., 2016). In 1994, Scott and Bruce identified two types of innovation support: innovation climate support and resource support (Scott, 1994). Innovation climate support refers to the extent to which an organization's policies and practices support innovation, while resource support refers to the allocation of those resources (e.g. time, money, personnel) needed for innovation. Furthermore, Tierney and Farmer developed the creativity leadership index to assess leaders' performances in fostering creativity within organizations. Its components include autonomy granting, creativity recognition, collaboration encouragement, resource support, and creativity modeling. Hammer further categorized innovation support into four dimensions: emotional support, instrumental support, role modeling behaviors, and creative work-family management (Hammer et al., 2009). This research identified three dimensions of innovation support based on the

characteristics of Chinese universities and previous literature: emotional support, interpersonal support, and resource support.

2.2.1 Emotional Support

Emotional support involves caring, encouraging, and appreciating individual contributions towards innovative behaviors. Moreover, emotional support is essential in creating a positive and supportive learning environment that promotes the autonomy of university students. According to the Demand-Control-Support Model, students tend to be happier, more satisfied, and more positive when they have access to a supportive learning environment (Cotton et al., 2002). Furthermore, emotions play a crucial role in the innovative process and assist individuals in coping with the stress and challenges of innovative tasks (Xie et al., 2024). When people receive emotional support, they feel more confident and motivated in their innovative tasks (Gashema & Kadhafi, 2020; Javed et al., 2021). They are also more likely to develop a growth mindset, which means they are willing to take risks and learn from their mistakes. Furthermore, when individuals feel appreciated by their organizations for their achievements, they tend to be more engaged and committed to their work. Research has shown that recognition and appreciation of employees' contributions are crucial in creating a positive and supportive work environment (Madjar, 2008). Therefore, emotional support for innovation is crucial in creating an innovative learning environment that fosters innovative thinking and behavior. By providing emotional support, organizations can create a positive and supportive learning environment that promotes the autonomy of university students and enhances their happiness, satisfaction, and positivity. Therefore, this research proposes the following hypothesis:

H1a: The emotional support that university students receive positively impacts their innovative behaviors.

2.2.2 Interpersonal support

Innovation is a complex process that requires collaboration and frequent interactions among team members. Individuals need to be able to work together and share their knowledge and skills to generate new ideas and solve problems. Interpersonal support is essential in promoting communication and interaction among team members. This support can come from the organization, which can actively encourage knowledge sharing and promote a culture of collaboration. Design thinking courses often use the Project-Based Learning (PBL) method, which emphasizes group learning and collaborative problem-solving (Jiang & Pang, 2023). Within this process, individuals must work together to identify problems, generate ideas, and reach a consensus on the best solution. Collaborative learning is integral to this process, as it encourages individuals to communicate with each other and share their knowledge and skills. Such interaction between individuals is conducive to encouraging students to generate new ideas and to learn creatively. Moreover, individuals interact socially in their environment, and the sharing of ideas, information, and skills among peers can stimulate and encourage innovative behaviors (Madjar, 2005; Zhou & George, 2001). Interpersonal interaction can lead to the exchange of different perspectives, which can help individuals to think innovatively and see things from a new perspective. Several researchers have found that students with good interpersonal relationships are more likely to be optimistic, cheerful, and helpful (Lu et al., 2023;

Rezaei & Bahadori Khosroshahi, 2018; Honmore & Jadhav, 2015). Therefore, the following hypothesis is proposed:
H1b: The interpersonal support that university students receive positively impacts their innovative behaviors.

2.2.3 Resource Support
Resource support refers to the assistance, guidance, and necessary support provided to individuals to help them complete tasks. In a corporate environment, resource support often includes flexible schedules and other practical assistance designed to help employees achieve their goals. The Resource-Gain-Development Perspective (RGD) model suggests that individuals have an innate desire to grow and develop(62.Wayne et al., 2007). When people take on a new role or responsibility, they will strive to obtain resources that are beneficial to their development. They will also maximize the use of those resources to achieve their goals. Resource support provides students with resources, benefits, and development opportunities that can help them achieve their goals (Hernández et al., 2007). Innovative behavior is more likely to occur when individuals feel that they have the material resources they need to succeed. Resource support can include ensuring students can access a wide variety of resources, such as mentorship programs, training opportunities, and financial assistance. Such resources can help students to develop new skills, increase their knowledge base, and gain valuable experience. Resource support can also provide students with benefits such as networking opportunities, job placement services, and opportunities to work on meaningful projects (Kogan et al., 2017). These benefits can help students to build their professional networks, gain exposure to new industries, and enhance their resumes. Additionally, resource support can provide students with development opportunities that can help them achieve their long-term career goals (Xu & Suntrayuth, 2022). By providing access to cutting-edge technology, industry experts, and other resources, resource support can help students to remain up-to-date with the latest trends and advancements in their field. Consequently, this research proposes the following hypothesis:
H1c: The resource support that university students receive positively impacts their innovative behaviors.

2.3 The Relationship Between Intrinsic Motivation and Innovative Behavior
Intrinsic motivation is a psychological concept that refers to a person's natural inclination to engage in activities that interest them or those that offer new perspectives (Ryan & Deci, 2000). The reward from performing such activities is the inherent satisfaction, fun, or challenge they provide, rather than external rewards or incentives. Motivation can be used to explain why people engage in cognitive activities. Many studies have emphasized that intrinsic motivation is a crucial factor in fostering innovative behavior, which, in turn, plays an essential role in driving innovation (Deci et al., 1991; Hon, 2012; Zhang & Bartol, 2010). In universities, students often display a strong desire for knowledge, curiosity, interest in innovation, and courage in tackling challenges, which indicates that they are intrinsically motivated for innovation, especially when they are given the freedom to explore and pursue their interests. Furthermore, individuals with a high degree of intrinsic motivation are likely to exceed performance expectations. They are more likely to persist in the face of setbacks, take risks, and explore new

possibilities because they are internally driven and find the work itself rewarding (Judge et al., 2005; Koestner et al., 2008; Bandura, 1977; Sheldon & Houser-Marko, 2001). Therefore, organizations that aim to promote innovation and creativity must focus on fostering an environment that supports intrinsic motivation. This can be achieved by providing individuals with autonomy, meaningful work, and opportunities for growth and development. In conclusion, intrinsic motivation is essential for driving innovation, and its cultivation is crucial for both individuals and organizations. Therefore, the following hypothesis is proposed:
H2: Intrinsic motivation can positively impact innovative behavior.

2.4 The Relationship Between Innovation Support and Intrinsic Motivation
Supportive behaviors such as encouragement, praise, and support can significantly improve individual innovation consciousness and intrinsic motivation (Akbari et al., 2020; Eisenberger et al., 2001; Kwon Choi et al., 2013). Several studies have suggested that incentivizing novel performance can enhance intrinsic motivation, which can, in turn, lead to increased innovative behavior (Eisenberger et al., 2001; Eisenberger & Shanock, 2003). Moreover, the feeling that an individual's contribution is acknowledged can promote positive emotions and stimulate innovation consciousness. Furthermore, sharing knowledge with others can generate creativity and increase one's knowledge reserves, leading to positive impacts on intrinsic motivation (Lin & Sun, 2013). Organizations need to provide adequate resources to enable individuals to perform their tasks to the best of their abilities and maintain the quality of their work. Such support is essential for task advancement and for individuals to perceive their environment as one that fosters innovation, especially when the organization places a strong emphasis on innovation. Overall, supportive behaviors, collaboration, and sufficient resources are key factors that can positively impact individual innovation consciousness and intrinsic motivation, leading to increased innovative behavior. Based on the above discussions, this research proposes the following hypotheses:
H3a: Emotional support positively affects intrinsic motivation.
H3b: Interpersonal support positively affects intrinsic motivation.
H3c: Resource support positively affects intrinsic motivation.

2.5 The Mediating Role of Intrinsic Motivation
The level of intrinsic motivation that an individual possesses can have a significant impact on the way in which they perceive support for innovation. Intrinsic motivation involves the internal drive to engage in an activity for its own sake, which can be a powerful force in shaping an individual's behavior. Those with high levels of intrinsic motivation are more likely to actively seek and make use of various forms of innovation support from their environment (Devloo et al., 2015). Such individuals are driven by a desire to learn and grow, seeing innovation as an opportunity to challenge themselves and develop new skills. Conversely, those who lack intrinsic motivation may perceive innovation support more passively. They may be less interested in the innovation activity itself and may view support as something that is imposed on them from the outside. Intrinsic motivation also plays a direct role in determining whether individuals are willing to accept and take advantage of the innovation support they receive (Ryan & Deci, 2000). Those with high levels of intrinsic motivation are more likely to accept and utilize encouragement, resources, and instrumental support from

others. Additionally, they are more open to feedback and are willing to take risks in order to learn and grow. Moreover, intrinsic motivation affects the degree to which individuals take advantage of innovation support (Koestner et al., 2008). Those with high intrinsic motivation are motivated by a desire to improve their skills and to achieve their personal goals, viewing innovation support as a means to achieving that target. In contrast, individuals who lack intrinsic motivation may behave passively towards innovation support and may even miss out on opportunities to receive such support. Thus, this research proposes the following hypotheses:

H4a: Intrinsic motivation plays a mediating role between emotional support and innovative behavior.

H4b: Intrinsic motivation plays a mediating role between interpersonal support and innovative behavior.

H4c: Intrinsic motivation plays a mediating role between resource support and innovative behavior.

Therefore, based on the above discussion, a conceptual research model was established (Figure 1). As shown in Figure 1, the research model involves the causal relationship between innovation support and innovative behavior, with intrinsic motivation acting in a mediating role. Specifically, the independent variable is innovation support (emotional support, interpersonal support, and resource support), and the dependent variable is innovative behavior. Intrinsic motivation is the mediating variable that connects innovation support and innovative behavior.

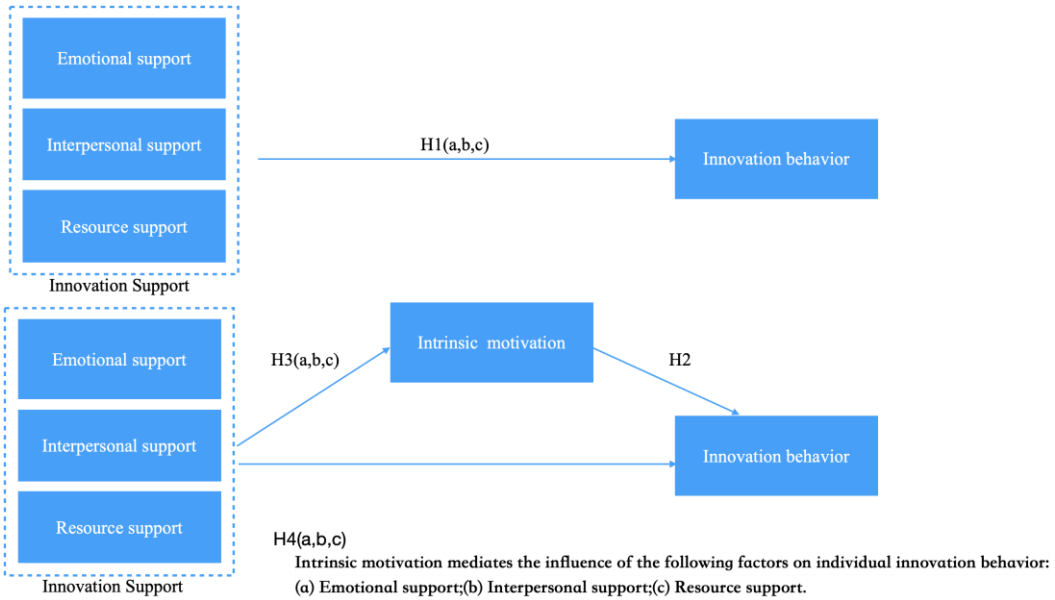

Figure 1: The research conceptual model

3. Methods

3.1 Measuring Instrument

This research examined the design thinking courses offered by four Chinese universities (Hefei University of Technology, Tongling University， Xiangtan University，Central South University of Forestry and Technology). The design

thinking course is an optional course that is offered by these universities in the second year of college. Approximately 400 students take this course each semester. The design thinking course teaches systematic methods for creative problem-solving and encourages the development and implementation of new ideas. It provides a practical, hands-on learning environment, allowing for the observation of the ways in which various types of support influence innovative behavior. The course has established support structures that are conducive to studying various dimensions of innovation support. Unlike other courses, design thinking is explicitly designed to cultivate innovative thinking and behavior. Its dynamic and project-based nature generates detailed data on student interactions, problem-solving processes, and innovative outcomes, all of which are essential for a thorough analysis of the study's variables.

The researchers devised a comprehensive survey questionnaire consisting of two parts. The first part incorporated an informed consent form and a screening question to determine whether the respondents had taken a design thinking course in the last year. The second part included measuring items that explored the respondents' experiences during the design thinking course. The questionnaire comprised basic personal information, such as gender, grade, major, and the crux of the study. The main part consisted of five measured variables, namely university innovation support (emotional support, interpersonal support, resource support), intrinsic motivation, and students' innovative behavior. Each item was rated using a 5-point Likert scale (1: Strongly disagree to 5: Strongly agree), and the measurement items were sourced from established research, with their references being presented in Table 1. The perceived scale of innovation support drew on Mei Hong et al.'s (2015) adaptation of the innovation support scale for enterprise managers by Tierney et al. (2002), totaling 16 items across three dimensions: emotional support, instrumental support, and interpersonal support (Mei et al., 2015). The intrinsic motivation scale adopted 13 items adapted by Chinese scholars from the intrinsic motivation section of Amabile's motivation measurement scale (Amabile et al., 1994). The innovation behavior scale was adapted from Scott's innovation behavior scale (Scott, 2013), comprising six items measuring university students' innovation behavior across one dimension. Moreover, in order to gain a comprehensive understanding of students' innovation levels, researchers also engaged in in-depth communication with several teachers on the design thinking courses. Those experienced teachers provided some practical and useful suggestions for the questionnaire. After creating the first draft of the questionnaire, the research enlisted 20 survey participants to participate in a pre-test, and two experts in relevant fields were consulted for their opinions. Based on the feedback received and considering the current situation of Chinese university students, the researchers made subtle adjustments to the wording of the questionnaire.

Table 1: The measurement items

Variable		Measurement Items	Source
Innovative Behavior		IB1: Willingness to try new techniques or methods in learning.	Scott, 2013
		IB2: Generating some innovative ideas or thoughts.	
		IB3: Communicating one's ideas to others and striving for support and recognition.	
		IB4: Seeking the necessary resources to realize one's new ideas.	
		IB5: Formulating suitable plans and schedules to implement new ideas.	
		IB6: Having awareness of innovation.	
Innovation Support	Resource support	RS1: The university tries to provide us with the necessary learning facilities.	Mei et al., 2015
		RS2: The university strives to ensure we have the resources needed for creative work.	
		RS3: I feel that there are good role models for cultivating creativity.	
		RS4: Our innovative work is rewarded appropriately.	
	Emotional support	ES1: Our innovative efforts are publicly recognized.	
		ES2: We are encouraged to set innovation goals.	
		ES3: Our innovative work is praised.	
		ES4: We are supported in creating and innovating.	
		ES5: Our innovation efforts are praised even if the results are not very successful.	
		ES6: Our efforts and achievements are a source of pride.	
	Interpersonal support	SS1: We are encouraged to believe in our potential for innovation.	
		SS2: We are encouraged to collaborate with others.	
		SS3: The importance of sharing knowledge with others is emphasized.	
		SS4: The university actively seeks opportunities for us to communicate with external members.	
		SS5: The university strives to provide us with relevant information that promotes development.	
		SS6: :We are encouraged to communicate with students from other departments, schools, and countries.	
Intrinsic motivation		IM1: The more difficult the problem, the more willing I am to try to solve it.	Amabile et al., 1994
		IM2: I enjoy attempting to solve complex problems.	
		IM3: I am keen to delve into completely new problems.	
		IM4: I enjoy independently thinking through and solving challenging issues.	

	IM5: I hope that the work I engage in provides opportunities for me to increase my knowledge and skills.
	IM6: When I can set my own goals, I am more satisfied.
	IM7: I am happy to engage in work that interests me so much that I can forget everything else.
	IM8: For me, it is most important to love the work I do.
	IM9: Being able to do work that I enjoy is important to me.
	IM10: As long as I am doing something I enjoy, I don't care as much about grades and rewards.
	IM11: Regardless of the outcome of what I do, as long as I feel I have gained new experience, I feel satisfied.
	IM12: I am very clear about the goals I need to achieve academically.
	IM13: Having the opportunity to express myself is important to me.
	IM14: I do many things driven by curiosity.

3.2 The Process of Data Collection and Data Analysis

To gather data for this research, an online survey was administered using the snowball sampling technique to recruit participants. Snowball sampling, a non-probability sampling technique, involves the initial participants recruiting more participants from their own social circles. As a result, the study was able to gather data from a specific and potentially widely spread group of people, ensuring a strong and representative sample for analyzing the connection between innovation support, intrinsic motivation, and innovative behavior. Prior to their participation, all of the respondents were informed about the study's objective, the voluntary nature of their involvement, the potential risks associated with the survey, and the confidentiality of their responses. The survey was conducted over a two-week period, from November 17th to November 30th. At the outset, 267 completed questionnaires were returned; however, following a rigorous review process, 33 were deemed unsuitable. Consequently, the final sample size for this study comprised 234 participants.

The researchers used two types of statistical software, SPSS 29.0 and SmartPLS 4.0, to analyze the collected data. According to Hair et al. (2019), PLS-SEM is a method that enables researchers to predict complex models with many structures, indicator variables, and ways of structuring without imposing any distributional assumptions on the data (Hair et al., 2019). It can operate with small samples and can also be used with resampling methods, which are more powerful than classic tests, such as the Sobel test, and are recommended for indirect effects analysis. Therefore, the data analysis in this study first used SPSS 29.0 to determine the distribution of each variable and calculate its correlation. Next, SmartPLS 4.0 was

used to test the mediating role in the research hypothesis and to determine the difference between the groups.

4. Results

4.1 Samples

The participants were comprised of 53% males and 47% females, with the majority (53%) being in their senior year (see Table 2).

Table 2: Demographic information

Item		n	Percent
Gender	Male	124	53%
	Female	110	47%
Grade	Junior year (1,2)	59	25%
	Senior year (3, 4)	124	53%
	Postgraduate	51	22%
Major	STEM	181	77%
	Others	53	23%

4.2 Common Method Bias Test

To ensure the validity of our data analysis, we took steps to address the potential issue of common method bias (CMV) (Podsakoff et al., 2003). Prior to the analysis, we conducted Harman's single factor test for statistical control, which involved an unrotated principal component factor analysis of all variable items. The results showed that the first factor explained only 24.49% of the variation, falling below the critical value of 50%. Therefore, no significant common method bias is present in the data gathered for this study.

4.3 Validity and Reliability Test

Partial least squares (PLS) were used to test the reliability and validity of the 234 questionnaires (see Table 3). The combined reliability (CR) of all variables was greater than the criterion of 0.70. The values of Cronbach's α are all above 0.70, and the average variance extracted (AVE) is higher than the discrimination standard of 0.50, which proves that the scale has high reliability and internal consistency.

Table 3: Validity and reliability test

Constructs	Variables	Cronbach's Alpha	CR	AVE
Innovative behavior	_	0.898	0.901	0.663
Intrinsic motivation	_	0.957	0.958	0.641
Innovation support	Interpersonal support	0.883	0.889	0.631
	Resource support	0.85	0.858	0.688
	Emotional support	0.897	0.899	0.661

In addition to the reliability estimation measurement, this study also tested the discriminant validity to further ensure the validity of the measurement. The factor loadings of all items were higher than 0.5 and reached a significant level (P<0.001), indicating that the scale has good convergent validity. In addition, the HTMT correlation ratios between pairs of variables were all found to be less than the discriminant standard of 0.85 (see Table 4), indicating that the discriminant validity of all variables in this study is good, and hypothesis testing of the model can be performed.

Table 4: HTMT of variables

Items	1	2	3	4	5
1.Emotional support					
2.Innovation behavior	0.463				
3.Interpersonal support	0.3	0.367			
4.Intrinsic motivation	0.538	0.575	0.408		
5.Resource support	0.565	0.491	0.415	0.49	

4.4 Descriptive Statistical Analysis and Correlation Analysis of Variables

The results of the correlation coefficient for each variable are presented in Table 5. As indicated in the table, the correlation between the variables in the first part of the questionnaire – namely gender, grade, and major – and other variables is not significant. The three dimensions of innovative behavior among university students and innovation support, namely emotional support (r= 0.747, P<0.01), interpersonal support (r=0.740, P<0.01), and resource support (r=0.743, P<0.01), are all significantly correlated. Furthermore, there is a significant positive correlation between intrinsic motivation and the three dimensions of innovation support in universities, namely emotional support (r=0.710, P<0.01), interpersonal support (r=0.721, P<0.01), and resource support (r=0.738, P<0.01). Overall, there is a significant positive correlation between the five variables of the three dimensions of innovation support, intrinsic motivation, and innovative behavior, which is consistent with the research hypothesis.

Table 5: Correlation analysis of variable

VAR	Gender	Major	Grade	IB	RS	ES	IS	IM
Gender	1							
Major	0.063	1						
Grade	0.036	-0.002	1					
IB	-0.042	-0.005	-0.084	1				
RS	0.073	0.06	-0.031	.743**	1			
ES	-0.001	-0.035	-0.046	.747**	.762**	1		
IS	-0.065	-0.031	-0.118	.740**	.705**	.718**	1	
IM	-0.049	-0.015	-0.016	.792**	.738**	.710**	.721**	1

N=234, ** P<0.01, * P<0.05.

4.5 Structural Model

In this study, the hypothesized model was tested using SmartPLS 4.0 software. The partial least squares method structural equation model was employed, which is a convenient way of testing complex structural equation models. It has the ability to effectively analyze the relationship between variables and has strong explanatory and predictive capabilities for variables (Manley et al., 2021).

Table 6: Coefficient of determination (Q^2) and (R^2)

Constructs	Q2	R2
Innovation behavior	0.235	0.355
Intrinsic motivation	0.315	0.345

This study evaluated model quality using the endogenous latent variable R^2. R^2 is a criterion that measures the impact of exogenous variables on an endogenous variable. In this study, weak, medium, and strong values of R^2 were considered to be 0.19, 0.33, and 0.67, respectively, indicating the extent to which endogenous latent variables are explained. The R^2 values for the innovative behavior model and intrinsic motivation were 0.355 and 0.345, respectively (Table 6). Q^2 values greater than 0 indicate that the model has predictive relevance for a particular endogenous construct. Furthermore, all variables in the model had VIF values between 1 and 3, which is less than 5, indicating that there is no multicollinearity. The SRMR was 0.049, which is less than 0.5, and the value-added fitness index NFI was 0.866, which is close to 0.9. Therefore, the model demonstrated a good fit.

Figure 2 presents the hypothesized structural model, showing the estimated regression path coefficient β between the hypotheses and the external loadings of the indicator terms and their significance levels.

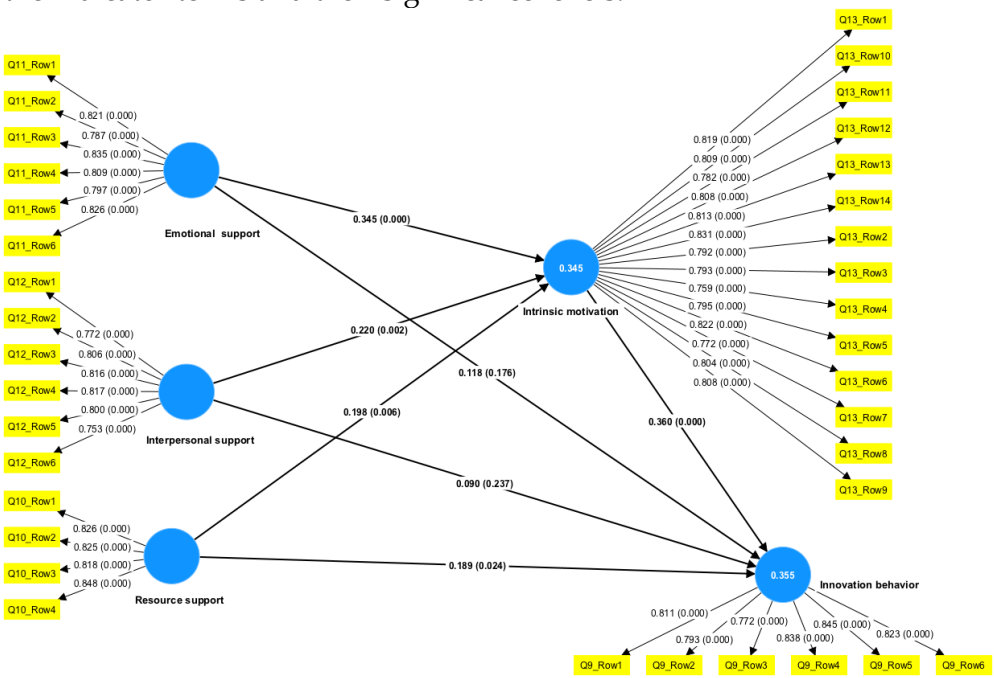

Figure 2: Inner and outer model

4.6 Hypotheses Testing

This study utilized SmartPLS 4.0 software to verify model assumptions and selected the Bootstrap method. A sample size of 5,000 and a confidence interval of 95% were chosen for verification purposes. As shown in Table 7, intrinsic motivation significantly predicts innovative behavior (β=0.36, P<0.05). Secondly, the three dimensions of innovation support, emotional support (β=0.345, P<0.05), resource support (β=0.198, P<0.05), and interpersonal support (β=0.22, P<0.05), significantly influence intrinsic motivation.

Table 7: Summary of hypothesis results

Effects	H#	Path	Influence Coefficient	t	Result
Direct effects	-	Emotional and emotional support -> Innovative behavior	0.118	1.353	-
	-	Resource support -> Innovative behavior	0.189*	2.26	-
	-	Interpersonal support -> Innovative behavior	0.09	1.183	-
Total effect	H1a	Emotional and emotional support -> Innovative behavior	0.242**	3.119	supported
	H1b	Interpersonal support -> Innovative behavior	0.169*	2.261	supported
	H1c	Resource support -> Innovative behavior	0.26**	3.015	supported
-	H2	Intrinsic motivation -> Innovative behavior	0.36**	4.171	supported
-	H3a	Emotional and emotional support -> Intrinsic motivation	0.345**	4.777	supported
-	H3b	Interpersonal support -> Intrinsic motivation	0.22**	3.136	supported
-	H3c	Resource support -> Intrinsic motivation	0.198**	2.773	supported
Total indirect effects	H4a	Emotional and emotional support -> Intrinsic motivation -> Innovative behavior	0.124**	3.041	supported
	H4b	Interpersonal support -> Intrinsic motivation -> Innovative behavior	0.079*	2.476	supported
	H4c	Resource support -> Intrinsic motivation -> Innovative behavior	0.071*	2.229	supported

Moreover, Table 7 displays the total effects of innovation support (emotional support，interpersonal support, resource support）on innovative behavior and indirect effects via intrinsic motivation. The total effect of emotional support（β=0.242, P<0.05） and interpersonal support（β=0.169, P<0.05）on innovative behavior was significant. The effect decreased to non-significance when intrinsic motivation was added to the model as a mediator. The mediating effects of emotional support（β=0.124, P<0.05） and interpersonal support（β=0.079, P<0.05）on innovative behavior through intrinsic motivation were supported, which accounted for 51.24% and 46.75% of the total effects, respectively.

The total effect（β=0.26, P<0.05）and direct effect（β=0.189，P<0.05）of resource support on innovative behavior was significant, and the mediating effect（β=0.071, P<0.05）of resource support on innovative behavior through intrinsic motivation was significant, which accounted for 27.31% of the total effects.

5. Discussion

This research presents a framework for measuring the impact of university innovation support on students' innovative behavior while studying design thinking courses. First, emotional support, interpersonal support, and resource support have a significant impact on innovative behavior. Furthermore, all three types of support positively impact intrinsic motivation. This is consistent with prior research, which shows that intrinsic motivation has a significant predictive effect on innovative behavior (Amabile, 1988; Fischer et al., 2019). Emotional support, interpersonal support, and resource support all significantly positively impact innovative behavior through intrinsic motivation. The statistic VAF shows that there is a partial intermediary role between the three types of support and innovative behavior.

Although emotional and interpersonal support may not be directly responsible for driving innovative behavior, they nevertheless play a crucial role in developing the intrinsic motivation required for innovation. Emotional support, such as the encouragement and understanding of mentors or classmates, can boost students' intrinsic motivation (Ryan & Deci, 2000; Shalley et al., 2000), making them more inclined to participate in innovative activities (Amabile & Conti, 1999; Bani-Melhem et al., 2018; Duan et al., 2020). Similarly, interpersonal support, such as collaboration and knowledge sharing among peers, can indirectly promote innovative behavior by creating an environment that fosters intrinsic motivation (Yepes et al., 2023). Design thinking courses are typically taught through a team-based approach, emphasizing interaction and cooperation among students (Henriksen et al., 2017; Rauth et al., 2010). Emotional and interpersonal support can create a positive learning atmosphere, enhancing students' confidence and desire for teamwork, and thus encouraging increased active involvement in innovative behaviors during the course. Interpersonal support can also provide students with opportunities to communicate with others, share ideas and receive feedback, further stimulating innovative thinking and behavior.

Resource support has a significant impact on innovative behavior, both directly and indirectly. This suggests that the tangible resources and support provided to students not only promote innovative behavior but also play a crucial role in enhancing intrinsic motivation (Su et al., 2023). Design thinking courses usually require students to use various resources to perform innovative practices, including information resources, material resources, and technical resources. Resource support can include the provision of the necessary tools and equipment, as well as a platform for learning and practice, which supports students in implementing innovative ideas (Afsar & Umrani, 2019). In design thinking courses, resource support can also promote students' understanding and mastery of the innovation process, thereby enhancing their innovation capabilities and

confidence (Rumahlatu et al., 2021). Resource support not only equips students with the necessary tools and resources to engage in innovative activities, but also boosts their confidence and reduces perceived barriers, thus stimulating their intrinsic motivation to innovate.

Design thinking courses place a strong emphasis on developing students' creative thinking and problem-solving skills. Being innovative requires not only professional expertise but also a positive attitude and continuous motivation when faced with challenges (Malik, 2019). Intrinsic motivation, a vital driving force for innovative behavior, plays a crucial role in design thinking courses. By nurturing students' curiosity regarding problems, enthusiasm for solutions, and their pursuit of achievement, intrinsic motivation inspires them to actively engage in innovative activities in the curriculum and aim for higher innovation results (Balakrishnan et al., 2022). The findings highlight the importance of intrinsic motivation as a mediator between various forms of support (emotional, interpersonal, and resource support) and innovative behavior among students. Although emotional and interpersonal support may not directly drive innovative behavior, they play an important role by fostering students' intrinsic motivation, which ultimately drives their innovative efforts (Xiang et al., 2024). In addition, the direct and indirect effects of resource support highlight its critical role in promoting the provision of necessary resources and enhancing intrinsic motivation, thereby creating a favorable environment in which university students can innovate.

6. Conclusion

This study aimed to investigate the causal relationship between innovation support and innovative behavior as well as the mediating role of intrinsic motivation in this relationship, particularly within the context of a design thinking course. An online survey was conducted, collecting 234 questionnaires from four universities in China. By employing structural equation modeling analysis, the research reveals that emotional, interpersonal, and resource support significantly impact students' innovative behavior. Furthermore, intrinsic motivation serves as a crucial mediator in this relationship, highlighting the importance of internal psychological factors in driving innovation.

6.1 Theoretical Implications

In providing a comprehensive theoretical understanding of innovation education and psychology, this research can help to promote the development of students' innovative abilities and intrinsic motivation. By studying the relationship between innovation support and innovative behavior in design thinking courses, this research reveals the specific impact of innovation support on students' innovative behavior in a particular environment. Such insights can assist educators in better comprehending the actual role of innovation support; as a result, innovative education programs can be more effectively designed and implemented. Furthermore, by studying the mediating role of intrinsic motivation between innovation support and innovative behavior, a deeper understanding of the mechanism of intrinsic motivation in the innovation process can be achieved. This is of great significance to the theory and research of intrinsic motivation in

the field of psychology, which can enrich the theoretical framework of intrinsic motivation and expand its application scope.

6.2 Practical Implications

The research findings can aid educators of design thinking courses to better comprehend the link between support for innovation, innovative behavior, and intrinsic motivation. By understanding the mediating role of intrinsic motivation between innovation support and innovative behavior, course designers can more effectively create course content and activities that are specifically designed to motivate students intrinsically and thus encourage their innovative behavior. Teachers of design thinking courses can adjust their teaching strategies and course designs based on the research results. For instance, they can increase their focus on students' intrinsic motivation, provide more challenging tasks, and offer more innovation support. By so doing, they can promote the development of students' innovative abilities and intrinsic motivation.

Furthermore, educational policymakers can use the research results to adjust educational policies and resource allocation to provide more effective innovation support. For example, increasing investment in innovative education projects can provide more innovation resources and support to meet students' innovation needs and stimulate their intrinsic motivation. Optimizing the educational environment is also crucial to provide innovation support. This can be achieved by improving the curriculum, providing better learning resources and facilities, and training more innovative teachers. Such initiatives can help to create an educational environment that is more conducive to students developing innovative abilities and intrinsic motivation.

6.3 Research Limitations and Future Research Suggestions

Certain limitations are acknowledged within the current research. Firstly, other variables, such as professional expertise and creative personality, were not accounted for in the model and should be considered in future studies. Secondly, the interaction between internal and external motivations and their impact on innovative behavior was not explored. Various types of rewards have distinct effects on internal and external motivation, and further research is needed to examine the combined impact of both on innovative behavior. Furthermore, it is worth noting that the current research was cross-sectional, and future research could adopt a longitudinal approach to evaluate the effects of innovation support on students' intrinsic motivation and innovative behavior over time. This would enable scholars to determine whether there are any complementary or compensatory relationships between the different dimensions of innovation support. For example, longitudinal studies could ascertain whether the positive impact of emotional support on intrinsic motivation strengthens or weakens over time.

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