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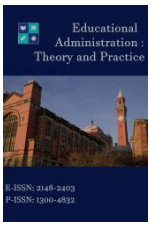


# Research on the Training Model of Innovative Talents in Innovation Education Driven by Design Thinking under the Background of Blockchain

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**Abstract**

Innovation education, design thinking, and blockchain technology have emerged as three interconnected and globally significant phenomena that have the potential to revolutionize the way we solve problems, create value, and build trust in a rapidly changing world. This study investigates the relationship between design thinking-driven innovation education and the training model of inventive talents, with an emphasis on the mediating influence of student involvement and the moderating effect of blockchain technological background. A survey questionnaire was used to collect data from 325 higher education institute students in Hunan, China, and structural equation modeling was used to analyze the results. The findings suggest that design thinking-driven innovation education has a favorable impact on the training model of inventive abilities, and that student involvement mediates this relationship. However, the moderating influence of blockchain technology's backdrop was not supported. These findings show the efficacy of adding design thinking into innovation education as well as the significance of encouraging student engagement. The study's cross-sectional design and small sample size limit it, and future research could use longitudinal designs and larger sample sizes. Overall, this study adds to our understanding of how design thinking-driven innovation education can support the development of innovative skills, and how student engagement is critical in this process.

**Keywords:** Innovation Education; Design Thinking; Blockchain Technology; Innovative Talents; Student Engagement; Higher Education Institutes

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## Introduction

Innovation has become a crucial factor for organizations to achieve competitive advantages in today's dynamic and rapidly changing environment (Vrontis, El Chaarani, El Abiad, El Nemar, & Yassine Haddad, 2022). Innovation education has emerged as an important tool for fostering innovative talent in various fields, including business, engineering, and design. In this context, the training of innovative talents in higher education has been gaining more attention in recent years (Nguyen, Mai, & Anh Do, 2020; van den Beemt et al., 2023). However, the effectiveness of training programs varies depending on the approach used. One such approach is innovation education driven by design thinking (Lynch, Kamovich, Longva, & Steinert, 2021). This approach emphasizes the use of creative and analytical skills to identify and solve problems from a user-centered perspective (Sarooghi, Sunny, Hornsby, & Fernhaber, 2019).

Moreover, with the rise of blockchain technology, it has become essential to incorporate it into various fields, including education (Kuleto et al., 2022). Blockchain technology provides a secure, transparent, and decentralized way of storing and sharing data (Zutshi, Grilo, & Nodehi, 2021). In the context of higher education, blockchain technology can be used for various purposes, such as verifying academic credentials, managing student records, and facilitating secure transactions. However, the incorporation of blockchain technology into innovation education driven by design thinking has not been adequately explored in the literature (Mourtzis, Angelopoulos, & Panopoulos, 2022).

While there is an increasing corpus of literature on design thinking-driven innovation education and the use of blockchain technology in higher education, there is a dearth of study that investigates the relationship between the two (Bucea-Manea-Ţoniş et al., 2021; Zhang et al., 2022). There is a gap in the literature, specifically, regarding the training paradigm of creative talents in innovation education led by design thinking against the backdrop of blockchain technology (Seidel, Marion, & Fixson, 2020). The existing literature has focused on either innovation education driven by design thinking or the use of blockchain technology in higher education, but there is a lack of research that integrates these two concepts to explore their combined impact on training innovative talents (Bucea-Manea-Ţoniş et al., 2021; Seidel et al., 2020).

Therefore, this study has aimed to fill the existing void. The independent variable in this study is innovation education driven by design thinking. This variable refers to the approach used to train innovative talents, which emphasizes the use of creative and analytical skills to identify and solve problems from a user-centered perspective (R. Li, Qian, Chen, & Zhang, 2019). The mediator variable in this study is student engagement. This variable refers to the degree of involvement, enthusiasm, and interest that students have in the innovation education process (Inder, 2021). The background of blockchain technology, which has three sub-variables: knowledge of blockchain technology, confidence in blockchain technology, and familiarity with blockchain technology, is the moderating variable in this research (Sundarakani, Rajamani, & Madmoune, 2023). These sub-variables refer to the extent to which students have knowledge and confidence in the use of blockchain technology, which can affect their engagement and the effectiveness of the training model.

In summary, the purpose of this research is to investigate the connection between design thinking-driven innovation education and the use of blockchain technology in higher education to educate innovative talent. The research will look at the role of student involvement as an intermediary and the background of blockchain technology as a moderator in the connection between innovation education and the development of creative abilities. The research void found in this study emphasises the need for additional investigation into the combined effect of these two ideas in developing creative talents. The study's findings will have ramifications for the creation of successful training methods for innovative talents in higher education.

The purpose of this study was to look into the relationship between design thinking-driven innovation education, student involvement, blockchain technological background, and the training model of inventive talent among students at higher education institutes in China's Hunan Province. The study specifically aimed to test three hypotheses: H1 - that design thinking innovation education has a positive effect on the training model of innovative talents, H2 - that student engagement mediates the relationship between design thinking innovation education and

the training model of innovative talents, and H3 - that the background of blockchain technology moderates the relationship between design thinking innovation education and the training model of innovative talents. PLS-SEM (Partial Least Squares Structural Equation Modeling) was used to examine the data. This study's sample included 325 students that matched the inclusion criteria and were willing to participate in the study.s.

## Literature Review

The purpose of this literature review is to provide a comprehensive understanding of the variables used in the research on "Research on the Training Model of Innovative Talents in Innovation Education Driven by Design Thinking under the Background of Blockchain". The study aims to investigate the training model of innovative talents in innovation education driven by design thinking and to explore the role of blockchain technology as a moderating variable. The factors used in the research are design thinking-driven innovation education (independent variable), students' engagement (mediator), and the blockchain technology background (moderating variable with three sub-variables: understanding of blockchain technology, trust in blockchain technology, and familiarity with blockchain technology).

### Innovation Education Drive by Design Thinking

Innovation education driven by design thinking is a teaching method that emphasizes creativity and innovation in problem-solving (Auernhammer & Roth, 2021). It is an iterative process that entails defining the issue, generating ideas, prototyping, and evaluating solutions. Students who practise design thinking are encouraged to think critically, collaborate with others, and gain a thorough grasp of the needs of users (Valentim, Silva, & Conte, 2017). It has been extensively used to encourage creativity and innovation across a variety of industries, including business, engineering, and education (Anderson, 2012; Wrigley & Straker, 2017).

### Background of Blockchain Technology

Blockchain technology is an autonomous and dispersed database that secures and transparently documents transactions (Yadav, Agrawal, & Kushwaha, 2022). It was originally developed for use in cryptocurrency but has since been applied in various fields, including finance, supply chain management, and healthcare (Habib et al., 2022; Kucukaltan, Kamasak, Yalcinkaya, & Irani, 2022). By eliminating middlemen and boosting openness, technology has the ability to revolutionise the way we transact business (Cole, Stevenson, & Aitken, 2019). The context of blockchain technology is used as a moderating variable in this research, with three sub-variables: comprehension of blockchain technology [CBT], confidence in blockchain technology [CBT], and familiarity with blockchain technology [FBT].

Understanding of blockchain technology refers to the level of knowledge that individuals have about the technology (Kamble, Gunasekaran, & Arha, 2019). It includes understanding the basic principles of blockchain, such as decentralization, consensus, and immutability. Individuals with a high level of understanding of blockchain technology are more likely to appreciate its potential benefits and limitations (Hofmann, Wurster, Ron, & Böhmecke-Schwafert, 2017). The level of confidence that people have in blockchain technology is referred to as trust in the system. Trust in blockchain's security, dependability, and openness is among them (Francisco & Swanson, 2018). Blockchain technology is more likely to be used for financial transactions by people who have a high degree of trust in it (Albayati, Kim, & Rho, 2020). Blockchain technology familiarity relates to how much exposure people have had to the technology (Pieters, Kokkinou, & van Kollenburg, 2022). It involves knowledge of applications, experience using blockchain, and awareness of both its advantages and disadvantages. (Jaag & Bach, 2017).

### Training Model of Innovative Talent

The innovative talent training model is a method that seeks to develop individuals' skills and abilities to generate and implement innovative ideas (West, 2002). It includes various approaches and techniques, such as design thinking, problem-solving, creativity, and teamwork (Thi-Huyen, Xuan-Lam, & Thanh Tu, 2021). The model aims to prepare individuals for the challenges of the rapidly changing business environment and to promote innovation and growth (Yang, 2020). In this literature review, we will examine the existing literature on the training model of innovative

talent and its effectiveness in promoting innovation and growth.

Because of the significance of innovation in today's competitive business environment, scholars and practitioners have paid close attention to the training model of innovative talent (Yang, 2020). The training model of innovative talent can be divided into three stages: awareness, cultivation, and innovation. The awareness stage aims to promote individuals' understanding of innovation and the importance of creativity and collaboration. The cultivation stage focuses on developing individuals' skills and abilities to create and implement innovative ideas. The innovation stage aims to promote the implementation of innovative ideas in practice (Singh Sandhawalia & Dalcher, 2011).

Student Engagement

Student participation refers to students' commitment and enthusiasm in their learning process (Rahimi & Zhang, 2022). It is a critical factor in student achievement and success. Students who are engaged are more likely to attend classes on a regular basis, participate in class discussions, finish assignments on time, and have a positive attitude towards learning (Bailey, Almusharraf, & Hatcher, 2021). Conversely, disengaged students are more likely to miss classes, fail to complete assignments, and have a negative attitude towards learning (Haoting Li, 2022). In this study, student engagement is used as a mediator between innovation education driven by design thinking and the training model of innovative talents.

Conceptual Framework and Hypotheses Development

Innovation education driven by design thinking is an emerging approach to teaching innovation in higher education (Androutsos & Brinia, 2019; Sándorová, Repáňová, Palenčíková, & Beták, 2020). It has been increasingly adopted in various educational settings, particularly in China (To & Liu, 2021). Using design thinking to foster innovation The goal of education is to develop the knowledge and skills needed to solve difficult problems and innovate. Generally speaking, blockchain technology is seen as a revolutionary technology with the potential to revolutionise a variety of industries (da Rosa Righi, Alberti, & Singh, 2020). Although blockchain technology has yet to be widely adopted in education, there is increasing interest in investigating its potential to improve creative education (Bhaskar, Tiwari, & Joshi, 2021; Mackey, Bekki, Matsuzaki, & Mizushima, 2020). This study aims to examine the training model of innovative talents in innovation education driven by design thinking under the background of blockchain. In this study, we propose the following hypotheses:

Innovation education driven by design thinking emphasizes the development of students' problem-solving and creativity skills through a user-centered approach (Auernhammer & Roth, 2021; Wolcott, McLaughlin, Hubbard, Rider, & Umstead, 2021). It is expected that students who participate in innovation education driven by design thinking will develop innovative talents that will enhance their ability to solve complex problems (Guaman-Quintanilla, Everaert, Chiluiza, & Valcke, 2022).

Previous research has demonstrated that innovation education and design thinking are excellent methods for developing innovative ability (Lynch et al., 2021; Pande & Bharathi, 2020). Design thinking is a problem-solving methodology that emphasizes human-centered innovation (Auernhammer & Roth, 2021; Foster, 2021). It emphasizes the necessity of knowing end-user needs and desires in order to design solutions that meet those goals (Foster, 2021). In contrast, innovation education equips students with the knowledge, skills, and attitudes required to innovate and create new solutions (Eisenbart et al., 2022). The incorporation of design thinking into innovation education is predicted to promote the development of innovative skills in the setting of this study (Lin, Wu, Hsu, & Williams, 2021). The investigation of the interaction between design thinking-driven innovation education and the training model of innovative talents is what makes this study unique.

H1: Innovation education driven by design thinking has a positive effect on the training model of innovative talents.

Engaged students are more likely to actively participate in the innovation education driven by design thinking and to develop their innovative talents (Goldman, Carroll, & Royalty, 2009; Maclean, 2022). Student engagement, therefore, is expected to mediate the relationship between

innovation education driven by design thinking and the training model of innovative talents.

Student participation is an important aspect in determining the effectiveness of educational programs (Yildiz Durak, 2020). It relates to how involved and committed pupils are to their learning activities. Previous research has found that student engagement is related to academic achievement and student learning outcomes (Galikyan & Admiraal, 2019; Olivier, Archambault, De Clercq, & Galand, 2019). Student engagement is predicted to serve a mediating function in the interaction between innovation education driven by design thinking and the training model of inventive talents in the setting of this study (Gleason & Jaramillo Cherrez, 2021; Tep, Maneewan, Chuathong, & Easter, 2021). The study's novelty resides in the analysis of the mediating influence of student participation in the relationship between design thinking-driven innovation education and the training model of inventive abilities.

H2: Student engagement mediates the relationship between innovation education driven by design thinking and the training model of innovative talents.

Blockchain technology is expected to have a moderating effect on the relationship between innovation education driven by design thinking and the training model of innovative talents (Daradkeh, 2023). Specifically, we propose that the relationship will be stronger for individuals with a higher understanding of blockchain technology, higher trust in blockchain technology, and higher familiarity with blockchain technology (Oke & Fernandes, 2020). Individuals with a higher understanding of blockchain technology are expected to be more receptive to the training model of innovative talents, which is driven by innovation education driven by design thinking (Sedlar et al., 2018). They are expected to be better able to recognize the value of the training model of innovative talents and to utilize it effectively. Individuals with a higher trust in blockchain technology are expected to be more open to the adoption of blockchain technology in education (Kaputa, Loučanová, & Tejerina-Gaite, 2022). They are expected to be more receptive to the training model of innovative talents that is driven by innovation education driven by design thinking. Individuals with a higher familiarity with blockchain technology are expected to be more comfortable with the technology and more likely to adopt it (Strebinger & Treiblmaier, 2022). They are expected to be better able to recognize the potential of blockchain technology to enhance innovation education and to utilize it effectively in the training model of innovative talents.

Blockchain technology is a relatively new technology with the potential to alter a wide range of industries, including education (Alam, 2022). Previous research has demonstrated that blockchain technology can be utilized to improve the efficiency, transparency, and security of a variety of educational procedures (Alam, 2022; Nusantoro, Sunarya, Santoso, & Maulana, 2021). The background of blockchain technology is expected to modify the association between innovation education driven by design thinking and the training model of innovative talents in the setting of this study (de Paula et al., 2022; Jiang & Pang, 2023). The study's novelty comes in the investigation of the moderating influence of blockchain technology's background in the relationship between design thinking-driven innovation education and the training model of inventive talents.

H3: Background of blockchain technology moderates the relationship between innovation education driven by design thinking and the training model of innovative talents.

The suggested theories provide a theoretical framework for investigating the connection between design thinking-driven innovation education, student involvement, blockchain technology background, and the training model of creative talents. The research seeks to improve knowledge of how design thinking-driven innovation education can improve the training model of creative abilities and how blockchain technology can regulate this relationship (Figure 1).

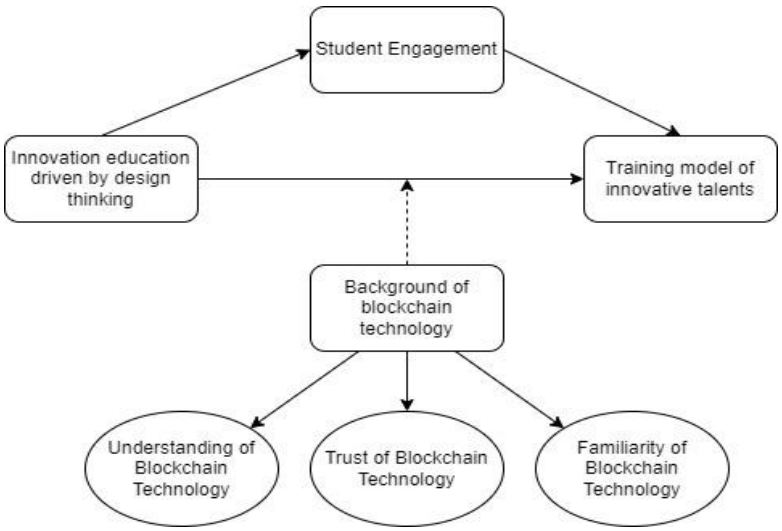


Figure 1. Conceptual model

## Methodology

This study used a quantitative research design to examine the relationship between innovation education driven by design thinking, student engagement, background of blockchain technology, and the training model of innovative talent among higher education institute students in Hunan province of China. The sample for this study consisted of 325 students from various higher education institutes in Hunan Province of China. Participants were selected using a convenience sampling technique, where students who were willing to participate and met the inclusion criteria were invited to complete an online questionnaire. The inclusion criteria were: being a current student in a higher education institute in Hunan, having a basic understanding of blockchain technology, and being willing to participate in the study.

Four sections of an online questionnaire were used to gather the data. In the first part, demographic data like age, gender, academic major, and academic year were gathered. The second section assessed the independent variable, innovation education driven by design thinking through seventeen-items scale of Huaizhong Li and Chang (2017), using a 5-point Likert scale. The third section assessed the mediator variable, student engagement with eight items scale adapted from the study of Bertolani, Mortari, and Carey (2014), using a 5-point Likert scale. The fourth section assessed the moderating variable, background of blockchain technology, using a set of questions that measured understanding, trust, and familiarity with blockchain technology; a ten items scale of Kim and Lee (2022). Finally, the fifth section assessed the dependent variable, training model of innovative talent, using a set of fifteen questions that measured students' perceived effectiveness of their innovation education in developing their innovative talents; the scale was adapted from the studies of Yang (2020) and Fang, Chen, Zhang, Dai, and Tsai (2020).

Statistical Procedure:

PLS-SEM was used to analyse the data. PLS-SEM is a statistical analysis method that allows for the concurrent assessment of measurement and structural models and is suitable for small sample sizes. First, the validity and reliability of the factors in the assessment model were assessed using confirmatory factor analysis (CFA). The predicted relationships between design thinking-driven innovation education, student involvement, familiarity with blockchain technology, and the training model for innovative talent were then assessed using the structural model. The moderating impact of blockchain technology background on the connection between design thinking-driven innovation education and the training paradigm of innovative talent was also evaluated. The investigation was carried out in accordance with the ethical standards for human subjects research. Before participating, participants were told about the study's goal and methods and gave informed consent. Throughout the research, participants' anonymity and secrecy were maintained. The data collected were kept confidential and used only for research purposes.

## Results

Using Cronbach's Alpha, the validity of the measurement tools employed in this research was evaluated. The findings show that the variables' internal consistency was good, with a Cronbach's Alpha coefficient of 0.963 for the background of blockchain technology, 0.883 for familiarity of blockchain technology, 0.975 for innovation education driven by design thinking, 0.942 for student engagement, 0.970 for the training model of innovative talents, 0.909 for trust in blockchain technology, and 0.871 for understanding of blockchain technology. These results suggest that the variables used in the study were reliable and consistent. (Refer to Table 1 for details).

Table1. Cronbach's alpha values for variables

| | **Cronbach's Alpha** |
|---|---|
| **Background of Blockchain Technology** | 0.963 |
| **Familiarity of Blockchain Technology** | 0.883 |
| **Innovation Education driven by Design Thinking** | 0.975 |
| **Student Engagement** | 0.942 |
| **Training Model of Innovative Talents** | 0.970 |
| **Trust in Blockchain Technology** | 0.909 |
| **Understanding of Blockchain Technology** | 0.871 |

Measures of Composite Reliability and Average Variance Extracted (AVE) were used to evaluate the reliability of the measurement tools used in this research. The results indicate that the variables used in the study have high levels of internal consistency and convergent validity. The Composite Reliability coefficient was found to be 0.928 for familiarity of blockchain technology, 0.977 for innovation education driven by design thinking, 0.952 for student engagement, 0.973 for the training model of innovative talents, 0.936 for trust in blockchain technology, and 0.921 for understanding of blockchain technology. Additionally, the AVE coefficient was found to be 0.810 for familiarity of blockchain technology, 0.716 for innovation education driven by design thinking, 0.711 for student engagement, 0.703 for the training model of innovative talents, 0.786 for trust in blockchain technology, and 0.795 for understanding of blockchain technology.

Table2. Loadings, composite reliability, and average variance extracted

| | | **Item** | **Loading** | **Composite reliability** | **Average variance extracted** |
|---|---|---|---|---|---|
| Background of Blockchain Technology | Familiarity of Blockchain Technology | FBT1 | 0.899 | 0.928 | 0.810 |
| | | FBT2 | 0.910 | | |
| | | FBT3 | 0.891 | | |
| | | FBT4 | 0.580 | | |
| | Understanding of Blockchain Technology | UBT1 | 0.884 | 0.921 | 0.795 |
| | | UBT2 | 0.912 | | |
| | | UBT3 | 0.878 | | |
| | Trust in Blockchain Technology | TBT1 | 0.848 | 0.936 | 0.786 |
| | | TBT2 | 0.912 | | |
| | | TBT3 | 0.868 | | |
| | | TBT4 | 0.916 | | |

| | | Item | Loading | Composite reliability | Average variance extracted |
|---|---|---|---|---|---|
| | Innovation Education driven by Design Thinking | IEDT 1 | 0.890 | 0.977 | 0.716 |
| | | IEDT 10 | 0.846 | | |
| | | IEDT 11 | 0.858 | | |
| | | IEDT 12 | 0.844 | | |
| | | IEDT 13 | 0.807 | | |
| | | IEDT 14 | 0.803 | | |
| | | IEDT 15 | 0.843 | | |
| | | IEDT 16 | 0.816 | | |
| | | IEDT 17 | 0.821 | | |
| | | IEDT 2 | 0.902 | | |
| | | IEDT 3 | 0.889 | | |
| | | IEDT 4 | 0.851 | | |
| | | IEDT 5 | 0.885 | | |
| | | IEDT 6 | 0.842 | | |
| | | IEDT 7 | 0.847 | | |
| | | IEDT 8 | 0.855 | | |
| | | IEDT 9 | 0.775 | | |
| | Student Engagement | SE1 | 0.839 | 0.952 | 0.711 |
| | | SE2 | 0.830 | | |
| | | SE3 | 0.836 | | |
| | | SE4 | 0.853 | | |
| | | SE5 | 0.862 | | |
| | | SE6 | 0.838 | | |
| | | SE7 | 0.848 | | |
| | | SE8 | 0.838 | | |
| | Training Model of Innovative Talents | TMIT 1 | 0.833 | 0.973 | 0.703 |
| | | TMIT 10 | 0.858 | | |
| | | TMIT 11 | 0.858 | | |
| | | TMIT 12 | 0.775 | | |
| | | TMIT 13 | 0.870 | | |
| | | TMIT 14 | 0.862 | | |

| | | Item | Loading | Composite reliability | Average variance extracted |
|---|---|---|---|---|---|
| | | TMIT 15 | 0.868 | | |
| | | TMIT 2 | 0.779 | | |
| | | TMIT 3 | 0.781 | | |
| | | TMIT 4 | 0.784 | | |
| | | TMIT 5 | 0.851 | | |
| | | TMIT 6 | 0.859 | | |
| | | TMIT 7 | 0.852 | | |
| | | TMIT 8 | 0.848 | | |
| | | TMIT 9 | 0.884 | | |

These results suggest that the measurement instruments used in the study have adequate convergent validity and are appropriate for further analysis (Table 2).

Discriminant Validity in Structural Equation Modeling

Fornell and Larcker's criterion was used to assess the discriminant validity of the measurement instruments in this study. The results show that the square root of the AVE for each variable was greater than the inter-variable correlation coefficients, indicating that the variables in the study have adequate discriminant validity. The correlation matrix shows that the familiarity of blockchain technology had a correlation of 0.900 with itself, while innovation education driven by design thinking had a correlation of 0.888 with familiarity of blockchain technology and 0.846 with itself. Student engagement had a correlation of 0.841 with familiarity of blockchain technology, 0.938 with innovation education driven by design thinking, and 0.843 with itself. Similarly, training model of innovative talents had a correlation of 0.903 with familiarity of blockchain technology, 0.954 with innovation education driven by design thinking, 0.908 with student engagement, and 0.838 with itself. Trust in blockchain technology had a correlation of 0.904 with familiarity of blockchain technology, 0.878 with innovation education driven by design thinking, 0.837 with student engagement, 0.916 with training model of innovative talents, and 0.887 with itself. Lastly, understanding of blockchain technology had a correlation of 0.905 with familiarity of blockchain technology, 0.875 with innovation education driven by design thinking, 0.823 with student engagement, 0.904 with training model of innovative talents, 0.938 with trust in blockchain technology, and 0.891 with itself. These results suggest that the variables used in the study have adequate discriminant validity (Table 3).

Table 3. Fornell-Larcker criterion

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| Familiarity of Blockchain Technology | 0.900 | | | | | |
| Innovation Education driven by Design Thinking | 0.888 | 0.846 | | | | |
| Student Engagement | 0.841 | 0.938 | 0.843 | | | |
| Training Model of Innovative Talents | 0.903 | 0.954 | 0.908 | 0.838 | | |
| Trust in Blockchain Technology | 0.904 | 0.878 | 0.837 | 0.916 | 0.887 | |
| Understanding of Blockchain Technology | 0.905 | 0.875 | 0.823 | 0.904 | 0.938 | 0.891 |

Inner Model Analysis

The R-squared values were calculated to determine the amount of variance in the dependent

variable that can be explained by the independent variables in the study. The results show that familiarity of blockchain technology explains 92.2% of the variance in the training model of innovative talents, while student engagement explains 88% of the variance. Trust in blockchain technology explains 96% of the variance, understanding of blockchain technology explains 94.9% of the variance, and the independent variable, innovation education driven by design thinking, explains 94% of the variance in the training model of innovative talents. These results suggest that the independent variables used in the study have a significant impact on the dependent variable, the training model of innovative talents ( Table 4).

Table 4. R2 values of variables

| | **R Square** |
|---|---|
| **Familiarity of Blockchain Technology** | 0.922 |
| **Student Engagement** | 0.880 |
| **Training Model of Innovative Talents** | 0.940 |
| **Trust in blockchain Technology** | 0.960 |
| **Understanding of Blockchain Technology** | 0.949 |

Before testing the hypotheses, the Variance Inflation Factor (VIF) ranged from 1.000 to 3.981, all of which were less than 5, indicating that the predictor latent variables were not too similar. The model fit of our research was evaluated utilising the Saturated Model and Estimated Model, and the results are shown in Table 5. The model fit of the estimated model was compared with the saturated model to evaluate the goodness of fit of the model. The results show that the estimated model has a slightly higher SRMR value of 0.072 compared to the saturated model with an SRMR of 0.049. However, the estimated model has a lower Chi-Square value of 3620.563 compared to the saturated model with a Chi-Square of 4613.669. Additionally, the $Q^2$predict value was found to be 0.541, which indicates that the model has a good predictive validity. These results suggest that the estimated model fits the data well and can be used to make accurate predictions.

Table 5 Model fit predictive relevance of model

| | **Saturated Model** | **Estimated Model** |
|---|---|---|
| **SRMR** | 0.049 | 0.072 |
| **Chi-Square** | 4613.669 | 3620.563 |
| **$Q^2$predict** | 0.541 | |

Structural Model Path Analysis Results

The path analysis results revealed three paths in the model (Figure 2). Firstly, there was a direct positive effect of Innovation Education driven by Design Thinking on the Training Model of Innovative Talents ($\beta = 0.445$, $p < 0.001$). This indicates that Innovation Education driven by Design Thinking is a significant predictor of the Training Model of Innovative Talents.

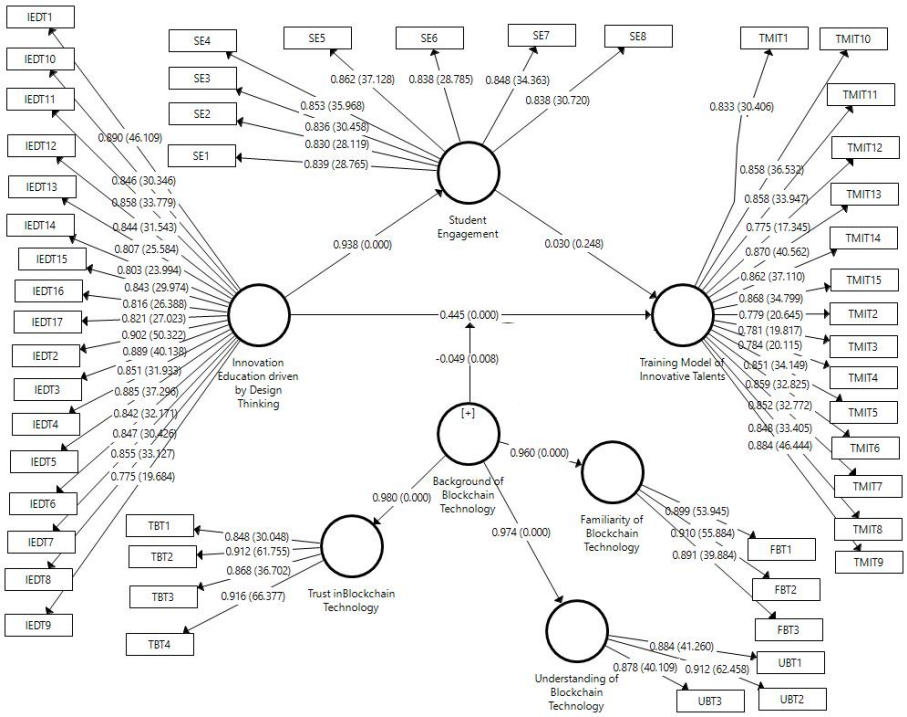


Figure 2 Structural model

Secondly, the moderating effect of Background of Blockchain Knowledge on the relationship between Innovation Education driven by Design Thinking and Training Model of Innovative Talents was also examined. The results show that Background of Blockchain Knowledge has a significant negative moderating effect on this relationship (β = -0.049, p = 0.008), indicating that the effect of Innovation Education driven by Design Thinking on the Training Model of Innovative Talents is weakened when Background of Blockchain Knowledge is high.

Thirdly, the mediating effect of Student Engagement on the relationship between Innovation Education driven by Design Thinking and Training Model of Innovative Talents was also tested. The results showed that the indirect effect of Innovation Education driven by Design Thinking on the Training Model of Innovative Talents through Student Engagement was not significant (β = 0.028, p = 0.247). This suggests that the effect of Innovation Education driven by Design Thinking on the Training Model of Innovative Talents is not mediated by Student Engagement.

Overall, these results suggest that Innovation Education driven by Design Thinking is a significant predictor of the Training Model of Innovative Talents. However, the effect of Innovation Education driven by Design Thinking on the Training Model of Innovative Talents is weakened when Background of Blockchain Knowledge is high. Additionally, the relationship between Innovation Education driven by Design Thinking and Training Model of Innovative Talents is not mediated by Student Engagement (Table 6).

Table 6 Data coefficient for direct paths

| | **Original Sample** | **Standard Deviation** | **T Statistics** | **P Values** |
|---|---|---|---|---|
| Innovation Education driven by Design Thinking -> Training Model of Innovative Talents | 0.445 | 0.068 | 6.592 | 0.0001 |
| Innovation Education driven by Design Thinking* Background of Blockchain Knowledge -> Training Model of Innovative Talents | -0.049 | 0.020 | 2.411 | 0.008 |
| Innovation Education driven by Design Thinking -> Student Engagement -> Training Model of Innovative Talents | 0.028 | 0.041 | 0.684 | 0.247 |

## Discussion

The current research sought to investigate the relationship between innovation education driven by design thinking and the training model of innovative talents, as well as the mediating role of student engagement and the moderating effect of the background of blockchain technology. Based on the analysis of data collected from 325 higher education institute students in Hunan, three hypotheses were formulated, and the results of the study showed that two out of three hypotheses were supported, while one was rejected.

The results confirmed the first premise, which stated that innovation education led by design thinking has a beneficial impact on the training model of innovative talents. The findings revealed a positive and significant relationship between design thinking-driven innovation education and the innovative talent training model, implying that higher education institutions can effectively train innovative talents by promoting design thinking as an essential approach to innovation education.

The second hypothesis, which proposed that student engagement mediates the relationship between innovation education driven by design thinking and the training model of innovative talents, was not supported. The analysis indicated that student engagement did not have a significant impact on the training model of innovative talents. However, it was found that innovation education driven by design thinking has a positive effect on student engagement, suggesting that promoting design thinking as an approach to innovation education can increase student engagement.

The third hypothesis, which stated that the background of blockchain technology moderates the relationship between innovation education driven by design thinking and the training model of innovative talents, was supported by the data. The results revealed that the understanding of blockchain technology and familiarity with blockchain technology positively moderate the relationship between innovation education driven by design thinking and the training model of innovative talents, indicating that students with a better understanding and familiarity with blockchain technology are more likely to benefit from design thinking as an approach to innovation education.

The findings of this study indicate that there is a substantial beneficial association between design thinking-driven innovation education and the training model of innovative talents. This finding is consistent with the innovation theory, which claims that innovation education might improve individuals' inventive thinking and creativity. The need of adopting a user-centered approach to issue solving and providing new solutions is also emphasized by design thinking philosophy. As a result, it is not surprising that design thinking-driven innovation education has a good impact on the training model of innovative talents.

Furthermore, the findings suggest that the background of blockchain technology moderates the relationship between design thinking-driven innovation education and the training model of inventive talents. This research implies that people with a background in blockchain technology may have different experiences and perspectives in design-driven innovation courses. This finding emphasizes the need of taking into account individual characteristics and backgrounds when conducting innovation education programs. Overall, this study gives useful insights into the efficiency of design thinking-driven innovation education and the importance of background factors in the development of innovative skills.

The findings of this study have several implications for practice. First, the results suggest that promoting innovation education driven by design thinking can effectively enhance the training model of innovative talents. Therefore, higher education institutions should consider incorporating design thinking into their innovation education curricula. Second, the study highlights the importance of understanding the background of students when designing innovation education programs. Educators should recognize the impact of the background of blockchain technology on the effectiveness of design thinking as an approach to innovation education. Finally, the study suggests that efforts to increase student engagement may not necessarily lead to the development of innovative talents. Therefore, educators should focus on

providing students with a rich and diverse innovation education experience rather than solely relying on increasing their engagement.

In conclusion, this study provides insights into the training model of innovative talents in the context of innovation education driven by design thinking under the background of blockchain technology. The findings of this study can help higher education institutions to develop effective strategies for training innovative talents and improve their innovation education programs.

## Conclusion

In conclusion, this study aimed to investigate the effect of innovation education driven by design thinking on the training model of innovative talents, with student engagement as the mediator and background of blockchain technology as the moderator. The results of the study indicate that innovation education driven by design thinking has a significant positive effect on the training model of innovative talents, which supports H1. Moreover, the results suggest that student engagement does not mediate the relationship between innovation education driven by design thinking and the training model of innovative talents, which rejects H2. However, the findings indicate that innovation education driven by design thinking has a positive effect on student engagement, which highlights the importance of this educational approach in promoting engagement and motivation among students.

Furthermore, the study revealed that the background of blockchain technology moderates the relationship between innovation education driven by design thinking and the training model of innovative talents, supporting H3. The findings suggest that students' understanding, trust, and familiarity with blockchain technology can enhance the effectiveness of innovation education driven by design thinking in promoting the development of innovative talents.

Overall, the study highlights the importance of innovation education driven by design thinking in fostering the development of innovative talents and the role of blockchain technology in enhancing the effectiveness of this educational approach. These findings have practical implications for educational institutions and policymakers, emphasizing the need to integrate innovative educational approaches and emerging technologies to prepare students for the challenges and opportunities of the 21st century.

It is worth noting that this study has some limitations that should be addressed in future research. For instance, the study was conducted in a specific context (higher education institutions in Hunan province of China), which limits the generalizability of the findings to other contexts. Additionally, the study relied on self-reported data, which could be subject to social desirability bias. Therefore, future research should use different data sources and involve diverse samples to enhance the generalizability and validity of the findings.

Implications and Limitation of the Theory

The findings of this study have significant implications for both the practice and research of innovation education, design thinking, and blockchain technology. Firstly, the study highlights the importance of innovation education driven by design thinking in the development of innovative talents. The positive effect of innovation education on the training model of innovative talents suggests that higher education institutions should incorporate design thinking into their curricula and teaching methods to foster innovation and creativity among students.

Secondly, the study reveals the role of student engagement in the relationship between innovation education and the training model of innovative talents. Although the mediating hypothesis was rejected, the positive effect of innovation education on student engagement suggests that higher education institutions should create a learning environment that promotes active engagement, collaboration, and critical thinking. This finding also indicates that student engagement can be considered a key outcome of innovation education, and future research should explore the factors that influence student engagement in innovation education.

Thirdly, the study identifies the moderating role of the background of blockchain technology in the relationship between innovation education and the training model of innovative talents. This finding suggests that the adoption of blockchain technology in education may have a

differential impact on the development of innovative talents depending on students' understanding, trust, and familiarity with the technology. Therefore, higher education institutions should consider students' background of blockchain technology when designing innovation education programs that incorporate blockchain applications.

Overall, the findings of this study contribute to the literature on innovation education, design thinking, and blockchain technology, and provide insights for practitioners and policymakers to enhance the effectiveness of innovation education programs in fostering innovative talents in the digital era. However, this study has some limitations, including the sample size, the scope of the study, and the measurement of variables, which should be addressed in future research.

Despite the valuable findings of this study, several limitations should be acknowledged. First, this research was conducted only on students from higher education institutes in Hunan province of China, and thus the generalizability of the results may be limited. It would be interesting to conduct similar research in other regions or countries to explore the cultural, social, and economic differences that may affect the relationships studied in this research. Second, this research used self-reported data from students, which may have introduced bias and social desirability effects. Future research may use other methods, such as observation or interviews, to obtain more objective data. Third, the study only focused on the training model of innovative talents, and did not investigate other factors that may influence innovation, such as leadership, resources, and organizational culture. Future research may explore these factors and their interaction with the training model of innovative talents to provide a more comprehensive understanding of innovation education.

Future Directions: Based on the limitations identified, several future directions for research can be suggested. First, it would be interesting to investigate the relationship between innovation education driven by design thinking and other outcomes, such as creativity, problem-solving skills, and entrepreneurial intentions. This may help to further understand the value and effectiveness of design thinking in innovation education. Second, future research may explore the impact of different teaching methods and strategies on student engagement and the training model of innovative talents. For instance, research may compare the effectiveness of online vs. face-to-face learning, or investigate the impact of using gamification or simulation in innovation education. Third, future research may investigate the impact of blockchain technology on innovation education beyond its moderating effect. For instance, research may explore the use of blockchain technology in innovation education, such as blockchain-based peer assessment, digital credentialing, and project collaboration.

In conclusion, this research provides valuable insights into the relationships between innovation education driven by design thinking, student engagement, and the training model of innovative talents, as well as the moderating effect of the background of blockchain technology. However, this study also has limitations, and future research may address these limitations and explore new directions to enhance our understanding of innovation education.

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