

# The Role of Micro and Macro-Level Factors in Shaping Innovation Management in Online Education and ICT Usage in China

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## ABSTRACT

The context of education has changed dramatically as a result of the information and communication technology (ICT) revolution, particularly as it relates to online learning. In order to better understand how innovation management is impacted by ICT usage and online education in China's higher education institutions, this study will look at how both micro and macro-level elements play a significant influence. The study uses a quantitative, cross-sectional methodology to collect information from 390 individuals from both public and private universities. The study aims to comprehend how faculty members, students, and educational administrators view the use and integration of ICT tools and online learning platforms through a standardized survey questionnaire. The collected data were subjected to statistical analysis using SPSS (Statistical Package for the Social Sciences) software. The findings reveal significant insights into the interplay of various factors affecting innovation management in the rapidly evolving landscape of online education and ICT adoption in China's higher education institutions. The purpose of the study is to gain an important understanding of the intricate relationships between micro and macro-level variables and how these interactions affect innovation management in online learning and ICT usage in China. The study's conclusions are anticipated to provide policymakers, university leaders, and educators with useful counsel for fostering an atmosphere that is supportive of technological integration and cutting-edge practices in higher education. A wide range of participants from both public and private universities are included in the study's scope, guaranteeing a complete representation of the higher education environment in China.

**Keywords:** Online Education, ICT Adoption, Innovation Management, SPSS.

## INTRODUCTION

In recent years, the rapid advancement of information and communication technology (ICT) has revolutionized the way education is delivered and experienced worldwide (Wang, 2022). In no other country is this transformation more evident than in China, where online education and ICT usage have witnessed unprecedented growth and adoption (Liu, 2021). The integration of innovative technologies into the educational ecosystem has opened new possibilities for personalized learning, access to knowledge, and collaborative engagement among students and educators (Appio et al., 2021). The direction and scope of innovation management in China are also significantly shaped by international trends and technological developments in the area of digital education (Elahi et al., 2022). China's economy,

which has recently evolved into a worldwide innovation leader, depends heavily on innovation management. China's distinct cultural, political, and economic environment has an impact on the country's innovation management practices (Liu, 2021). The government's role in promoting and guiding innovation has a significant impact on China's approach to managing innovation.

In the face of intense global competition, organizations are continually seeking ways to gain a competitive edge. With the development of technology and environmental changes, new energy vehicles, as clean, efficient, and energy-saving transportation tools, are increasingly favored and concerned by people (Lu & Sun, 2023). ICT adoption has emerged as a powerful tool to enhance operational efficiency,

improve customer experiences, and streamline processes (Kerdpitak, 2022). However, the successful integration of ICT into an organization's operations depends on several factors. One of these factors is the competitive pressure faced by the organization. As competition intensifies, firms are compelled to embrace technological advancements to keep pace with market demands and outperform their rivals (Cuevas-Vargas et al., 2021).

The compatibility of ICT with an organization's existing infrastructure, processes, and culture is another crucial determinant of successful adoption (Kerdpitak, 2022). Compatibility ensures smooth integration and minimizes disruptions during the implementation phase. Moreover, when new technologies align with the organization's values and objectives, they are more likely to be embraced by employees and stakeholders, facilitating the overall adoption process (Al-Rahmi et al., 2021).

Relative advantage, as a concept, refers to the degree to which a new technology is perceived to be superior to its predecessors or existing alternatives (Naaldenberg & Aarts, 2020). Organizations are more inclined to adopt ICT when they perceive clear advantages, such as increased productivity, cost savings, enhanced decision-making capabilities, and improved overall performance. Understanding the factors that influence the perception of relative advantage can help organizations strategically position their ICT initiatives to maximize their benefits (Cuevas-Vargas et al., 2021).

The successful adoption and utilization of ICT within an organization depend on the skills and competencies of its workforce (Jia et al., 2022). Training and education play a pivotal role in empowering employees to leverage the full potential of technological tools. Adequate training ensures that employees are proficient in using ICT, reducing resistance to change and promoting a culture of continuous learning and innovation (Appio et al., 2021).

Effective innovation management is a key driver of successful ICT adoption. Organizations that prioritize innovation management strategies can adapt swiftly to technological advancements and capitalize on emerging opportunities (Walters, 2023). Innovation management entails processes for identifying, evaluating, and implementing new ideas, technologies, and practices, ensuring that ICT adoption is purposeful and aligned with organizational goals (Luan et al., 2020).

Compatibility in the context of online education and ICT usage in China may be affected by several factors, including language barriers, cultural attitudes toward education and technology, and the availability of infrastructure and resources to enable online learning (George et al., 2020; Nayahangan et al., 2021).

Micro-level criteria, such as relative advantage and compatibility, are not the only ones that affect China's adoption and success with online education and ICT use. The pressure of the marketplace and training and education are two essential macro-level variables. Macro-level issues, such as training and education, also have a significant impact on the success of online education and ICT usage in China. This

entails not just teaching but also educating educators and students to make the most of digital tools and resources for education. The development of policies and programs to promote the production and dissemination of high-quality online training materials and educational resources is also part of this goal (Bunjak et al., 2022; Rondi et al., 2022).

While the integration of information and communication technology (ICT) in education has gained significant attention in recent years, there remains a noticeable gap in the literature concerning the role of both micro and macro-level factors in shaping innovation management specifically in the context of online education and ICT usage in China (Zhu et al., 2022). Existing studies have often focused on the adoption of ICT in education more broadly, without delving into the complexities of innovation management and the contextual factors that influence it. Additionally, most studies have primarily concentrated on either micro-level factors, such as individual attitudes and perceptions, or macro-level factors, such as government policies, in isolation. Other researchers such as Hesham et al. (2021) also studied the communication usage like this.

The study's outcomes can contribute to enhancing educational outcomes in China by identifying effective ways to integrate ICT into the learning process. By understanding the factors that influence successful innovation management, educational institutions can implement evidence-based practices to improve teaching and learning experiences and better prepare students for a technology-driven world. As the world increasingly embraces online education and ICT usage, the insights from this study can have broader global relevance. The challenges and opportunities faced by Chinese higher education institutions in managing innovation can apply to other countries seeking to enhance their education systems through technology integration. The current study involves the role of micro and macro-level factors in shaping innovation management in online education and ICT Usage in China. The present study established its own dynamic capability theory. Dynamic capability theory refers to "explains how businesses can adapt to changing conditions and prosper in them" (Al-Rahmi et al., 2021). The notion states that a company's long-term success depends on its capacity for learning, innovation, and adaptation. Objectives of the study are; 1. To examine that intention to integrate e-learning mediates the relationship between relative advantage and innovation management. 2. To examine that intention to integrate e-learning mediates the relationship between compatibility and innovation management. 3. To examine the intention to integrate e-learning mediates the relationship between competitive pressure and innovation management. 4. To examine that intention to integrate e-learning mediates the relationship between training and education and innovation management. 5. To explore that ICT adoption moderates the relationship between the Intention to integrate e-learning and innovation management. 6. To examine whether the intention to integrate e-learning has a significant impact on innovation management.

## LITERATURE REVIEW

### Dynamic Capability Theory

Dynamic Capability Theory is a management theory that emerged in the early 1990s and gained prominence in the field of strategic management (Min et al., 2019). It was initially introduced by David Teece and his colleagues, aiming to explain how firms can adapt and innovate in response to rapidly changing environments and gain competitive advantage. The theory focuses on an organization's ability to integrate, build, and reconfigure internal and external competencies to effectively respond to market dynamics and seize new opportunities (Olugbara et al., 2020).

At the micro-level, individual educational institutions must possess dynamic capabilities to adapt to the changing demands of learners and incorporate innovative e-learning technologies into their teaching practices (Chan et al., 2020). Institutions need to foster a culture of innovation, encourage experimentation, and invest in faculty training to build the necessary competencies to effectively integrate online education and ICT tools. Dynamic capabilities at the micro-level enable institutions to continuously scan the educational environment, identify emerging trends and opportunities, and swiftly respond with innovative e-learning solutions that cater to the needs of students (Shirowzhan et al., 2020).

At the macro level, government policies and regulations significantly influence the adoption and implementation of online education and ICT usage in China (Jia et al., 2022). The Chinese government has been actively promoting the development of online education, e-learning platforms, and the integration of ICT in schools and universities through various initiatives and funding programs. These macro-level factors create an enabling environment for innovation management in the education sector, incentivizing educational institutions to invest in e-learning technologies and continuously enhance their offerings to stay competitive (Naaldenberg & Aarts, 2020).

The Dynamic Capability Theory can be used for online learning and ICT adoption in China. The rapid development of technology and the Internet has increased the significance and popularity of online education in China. To adapt to shifting market conditions and new technologies, businesses, according to the Dynamic Capability Theory, must be prepared to spot and act on opportunities for innovation and operational transformation (Al-Rahmi et al., 2021). To stay up with market needs and the different expectations of Chinese students, online education companies in China must continuously innovate their products. ICT usage has increased exponentially in China during the past few years. Companies that can swiftly adapt new technologies to improve internal processes and deliver higher value to customers are more likely to be successful, according to the Dynamic Capability Theory (George et al., 2020). Schools in China need expert knowledge of ICT tools and platforms to give their pupils the best possible online education (Yuen et al., 2020).

### Past Studies

Micro-level factors such as relative advantage and

compatibility are included in online education and ICT Usage in China. The widespread implementation of e-learning and ICT has the potential to improve China's educational system in numerous ways (Kerdpitak, 2022). One of the key advantages of online learning is that it provides students the freedom to learn in the ways and forms they like, including video lectures, text-based forums, and even 3D models. Schools may be able to educate more students via e-learning at a lower cost and without considerably extending their physical facilities (Shahzad et al., 2020; Wongwatkit et al., 2020). Additionally essential to the success of e-learning in China is innovation management. Technology advancements, systemic changes in the educational system, and the creation of new teaching and learning methodologies can all contribute to innovations in education. Finding opportunities for innovation, creating an innovative culture, and putting those tactics into practice are all necessary for effective innovation management (Zhu et al., 2022). By facilitating collaboration, communication, and knowledge sharing between educators, students, and other stakeholders, the use of ICT can also facilitate innovation management in e-learning. However, integrating e-learning and ICT use in China is not without its difficulties. These include challenges with the digital divide, the necessity to adapt to cultural and linguistic variances, and the fact that some locations have restricted access to technology and internet connectivity (Olugbara et al., 2020). Additional regulation and accreditation mechanisms may be needed due to concerns about the credibility of online degrees and the quality of online education. Walters (2023) looked into the elements affecting Chinese higher education institutions' intentions to adopt e-learning. According to the study, subjective norm, perceived usefulness, and perceived ease of use all had a substantial impact on respondents' intentions to use e-learning. Mihardjo et al (2019) investigated the variables affecting Iranian university students' intentions to use e-learning. According to the study, the intention to utilize e-learning was highly influenced by perceived utility, perceived simplicity of use, social influence, and facilitating factors.

Previous research on the adoption of technology in education has explored the factors influencing educators' intention to integrate technology and its subsequent impact on innovation management (Olugbara et al., 2020). Several studies have found that relative advantage is a significant predictor of the intention to adopt technology in education (Menéndez Álvarez-Dardet et al., 2020; Wang, 2022; Zhu et al., 2022). Kassim et al. (2023) stated that adoption of technology involves the application of transmission technologies, choice of channels, and frequency of dissemination. Educators who perceive higher relative advantages are more likely to develop a positive intention to integrate technology into their teaching practices. Furthermore, research in the field of innovation management has shown that a positive intention to adopt technology enhances the likelihood of successful implementation and innovation within organizations (Kerdpitak, 2022; Shirowzhan et al., 2020). Educators who possess a positive intention to integrate e-learning are more inclined to actively seek training and professional development opportunities,

collaborate with peers, and experiment with innovative teaching methodologies that leverage e-learning technologies. Wong et al. (2020) explore how perceived relative advantage and other factors influence faculty members' intention to integrate LMSs into their teaching practices, thereby affecting innovation management. Min et al. (2019) examine how the relative advantage of information and communication technology (ICT) affects the intention to use ICT and explores how these factors influence organizational capabilities. While the context is a university setting rather than e-learning, it provides insights into the mediating role of intention in the relationship between relative advantage and technology usage.

H1: The intention to integrate e-learning mediates the relationship between relative advantage and innovation management.

When incorporating e-learning into online education and using ICT in China, compatibility is also a crucial factor to take into account in addition to relative advantage (Shirowzhan et al., 2020). The level of compatibility between e-learning and ICT and the values practices and beliefs of educators, students, and other stakeholders in the educational system is referred to as compatibility. The acceptance and use of e-learning and ICT, as well as the success of innovation management initiatives, can all be impacted by compatibility (Yenipazarli, 2019). Students who prefer traditional classroom-based learning or who have trouble accessing technology and internet connectivity may be reluctant to engage in online learning. A key component of overcoming compatibility issues is including stakeholders in the planning and execution of e-learning and ICT initiatives (Stephan et al., 2019). This may entail performing needs analyses, offering instruction and assistance, and establishing chances for feedback and cooperation. It might also be required to create laws and guidelines that support the integration of ICT and e-learning into Chinese culture and the educational system. Implementing strategies to increase the uptake and spread of innovations; fostering an environment where risk-taking and exploration are valued; and spotting fresh ways of approaching e-learning and ICT that mesh with teachers' and students' pedagogical tenets are all factors that can help (Yenipazarli, 2019). Competitive pressure in the industrial sector was correlated with new product development by Jawabreh (2020). The research found that companies with high levels of competition were more inclined to engage in creative endeavors. Wang (2022) investigated the impact of competition on retail marketing creativity. Companies in highly competitive environments were shown to be more open to trying new forms of advertising.

Jawabreh (2020) and Yuen et al. (2021) examine the mediating role of innovative behavior in the relationship between various factors, including compatibility and e-learning adoption. While not directly focusing on innovation management, it provides valuable insights into the influence of compatibility on innovative practices in e-learning. Pei et al. (2018) investigate the role of compatibility among other factors and its impact on perceived usefulness and intention to engage in innovative practices. While it doesn't explicitly

focus on innovation management, it provides insights into the relationship between compatibility, intention, and innovation behavior in an e-learning setting.

H2: The intention to integrate e-learning mediates the relationship between compatibility and innovation management.

Several studies have highlighted the influence of competitive pressure on the adoption of e-learning in educational institutions (Wongwatkit et al., 2020). As the landscape of education evolves, institutions face the challenge of attracting and retaining students in an increasingly competitive market. This pressure prompts educational institutions to consider innovative approaches like e-learning to enhance their offerings and differentiate themselves from competitors (Yuen et al., 2020). Institutions that perceive a high level of competitive pressure are more likely to prioritize the adoption of e-learning technologies to meet the changing demands of students and stakeholders. The adoption of e-learning not only impacts the delivery of educational content but also catalyzes innovation management within educational institutions. E-learning technologies open up new possibilities for instructional design, assessment methods, and collaboration, leading to more innovative teaching and learning practices (Khayer et al., 2020). Effective innovation management involves identifying, evaluating, and implementing new ideas and technologies to improve educational practices and enhance student outcomes. E-learning adoption can serve as a catalyst for innovation management, fostering a culture of continuous improvement and experimentation within educational institutions. Yuen et al. (2021) investigate the factors influencing e-learning acceptance in higher education institutions. It includes competitive pressure as one of the determinants, along with other factors like perceived usefulness and perceived ease of use. While not explicitly focusing on innovation management, the study provides insights into the mediating role of e-learning acceptance (which includes intention) in the relationship between competitive pressure and technology adoption.

H3: The intention to integrate e-learning mediates the relationship between competitive pressure and innovation management.

Macro-level factors such as training and education are included in online education and ICT Usage in China. E-learning and ICT adoption in China's online education can be driven not just by relative advantage and compatibility, but also by competitive pressure (George et al., 2020). New educational providers, shifting requirements from students and businesses, and the push to make China's education system more globally competitive are all causes of competition. The advantages of e-learning and ICT lie in their ability to foster creative and adaptable methods of education that can keep up with the ever-evolving requirements of both students and companies (Nayahangan et al., 2021). For instance, online education can be molded to better equip students for the requirements of the business sector and the accompanying job market. Furthermore, e-learning and ICT can make a school more competitive by catering to each student's interests and providing them with

engaging content. Leveraging the competitive potential of e-learning and ICT in China's online education requires careful innovation management (Pundziene et al., 2021). Tapping the education market for innovation that keeps up with the industry's ever-changing demands can be accomplished by measures such as encouraging a culture of experimentation and risk-taking and developing strategies to help spread the word. Khayer et al. (2020) investigate the roles of perceived usefulness, perceived ease of use, and training in influencing students' intention to use e-learning. While not directly addressing innovation management, the study may offer insights into the role of training and education in shaping students' intention to integrate e-learning.

H4: The intention to integrate e-learning mediates the relationship between training and education and innovation management.

Online education has improved educational opportunities and outcomes by making a wider variety of resources more accessible, reducing barriers to communication, and encouraging teamwork (Fisher, 2021). Tapping the education market for innovation that keeps up with the industry's ever-changing demands can be accomplished by measures such as encouraging a culture of experimentation and risk-taking and developing strategies to help spread the word. Information and communication technology, reaching China's massive student population has never been simpler. In addition, by providing access to the best materials and lecturers in the country, online education has helped China eradicate educational gaps. Several factors, including the need to lower tuition costs, boost instructor quality, and address problems with conventional classroom instruction, have fueled the development of online education in China (Appio et al., 2021). With the help of ICT, students in China's highly competitive educational system now have equal access to the best resources and teachers. According to Stephan et al (2019), subjective norm, perceived usefulness, and perceived ease of use all had a substantial impact on respondents' intentions to use e-learning. Chan et al (2020) suggested that the use of e-learning by Pakistani university students. According to Stephan et al (2019), the desire to adopt e-learning was substantially influenced by perceptions of perceived ease of use, perceived usefulness, and attitude towards e-learning. Rondi et al. (2022) explore a model for ICT adoption in schools, examining factors that influence the adoption process. While not directly focused on e-learning or innovation management, the study highlights the importance of understanding the complexities of ICT adoption in educational settings. Considering ICT adoption as a moderating factor between intention and innovation management in the context of e-learning could provide valuable insights for educational institutions.

H5: ICT adoption moderates the relationship between the Intention to integrate e-learning and innovation management.

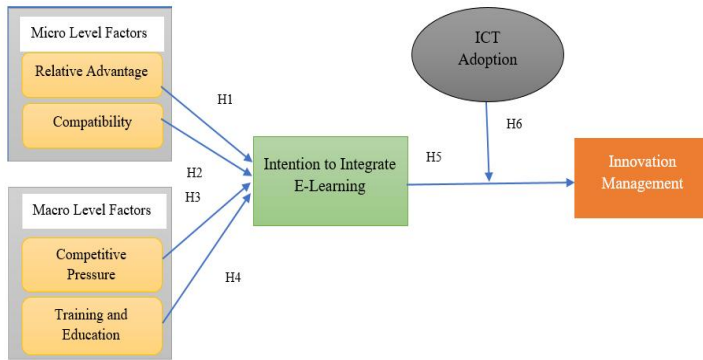
The creation and application of ICT in online education depends critically on innovation management. It is crucial to recognize the potential of emerging technologies and investigate ways to incorporate them into the educational system to improve learning results (Jia et al., 2022). To

transform its educational system, China has been actively embracing innovative management in online learning. The creation of online learning platforms is one area where innovation management has been crucial. With numerous businesses offering online materials and courses, China has a highly developed online education market (Min et al., 2019). These businesses are always developing and enhancing their platforms, adding fresh elements like virtual reality and interactive simulations to improve the educational process. In the creation of personalized learning systems, innovation management has also been essential. The emphasis on personalized learning has changed in China, where pupils now have access to learning materials that are specifically designed to meet their needs. ICT, which enables the gathering and analysis of data on student performance and the provision of specialized feedback and resources, has made this possible (Moshood et al., 2020). A large part of the growth of China's ICT infrastructure and extension of internet access has also been played by innovation management. The widespread use of online education in China can be attributed in large part to the government's heavy investment in the development of ICT infrastructure, especially high-speed internet access. Intents to use e-learning were studied by Stockemer (2018) among college students. According to the study, perceptions of e-learning's effectiveness, usability, and attitude towards it all had a big impact on participants' intentions to utilize it. Chan et al (2020) investigated the variables influencing Saudi Arabian university faculty members' intention to adopt e-learning. According to the study, subjective norms, attitudes toward e-learning, and perceived usefulness all had a substantial impact on respondents' intentions to use e-learning. The intention to integrate e-learning is a key predictor of organizational innovation within educational institutions. When educators and administrators express a strong intention to embrace e-learning technologies, it indicates a willingness to explore new teaching methods, assessment techniques, and collaborative platforms (Liu, 2021). This openness to change creates opportunities for the emergence of innovative practices, leading to improved student engagement, personalized learning experiences, and enhanced overall educational outcomes. Research in the field of technology adoption has consistently highlighted the crucial role of intention in driving the adoption and implementation of innovative technologies. When educators and institutions have a positive intention to integrate e-learning, they are more likely to actively seek opportunities for training, collaboration, and experimentation with innovative pedagogical approaches (Cuevas-Vargas et al., 2021). This proactive attitude fosters an environment conducive to innovation and continuous improvement in teaching and learning practices.

H6: The intention to integrate e-learning has a significant impact on innovation management.

### Conceptual Framework

Based on the above-discussed literature and hypothesis, the following framework has been developed as shown in **Figure 1**.



**Figure 1.** Study Framework

## METHODOLOGY

To test the conceptual model related to the role of micro and macro-level factors in shaping innovation management in online education and ICT Usage, a questionnaire method was used to test the hypotheses. This research is quantitative and descriptive based on primary data collection using the adapted questionnaire. This survey-oriented data collection was based on a cross-section time horizon where data was gathered from Public and private universities in China, where they were asked about the different questions related to variables in the context of shaping innovation management. This study was quantitative which is why Likert scale-based items were used where respondents were given closed options on a specific scale to respond. For an understanding of the study, it was explained to all the respondents so that they can give true opinions based on what they have experienced and what was asked in the adapted questionnaire. Data was just collected once from the respondents which is why cross sectional approach was used for data collection. Under non-probability sampling, the method which was used was convenience sampling. As the population was unknown and the researcher was not aware of the whole population. This method was suitable according to the situation which is why it was used for gathering the data. A total 450 number of questionnaires were distributed among the Chinese and out of that, 390 were properly filled and received and their percentage was more than 86 percent. Which was the appropriate respondent rate for further data analysis?

Out of which 210 were male respondents and 189 were female respondents. After gathering the data, for analysis, SPSS 22 was used, where all the statistical tests were performed to test the hypotheses. While data analysis, direct and indirect relationships were tested along with the presence of mediating and moderating variables. For mediation and moderation analysis, Hayes (2017) was used to find out the results. The structural equation modeling (SEM) method was recommended by Hayes (2017) for such

types of research models where mediation and moderation both are required to measure.

### Measurements

An adapted questionnaire was used as an instrument in this study, for that instance scale (Kerdpitak, 2022; Yuen et al., 2020) was used. Total 25 items were adapted from (Menéndez Álvarez-Dardet et al., 2020; Shahzad et al., 2020; Stephan et al., 2019; Tawafak et al., 2020; Wongwatkit et al., 2020). The unit of analysis was the Public and private universities of China and respondents were selected based on the convenience sampling method under the non-probability sampling technique. These items were tested for reliability analysis to find out whether these items are reliable for this study or not. During the pilot study, it was analyzed that the items are reliable and their value was more than 0.70 (Purwanto et al., 2021). Regarding the use of the 5-point Likert scale, it is a commonly used rating scale in survey research to measure respondents' agreement or disagreement with statements or questions. The scale typically ranges from "1" (Strongly Disagree) to "5" (Strongly Agree), with "3" often representing a neutral response.

## RESULTS

The present study evolved the role of micro and macro-level factors in shaping innovation management in online education and ICT Usage in China, as well as the dynamic capability theory established.

### Demographics

Table 1 presents demographic information and highlights how the present study applies dynamic capability theory to the role of micro and macro-level elements in determining innovation management in online education and ICT usage in China. There was a clear hierarchy of importance among gender, age, level of education, and economic sector among Chinese students. **Figure 1** shows a sample demographic breakdown.

**Table 1.** Demographic Profile

Demography	Description	No. Of Responses	%
Gender	Male	210	54
	Female	180	46

Demography	Description	No. Of Responses	%
Age	21-35	170	44
	35-50	150	38
	Above 50	70	18
Education	Bachelors	190	49
	Masters	140	36
	Others	60	15
Sector	Public	250	64
	Private	140	36

**Table 1** results show the gender of male students of universities in China were 54% and female were 46%. The age of university students in China 21-35 was 44%, 35-50 was 38%, and above 50 was 18%. The education of university students in China bachelors were 49%, masters were 36% and others were 15%. The sector of university students in China public was 64%, and private was 36%.

### Descriptive Statistics

When the researcher adds up all of the numbers in a set and divides them by the total number of numbers, you get

the average or mean. It is a statistical measure of the middle ground between extremes. The standard deviation quantifies the spread or variation in the data. A sample standard deviation can be calculated by multiplying the square root of the sample size minus one by the sum of the squares of the differences between each result and the mean (Purwanto et al., 2021). The median represents the midpoint when a set of data is ordered from smallest to largest. It's a measure of central tendency that, unlike the mean, tends to be less affected by outliers. **Table 2** displays the study variables' means, standard deviations, skewness, and kurtosis.

**Table 2.** Mean, Std. Deviation, Skewness, and Kurtosis

	N	Mini	Maxi	Mean	SD	Skewness	Kurtosis
Relative Advantage	390	1.00	4.20	1.5164	.62943	1.078	.247
Compatibility	390	1.00	5.00	1.7782	1.04855	1.619	1.913
Competitive Pressure	390	1.00	4.67	1.9239	.68665	.724	.231
Training and Education	390	1.00	5.00	2.1701	1.26940	.916	-.388
Intention to Integrate E-learning	390	1.00	5.00	2.5983	1.17233	.372	-.766
ICT Adoption	390	1.00	4.50	2.1962	.94481	.504	-.531
Innovation Management	390	1.00	5.00	2.1769	.91313	1.031	.913

### Reliability Test

A reliability test is a statistical procedure for evaluating a test's dependability and consistency. Measurement of attitudes, opinions, and other psychological constructs is a widespread practice in many social scientific disciplines, making this an invaluable instrument for this type of study. Cronbach's alpha coefficient is the most widely used metric of reliability. The reliability of a scale or questionnaire is shown by its internal consistency coefficient, which can take on values from 0 to 1. Cronbach's alpha was used as a

relative advantage in **Table 3**. Cronbach's alpha was .824, indicating high levels of consistency and congruence (Stockemer, 2018). Cronbach's alpha was .900, indicating excellent reliability even in the face of intense competition. Cronbach's alpha was .648, which can be translated as mediate, train, or educate. The ICT adoption Cronbach's alpha was .918, indicating excellent reliability. Cronbach's alpha was .892, indicating exceptionally high levels of trustworthiness and capacity to manage innovation and Good dependability .720.

**Table 3.** Reliability Statistics

Variables	Cronbach's Alpha	N of Items
Relative Advantage	.824	5
Compatibility	.900	4
Competitive Pressure	.648	3
Training and Education	.918	3
Intention to Integrate E-learning	.896	3
ICT Adoption	.892	4
Innovation Management	.720	3

### Correlation Test

The level of connection between two variables can be analyzed with the help of correlation tests, a statistical

technique. The Pearson correlation test is the most typical sort of correlation analysis performed (Purwanto et al., 2021). Relative advantage has a significant correlation. Compatibility has a significant correlation. Competitive

pressure has a significant correlation. Training and education have a significant correlation. Integrate to e-learning have a significant correlation. ICT adoption has a significant

correlation. Innovation management has a significant correlation (Table 4).

**Table 4.** Correlations Tests

		RA	C	CP	TE	IIEL	ICT	IM
Relative Advantage	Pearson Correlation	1	.641**	.456**	.408	.472**	.472**	.592
	Sig. (2-tailed)		.000	.000	.000	.000	.000	.000
	N	390	390	390	390	390	390	390
Compatibility	Pearson Correlation	.641**	1	.448**	.600**	.672	.462**	.661**
	Sig. (2-tailed)	.000		.000	.000	.000	.000	.000
	N	390	390	390	390	390	390	390
Competitive Pressure	Pearson Correlation	.456**	.448**	1	.693**	.507**	.589	.698**
	Sig. (2-tailed)	.000	.000		.000	.000	.000	.000
	N	390	390	390	390	390	390	390
Training and Education	Pearson Correlation	.408**	.600**	.693**	1**	.710**	.745**	.743**
	Sig. (2-tailed)	.000	.000	.000		.000	.000	.000
	N	390	390	390	390	390	390	390
Intention to Integrate E-learning	Pearson Correlation	.472**	.672**	.507**	.710**	1**	.767**	.638**
	Sig. (2-tailed)	.000	.000	.000	.000		.000	.000
	N	390	390	390	390	390	390	390
ICT Adoption	Pearson Correlation	.472**	.462**	.589**	.745**	.767**	1**	.643**
	Sig. (2-tailed)	.000	.000	.000	.000	.000		.000
	N	390	390	390	390	390	390	390
Innovation Management	Pearson Correlation	.592**	.661**	.698**	.743**	.638**	.643**	1**
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	
	N	390	390	390	390	390	390	390

**KMO and Bartlett’s Test**

The KMO test evaluates the significance of correlations between variables and the size of the sample. A result between 0 and 1 is generated; higher values suggest the data are appropriate for factor analysis. To determine if the correlation matrix of the variables is an identity matrix (showing no correlation), we can apply Bartlett’s test of sphericity. The variables are correlated and appropriate for factor analysis if the result is statistically significant (p 0.05) and the correlation matrix is not an identity matrix (Purwanto et al., 2021). Table 5 shows a KMO value of 0.820, which is statistically close to 1, suggesting the data are appropriate for factor analysis and that the significance level of Bartlett’s test should be high.

**Table 5.** KMO and Bartlett’s Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.820
Bartlett’s Test of Sphericity	Approx. Chi-Square	1984.971
	df	21
	Sig.	.000

**Table 6.** Coefficients

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	
	B	Std. Error	Beta			
1	(Constant)	.885	.087		10.202	.000
	Intention to Integrate E-Learning	.497	.030	.638	16.336	.000

**Regression Test (Direct Hypothesis)**

The goal of regression testing is to verify that newly implemented features do not break previously tested software components or systems. Regression testing verifies that no new defects or bugs have been introduced into the software as a result of any changes or updates (Hayes, 2017). After making modifications to the software, a collection of test cases is run in regression testing to ensure that the previously tested functionality continues to operate as expected. When working on a software development project, this kind of testing is crucial because of the constant stream of code updates. When modelling the relationship between a dependent variable and multiple independent variables, linear regression is the method of choice (Figure 2). Table 6 demonstrates a statistically significant direct association.



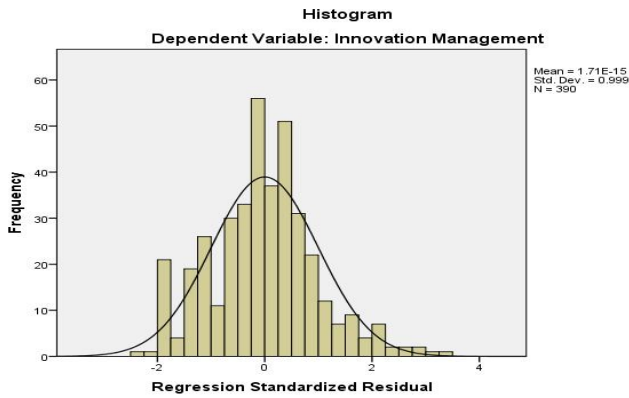


Figure 2. Regression Test (Innovation Management)

Test Mediation Analysis

Mediation analysis is a statistical technique for investigating the possibility of a third-party influence between an independent and a dependent variable. Researchers can examine the mediated influence of an independent variable on a dependent variable by employing one or more mediating factors (Hayes, 2017). Principles of mediation state that the dependent variable is influenced not only by the independent variable but also by the mediator variable. Simple mediation analysis was used to look at the first four hypotheses. Table 7 displays the results. The relationship between comparative advantage, compatibility, competitive pressure, and formal education and training is hypothesized to exist.

Table 7. Mediation Analysis

Outcome Variable: Innovation Management		
Model 4	T-Value	P-Value
RA->IIEL->IM	9.3340	0.000
C->IIEL->IM	8.7624	0.000
CP->IIEL->IM	13.4626	0.000
TE->IIEL->IM	12.4226	0.000
Mediating Variable: Intention-to-Integrate E-learning		

Note: "RA=Relative Advantage, C=Compatibility, CP=Competitive Pressure, TE=Training and Education".

Test Moderation Analysis

Moderation analysis is a statistical technique for testing whether the strength of a relationship between two variables varies with the value of a third variable. According to Hayes (2017), the third factor is referred to as the moderator. Analysis of the relationship between two variables and a third variable that changes or moderates that relationship is what moderation analysis is all about in the realm of statistics. The moderator or moderating variable describes the third factor. Analyzing the level of the moderating variable with respect to the two main variables is what moderation analysis is all about. The purpose is to ascertain whether or not a change in the value of the moderating variable affects the magnitude or direction of the link between the two primary variables. A simple moderation analysis was run to look at Hypothesis 6 (Figure 3). Table 8 displays the results. The hypothesis states that the use of information and communication technologies (ICTs) moderates the link between e-learning integration and innovation management.

Table 8. Moderation Analysis (Hypothesis 5)

Outcome Variable: Innovation Management		
Model 1	T-Value	P-Value
Intention to Integrate E-learning		
* ICT Adoption->	3.6140	0.0003
Innovation Management		
Moderating Variable: ICT Adoption		

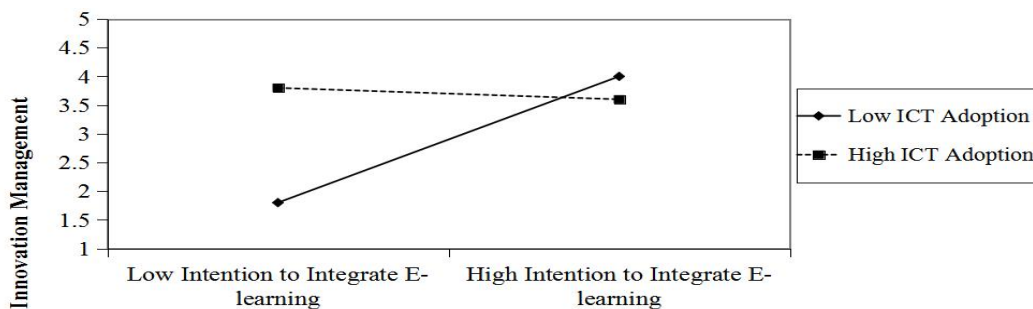


Figure 3. Moderation

## DISCUSSION

The current study extended the dynamic capability theory as well as the function of micro and macro-level elements in influencing innovation management in online education and ICT usage in China. The present study involves relationships between Competitive Pressure, Compatibility, Relative Advantage, and Training and Education on Innovation Management, ICT Adoption plays moderating role and intention to integrate e-learning as a mediator. All hypotheses were accepted.

According to the study's findings, the relative advantage of e-learning technology has a key role in innovation management in educational settings. The aim to incorporate e-learning serves as a mediator in this relationship. The results of our study indicate that educators are more inclined to innovate and manage innovation in their educational settings if they believe that e-learning technology has a bigger relative benefit. This result is consistent with other research that has shown the beneficial influence of relative advantage on technology adoption and utilization (Rondi et al., 2022). These findings further highlight the significance of the study's intended goal of utilizing e-learning technology to mediate the connection between relative advantage and innovation management. This research shows that e-learning implementation rates are higher among educators who place a premium on pedagogical novelty in the classroom.

Our research suggests that educators are more open to incorporating e-learning tools into their practice when they view such tools as supplementary to their already established pedagogical practices. This finding agrees with previous studies that found compatibility to be an important factor in the success of new technologies (Bunjak et al., 2022). The research's conclusions also point to the importance of the aim to include e-learning technology in mediating the link between compatibility and innovation management. This finding implies that teachers are more inclined to try incorporating e-learning technology into their pedagogical practise if they see it as complementary to the way they've always taught.

Our findings suggest that competitive pressure to use e-learning technology leads to greater creativity and more effective management of innovation in the classroom. Other studies have found that increased competition spurs creativity inside a company, thus these findings make sense. E-learning technology integration was also found to be important in mediating the relationship between innovation management and competitive pressure, supporting the findings of the study (Eze et al., 2019). As a result of this discovery, it is hypothesized that innovation management is enhanced in classrooms where teachers are required by the market to embrace e-learning technologies.

Based on our findings, creative environments can flourish in schools where teachers have undergone professional development in the use of e-learning strategies. Training and education increase people's propensity to accept new technology, which is consistent with previous research. The importance of e-learning tools as a bridge between training and innovation management is also highlighted by the

study's findings (Yuen et al., 2021). This evidence demonstrates that teachers who are exposed to e-learning technologies are more interested in incorporating them into their classrooms, leading to increased innovation management.

ICT adoption refers to the extent to which businesses embrace and make use of information and communication technologies. One example of how ICT is being used in the classroom is the widespread acceptance and use of e-learning software by educators. Our research shows that classrooms where educators actively foster an environment conducive to experimentation and experiment management are more successful overall (Al-Rahmi et al., 2021). This finding is consistent with other studies that have found that implementing ICT increases creativity and productivity within a company. This result is in line with other research that has shown the beneficial effects of ICT adoption on innovation and organizational effectiveness. This result is in line with the Contingency Model of Technology Adoption, which contends that organizational and environmental factors have a role in how effectively technology is adopted.

## CONCLUSION

The present study explored the intricate relationships between competitive pressure, compatibility, relative advantage, and training and education in shaping innovation management within the context of e-learning adoption. Additionally, the study examined the moderating role of ICT adoption and the mediating effect of intention to integrate e-learning in this framework. The findings provide valuable insights into the factors influencing innovation management in online learning and shed light on the crucial role of intention and ICT adoption in this process. The results indicate that competitive pressure, compatibility, relative advantage, and training and education all significantly contribute to the enhancement of innovation management in the realm of e-learning adoption. As educational institutions face growing competitive pressure in the digital era, they recognize the need to adopt innovative technologies to stay ahead in the ever-evolving landscape of education. The compatibility of e-learning with existing pedagogical practices and the perceived relative advantages over traditional methods play pivotal roles in influencing educators' and administrators' attitudes toward e-learning adoption, thereby fostering innovation management initiatives. Moreover, the study highlights the significance of training and education in supporting successful innovation management. When educators and administrators receive proper training and support, they are better equipped to harness the full potential of e-learning technologies, leading to more innovative teaching methodologies and improved learning outcomes. Furthermore, the study unravels the moderating role of ICT adoption in the relationship between the aforementioned factors and innovation management. As ICT adoption advances, it amplifies the impact of competitive pressure, compatibility, relative advantage, and training and education on innovation management. This suggests that organizations that have embraced ICT to a

greater extent are more likely to exhibit a higher level of innovation management when confronted with competitive pressures and perceive greater compatibility, relative advantage, and training and education support. Crucially, the study also identifies the mediating role of intention to integrate e-learning in the relationship between the studied factors and innovation management. Intention emerges as a key driver of innovation management, as educators and administrators who exhibit a strong intention to embrace e-learning technologies are more likely to actively pursue innovative practices, collaborate with peers, and actively seek opportunities for professional development. This proactive attitude towards e-learning integration acts as a catalyst for successful innovation management, ensuring the seamless incorporation of e-learning technologies into educational practices.

## IMPLICATIONS

There are theoretical and practical ramifications to the study on the function of micro and macro-level variables in influencing innovation management in online education and ICT usage in China. To facilitate the acceptance and efficient use of ICT in online education, educational institutions in China should give priority to investments in technology infrastructure and training programs. This can be achieved through institutionalizing norms and practices that incentivize original thought and action. By offering funding and other incentives to educational institutions, promoting industry-academia collaboration, and other measures, government policies and regulations should support innovation in online education. A thorough grasp of the micro- and macro-level variables affecting innovation management in online education and ICT usage in China is provided by the study. The study's conclusions can guide future research on the elements that support innovation in other contexts of education. The study emphasizes how crucial it is to take into account both micro and macro elements when comprehending innovation management in educational settings. This emphasizes the necessity for innovation management research to use a multi-level approach. By stressing the mediating function of intention to integrate e-learning and the moderating effect of ICT adoption in the interaction between micro and macro-level elements and innovation management, the study's findings contribute to the development of innovation management theory. This offers a theoretical framework for comprehending the ways that micro and macro factors influence innovation management in online education. The study contributes to enriching the understanding and application of Dynamic Capability Theory in the context of education. By exploring the influence of micro and macro-level variables on innovation management in the e-learning and ICT adoption domain, the study highlights the relevance of dynamic capabilities in educational institutions' ability to adapt and innovate in response to changing environments. The study's contribution to the literature on e-learning, ICT adoption, and innovation management in the educational context can inspire further research in this area. Future studies can build upon the study's framework and delve

deeper into specific aspects of micro and macro-level variables, intention to integrate e-learning, and dynamic capabilities, further advancing the field of educational innovation.

## LIMITATIONS AND FUTURE RESEARCH

Although the study on the influence of micro and macro-level variables on innovation management in online learning and ICT usage in China offers insightful information, some limitations should be taken into account. The use of a small sample size of 390 participants from public and private universities may limit the generalizability of the study's findings. A larger and more diverse sample could provide a more comprehensive understanding of the influence of micro and macro-level variables on innovation management in online learning and ICT usage in China. While the quantitative research design allows for statistical analysis and the examination of relationships between variables, it may not capture the richness and depth of participants' experiences and perceptions. Complementing the quantitative approach with qualitative methods, such as interviews or focus groups, could provide valuable insights into the complexities of innovation management in the context of e-learning and ICT usage. Future studies could explore the moderation and mediation effects of other variables on the relationship between micro and macro-level factors, intention to integrate e-learning and innovation management. For instance, organizational culture, leadership styles, and technology infrastructure could act as important moderators or mediators in this context. Conducting comparative studies between different regions or countries would allow for a more nuanced understanding of the influence of cultural and contextual factors on innovation management in online learning and ICT usage. Such studies could provide valuable insights for educational policymakers and administrators in tailoring strategies to foster innovation in diverse settings. The cross-sectional design of the study limits the ability to establish causality between variables. Longitudinal research that follows participants over time could help identify the temporal relationships between micro and macro-level variables, and intention to integrate e-learning and innovation management. Additional investigation might look at the effects of various ICT platforms, like virtual reality or mobile learning, on innovation management in online education. Future research could take a more in-depth look at the variables that affect innovation management in online education and ICT usage in China by using qualitative research techniques like focus groups and interviews. This might offer insightful information on how administrators and teachers see and experience these situations.

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