Key Drivers of Student Satisfaction in E-Learning: A Case Study of Higher Education at a Public University in Harbin, China

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Abstract

Purpose: The study investigates the influence of five independent variables (Student Engagement, Interactions, Digital Literacy, Perceived Quality, and Cognitive Absorption) on one dependent variable (Student Satisfaction with E-learning). Additionally, it aims to identify significant differences between variables. **Research design, data, and methodology:** The research employed the Index of Item-Objective Congruence (IOC) for validity and a Cronbach's Alpha in a pilot test for reliability. Data was obtained from the target population using a quantitative methodology and a questionnaire. Eighty valid responses from students at Harbin University were analyzed by multiple linear regression to verify significant relationship between variables. Following this, all students from the research population implemented the 20-week strategic plan. Two types of tactics were used: behavioral interventional tactic and collaborative interventional tactic. Afterward, the quantitative results from post-SP and pre-SP were analyzed in the paired-sample t-test for comparison. **Results:** In multiple linear regression, the study revealed that student engagement, interactions, digital literacy, perceived quality, and cognitive absorption significantly impacted students' satisfaction with E-learning. Finally, the results from the paired-sample t-test for comparison demonstrated a significant difference in students' satisfaction with E-learning between the post-SP and pre-SP stages. **Conclusions:** This study aimed to help school administrators address questions about E-learning and analyze the factors affecting student satisfaction with E-learning courses at a public university in Harbin, China.

Keywords: Satisfaction, E-learning, China, Student engagement, Digital literacy

JEL Classification Code: I23, J28, L2

1. Introduction

Since the turn of the new century, advances in information and communication technologies have challenged traditional face-to-face classroom and educational formats. Both technologies have created new possibilities for teaching, research, and learning. Some experts have even predicted that online learners will outperform students in traditional face-to-face classrooms in universities if the online learning environment is transformed into learner-centered and the system's interactivity is emphasized (Zhang et al., 2004). In their research by Mukhtar et al. (2020), they found two advantages of e-learning: flexibility and student-centered learning. Sunami (2023) described that the seven benefits of online learning: attention to physical health, understanding behavior, confidentiality, uninterrupted progress, collaboration, instant access, and ease.

While e-learning offers many benefits and advantages to students and staff, its disadvantages and drawbacks should be considered. While the demand for E-learning has increased dramatically in most institutions due to the global

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COVID-19 explosion, there are inevitable technical issues associated with E-learning that led to unsatisfactory learning experiences for students and faculty (O'Keefe et al., 2020). Even during COVID-19, the shortage of learning devices, internet connectivity, and online learning platforms were recognized as barriers to online learning for students, especially those in backward and poor areas. So, the need for more infrastructure is another problem e-learning faces (Adnan & Anwar, 2020).

Carliner and Shank (2008) identified four main barriers in the e-learning field: organizational barriers and educational, technological, and economic issues. This study's findings are instructive for administrators and faculty at higher education institutions that plan to develop online learning programs. It also provides a tool for higher education administrators to recognize and identify the factors that influence student satisfaction with online learning. At Harbin University, strategic plans were designed to manipulate these factors to increase student satisfaction with E-learning.

However, the current study has two major limitations. First, the study derives much of its data collection from self-reported questionnaires. Social institutions, personal ethical and moral standards, and personal preferences may influence self-reported measurements. So, this type of research can only partially eliminate the bias caused by self-reported measurements. In addition, this study only distributed questionnaires and conducted interviews with college students at Harbin University, a university in Harbin, China. Because each institution of higher education is different, it is possible that the findings of this study cannot be generalized to other universities or other populations, and it is difficult to apply the implications of the study to other institutions of higher education in China as well as in a wider geographical area of the world.

Therefore, finding practical ways to increase student satisfaction with Harbin University's E-learning programs has become an urgent and serious consideration for the university's leaders, management team, and educators.

2. Literature Review

2.1 Student Satisfaction

The concept of student satisfaction originated in marketing-related literature and was based on customer satisfaction in various settings. The original conceptualization of satisfaction emerged in the areas of employment and customer satisfaction (Oliver, 1980).

Student satisfaction is a transient state of mind that arises from assessing a student's educational (Elliott & Healy, 2001). Elliott and Shin (2002) defined student satisfaction as a student's subjective appraisal of the learning outcomes and experiences. Student satisfaction with E-learning can be described as a transient disposition that arises from assessing their overall educational experience and the quality of the programs, services, and facilities offered (Weerasinghe et al., 2017).

2.2. Student Engagement

Student engagement is conceptualized as the amount of effort and time students invest in an online course's participation, interaction, skills, emotions, and performance (Handelsman et al., 2005). Kub defined student engagement as the amount of time and energy that a student purposefully invests in activities related to learning. Later, Fredericks et al. (2004) considered student engagement a combination of cognitive, behavioral, and affective aspects. With the rise and advancement of ICT, student engagement in online learning can be understood in three ways. The first factor is behavioral engagement, which refers to the active participation of online students in various online learning activities. The second factor is cognitive engagement, which refers to online learners' strong motivation and self-regulation in acquiring knowledge during the learning process. The last factor is affective engagement, which refers to students' positive and interactive attitudes in the online learning environment (Salas-Pilco et al., 2022). Consequently, the following hypothesis is formulated:
H1: Student engagement has a significant impact on student satisfaction.

2.3 Interactions

The concept of interaction is the opportunity for synchronized or simultaneous communication between students and instructors, students and content or online resources, and students (Moore, 1989).

Based on Moore's model, other interaction types are proposed for E-learning. These include student-interface interaction, student-tutor interaction, student-designer interaction, student-task interaction, student-tool interaction, and alternative interaction (Kuo et al., 2014).

Liu et al. (2007). Mahle (2011) and Offir et al. (2008) demonstrate a strong and favorable relationship between interactivity and learner acquisition of knowledge, self-affirmation, perceived engagement, and other relevance and student satisfaction. Consequently, the following hypothesis is formulated:
H2: Interactions have a significant impact on student satisfaction.

2.4 Digital Literacy

Digital literacy refers to students' ability to use digital tools and materials for information retrieval and use, content creation, and communication (Spires et al., 2019).

In today's digital age, digital literacy is widely associated with software proficiency, information knowledge, understanding of visual elements, and computer proficiency. A five-element framework for students' digital competence includes digital content creation, data and information literacy, communication and collaboration, problem-solving skills, and cybersecurity (Carretero et al., 2018). The JISC (2014) identified digital literacy in higher education as digital academic competence, career and identity management, and communication and collaboration.

The researchers claim that students' high digital literacy is reflected in their ability to operate learning platforms, do data mining and coding, and fully communicate with co-learners, resulting in a better sense of online learning experience and higher online learning satisfaction. Consequently, the following hypothesis is formulated:

H3: Digital literacy has a significant impact on student satisfaction.

2.5 Perceived Quality

The concept of perceived quality refers to the overall perceived quality of teaching, administrative services, academic facilities, campus infrastructure, support services, and internationalization (Annamdevula & Bellamkonda, 2016). In higher education, some literature explores the concept of students' perception of the quality of their courses. Annamdevula and Bellamkonda (2016) examine six aspects of perceived quality in higher education: teaching, administrative support, academic resources, campus infrastructure, student services, and international integration. Campos et al. (2017) identified five factors that influence the development of perceived quality: teachers, learning facilities, ease of use, additional facilities, and other services. Teeroovengadum et al. (2019) conducted an extensive literature review and divided service quality into five specific parameters: management quality, logistics quality, core academic quality, transformation quality, and physical environment quality. The main indicators commonly used to evaluate the quality of online courses' quality are course materials (Choi et al., 2007) and the quality of course design (Liu et al., 2010). The perceived course quality, as determined by the literature review, can be defined as the degree to which teaching staff and administrators assist students in online learning and the degree to which students can apply the information obtained in online courses to real

life. In addition, Doña-Toledo et al. (2017) investigated four aspects of perceived quality: teaching staff, administrative staff, infrastructure, and assistance services.

According to Olmos-Gómez et al. (2023), students are more satisfied with courses that allow them to participate in various activities and with facilities that help plan their academic experience, enhancing their learning experience. Therefore, the authors also argue that an improvement in the quality of online learning would increase students' perceived satisfaction (Olmos-Gómez et al., 2023). Consequently, the following hypothesis is formulated:

H4: Perceived quality has a significant impact on student satisfaction.

2.6 Cognitive Absorption

Cognitive absorption refers to an individual's deep engagement with online learning (including temporary disconnection, focused immersion, higher enjoyment, control, and curiosity) (Agarwal & Karahanna, 2000). Cognitive absorption is a key factor in student learning and satisfaction, and some experts believe that cognitive absorption is an essential personal trait necessary to utilize and influence technology effectively. As defined by Agarwal and Karahanna (2000), cognitive absorption refers to an individual's deep engagement with online learning. Butt et al. (2022) argue that cognitive absorption is a trait recognized by some experts as essential for the effective use and influence of technology. Cognitive absorption is the degree to which users find a system valuable and strongly want to use it again. It is often referred to as a student's overall experience with information technology or a state of deep engagement with software. This refers to an individual's overall experience with information technology, including Internet use and online learning, as measured by attention, time, and enjoyment.

Cognitive engagement is the basis of cognitive absorption (Webster & Ho, 1997). The concept of cognitive engagement is derived from the principles of absorption theory. Natural characteristics and tendencies can lead to high concentration levels and consume individual abilities. Later, the term absorption was expanded by incorporating the concept of cognitive involvement, resulting in a more comprehensive interpretation. Deci and Ryan (1985) argue that cognitive absorption is an intrinsic drive that stems from the desire to seek pleasure and fulfillment.

Hou et al. (2019) conducted a study that illustrates and highlights the beneficial association between cognitive absorption and user well-being. The study delves into cognitive absorption, which deals with how students experience complete engagement and concentration while

utilizing online learning platforms and how they can have full fun doing so. According to Butt et al. (2022), there is a strong correlation between cognitive absorption and user well-being in online learning. This means that when students experience a higher degree of cognitive absorption in E-learning, their learning satisfaction also increases. Consequently, the following hypothesis is formulated:

H5: Cognitive absorption has a significant impact on student satisfaction.

3. Research Methods and Materials

3.1 Research Framework

This study's conceptual framework is established through three basic perspectives and three important preliminary research projects. The conceptual framework employed the Unified Theory of Acceptance and Use of Technology (UTAUT), the Expectancy Disconfirmation Model (EDM), and the Social Cognitive Theory (SCT).

The researcher applied five model theories from Tharapos, et al. (2023), Duque and Lado (2010), All five theoretical frameworks mentioned above supported and developed a conceptual framework in Figure 1.
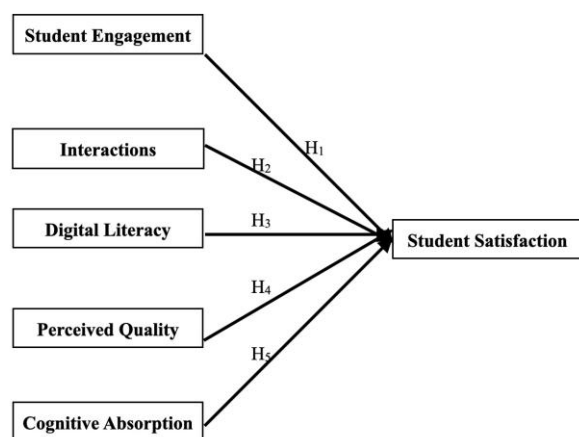

Figure 1: Conceptual Framework

H1: Student engagement has a significant impact on student satisfaction.

H2: Interactions have a significant impact on student satisfaction.

H3: Digital literacy has a significant impact on student satisfaction.

H4: Perceived quality has a significant impact on student satisfaction.

H5: Cognitive absorption has a significant impact on student

satisfaction.

3.2 Research Methodology

In the pre-strategic plan phase, current research seeks to identify problems, considering the current situation and the need for improvement. The study adopted a mixture of quantitative and qualitative research methods. In order to identify problems and change needs, the researchers of this study will conduct interviews with learners and collect qualitative data for analysis in the pre-strategic plan period. The pre-strategic plan interviews were conducted with 15 students, selected from students who had taken or were taking learning courses. Feedback from interviews will be recorded, interpreted, and analyzed in detail.

The next step in the study will be to collect quantitative data from questionnaires given to 80 learners to examine the correlation between independent and dependent variables. The results of Jamovi's multiple linear regression were used to finalize the proposed conceptual framework and to test the validity of the hypotheses presented in the previous chapter. Intervention strategies will be designed to fit the independent variables, and the proposed hypothesis relationships will be confirmed. The study's students and faculty members will be included in implementing the strategy.

In the final phase of the study, the post-strategic planning phase, quantitative and qualitative research methods will be used to examine the results of the strategy implementation.

Current research is divided into three stages: the pre-strategic plan stage, the strategic planning stage, and the post-strategic planning stage. In the pre-strategic plan phase, current research focuses on observing and diagnosing the current situation, identifying the need for change, and developing a plan for the next phase. During the strategic plan phase, tactics and plans will be implemented. The expected results of the previous implementation phase will be analyzed in the post-strategic plan phase.

Jamovi is the main tool for statistical analysis of data.

IOC was utilized to test the validity of the current research. Experts were asked to rate each questionnaire item with +1 (Congruent), 0 (Questionable), and -1(Incongruent). All items were accepted and proved expected to be valid. Afterward, the questionnaire with 64 items was given to students through an online survey App named Wenjuanxing.

The Cronbach alpha coefficient was examined for the current research to test the reliability of the data. Multiple linear regression was performed to test the correlation between the independent and dependent variables.

3.3 Research Population, Sample Size, and Sampling Procedures

3.3.1 Research Population
This study's subjects are sophomores majoring in foreign languages, Food Science, Art, and Civil and Architectural Engineering at Harbin University, China. There were 34 students majoring in foreign languages, 33 majoring in Food Science, 35 majoring in Art, and 44 majoring in Civil and Architectural Engineering. The total research population was 126.

3.3.2 Sample size
It is widely acknowledged that determining the required sample size is one of the most critical steps in planning a quantitative study to ensure research quality (Adhikari, 2021). The survey encompassed 80 students from various classes who were given online instructions. The participants consisted of second-year undergraduate students from Harbin University. 80 (63%) students across the courses were selected and completed the survey.

3.3.3 Sampling Procedures
In this study, participants were recruited using multi-stage sampling techniques. In the initial stage, the researchers used probability sampling to select 30 students who had taken online courses at Harbin University and conducted reliability tests on 64-item questionnaires.

The second stage adopts a stratified random sampling method; 21 students were selected from 34 students major in foreign languages, 21 students were randomly selected from 33 students major in Food Sciences, 16 students were randomly selected from 25 students major in art, and 22 students were randomly selected from 34 students major in civil and architectural engineering. Among the 80 students chosen, questionnaires were sent to students via WeChat Groups; 80 responded and were considered eligible for further research. The multiple linear regression results of the questionnaire were assessed to finalize the action research plan.

In the third stage, 80 students were selected out of 126. Those selected were invited to complete our survey through an online questionnaire handed out by a software called Questionnaire Star. The researcher received 80 completed surveys.

During the preliminary diagnosis state, 15 students from the 80 students who had completed the questionnaire would be randomly selected for an interview, and 30 students from the 80 students who had completed the questionnaire would be selected for an expected situation questionnaire for post-strategic plan analysis.

3.4. Research Instruments

3.4.1 Design of Questionnaire
The researcher designed the survey questionnaire by following three steps.

Step1: Identifying questionnaire sources from six openly published articles (Agarwal & Karahanna, 2000; Bolliger & Halupa, 2012; Gantasala et al., 2021; Majewska & Zvobgo, 2023; Robinson & Hullinger, 2008; Tang & Chaw, 2016)

Step 2: Adjusting and Presenting survey questionnaires on Harbin University students' Context.

Step 3: Implementing IOC.

3.4.2 Components of Questionnaire
Survey questionnaire items were composed of the following three parts:

Part 1: Screening Questions. There were screening questions to filter out the non-research population.

Part 2: Basic info Questions. Questions were asked to gather basic information about the research population, including gender, whether they have participated in online learning, and so on.

Part 3: Survey questions: A 64-item questionnaire was distributed for quantitative analysis, including the current level of IV and DV and the relationship between IV and DV.

3.4.3 IOC Results
In the current research, five experts (two experts were education professors at Harbin University, and three experts were Ph. D.s in education from the Education Bureau of Heilongjiang Province) were asked to evaluate the items developed for the questionnaire. Each expert judged the items from the questionnaire and made his or her decision independently. In the review, expert 1 gave 0 points to I6, expert 2 gave o points to SE2, expert 3 gave 0 points to SS6 and CA3, expert 4 gave no 0 points, and expert 5 gave 0 points to SS11 and PCQ7. Concluding from the expert's opinion, some of the items in the questionnaire could be questionable. However, none of the items were refused by any of the experts, and after a detailed discussion, the experts decided to retain the questions originally designed. In this research, all questionnaire items were greater than 0.67, so the researcher retained all questionnaire items.

3.4.4 Pilot survey and Pilot test results
A questionnaire with 64 questions of 6 sub-scales, original items tested by IOC kept, was delivered to 15 respondents for the reliability test. Each item in this research has passed the reliability test, meaning all results were above 0.6, with 0.948 for student satisfaction, 0.912 for student engagement, 0.845 for interaction, 0.783 for digital literacy, 0.936 for perceived course quality, and 0.831 for cognitive

absorption. The researcher implemented Cronbach's Alpha's internal consistency reliability test, in which values should be equal to or greater than 0.7. Therefore, the table below demonstrates the approved results for the high reliability of each construct.

Table 1: Pilot Test Result

Variables	No. of Items	Sources	Cronbach's Alpha	Strength of Association
Student Satisfaction	24	Bolliger and Halupa (2012)	0.948	Excellent
Student Engagement	5	Robinson and Hullinger (2008)	0.912	Excellent
Interactions	15	Majewska and Zvobgo (2023)	0.845	Good
Digital Literacy	5	Tang and Chaw (2016)	0.783	Good
Perceived Quality	9	Gantasala et al. (2021)	0.936	Excellent
Cognitive Absorption	6	Agarwal and Karahanna (2000)	0.831	Good

4. Results and Discussion

4.1 Results

4.1.1 Demographic Profile

The researcher demonstrated the demographic profile of the entire research population (n=80), followed by selected gender (n=30), who participated in IDI, as shown in Table 2.

Table 2: Demographic Profile

Entire Research Population (n=80)		Frequency	Percent
Gender	Male	42	52.50%
	Female	38	47.50%
Total		**80**	**100%**
IDI Participants (n=30)		Frequency	Percent
Gender	Male	18	60%
	Female	12	40%
Total		**30**	**100%**

4.1.2 Results of multiple linear regression

Multi-linear regression was used to test the hypothesis because the variables, both independent and dependent, in the current research were continuous.

Table 3 indicates the relationship between each independent variable and dependent variable—student satisfaction. Using Jamovi to perform multi-linear regression analysis, the significant test showed that all p-values were less than 0.05, showing that all five independent variables had a significant impact on the dependent variable. The standardized coefficients were all tested to be positive,

indicating that each independent variable was positively correlated to the dependent variable—student satisfaction. By comparing the standardized coefficients, it could be inferred that cognitive absorption, with a coefficient of 0.196, had the least impact on student satisfaction. Other variables had a higher impact on student satisfaction in this order: perceived quality, interactions, digital literacy, and student engagement, with standardized coefficients of 0.249, 0.266, 0.273, and 0.282, respectively.

The researcher conducted multiple linear regression (MLR) on 126 survey questionnaire results to determine whether each hypothesis was supported. Five research hypotheses were identified, all related to the dependent variable, student satisfaction (SS).

Table 3: The multiple linear regression of five independent variables on teacher's student satisfaction

Variables	Standardized Coefficients Beta	t-value	p-value	VIF	R	R Square
Student Engagement (SE)	0.282	7.733	0.002*	1.254		
Digital Literacy (DL)	0.266	-.853	0.003*	1.086		
Interactions (I)	0.273	.496	0.001*	1.241	0.74	0.548
Perceived Quality (PQ)	0.249	.157	0.004*	1.164		
Cognitive Absorption (CA)	0.196	1.508	0.026*	1.226		
Dependent variable: student satisfaction						

Note: p-value <0.05*

In sum, there were 11 hypotheses in this study, and the results of hypotheses 1-5 for conceptual framework construction have been tested. The results of hypotheses 6-11 for Strategic plan testing were tested and supported by both quantitative and qualitative results, and they were shown in the following:

H6: There is a significant mean difference in student engagement between pre-strategic plan and post-strategic plan

H7: There is a significant mean difference in interactions between pre-strategic plan and post-strategic plan

H8: There is a significant mean difference in digital literacy between pre-strategic plan and post-strategic plan

H9: There is a significant mean difference in perceived quality between pre-strategic plan and post-strategic plan

H10: There is a significant mean difference in cognitive absorption between pre-strategic plan and post-strategic plan

H11: There is a significant mean difference in student satisfaction between pre-strategic plan and post-strategic plan

4.2 Strategic Plan Implementation Stage

The Strategic Plan implementation lasted for 20 weeks and was based on quantitative and qualitative data collected at the pre-strategic plan stage to achieve the purpose of this research, which was enhancing student satisfaction. The researcher illustrated the Strategic Plan intervention in chronological order, as illustrated in Table 4.

Table 4: Implementation of Strategic Plan

No.	Time and Duration	Implementation Keywords
1	Week 1	Identification of problem
		Goal setting
		SWOT analysis
2	Week 2-14	Group training for lecturers
3	Week 2-14	Individual Counseling for students
4	Week 3-15	Group training for students
5	Week 4-16	Group tutoring for students
6	Week 16-19	Implementation of practice courses
7	Week 20	Interview/questionnaire

4.3 Results Comparison between Pre-IDI and Post-IDI

The researcher implemented a paired-sample t-test analysis on all six variables to identify whether there were any differences in student satisfaction between the pre-strategic plan and post-strategic plan phases. This part would show the results of paired samples t-tests before and after each strategic plan variable and reveal whether the strategic plan worked. The tables below illustrate paired-sample t-test analysis on six variables as follows:

Table 5: Paired-Sample T-Test Results

Variables	Mean	SD	SE	p-value
Student Engagement (SE)				
Pre-IDI	3.03	1.23	0.225	0.032
Post-IDI	4.13	0.774	0.141	
Digital Literacy (DL)				
Pre-IDI	3.04	1.21	0.204	0.001
Post-IDI	4.09	0.780	0.142	
Interactions (I)				
Pre-IDI	3.01	1.24	0.226	0.027
Post-IDI	4.26	0.724	0.132	
Perceived Quality (PQ)				
Pre-IDI	2.95	1.18	0.215	0.011
Post-IDI	4.27	0.730	0.133	
Cognitive Absorption (CA)				
Pre-IDI	2.98	1.23	0.225	0.003
Post-IDI	4.18	0.766	0.140	
Student Satisfaction (SS)				
Pre-IDI	3.02	1.19	0.217	0.004
Post-IDI	4.21	0.751	0.141	

Table 5 illustrates the results of the paired-sample t-test Table 5 illustrates the results of the paired-sample t-test analysis of the pre-Strategic Plan and post-Strategic Plan comparison as follows: There was a significant increase in Student Engagement between the post-Strategic Plan (M=4.13, SD=0.774, SE=0.141) stage and pre-Strategic Plan stage (M=3.03, SD=1.23, SE=0.225), while P<0.001 and mean value difference between post-Strategic Plan stage and pre-Strategic Plan stage was 1.1. Therefore, H6 supported the idea that there is a significant mean difference in student engagement between the pre and post-strategic plans. There was a significant increase in Digital Literacy between post-Strategic Plan (M=4.09, SD=0.780, SE=0.142) stage and pre-Strategic Plan stage (M=3.04, SD=1.21, SE=0.204), while P<0.001 and mean value difference between post-Strategic Plan stage and pre-Strategic Plan stage was 1.05. Therefore, H8 supported the idea that there is a significant mean difference in digital literacy between the pre-strategic Plan and the post-strategic Plan. There was a significant increase in Interactions between post-Strategic Plan (M=4.26, SD=0.724, SE=0.132) stage and pre-Strategic Plan stage (M=3.01, SD=1.24, SE=0.226), while P<0.001 and mean value difference between post-Strategic Plan stage and pre-Strategic Plan stage was 1.25. Therefore, H7 supported the idea that there is a significant mean difference in interactions between the pre and post-strategic plans. There was a significant increase in Perceived Quality between post-Strategic Plan (M=4.27, SD=0.730, SE=0.133) stage and pre-Strategic Plan stage (M=2.95, SD=1.18, SE=0.215), while P<0.001 and mean value difference between post-Strategic Plan stage and pre-Strategic Plan stage was 1.32. Therefore, H9 supported the idea that there is a significant mean difference in perceived quality between the pre and post-strategic plans. There was a significant increase in Cognitive Absorption between post-Strategic Plan (M=4.18, SD=0.766, SE=0.140) stage and pre-Strategic Plan stage (M=2.98, SD=1.23, SE=0.225), while P<0.001 and mean value difference between post-Strategic Plan stage and pre-Strategic Plan stage was 1.2. Therefore, H10 supported the idea that there is a significant mean difference in cognitive absorption between the pre and post-strategic plans. There was a significant increase in Student Satisfaction between post-Strategic Plan (M=4.21, SD=0.751, SE=0.141) stage and pre-Strategic Plan stage (M=3.02, SD=1.19, SE=0.217), while P<0.001 and mean value difference between post-Strategic Plan stage and pre-Strategic Plan stage was 1.19. Therefore, H11 supported the idea that there is a significant mean difference in student satisfaction between the pre and post-strategic plans.

According to the paired-sample t-test results demonstrated above, the researcher reached the following conclusions. First, all six variables had significant mean

differences between the post-strategic and pre-strategic Plan stages. Second, the researcher found a significant increase in Student Satisfaction between the pre-and post-strategic Plan phases. The quantitative results indicated notable disparities between the pre-and post-strategic plan phases in student involvement, digital literacy, interactions, perceived quality, and cognitive absorption.

5. Conclusions, Recommendations and Limitations

5.1 Conclusions & Discussions

In technological innovation, digital learning has emerged as a predominant mode of education for higher education institutions offering distance learning programs. With the rapid advancement of information and communication technologies over the past few decades, there has been a significant surge in online learning or E-learning. Furthermore, due to the global COVID-19 pandemic, colleges and universities increasingly embrace online learning. However, higher education institutions' widespread adoption of online learning platforms has raised concerns regarding their effectiveness. Of particular concern is student satisfaction with E-learning, which directly impacts the academic performance of online learners. Therefore, this study aims to investigate strategies for enhancing students' satisfaction with E-learning by improving participation levels, digital literacy, interaction opportunities, perceived quality, and cognitive absorption at Harbin University.

student engagement, digital literacy, interactions, perceived quality, and cognitive absorption

This study investigated the influence of five independent variables: Student Engagement, Digital Literacy, Interactions, Perceived Quality, and Cognitive Absorption, and the dependent variable, Student Satisfaction. The research employed a comprehensive research design, data collection, and methodology to draw meaningful conclusions.

The study consisted of three primary phases: pre-strategic plan, strategic plan, and post-strategic plan. During the initial phase, the primary focus was on diagnosing the present circumstances, investigating and defining the need for modifications, conducting a SWOT analysis, developing a conceptual framework, and gathering and evaluating data in preparation for the execution of the strategic plan. The author selected independent variables based on a review of relevant literature. These variables include student engagement from Tharapos et al. (2023), digital literacy from Golding and Jackson (2021), interactions from Ayanbode et al. (2022), perceived quality from Duque and Lado (2010), cognitive absorption from Cheng (2023), and the dependent variable, which is student satisfaction, from Elliott and Healy

(2001). Subsequently, the researchers established the conceptual framework and employed quantitative and qualitative methodologies to gather and analyze the data. Initially, a questionnaire was implemented, and three experts conducted the Index of Item-Objective Congruence (IOC) assessment to assess the validity of the exam. All the questions were retained in their original design.

Subsequently, a pilot test was carried out on a sample of 30 participants using Jamovi software to verify the reliability and consistency of each measurement item. All items were retained after the test. Subsequently, the author administered questionnaires to a sample of 80 randomly selected students from those who had completed an online course. The data collected from the questionnaires was then analyzed using Multiple Linear Regression (MLR) to formulate and present hypotheses. The MLR analysis revealed strong relationships among student involvement, digital literacy, interactions, perceived quality, cognitive absorption, and student happiness. Thus, all independent variables were retained to implement the strategic plan. During the study, 15 students were interviewed to gather suggestions for implementing techniques. Among the participants, 15 students were selected from 80 who had previously completed a questionnaire. The Finalized Strategic Plan and Implementation Model have been completed.

In the second phase, the strategic plan was implemented for all students and faculty members in the four majors of Foreign Languages, Food Science, Art, and Civil and Architectural Engineering. As mentioned earlier, the students and faculty members selected for the strategic plan came from the majors with the largest number of students. Therefore, these students and faculty members represented most students and faculty members exposed to online learning. Based on the results of the multilingual study, the strategic plan focused on improving students' engagement, interaction, digital literacy, perceived quality, and cognitive absorption ability. The author designed a strategic plan from both the student and faculty perspectives to achieve differentiation in the variables mentioned above and improve student satisfaction.

Foreign Languages, Food Science, Art, and Civil and Architectural Engineering

The third stage involved using a paired sample t-test to determine if there were any significant disparities between the pre-and-strategic plan periods. The paired sample t-test results indicated substantial disparities in student engagement, digital literacy, interactions, perceived quality, cognitive absorption, and student satisfaction between the pre-and post-strategic plan periods, suggesting that the 20-week strategic plan was effective.

5.2 Recommendations

The results show that implementing the strategies of "continuous professional learning and Improvement of teaching staff" and "student cooperation" has indeed improved student satisfaction with E-learning. Recommendations are made in four areas below.

5.2.1 Incorporating the Interactive Learning

Interactive learning has gained great popularity in education, and the role of the teacher in promoting an effective learning environment is extremely important (Cavinato et al., 2021). It increases learner engagement, promotes analytical thinking, and fosters team spirit. Integrating interactive learning into the curriculum can enhance the learning process's passion, vitality, and effectiveness. A significant advantage of interactive learning is the ability to promote the active participation of students. Learners do not simply listen to the lecture but actively participate in the learning process. Interactive learning has the advantage of improving academic performance. Using interactive methods to teach complex concepts can enhance students' understanding of the content and long-term memory. Incorporating interactive learning into the curriculum benefits students and educators and creates a mutually beneficial situation. Interactive learning is a powerful tool that educators should consider incorporating into the curriculum because it promotes active student engagement, improves academic performance, and teaches important life skills.

5.2.2 Fostering Students' Capacity for Self-Directed Learning

In contemporary society, the social and environmental situation is evolving rapidly, especially in the digital age, and self-directed learning is an essential skill for adults (Morris, 2018). Prioritizing the development of self-directed learning should be a primary goal in many formal education Settings. The ability to learn independently has several potential benefits. It can help individuals avoid the risk of knowledge and skills becoming obsolete, which is particularly important for people in complex professions (Morrison & Premkumar, 2014). It also enables individuals to acquire new skills in response to changing economic conditions, protecting against long-term unemployment (Barnes, 2016). In addition, it enhances the ability of individuals to take action to free themselves from oppressive situations (Bagnall & Hodge, 2018). In addition, it promotes learners' progress toward self-realization and contributes to long-term career success.

5.2.3 Developing Lesson Planning Standards

A perfect lesson plan has the following functions: First, it clarifies the goal of the teaching module and sets the direction for students and teachers; Promotes the effectiveness of curriculum learning; Ensures that teaching materials are aligned with the assessment plan; Ensure that assessment programs are aligned with learning objectives; Ensure the availability of necessary teaching materials; To enable teachers to meet the individual learning needs of students effectively. As for the new type of E-learning courses, Harbin University has no standardized lesson plans that enable students to achieve the expected results. Therefore, formulating standardized or simple teaching plan standards can improve teachers' teaching ability and enhance student satisfaction with electronic courses.

5.2.4 Long-term Promotion of Professional Development

This study sets out a strategy to promote the ability of teaching staff to sustain professional learning and development. However, some specific lecturers showed indifference to participating in the activity. Teachers must recognize that good continuing professional development is essential for teachers to implement curriculum changes. The role of teacher educators is extremely valuable and important, and improving their quality can improve the quality of education more broadly.

To sum up, improving student satisfaction requires the joint efforts of both teachers and students. Only by integrating interactive learning, cultivating students' ability to learn independently, setting standards for lesson preparation, and promoting long-term professional development can universities achieve their goals of improving student satisfaction, student learning outcomes, and teaching quality.

5.3 Limitations for Future Research

Further investigation is necessary to understand the limitations of this study. The current study has two major flaws. A major limiting factor is that this study relied primarily on self-reported questionnaires to collect data. All factors measured in this study, including student satisfaction with E-learning, student engagement, interaction, digital literacy, perceived quality, and cognitive absorption, were self-reports. Social norms, personal moral and ethical principles, or personal tendencies may influence self-reported measurements. It is not possible to eliminate the bias caused by self-reported measurements. Thus, the results of this survey are limited by its limitations.

In addition, only questionnaires were used in this study, and only college students from Harbin University in Harbin, China, were interviewed. Although rigorous scientific

methods were used in the selection of subjects and samples, it must be noted that the results of this study may not apply to other populations, nor can they be easily applied to other higher education institutions in China or different parts of the globe. This is because each institution has its unique background and characteristics.

Finally, this study focuses on interaction in the classroom so future research can link interactions before, during, and after class to truly realize the concept of student-centered teaching.

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