



A Framework of Interactive Mind-Map Multimedia System in Blended Learning

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ABSTRACT

In modern education, students advocate a high-quality and intelligent instructional environment, and their requirements have changed in lockstep, including how they participate in the classroom, acquire knowledge, improve innovation, and confidently solve problems. In the target group involved in this study, the students from the design colleges tend to stay in mastering design skills and lack innovation. They have a certain level of artistic thinking but are often not competent in the thinking ability to complete the user-centered functions and services of the whole application required. Thus, conventional instructional design and thinking are facing an awkward position, while blended learning will play the future instructional design role in the next normal. The framework of interactive and mind-map multimedia systems is one of the manifestations of blended learning that may change this embarrassing situation. Therefore, the research purpose is to design an interactive and mind-map multimedia instructional system for enhancing Chinese design college students' innovation and service design thinking.

Keywords: multimedia instructional system; blended learning; design college student; innovation; service design thinking



INTRODUCTION

In the era of Industry 4.0, information and communication technology has penetrated every field of people's life and work and opened many new occupational areas, UI design is one of them (Guo, 2022). It is no wonder that, according to CNNMoney/PayScale's Best Jobs in America, user interface designer ranks 57th on the top 100 Best jobs in America, with a projected 10-year job growth rate of 27% (CNNMoney, 2017). Meanwhile, Georgiou (2022) described that designers would need to innovate more in UI Design than in the last few years and must pay close attention to trends that bring freshness to user interfaces with newer technologies. Also, UI Design usually requires designers to design with the user-centered principle to provide users with certain functions and services and requires students to have service design thinking, which leads to UI design becoming a popular curriculum established by design colleges in China.

Nowadays, students' lifestyles and educational environments have shifted, and their requirements have changed in lockstep, including how they participate in the classroom, acquire knowledge, improve innovation, and solve problems with confidence (Lim et al., 2009). They are now more equipped with intelligent tools than ever before. According to studies, generation Z has steadily surpassed millennials as the primary force behind new college students, and the learning concept is continually evolving. They advocate a high-quality and intelligent instructional environment. Traditional education is facing an awkward position, while blended learning will play the future instructional design role in the next normal. The students involved in this subject are mainly undergraduates in design colleges. According to the author's six years of teaching and research (2017-2023) and the feedback from some graduates engaged in the UI design field, students often encounter bottlenecks in design creation as well as work and fail to implement a good design. They are judged to lack innovation and a service mindset that thinks for the user.

At the present stage, the teaching cannot fully release the students' creative thinking and analysis abilities and cannot meet the requirements of students in the workplace after graduation (Chen, 2020). Furthermore, Zhang (2022) reported in Guangming Daily that, with the in-depth implementation of the innovation-driven development strategy, college education should give full play to the maximum efficiency of all kinds of school-running elements and ultimately enhance the service design thinking. Based on teaching experience, interactive technology is integral to education (Kholikova, 2021). Furthermore, mind maps are a valuable tool in helping to tease out logic and expand the imagination. Consequently, there is a need to focus on improving the innovation and service design thinking of Chinese design college students in UI Design creation through the interactive and mind-map multimedia system.

Problem Statement

Today's learning methods have been completely revolutionized by the comprehensive application of the Internet (Mishra & Sharma, 2005). However, considering that it is difficult for students to understand and remember various knowledge points during learning, if there are no additional auxiliary learning tools, hence, it is necessary to provide the interactive and mind-map multimedia system to help students understand these information (Saleem et al., 2011). Interactive learning adapts to the present educational situation and is developed in the rapid development of digital technology and virtual communication. As a pedagogical technique, interaction needs to



fundamentally innovate the method of education. Tapscott (1999) identified that this would promote students' learning styles from linear learning to hypermedia learning. Although this argument was put forward earlier, the current epidemic Power Point teaching mode of turning pages can still be regarded as a linear learning mode for students.

The author believes that the use of most multimedia does not help students in terms of cognitive structure, or it cannot help students in terms of cognitive structure on a larger scale. Also, art and design students' positive views of the effectiveness of mind mapping were more prominent than those of some other majors, with 62.5% and 34% (respectively) agreeing that they could better understand the concept of the mind mapping style (Holland et al., 2004). Especially, UI Design is a comprehensive course blending intricate theoretical knowledge and creation in Chinese design colleges (Guo, 2022). According to the notice issued by the Ministry of Education of the People's Republic of China (MoE of PRC) on the Action Plan of Scientific and Technological Innovation in Colleges and Universities to serve the Belt and Road Initiative, colleges are required to cultivate innovative students who can serve social construction (MoE of PRC, 2018), which is more for this research to find an anchor point in policy and reflects the requirements and goals of society.

Therefore, the major problem faced by Generation Z in Chinese design colleges presently is that they have problems learning UI Design curriculum. What kind of multimedia teaching can help learners increase engagement, build their cognitive structure, reduce cognitive load, and expand their innovative (creativity and creative thinking) and service design thinking? The framework and application of interactive and mind-map multimedia will be paid more attention to.

The second problem is how this multimedia teaching can help students improve their innovation and service design thinking. Since both innovation and service design require learners to have a certain amount of knowledge reserve, it is imperative to help construct the cognitive structure and reduce cognitive load. At the same time, innovation requires divergent thinking, which makes mind mapping even more helpful.

Research Objectives

The following are the research objectives:

1. Structure and develop an interactive and mind-map multimedia system that contains two-dimensional and pseudo-three-dimensional scenes, videos, audios, graphs, mind mappings, and interactive buttons based on user interface design theories for relevant educators and students in relevant design colleges, involving five phases according to ADDIE model. (Corresponding to research questions 1 and 2)
2. Test the system as a solution for design college students who have difficulty in innovation and service design thinking in UI Design Creation. The quasi-experimental method was employed to examine the effective use of this system for teaching theoretical knowledge, service design thinking, and innovative creation. (Corresponding to research questions 3, 4 and 5)
3. Cultivate innovative students who can serve social construction based on MoE of PRC document requirements. By improving design college students' innovation and service design thinking and designing more innovative and user-centered designs after students enter



the workplace, socially responsible design can increase their professional and social value.
(Corresponding to research questions 6)

Research Questions

The following are the research questions:

1. What are the motivation and emotional engagement of design college students after UI Design learning using the system featuring interactive and mind-map?
2. What is the cognitive structure, cognitive load, and cognitive engagement of design college students after UI Design learning using the system featuring interactive and mind-map?
3. What are the academic performance and interactive engagement of design college students after UI Design learning using the system featuring interactive and mind-map?
4. How do design college students apply the skills to their UI Design creation from UI Design learning, including UI Design technical skills, innovation skills, and service design thinking?
5. What are the learning achievements and evaluation of design college students after UI Design learning using the system featuring interactive and mind-map?
6. How to design an interactive and mind-map multimedia framework according to the ADDIE model to cultivate innovative and service-oriented students?

LITERATURE REVIEW

Due to the development of intelligent devices and the increasingly close interaction between users and intelligent devices, UI Design has become increasingly prominent. Meanwhile, the study of UI Design courses has also attracted wide attention. Through sorting out and analyzing the existing literature, from the status quo of UI Design education to the cultivation of innovative and service design thinking college students, the design and application of multimedia teaching systems in UI Design education, this part will conduct discussion and analysis research.

Previous studies believed UI Design involves more disciplines, a prominent content system, and a relatively complex curriculum design. Its teaching mode and content need to be made more practical and modern according to the development and needs of the times to cultivate more outstanding UI design students for society (Guo, 2022). Li and Yao (2022) stated that there are some problems in the teaching process of UI Design in Chinese universities, such as disconnection between theory and practice, single teaching method, and unsatisfactory teaching effect. To help teachers deal with numerous issues effectively, students' innovative thinking should be cultivated. Therefore, they advocate employment-oriented UI design course content (Li & Yao, 2022). In addition, Li (2022) supported that the teaching design of UI Design would follow the basic teaching procedures of Butler learning mode, take the course design as the entry point, focus on improving students' learning and thinking ability, pay attention to market demand and user experience, and conduct blended teaching research guided by the innovation effect. On the other hand, Wu (2022) believed that a project-based teaching mode should be introduced into UI design courses to solve such problems as a single training mode for digital media technology professionals, weak learning initiative of students, and disconnection between professional ability and society, to cultivate highly skilled interdisciplinary talents who can better adapt to the development trend of design. There are many similar discussions, including some research on UI



design course design under the background of the Internet. To sum up, UI Design courses in Chinese design colleges often face the problems of weak learning initiative, poor thinking logic, and insufficient innovation of some students. In contrast, the industry and society have increasingly higher requirements for them. The requirements of training service design thinking students proposed by the Ministry of Education of China are rarely mentioned. Therefore, there are still many opportunities and challenges for this course.

Referring to the cultivation of innovative and service design thinking. Kholikova (2021) held the view that the development of student's creative thinking is one of the criteria for them to grow into fully mature human beings. An innovative approach involves not only the creation of a new creative product but also the realization of a practical idea and its development process. Each student sets goals and seeks ways to achieve them, based to some extent on their worldview, thinking, imagining, and understanding, and needs to represent personal or social interests. Meanwhile, his Goals, desires, interests, and needs are revealed, and most importantly, these tools are revealed as essential factors in developing the ability to think creatively. It is based on combining education with science and production to develop and improve students' innovative thinking abilities (Kholikova, 2021). Hundreds of autobiographical and archival sources, interviews, and formal psychological studies show that every creative person uses a common "tool kit" of imagination that contains several skills : (1) Observation; (2) Imagination; (3) Abstract; (4) Pattern recognition; (5) Pattern formation; (6) Analogy; (7) Body kinesthetic thinking; (8) Empathy; (9) Dimensional thinking; (10) Modeling; (11) Playing; (12) Transformation; And (13) synthesis (Root-Bernstein R & Root-Bernstein M, 2003). On the other hand, service design thinking is an interdisciplinary knowledge that combines different methods and tools in various professional fields. It is an integrated design based on user experience, interaction, functions, and visual communication. Nowadays, the ever-increasing expectations for user experience and the rapid growth of mass digital society systems prioritize end-user pleasure, prompting us to realize the importance of further improving user experience and implementing sustainable, intelligent social services (Stickdorn & Jacobs, 2012). However, many institutions and design studios have been created in service design work and consulting, gradually occupying a considerable market, and creating an awe-inspiring network.

In this subject's interactive and mind-map multimedia system, interactive and mind-map are emphasized. Kholikova (2021) also demonstrated that there is a growing interest in interactive approaches, the role of innovative technologies, teaching, and information technology in the educational process. For another, mind maps use lines, colours, arrows, branches, or other means to show connections between the ideas generated in a mind map. It is a non-linear graphical approach that encourages brainstorming for any given organizational task, removing the initial barriers to building an organization within an appropriate or relevant conceptual framework. It also makes our brains better able to remember sights, colours, and pictures, associate facts, and ideas, and enhance comprehension (Moi & Lian, 2007). Searching the book Delft Design Guide (Van Boeijen et al., 2014), mind maps are one of the most used and simplest methods in design disciplines, and they are also a great way to exercise a designer's intuition, including design innovation and service design. By summarizing the above literature, it is feasible to use an interactive and mind-map multimedia teaching system to assist students in design colleges to enhance their innovation ability and service design thinking. However, the specific multimedia teaching system has not been shown in the literature.



Conceptual Framework

In this research, aiming at designing a multimedia system framework, three theories and one model will be adopted, namely Mayer's Multimedia learning theory, constructivism, cognitivism, and ADDIE model. Richard Mayer (2009) in seminal book *Multimedia Learning*, which relies on extensive experimentation, details his extensive research into how to construct multimedia materials effectively to maximize learning based on 12 principles he found distilled. These principles constitute what he calls a "cognitive theory of multimedia learning." Also included are three assumptions about how humans process information. The theory and its principles guide how to create effective multimedia learning presentations. The design of an interactive and mind-map multimedia system in this research also follows his proposed principles and theories.

Furthermore, Mayer's theory is consistent with contemporary thinking about effective learning, and there are many similarities to constructivism (Norman & Davis, 2016). Constructivism has been used for higher education. The current trend of higher education has driven more "active learning" teaching methods, which are often based on constructivism. From the research of recent decades, constructivist theorists have extended the traditional focus on individual learning, and some curriculum focus has shifted to address the collaborative and social dimensions of learning. Social constructivism can be seen as a combination of aspects of the work of Piaget with that of Bruner and Vygotsky (Wood, 1998). This part can be used as theoretical guidance for cultivating innovative and service-oriented students for society. On the other hand, an important theme of Bruner's theoretical framework is that learning is an active process in which learners create new ideas or concepts based on current or past knowledge. This theory can explore the establishment of innovation consciousness and service consciousness of design college students from the perspective of cognitivism.

The teaching design of this study adopts the ADDIE approach, according to the analysis, design, development, implementation, and evaluation of five steps to design and develop the system. ADDIE's applied philosophy of education should be student-centered, innovative, authentic, and inspiring. Using the ADDIE model flow to design a system is still one of the most effective tools available today (Branch, 2009).

Regarding the design of course content, two thinking theories will be adopted to improve students' thinking ability, namely, innovative thinking and service design thinking. This research UI Design course focuses on the cultivation of students' innovative thinking ability, and innovative technology is an educational process, as well as innovative and changing activities between teachers and students, making full use of interactive methods in the realization. Their characteristic is that they can only be achieved through the joint efforts of teachers and students (Kholikova, 2021).

Service design thinking has five principles: user-centered, co-creative, iterative, sequential, and holistic. Meanwhile, service design employs the design process's thinking model and workflow, combining an initiative-driven and iterative approach with a more versatile and lightweight collection of tools drawn from marketing, design, user experience, and other domains (Stickdorn et al., 2012). Also, Livework (2023) company generally believes that service design



assists and supports designs to deliver new ideas more effectively, meet users' needs, break segmentation, and create social value and empowerment. At the same time, this method emphasizes latent challenges and ideas generation to gain immense confidence in the thoughts and higher commitment by visualizing new ideas and user journeys and examining with users (Livework, 2023).

METHODOLOGY

Quantitative approaches, qualitative approaches, and mixed methods are used in this research. In the first part, this study mainly conducts the approaches through quantitative approaches, including quasi-experimental, exploratory, descriptive, empirical research, evaluation, and classification. In the second part, qualitative approaches are applied in this research, covering a literature review, case studies, and critical theory. In this final section, the above two parts are mixed. The main methods of data collection are questionnaires, log files, tests, and direct observation.

Focus Group

Sixty undergraduate students from Shanghai Sanda University Art Design and Media College in the Digital Design program participate in this action study (get the students' permission first). The researchers arrange a 12-week UI Design course to experiment which three classes in succession per week, and each class is 45 minutes. There are two classes in total: one is the experimental group, and the other is the variable control group, with 30 students in each class. As soon as the project is launched, the teacher, teaching content, instructional programmed, course schedule, and assignment in the experiment are consistent. The experimental group uses the interactive and mind-map multimedia system by computers or mobile phones in learning UI design in the computer classroom. For another, the control group uses the conventional method of PowerPoint in the same academic environment. At the same time, data sets are collected from observations, self-reflection logs, questionnaire methods, and individual interviews. Moreover, the test (quasi-experimental method) and inspection (curriculum outcome) of UI design work verified the design ability of students.

The Design Process

The framework of the interactive and mind-map multimedia instructional system for Chinese design college students in UI design includes five steps based on the ADDIE model. The steps are described below:

- Step 1: Analysis of Focus Group

The first step is to identify the characteristics of the target group through the literature method, questionnaire and observation method, to analyze the students at Chinese design colleges. Based on SWOT analysis, this study is elaborated from the four perspectives of strengths, weaknesses, threats, and opportunities. In recent years, through the observation, questionnaires and interviews of students, the author found that graduates of design schools are prone to encounter bottlenecks in innovation and thinking in design work. If students only master design skills without paying attention to knowledge structure and thinking growth, they will be abandoned sooner or later. Compared with undergraduates in other majors, they are characterized by certain painting abilities, aesthetics, distinct personalities, and strong

emotional thinking. In contrast, students from design colleges tend to stay in the thinking of making graphics well, and the positioning of their works is often in graphic design. On the other hand, they have low enthusiasm in class, weak logic ability and pay attention to design skills and despise culture. They are often not competent in the thinking ability to complete the user-centered functions and services of the whole application required by courses such as UI design. Given this and the policy opportunity, this framework of the interactive and mind-map multimedia instructional system will be used in the subject of UI Design to ameliorate their situation.

- **Step 2: Design Prototype**

The second stage of this research is to design the prototype of the multimedia teaching system. Design prototypes based on instructional design (cognitive structure, cognitive load, and cognitive engagement), interface design, navigation design, mind mapping design (sorting out logic), interactive button design (interactive engagement) and information design. An example of the design prototype is shown in Figure 1 below.

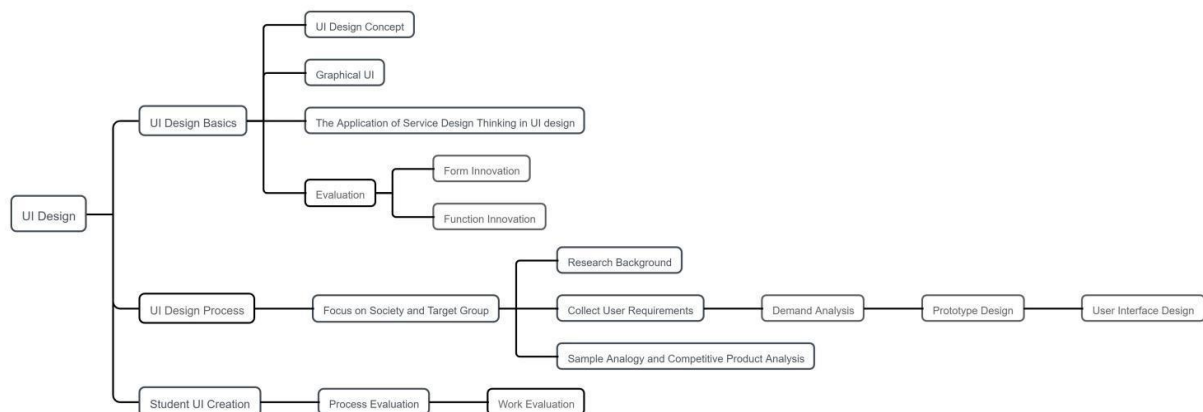


Figure 1: Design Prototype

- **Step 3: Development**

In the third phase, the researchers will consider the system's operation, renewal, and development from a long-term perspective. The framework involved in the mind-map instructional multimedia system is discussed in Figure 2 below. The current framework focuses on the elaboration of the main characteristics of the system and the corresponding research problems and objectives to be solved, which still needs to be improved in the process.

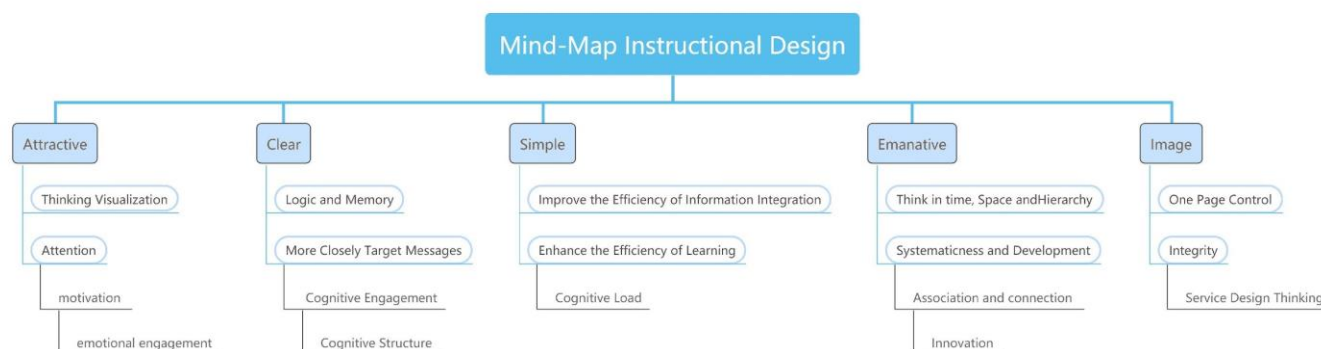


Figure 2: A Framework of Interactive and Mind-map Instructional Multimedia System

- Step 4: Implementation

This stage is where effectiveness is assessed, and problems are identified in the design and development process. This process may require repeated experiments to collect more comprehensive data. It may also face some unexpected situations.

- Step 5: Evaluation

Subject experts and experts in multimedia instructional technology are evaluated to make recommendations on the prototype and framework. Subject experts will invite teachers from design schools to conduct evaluations from a professional design perspective, such as instructional design, instructional content, and student design creation. Multimedia instructional technology experts, including four lecturers and one professor, have recommended multimedia instructional design and interaction design. In addition, interviews and questionnaires were conducted to understand students' feelings and opinions after using this system framework.

FINDINGS

Based on Table 1 below, the summary of students' scores in academic performance tests for the control and experimental group, the data obtained from the experiment showed an improvement in their results. The overall score of the experimental group was higher than that of the control group, and the proportion of A and A+ was also higher than that of the control group.



Table 1

The Summary of Students' Score in Academic Performance Test for Control and Experimental Group

Grade	Control Group		Experimental Group	
	(n)	(%)	(n)	(%)
A+(90-100)	3	10	5	16.7
A(80-89)	11	36.7	13	43.3
A-(75-79)	6	20	7	23.3
B+(70-74)	5	16.7	2	6.7
B(65-69)	2	6.7	2	6.7
B-(60-64)	2	6.7	1	3.3
C+(55-59)	1	3.3	0	0
Total	30	100	30	100

Score the following questions		Not at all ----Absolutely (1-10)
Innovation--Measure students' creative thinking and creative performance.		
1	Fluency--Whether students generate multiple design ideas?	
2	Originality--Do students often come up with new, different, or original ideas?	
3	Flexibility--When conditions change or difficulties cannot be resolved, whether new methods be proposed to overcome them?	
4	Creativity--Is the design work be fully creatively presented?	
5	Elaboration--Is it possible to consider all aspects when students summarize the design proposal?	
Service design thinking--Test whether students' UI design works can reflect service design thinking.		
6	User-centered--Does the UI design work meet real users' needs?	
7	Co-creative--Are the various professional and functional stakeholders involved in the design process as much as possible?	
8	Iterative--Does the UI design work take into account future operations and version updates?	
9	Sequential--Does the UI design work provide a sequential high-quality user experience?	
10	Holistic--Does the UI design work focus on the entire service process and role participation?	

Figure 3: Measurement of Innovation and Service Design Thinking

Figure 3 presents the measurement of innovation and service design thinking. During the experiment, the author scored the design process of each student according to the ten questions in the figure, whether the students were in the experimental group or the control group. The purpose of questions 1-5 is to measure students' innovation, including creative thinking and creative performance, which were scored on five scales: fluency, flexibility, originality, creativity, and elaboration. In addition, the purpose of questions 6-10 is to test whether students' UI design works can reflect service design thinking, which was scored on five principles: user-centred, co-creative, iterative, sequential, and holistic.



Figure 4: Mean Scores of the Control Group and the Experimental Group after Measurement of Innovation and Service Design Thinking

Figure 4 shows that both the control and experimental groups were more likely to score higher on the innovation measurement. Furthermore, the service design thinking scores of the experimental group were more than three points higher than the control group. However, the experimental group had a lower innovation score than the control group.

DISCUSSION

This study was limited to Shanghai Sanda University Art Design and Media College, a private university. Therefore, this study needs more discussion on other public colleges and universities. In terms of the overall survey data, it could be more comprehensive. To make the experiment more critical, all students should be tested at the beginning of the course to facilitate the comparison between the ability assessment after and before the course. Moreover, a more detailed UI design scale needs to be given for students' UI design works, their works will be evaluated, and the degree of their innovation ability and service design thinking will be deduced.

The findings of this study may help design college students with a learning scaffold to enhance service design thinking. However, the increase in innovation did not come from the experiment because the students' scores were even lower. The reason for the decline in scores may be that the thinking of service design restricts students' innovation. The author believes that service design thinking requires students' design works to be closer to social life rather than unrealistic.

Cheng (2020) believes that designers' cognition is also improving with the development of the education sector and society. In the future, they will need more full-service design students who can bring new possibilities (Cheng, 2020). Therefore, for individual designers, service design



thinking can develop innovative ideas, enhance overall planning and management ability, increase employment potential, and increase enterprise value. On the other hand, sustainability targets must be developed with social values and based on service design thinking to ensure sound judgment and long-term success in future blended learning in design colleges (Helena Sustar, 2022).

Besides, the design of a multimedia educational system may improve the multimedia technology ability of contemporary teachers. However, relatively speaking, the workload of the design system may become a burden in the work of teachers. This kind of multimedia teaching system in blended learning may take some time to play the future instructional design role in the next normal.

CONCLUSION & RECOMMENDATIONS

Multimedia technology presents different forms of information to students, and information is no longer a simple superposition but makes an organic, logical connection (Shang, 2018). Therefore, this study provides a way to help students build a cognitive structure by designing an interactive mind-map multimedia system. This experiment cannot claim that the framework of the interactive and mind-map multimedia system will hinder students' innovation. More experiments are needed to confirm the conclusion by critical thinking. What this study hopes to show is that students can reasonably apply innovation and service design thinking to deal with more social practice cases in the working environment after graduation. At the same time, this research is also in response to the document requirements of the Ministry of Education of China to conduct talent training, hoping that this research can be applied to a broader field of design education in the future.

In this investigation, the aim was to assess the framework of an interactive and mind-map multimedia system for enhancing Chinese design college students' innovation and service design thinking in UI Design creation to enrich the future of instructional design form in blended learning. The pain point of this study is an extension of the thinking requirements of students in design colleges.

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Conflict of Interest

No conflict of interest to disclose.

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Authors' Contributions

It contributes to construct students' cognitive structure thinking expansion, stimulating interest in learning, building students to participate in immersive circumstances, and giving play to students' subjectivity in blended learning. In the aspect of knowledge transmission, the teaching of knowledge and development skills and quality training are unified. Multimedia education technology can guide students to focus on innovative and independent thinking through discovering, exploring, and constructing knowledge. At the same time, it shows the high efficiency of the multimedia educational system. It promotes the informatization and modernization of higher



education, that is, through the design, development, utilization, management, and evaluation of educational resources, optimization, and innovation.

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