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# **Development and Usability Evaluation of a Nursing Graduate Information Management System (GSMIS) Based on User Experience**

Future Health and Technology/Nursing Science

Master's thesis

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## **Abstract.**

### **[Research Background]**

Recent years, the rapid development of information technology in colleges and universities and the continuous expansion of graduate students have not only increased the pressure of graduate student management in the School of Nursing of Fudan University, but also accelerated the pace of information technology construction in the college, and the School of Nursing urgently needs to use the existing good platform to realize the information technology of nursing graduate student management in combination with the actual situation of the college, so as to realize the communication between graduate student supervisors, graduate students and management, and also to build an objective and scientific clinical competence assessment system in line with It is also important to provide material for the construction of an objective and scientific clinical competence assessment and evaluation system that is in line with the postgraduate nursing education, which is important to achieve the cultivation goals and improve the quality of nursing graduate training.

### **[Research Purpose]**

Based on the theory of user experience and the concept of "User-Centered Design", this project develops the information management system for graduate students in the School of Nursing by studying the actual needs of teachers and graduate students in the School of Nursing, which can be divided into the following contents:

- (1) Construction of the framework content of a Nursing GSMIS
- (2) Development and testing of a Nursing GSMIS
- (3) Usability evaluation of the a Nursing GSMIS

### **[Research Methods]**

#### 1. Demand analysis of the Nursing GSMIS

- (1) Preliminary framework: Using target sampling method and maximum variation method, semi-structured interviews were conducted with both faculty and student users of the School of Nursing to build the preliminary framework of the system.
- (2) Final framework: Expert focus group interviews were used to revise and adjust the required content such as interface design, business functions and performance, and to determine the final framework of the system.

#### 2. Development and testing of Nursing GSMIS

The "Rapid Prototype Interaction" model was used to develop the system. After the prototype was developed, the Shanghai Institute of Comprehensive Application of Network Technology was contacted for professional system testing, and then the system was modified and adjusted until it met the research requirements.

#### 3. Usability evaluation of Nursing GSMIS

A mixed evaluation method of usability test, questionnaire and qualitative interview was used to conduct a more comprehensive and objective usability evaluation of the GSMIS successfully developed in the early stage. It was used to understand the users' feelings and experiences of the system, analyze the advantages and shortcomings of the system, and explore its actual usability.

## [Research Results]

### 1. Demand analysis of Nursing GSMIS

#### (1) Preliminary framework of the system:

The faculty and student users interviewed expressed that information management is an important step in the progress of the college and the nursing discipline, and expressed strong support and need for the construction of our information system. Based on the literature review and the needs of faculty and students, the framework was initially formulated as four modules: basic information of admission, cultivation process, research results, and clinical cases.

#### (2) The final framework of Nursing GSMIS:

It is built from modules and functions, performance, interface, text, color, etc.; Modules include: basic information module for admission, training process module, scientific research achievement module, clinical case library module, employment information module, graduation tracking module; functions include password setting and retrieval, user log-in, user management, data maintenance, custom query, audit and message notification; Performance can be summarized as follows: data structure is clear, complete, with real-time, expansion, operation and stability; Interface Design is friendly and beautiful, simple and easy to use; Layout should highlight the key points; text design is easy to recognize and read, color design reflects the connotation and characteristics of the college. The performance can be summarized as: clear data structure, complete, real-time, scalability, operability and stability; friendly and beautiful interface design, simple and easy to use, layout to highlight the key points; text design is easy to identify, easy to read, color design reflects the connotation and characteristics of the college.

### 2. Development and testing of Nursing GSMIS

Based on the requirements, the engineers used the "Rapid Prototype Interaction Model" to develop the system. After the prototype was developed, the Shanghai Institute of Comprehensive Application of Network Technology was contacted for professional system testing, and then after many rounds of software discussions and corrections between the software engineers and researchers, the GSMIS finally had the registration and log-in page, the informed consent notification page, the information notification page and six main modules.

### 3. Usability evaluation of Nursing GSMIS

(1) Usability Test: Based on the usability test theory, the target sampling method was used, and five graduate students users were selected to participate in the test is sufficient, and the results are as follows.

1) Quantitative results: The effectiveness was mostly at 100%, and the efficiency was 56.2min/s, 72.2min/s, 53min/s, 225.2min/s, 75.8min/s, 33min/s, and 5.5min/s; The overall score of the post-scene questionnaire (ASQ) was 1.24. The evaluation indexes all indicated that the users rated the system highly.

2) Qualitative results: The test subjects all easily completed and highly praised the system during the test, indicating that the operation was not difficult and satisfied the interaction needs of users.

(2) SUS Questionnaire: A total of 40 users completed the SUS using the convenience sampling method and the maximum variance method, and the Mean $\pm$ SD was 70.23 $\pm$ 7.7. Among them, the mean score of the Usability sub-scale was 71.59 $\pm$ 8.93, and the mean score of the ease of Learning sub-scale was 64.77 $\pm$ 7.53, with scores ranging from 60 to 70.

(3) Qualitative interviews: Using target sampling method and maximum variation method, a total of 10 people were interviewed, including 5 students and 5 staff users, and the number of interviews was 3, with no repeated interviews or secondary interviews. The maximum interview time was 46 minutes,

the minimum was 25 minutes, and the average was 35.5 minutes. The results can be summarized into three aspects: general evaluation, content and function evaluation, and shortcomings and improvement.

This study combines qualitative and quantitative results, reflecting the good usability of the system, but there are also shortcomings and improvements.

### **[Conclusion]**

This study used various research methods such as literature review, qualitative interview, and focus group interview to construct a system framework based on user experience, completed the development of the graduate student information management system in the School of Nursing, and used mixed methods such as out-of-sound thinking method, usability testing method, questionnaire survey method, and qualitative interview to evaluate the usability of the system, and the results showed that the system has high acceptance, ease of use, and usability.

**Key words:** Graduate student information management system, Usability evaluation, User Experience, Need analysis.

# Tiivistelmä.

## [Tausta]

Viime vuosina tietotekniikan nopea kehitys korkeakouluissa ja yliopistoissa sekä jatko-opiskelijoiden määrän jatkuva kasvu ovat sekä lisänneet painetta jatko-opiskelijoiden hallintoihin Fudanin yliopiston sairaanhoitajakoulussa että nopeuttaneet tietotekniikan rakentamista korkeakoulussa. Sairaanhoitajakoulun on kiireellisesti hyödynnettävä olemassa olevaa hyvää alustaa ja yhdistettävä korkeakoulun todellinen tilanne, jotta se voi toteuttaa tietotekniikkaa hoitotyön jatko-opiskelijoiden hallinnoinnissa, jotta se voi toteuttaa viestintää jatko-opiskelijoiden valvojen, jatko-opiskelijoiden ja johdon välillä ja myös tarjota materiaalia objektiivisen ja tieteellisen kliinisen pätevyyden arviointijärjestelmän rakentamiseen. On myös tärkeää tarjota materiaalia objektiivisen ja tieteellisen kliinisen pätevyyden arviointi- ja arviointijärjestelmän rakentamiseksi hoitotyön jatkokoulutuksen mukaisesti, mikä on tärkeää koulutustavoitteiden saavuttamiseksi ja hoitotyön jatkokoulutuksen laadun parantamiseksi.

## [Tutkimuksen tarkoitus]

Käyttäjäkokemuksen teorian ja käyttäjakeskeisen konseptin periaatteen perusteella tässä aiheessa kehitetään jatko-opiskelijoiden tiedonhallintajärjestelmä hoitotyön opiskelijoille tutkimalla hoitotyön koulun opettajien ja opiskelijoiden todellisia tarpeita, jotka voidaan jakaa seuraaviin sisältöihin.

- (1) Sairaanhoidon jatko-opiskelijoiden tiedonhallintajärjestelmän kehyyssisällön rakentaminen
- (2) Sairaanhoitajien jatko-opintojen tiedonhallintajärjestelmän kehittäminen ja testaus.
- (3) Jatko-opiskelijoiden hoitotyön tiedonhallintajärjestelmän käytettävyyden arviointi.

## [Tutkimusmetodologia]

1. Hoitotyön jatko-opiskelijoiden tiedonhallintajärjestelmän tarveanalyysi

(1) Järjestelmän alustava kehys: Järjestelmän alustavan kehysten rakentamiseksi suoritettiin puolistrukturoituja haastatteluja sekä hoitotyön korkeakoulun tiedekunnan että opiskelijoiden käyttäjien kanssa heidän järjestelmää koskevista tarpeistaan käyttäen kohdeotantaan perustuvaa otantaa ja maksimivarianssimenetelmää.

(2) Järjestelmän lopullinen kehys: Asiantuntijoiden fokusryhmähaastattelujen menetelmän avulla muutettiin ja mukautettiin käyttöliittymäsuunnittelun, liiketoiminnan toimintojen ja suorituskyvyn kaltaisten vaatimusten sisältöä järjestelmän lopullisen kehysten määrittämiseksi.

2. Hoitotyön jatko-opiskelijoiden tiedonhallintajärjestelmän kehittäminen ja testaaminen.

Järjestelmän kehittämisessä käytettiin nopean prototyypin vuorovaikutusmallia, ja prototyypin kehittämisen jälkeen otettiin yhteyttä Shanghai Institute of Comprehensive Application of Web Technology -laitokseen ammattimaista järjestelmätestausta varten, minkä jälkeen järjestelmää muokattiin ja mukautettiin, kunnes se vastasi tutkimuksen vaatimuksia.

3. Hoitotyön jatkokoulutuksen tiedonhallintajärjestelmän käytettävyyden arviointi

Menestyksekkäästi kehitetyn GSMIS-järjestelmän kattavamman ja objektiivisemmän käytettävyyden arvioinnin toteuttamiseksi käytettiin käytettävyydestaustuksen,

kyselylomakkeiden ja laadullisten haastattelujen yhdistelmämenetelmää. Sen avulla saatiin syvälinen käsitys käyttäjien tunteista ja kokemuksista järjestelmän käytöstä, analysoitiin järjestelmän vahvuuksia ja heikkouksia sekä tutkittiin sen todellista käytettävyyttä.

### [**Tutkimustulokset**].

1. Hoitotyön jatko-opiskelijoiden tiedonhallintajärjestelmän kysyntäanalyysi

(1) Järjestelmän alustava kehys: neljä moduulia: sisäänpääsyn perustiedot, viljelyprosessi, tieteelliset tutkimustulokset ja kliiniset tapaukset.

(2) Järjestelmän lopullinen kehys: rakennettu moduulien ja toimintojen, suorituskyvyn, käyttöliittymän, tekstin, värin jne. osalta; moduuleihin kuuluvat: sisäänpääsyn perustiedot, viljelyprosessimoduuli, tieteellisten tutkimustulosten moduuli, kliinisten tapausten kirjastomoduuli, työllisyystietomoduuli, valmistumisen seurantamoduuli; toimintoihin kuuluvat salasanan asettaminen ja hakeminen, käyttäjän kirjautuminen, käyttäjähallinta, tietojen ylläpito, mukautetut kyselyt, tarkastukset ja viesti-ilmoitukset; suorituskyky. Se voidaan tiivistää seuraavasti: selkeä ja täydellinen tietorakenne, reaaliaikaisuus, skaalautuvuus, toimivuus ja vakaus; ystävällinen ja kaunis käyttöliittymäsuunnittelu, yksinkertainen ja helppokäyttöinen, ulkoasu keskeisten kohtien korostamiseksi; tekstisuunnittelu on helppo tunnistaa ja lukea, värisuunnittelu heijastaa kollegion merkityksiä ja ominaisuuksia.

2. Sairaanhoidajatutkimuksen suorittaneiden hoitotyön tiedonhallintajärjestelmän kehittäminen ja testaus.

Vaatimusten perusteella insinöörit kehittivät järjestelmän nopean prototyypin vuorovaikutusmallin avulla ja ottivat valmistuttuaan yhteyttä Shanghai Institute of Integrated Application of Web Technology -instituuttiin järjestelmän ammattimaista testausta varten. Ohjelmistoinsinöörien ja tutkijoiden välillä käytyjen useiden ohjelmistokeskustelujen ja -muutosten jälkeen GSMIS-järjestelmässä oli lopulta rekisteröinti- ja kirjautumissivu, tietoon perustuva suostumussivu, tiedona<sup>3</sup>. Hoitotyön jatkokoulutuksen tiedonhallintajärjestelmän käytettävyyden arviointi

(1) Käytettävyydestä: Käytettävyydestäuksen teorian perusteella käytettiin kohdeotantamenetelmää, ja viisi jatko-opiskelijaa valittiin osallistumaan testaukseen, ja tulokset ovat seuraavat.

1) Kvantitatiiviset tulokset: Validiteetti oli enimmäkseen 100 %, ja tehokkuudet olivat 56,2min/s, 72,2min/s, 53min/s, 225,2min/s, 75,8min/s, 33min/s, 5,5min/s; kohtausten jälkeisen kyselylomakkeen (ASQ) kokonaispistemäärä oli 1,24. Kaikki arviointi-indikaattorit viittasivat siihen, että käyttäjät arvioivat järjestelmän korkealle.

2) Laadulliset tulokset: Kaikki koehenkilöt suorittivat testin helposti ja kiittivät järjestelmää, mikä osoittaa, että toiminta ei ollut vaikeaa ja vastasi käyttäjien vuorovaikutustarpeita.

(2) SUS-kyselylomake: Kaikkiaan 40 käyttäjää täytti SUS-kyselylomakkeen mukavuusotantamenetelmää käyttäen, ja sen keskiarvo  $\pm$  keskihajonta oli  $70,23 \pm 7,7$ . Käytettävyyden osa-asteikon keskiarvo oli  $71,59 \pm 8,93$  ja oppimisen helppous -osa-asteikon keskiarvo oli  $64,77 \pm 7,53$ , ja pisteet olivat 60-70 välillä.

(3) Kvalitatiiviset haastattelut: Kohdennetun otannan menetelmää käyttäen haastateltiin yhteensä 10 henkilöä, joista kumpikin 5 opiskelija- ja henkilökunnan käyttäjää, ja haastattelujen määrä oli 3. Toistohaastatteluja tai toissijaisia haastatteluja ei tehty, ja pisin haastattelu-aika oli 46 minuuttia, lyhin 25 minuuttia ja keskiarvo 35,5 minuuttia. Tulokset voidaan tiivistää siten, että tutkimus voidaan jakaa kolmeen osa-alueeseen: kokonaisarviointi, sisällön ja toiminnallisuuden arviointi sekä järjestelmän puutteet ja parannukset.

Tässä tutkimuksessa yhdistyvät sekä laadulliset että määrälliset tulokset, ja se antaa objektiivisemmän ja kattavamman kuvan järjestelmän hyvästä käytettävyydestä, mutta myös sen puutteista ja parannuksista. ntuosivu ja kuusi päämoduulia.

### **[Johtopäätös]**

Tässä tutkimuksessa käytettiin erilaisia tutkimusmenetelmiä, kuten kirjallisuuskatsausta, kvalitatiivisia haastatteluja ja fokusryhmähaastatteluja, joilla rakennettiin käyttäjäkokemukseen perustuva järjestelmäkehys, saatiin valmiiksi jatko-opiskelijoiden tiedonhallintajärjestelmän kehittäminen sairaanhoitajakoulua varten ja käytettiin sekamenetelmiä, kuten äänettömän ajattelun menetelmää, käytettävyytestausmenetelmää, kyselylomaketutkimusmenetelmää ja kvalitatiivisia haastatteluja, järjestelmän käytettävyyden arvioimiseksi, ja tulokset osoittivat, että järjestelmän hyväksyttävyyden, helppokäyttöisyyden ja käytettävyyden olivat korkeat.

**Asiasanat:** jatko-opiskelijoiden tiedonhallintajärjestelmä; käytettävyyden arviointi; käyttäjäkokemus; vaatimusanalyysi.

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# 1 Background and Basis of the study

## 1.1 Background of the study

### 1.1.1 Challenges to university management brought by enrollment expansion

Since the restoration of graduate student enrollment in China in 1978 and the implementation of degree system in 1981, the undertaking of graduate education has been developing continuously<sup>[1]</sup>. According to the statistics of the Ministry of Education, the number of applicants was about 1.65 million in 2015, and more than doubled to about 3.41 million in 2020 on the basis of that. With the continuous expansion of master's degree enrollment, the enrollment data volume and workload increase geometrically, coupled with the emergence of public health safety emergencies such as Covid-19 in early 2020, the management of graduate students has raised higher demands and brought new challenges.

Since 1992, China started the nursing master's degree, and since then, the major universities have been improving the cultivation of nursing graduates, with the requirements of nursing graduates for their future development and the increasing demand of society for high-level nursing talents, the enrollment scale of nursing graduate students has been expanding, the cultivation of high-level nursing talents is not only about quantity but also about quality, the information quantity of graduate training and management is increasing, the management tends to be multi-level and multi-faceted, and the management activities are becoming more and more complex, meanwhile, the number of personnel specialized in education management is decreasing.<sup>[2]</sup>

Nursing School of Fudan University opened its master's education in 1995 and doctoral education in 2008, and became one of the first master's and doctoral sites in the first discipline of nursing in 2011 and one of the first post-doctoral mobile stations in nursing in 2012. So far, the expansion has caused a dramatic increase in the number of graduate students enrolled in the college, which has brought impacts and challenges to student management. The effective way to solve this contradiction is to strive to improve the efficiency and level of information management work, to make full use of computer network technology and database technology, to realize office automation and resource sharing, and to let computers replace people to complete the repetitive work in information management work

### 1.1.2 The important position of informatization in college management

The college responds to the demands of the national "14th Five-Year Plan" on education informatization, and aims at " Interconnection, Business Collaboration and Data Sharing", and continues to build an integrated data governance and service system to make data deep business, data asset management efficient and data service agile. It will further improve data service capability, promote data-assisted decision support, and build a digital ecosystem of sharing, building and governance for everyone in the school with data and data for everyone. The main informatization method of student management in colleges and universities is to build student information management system, i.e. a system for managing basic student information, which realizes efficient management and sharing of information and makes student management more standardized, standardized, scientific and modernized.

As graduate education is the core component of university education and research work, the use of information technology to improve the information management of graduate students in universities is of great concern to all universities. Among them, the construction of graduate student information management system is an essential information technology tool. It is crucial for the decision makers and administrators of the university to show the traditional graduate teaching, scientific research and management in a more standardized and efficient informatized form by building the related business system, so the scientific and informatized realization of the management process of graduate school can provide sufficient shared information and fast and accurate information sources for the management users and teachers and students, and is also important for enhancing the overall quality of the university.<sup>[3]</sup> At the same time, It is also important to improve the overall quality of school operation.

### 1.1.3 Personalized information needs of Nursing School of Fudan

At present, the Nursing school of Fudan University has realized the second level of management and become a grassroots unit directly facing the front line of teaching. With the construction of the first-level teaching management informatization of the university basically completed, it is urgent for the nursing colleges to realize the construction of teaching

management informatization by relying on the good platform of teaching management and combining with the actual situation of nursing colleges.

The training of nursing graduate students is combined with classroom teaching and clinical practice, and nursing graduate students have to carry out clinical practice in the clinic for more than one year, with mid-term examination and discharge examination. The typical nursing cases of nursing graduate students in clinical nursing practice are collected and carried out through nursing procedures, through nursing assessment, nursing diagnosis, nursing intervention and effect evaluation, each nursing patient is condensed with the wisdom and efforts of nursing graduate students, and the cases demonstrate each nursing graduate student's own unique and personalized experience, further providing comprehensive, whole process, active and humanistic care for patients.

However, the current situation of teaching information management in nursing colleges is still not optimistic. The teaching management and student management departments of colleges use various kinds of original special software or manage various teaching information and student information in a stand-alone or even manual way, and these systems are independent of each other, so it is difficult to achieve unified management. Poor data sharing inevitably leads to duplication of work, low efficiency and difficulty in guaranteeing the integrity and consistency of data. This brings a waste of human and financial resources to the management of teaching-centered second-level colleges, and this fragmented way of information processing is no longer suitable for the new requirements of the development of second-level colleges. The development of GMIS (information management system), which is suitable for its own development needs and provides scientific management and networked and convenient services for students, has become an inherent need and inevitable trend for nursing colleges to use modern management technology to rapidly improve the efficiency of student information management.

Through the construction of information technology, which can realize the communication among teachers, students and administrators, give full play to the efficient and convenient characteristics of the network, and avoid a lot of repetitive work. To realize the sharing and rapid integration of teaching information resources and improve the dynamics of teaching management of the college, and improve the situation of narrow management surface with backward teaching management means. Through the timely communication and exchange

between the three parties, which can reduce the limitations in the process of obtaining feedback information, improve the management efficiency and enhance the management level to ensure the quality of management and achieve quality control.<sup>[4]</sup>

## **1.2 Project Overview**

### **1.2.1 Project name**

Nursing Graduate Student Information Management System of Nursing School

### **1.2.2 Project Background**

It is pointed out in the Fourteenth Five-Year Plan of National Development of Degree and Graduate Education that graduate education is the top of the national education cultivation system, the important pillar of national competition for talents and science and technology, and also the core element of implementing innovation-driven development strategy and building an innovative country. Without strong graduate education, there is no strong national innovation system.

The Ministry of Education's Education Informatization 2.0 Action Plan proposes to " Promote the high-level evolution of education informatization from integrating applications to innovative development, and deeply integrate information technology and intelligent technology into the whole education process to promote improved teaching, optimized management, and enhanced performance." With the layout of major strategic tasks such as "Internet+", cloud computing, big data and new generation of artificial intelligence, in order to further realize the development goal of modernizing education and building a strong education country, promoting the development of graduate education informatization in the new era has become the top priority for the development of education. In the Construction Plan of Graduate School of the University for 2020-2022, the construction of Graduate Education Management Information System is the core of this three-year plan. The construction of the system will provide scientific and advanced management modes and means for the management of graduate education, so that the university can better fulfill the task of training high-level specialists for the country and meet the requirements of cultivating high-level talents for the continuous development of society and economy.

The management system of this study is a sub-system of Fudan University, which has a university-level information management system. In September 2015, the one-stop service hall ("eHall") of Fudan University<sup>[5]</sup> was officially put into use, and in the past 6 years, it has provided "one-stop" online services for all students and teachers. "One-stop" online services, such as online application, supervision and student information management, academic registration management, teaching plan management, class scheduling management, course selection management, examination management, grade management, graduation audit and other functions, can realize basic academic affairs management.

However, it cannot meet the personalized requirements of the School of Nursing for the summary of students' scientific research, clinical and practical information, etc. So far, the management personnel collect students' academic achievements and participation in conferences and other information through the traditional manual management mode every academic year, which cannot comprehensively present the comprehensive situation of teaching, scientific research, management and service, so that it cannot play the role of tracking the progress of graduate studies and providing early warning. The requirement of informatization of student management at the second level of the faculty (department) is to accomplish a large amount of work more efficiently and with high quality using as little manpower as possible. The student management information system to be developed in this study is such a platform with individualized requirements for nursing schools.

The Graduate Student Information Management System of School of Nursing, Fudan University is an important project in 2021 under the supervision of the College and the Academic Affairs Office. The author has the honor to be the tracker of the project and is responsible for the requirement analysis, general design and assistance in system testing of the project. The project is planned to complete the requirement research from 2021-2 to 2021-6, develop from 2021-6 to 2021-9, test and modify the system from 2021-9 to 2022-3, and start the official operation from 2022-4.

This research team undertakes the construction of the content of the system modules for researching the needs of the faculty and students in the development process, repeatedly modifying and testing the system, domain name application for the website, and contacting the professional team for security testing of the system until all the expected development purposes are achieved.

### 1.2.3 Construction basis

The design and construction of the software system of this project strictly follows the national and local standards and norms, as well as the relevant norms and standards of the Ministry of Industry and Information Technology, as follows. "Information Security Level Protection Management Measures" (Gong Tong Zi [2007] No.43) 1)"Information System Security Level Protection Measurement Requirements" GB/T28448GB/T2844820122012; 2)"Government Information Resources Exchange System" (GB/T 21062-2007); 3)"Computer Software Development Specification" (GB8566-88); 4) "Guidelines for the Preparation of Computer Software Product Development Documents" (GB 8567-88); 4)"Software Engineering Terminology" (GB/T 11457-89); 5) Specification for Computer Software Configuration Management Plan (GB/T 12260-90); 6)Specification for Computer Software Quality Assurance Plan (GB/T 12504-90); 7)"Computer Software Requirements Specification Preparation Guide" (GB9385-88); 8)"Computer Software Testing Documentation Preparation Guide" (GB9386-88); 9)Guide to Software Maintenance (GB/T 14079-93); 10)Computer Software Reliability and Maintainability Management (GB/T 14394-93); 11)University Information Standards and Specifications National and Ministry of Education Code Set; 11)University Information Standards and Codes University Self-Coded Code Set "University Information Standards and Codes Information System Construction Specifications.

## 1.3 Literature Review

### 1.3.1 SMIS

Student Information Management System (SMIS) is a school management software developed to improve the efficiency of a large number of teaching operations, is a human-led, based on network communication equipment and computer software, hardware and other information processing terminal tools, through the collection, transmission, storage, processing and maintenance of data, in order to improve efficiency and school effectiveness, and to support high-level decision-making, middle-level control, and The integrated human-machine system that supports top-level decision-making, middle-level control, and grassroots operations.<sup>[6]</sup> It is an integrated human-machine system that supports top-level decision-making, middle-level control, and bottom-level operation. Graduate student information management system is one of the typical MIS, and the two essential parts of the system development are the design and implementation of the front page and the establishment and

maintenance of the back-end database.<sup>[7]</sup> The two essential parts of the system development are the design and implementation of front-end pages and the establishment and maintenance of back-end database.

#### 1.3.1.1 Foreign development status of SMIS

Information management systems for graduate students in foreign universities were developed earlier, quickly and efficiently. In foreign countries, the construction of digital campus started earlier, and some western developed countries in Western Europe and North America, are leading the world in science and technology as well as the development of education, and in management, online information management systems based on computer and Internet technologies are also commonly applied. As early as the 1970s, the Massachusetts Institute of Technology in the United States introduced the concept of digital campus. According to the information, since the 1990s, most famous schools in developed countries have completed the digitalization of campus construction very successfully through the management of academic registrations, grade inquiries and information systems. For example, the graduate information system of the University of Reading in the United Kingdom not only contains information on enrollment, admission, basic management, academic registration, research, awards, cultivation, degree, graduation and departure of graduates, but also has good correlation between each module, and what is particularly outstanding is that the university has achieved not only internal data sharing, but also data sharing with relevant government departments (such as employment department)<sup>[8]</sup>, For example, the information system for graduate students at the University of Rhode Island in the United States contains information modules for basic management, admission, enrollment, research, cultivation, registration, practice, teaching, thesis, graduation, etc. The system also enables the sharing of data within the university.<sup>[9]</sup> However, compared with the graduate information system of the University of Reading in the UK, it does not share data with relevant government departments. The teaching, research and daily management of the university have been networked and computerized. As scholars such as N.M.Z. Hashim<sup>[10]</sup>, who conducted a study on two developed countries, the United States and the United Kingdom, showed that although the educational systems of different countries are different, there are common features in the management of student information.

Foreign countries have advanced information infrastructure construction and stable technicians and technical support. On the one hand, the information system of foreign

universities, including the student management information system, is already a very mature system. On the other hand, the information system of foreign universities, including student management information system, has been a very mature system. On the whole, foreign developed countries mainly rely on information technology to deal with student work through information management system, and the system has become the main way for universities to grasp student information. Europe, America and other countries are far ahead of other countries in using science and technology to manage information, and the information management system for graduate students is no exception, while their construction and application are far ahead of our country. On the whole, the construction of the graduate information management system in China can selectively refer to the experience of foreign technology and module design.

#### 1.3.1.2 Domestic development status of SMIS

Graduate student management, which is the core part of the management of each institution of higher education, is carried out by the teachers of each school department, graduate students of each major and graduate managers of the school to enter and summarize the information of majors, course information, class schedules, personal information of graduate students, academic affairs information, and student results, etc. each into the whole system, so that it is convenient for each participant to convey and obtain information in a timely manner. In the past, these informations were not delivered timely and needed to be notified by telephone, meeting, paper, etc., which brought certain inconvenience to the graduate management and made the work of teachers and managers very difficult. At present, various institutions of higher education have launched graduate information management systems one after another, gradually realizing the informatized, scientific and standardized management of graduates. The first one is the management information system of Shanghai Jiao Tong University, which has built more than ten management information systems since 1999, and they have been successfully put into use, which has greatly improved the level of management information application of the university; the second representative one is the online information inquiry system and online student assistance system of Bei Hang University.<sup>[11]</sup> The second representative one is Peking University's online information inquiry system and online student assistance system. In addition, there is also Zhe Jiang University's graduate management information system, which mainly includes student course selection, teacher grade entry, academic registration management, degree application, supervisor thesis review, and college management. For example, the graduate management system of Wuhan University, which not

only runs through the management modules of enrollment, admission, basic information, academic registration, scholarship, cultivation, degree, graduation and departure of graduates, but also realizes the corresponding functions and processes of each management module, and at the same time organically links each module together to realize the integrity and sustainability of the system, making the whole system more tight and complete.<sup>[12]</sup>

With the change of graduate training mode from school management to college management and the change of graduate training management mode, it becomes necessary to develop an information system for graduate college management, and scholars such as Yang jingjing designed a B/S-based graduate management system for the needs and characteristics of graduate college management, and also innovatively proposed a web-based management system for graduates and supervisors.<sup>[13]</sup> The specific solution for the web-based management system of graduate students and supervisors, such as dual selection and training program, is also innovatively proposed. The web-based management system for graduate students and supervisors It also provides services for the whole process of graduate training at the faculty level and effectively ensures the transformation of the current graduate management mode<sup>[14-18]</sup>. The online inquiry system provides information on the establishment of the institution, its management statute and staff, and the online system provides information on the work related to the school's attendance and examination.<sup>[15]</sup> Liang wei et al. used the B/S model to develop the general framework of the graduate education information management system with the idea of .net three-layer architecture to ensure the security and confidentiality of data<sup>[19]</sup>. It also provides interfaces with other software, which greatly improves the efficiency of graduate management. For example, Fu Wei designed a B/S-based information system for a vocational college by investigating the information needs of students in vocational colleges, and through the establishment of the system, it not only promotes mutual communication between schools and departments, enhances the ability of unity and collaboration<sup>[20-23]</sup>. By setting up the system, it not only facilitates the communication among schools and departments, enhances the unity and collaboration ability, realizes the data sharing on the network and improves the work efficiency, but also greatly expands the publicity platform of vocational colleges and improves the visibility and influence. Bai Xuefeng and Chen Weiping designed a comprehensive student management system for medical students, which includes not only the basic student information management module but also a special clinical internship module to realize the interface between medical schools and internship hospitals.<sup>[24]</sup> The system includes not only the basic student information management module but also a special clinical

internship module, which enables the interface between medical schools and internship hospitals. The clinical teaching hospitals and schools can manage medical interns more easily.

To sum up, compared with foreign countries, China's graduate information management system started late, but in recent years, under the background of *Internet+* and big data era, the information construction of campus has achieved rapid development. Most of China's graduate student information systems are based on B/S mode and designed with ASP.NET development technology, which is relatively mature both at home and abroad. However, the construction needs to strengthen data sharing and integration, and most of the scholars only focus on the design process of the information system, but there are only a few studies on the impact of the information system on the users and how to make full use of its advantages to provide better information services for users.

Moreover, the domestic and foreign researches on SMIS mainly focus on the information construction and networked realization of the whole school management, and the research on SMIS of secondary colleges is less. However, with the expansion of the scale of universities and the further promotion of the institutional reform of universities, there are now preliminary researches specifically for the management of second-level colleges. It is believed that with the development and further improvement of the network technology, the authority of academic affairs management of universities will be devolved to the second-level management units, and the development and research of SMIS of second-level colleges will become more and more important.

#### 1.3.1.3 Common domestic management systems

Today, there are several widely used academic affairs management systems in China, which can be summarized to provide reference for the construction of later systems, and each system will be briefly introduced below.

##### (1) Comprehensive Academic Affairs Management System

Beijing Aolong Feiteng Technology Company Limited's comprehensive academic affairs management system for colleges and universities is a widely used academic affairs management system, as shown in Figure 1-1, whose users include Heilongjiang University, Shenyang University, Sichuan Agricultural University, Capital Normal University, Beijing

University of Political Science and Law and many other institutions of higher education. The system contains many modules such as registration management, academic registration management, teaching plan, course selection management, grade management, intelligent scheduling, user management, graduation review, fee management, auditing system management, research management, etc.



Figure 1-1 Comprehensive Academic Affairs Management System

## (2) East York University Academic Affairs Management System

The products of Dongyo Times are applied in universities such as Beijing University of Posts and Telecommunications, University of Science and Technology Beijing, Guangzhou Academy of Fine Arts, Sun Yat-sen University, Harbin Institute of Technology, South China University of Technology, South China Normal University and Guangzhou University. The system adopts B/S structure, including teaching plan, student registration management, intelligent scheduling, grade management, teacher management, assessment management, elective course management, examination management and other functional modules, and can provide customizable and secondary development. As shown in Figure 1-2.

中山大学研究生教育管理服务平台



Figure 1-2 East York University Academic Affairs Management System

### (3) Hill Academic Affairs Management System Hill Academic Affairs Management System

This system also adopts B/S structure, including class scheduling, class selection, examinations, grades, teaching evaluation, teaching materials and many other functional modules, and is used in Harbin Institute of Technology, Harbin Engineering University, Sun Yat-sen University, Chongqing Industrial and Commercial University and other institutions. As shown in Figure 1-3.



Figure 1-3 Hill Academic Affairs Management System

### (4) Zheng Fang Modern Teaching Management System

Zheng Fang modern teaching management system is a multi-module comprehensive information management system for all departments and users at all levels, including public

information maintenance of teaching affairs, student management, teacher management, teaching plan management, intelligent scheduling, examination management, course selection management, grade management, textbook management, practice management, fee management, teaching quality evaluation, graduate management, sports management, laboratory management and student The modules of comprehensive information inquiry and online grade entry for teachers are shown in Figure 1-4.



Figure 1-4 Zheng Fang Academic Affairs Management System

By studying and comparing the mainstream academic affairs management systems. The main functional modules of the mainstream academic affairs management systems today are all very similar except for the different product names. The main functional modules basically include: system and its management authority, basic information management, teaching management, teacher management, student training, discipline research management, etc. While containing the basic faculty management functional modules, the design structure is beginning to change significantly from C/S to B/S.<sup>[25]</sup>

### 1.3.2 The current situation of university construction based on user experience

The ISO 9241-210 standard defines user experience as "people's cognitive impressions and responses to the products, systems or services they use or expect to use"<sup>[26]</sup>, in the background of the era of experience economy, with the increasingly fierce competition in the education market, the information construction of colleges and universities has become an important part of the overall construction of colleges and universities that cannot be ignored.

In the background of the era of experience economy, with the increasing competition in education market, the information construction of colleges and universities has become an important part of the overall construction of colleges and universities. At present, the research on user experience theory is mostly applied to business, IT industry, service industry and entertainment industry, but rarely applied to education industry. Moreover, there are not many studies on applying UX theory to the design of college website interface. The main reason is that the present college website system is not very perfect and is limited to a narrow scope, such as the provision of network information and simple interactive services. Whether in China or abroad, the application of UX theory to the education industry, especially the research on the design of college website interface, is a research field with certain practical significance and value.

#### 1.3.2.1 Status of foreign research

Foreign scholars are the first to conduct research on user experience, and their start is earlier than that of China, and they are more mature. At present, foreign scholars have their own more mature theoretical research works, which elaborate on the theories related to user experience. For example, in Donald Norman's book "Emotional Design", it is written that when designing user experience, research should be conducted from the perspective of emotional cognition, instinctive level, behavioral level and reflective level<sup>[27]</sup>; Zhou, R in "How to Quantify User Experience: Fuzzy Comprehensive Evaluation Model Based on Summative Usability Testing" mentions four elements of user experience, namely, brand, usability, functionality, and content, and elaborates on them<sup>[28]</sup>; Jesse James Garrett in "The Elements of User Experience" introduces five levels of web product experience design and development, namely, strategic, scoping, structural, framework, and The Elements of User Experience by Jesse James Garrett introduces five levels of web product experience design development: strategic, scoping, structural, framework, and performance<sup>[29]</sup>. Chauncey Wilson in "User Experience Re-Mastered: Your Guide to Getting the Right Design" focuses on the development process of user experience design in detail, according to which design can be guided<sup>[30]</sup>. Jacob Nielsen in "Usability Engineering", Jacob Nielsen writes that in the process of UX design, users are put at the center of the design, users' needs are studied, users are involved in the design process and evaluation, and feedback from users on the product is used to improve the product and bring users a good experience.<sup>[31]</sup>

Theoretical research on UX is mostly applied to business and IT industry, and other industries are also developing. At present, it is mostly applied to some UX research institutions and UX research departments of famous companies, such as Microsoft, Apple, Google, and Samsung. However, there are not many studies on applying UX theory to the construction of college websites in the education industry, and there are few theoretical papers summarizing it. Most of the research results in the field of web interface design have been studied in depth in the commercial, IT and service industries. For some theoretical research on interface design, foreign scholars have their own theoretical research works. For example, Ben Shneiderman, in "Designing the User Interface" explained the theoretical knowledge of user interface and the specific considerations involved in the user interface design process<sup>[32]</sup>; Robert Hoekman in "Designing the Moment: Web Interface Design Concepts Moment: Web Interface Design Concepts in Action" explains the design methods and guidelines for web interfaces<sup>[33]</sup>; "Effective UI" by Jonathan Anderson, John McRee, and Robb Wilson, which is written from a business standpoint to formulate user requirements, introduces the entire development process of interface design<sup>[34]</sup>. Jeff Johnson's "Designing with the Mind in Mind: Simple Guide to Understanding User Interface Design Rules" explains some of the design principles that need to be followed in user interface design<sup>[35]</sup>. With regard to web interface design, different industries have different nature, so the main users of web interface design in each industry are different. Therefore, it is important for designers to understand and do their own user research to choose the right approach to web interface design.

#### 1.3.2.2 Domestic Status

In 2004, UPA china was established by UX Research Center of Beijing Guanghai Design Development Foundation to actively promote the theoretical knowledge of UX in China, provide a professional learning and communication platform, and promote the development of UX theory in China. UPA china" was established in 2004 by the UPA Research Center of Beijing Guanghai Design Development Foundation.

Although the research in China started later than that in foreign countries, it has also developed relatively rapidly in recent years. For example, the book "Web User Experience and Interaction Design" edited by Zhao Huiwen and Zhang Jianjun explains the theoretical knowledge about user experience in web interaction design, and researches the sensory characteristics, psychological characteristics and individual differences of users respectively<sup>[36]</sup>; Xiang Yining in "It's That Simple" explains usability and user experience in

web development, and researches user requirements, prototyping and testing and evaluation<sup>[37]</sup>. Yang Aixiang's book "The Next Stop: User Experience" researches the design of web pages from the perspective of users' sensory experience and interaction experience<sup>[38]</sup>. Yang Huili et al.'s book "User Experience and Its Application in Communication Product Development" researches the experience design of web pages, communication products and Internet products<sup>[39]</sup>. At present, theoretical research on user experience is mostly applied to the Internet and business, and other industries are also developing. Many domestic enterprises have also established user experience research departments, such as Baidu, Sina, SoHu, Haier, Lenovo, etc. However, there are not many studies on applying user experience theory to the construction of college websites in the education industry, and there are few relevant theoretical documents summarized. Domestic research on college websites mainly focuses on visual design or information structure framework design, and most of them will draw on more mature and excellent web interface design cases in commercial and IT industries when designing college website interfaces.

Nowadays, domestic scholars also have some theoretical researches on interface design. For example, Sun Rong analyzes the visual design part of college website interface and puts forward specific suggestions in the article "Talking about the visual creativity of college campus website interface design"<sup>[40]</sup>; Hou Wanlong conducts research on current college portal websites, creates user role model and comes up with important indexes affecting the usability design of college portal interface in the article "Research on the usability design of college portal interface"<sup>[41]</sup>; Huang Yan In his book "User Interface Design and Production", he researches the design of different types of user interfaces, such as cell phones and web pages<sup>[42]</sup>; Liao Hongyong's book "Digital Interface Design" explains the theoretical knowledge and design principles of interface design<sup>[43]</sup>.

To sum up, nowadays the Internet is developing rapidly, not only the competition among enterprises is fierce, but also the competition among colleges and universities is getting more and more fierce. The good or bad information construction of colleges and universities can affect the students' choice of schools and the students' source and economic situation of colleges and universities. Therefore, promoting the development of college informatization construction is not only beneficial to the promotion of college image itself, but also can keep the lasting vitality of college, and the interface design of college system is one of the tools and means to promote good college informatization construction.

It is challenging to draw on existing literature to study a new topic, and it is important to pay attention to and promote this research for the sustainable development of information technology construction in universities.

## **1.4 Research Significance**

### **1.4.1 Practical significance**

As the enrollment of graduate students increases scale of the Nursing school continues to expand, the application data of the graduate training process is accumulating more and more huge. Therefore, in order to improve the information management of the college and the overall information management quality of the college, the college would like to develop a set of customized and perfect information management system for the college in 2021 that can record and save the training process of graduate students in real time, so as to realize the early warning and dynamic monitoring of graduate students' studies. Student information management system. It will help to collect a typical nursing case database in the context of the clinical practice process of nursing research and the characteristics of nursing, and provide materials for the construction of an objective and scientific clinical competence assessment and evaluation system in line with the nursing degree research education, which is of great significance for achieving the cultivation goal and improving the quality of nursing degree research training.

### **1.4.2 Theoretical significance**

Informatization in colleges and universities has become an important work content for the construction and development of colleges and universities, and the information network construction in colleges and universities will attract more and more attention from the majority of researchers. The successful development of college informatization network construction cannot be carried out without the guidance of relevant theories, but there are not many results of research on college informatization network construction with user satisfaction as the evaluation subject, and there are relatively few studies combining qualitative analysis and quantitative description, and this paper hopes to play some facilitating role in this regard.

## 1.5 Research Questions and Research Contents

### 1.5.1 Research Questions

In the process of reviewing the literature, it is found that most scholars focus only on the design process of information systems, while there are only a few studies that apply the theoretical knowledge of user experience to the education industry and analyze the impact of university systems/websites on users and how to make full use of their advantages to provide better information services to users.

Therefore, based on the above literature review, the author poses the following scientific questions:

- ① How to develop and implement a GSMIS based on user experience?
- ② How to carry out the requirement analysis based on user experience?
- ③ How should the usability evaluation of GSMIS based on usability theory be carried out?

### 1.5.2 Research Contents

Based on the above proposed research questions, the main research contents and steps of this topic are determined as follows:

#### (1) Phrase I: The Needs Analysis of GSMIS

Qualitative research methods were used to construct the initial framework of GSMIS using the interview method, and focus group interviews were used to modify, adjust, and determine the modules, content, and functionality. The purpose of the first phase of the requirements analysis was to understand the current state of graduate student management at the college and to construct the framework content of the GSMIS with the theme of the recommended criteria perceived by the users and the perception of the system by the users.

#### (2) Phrase II: Development and testing of GSMIS

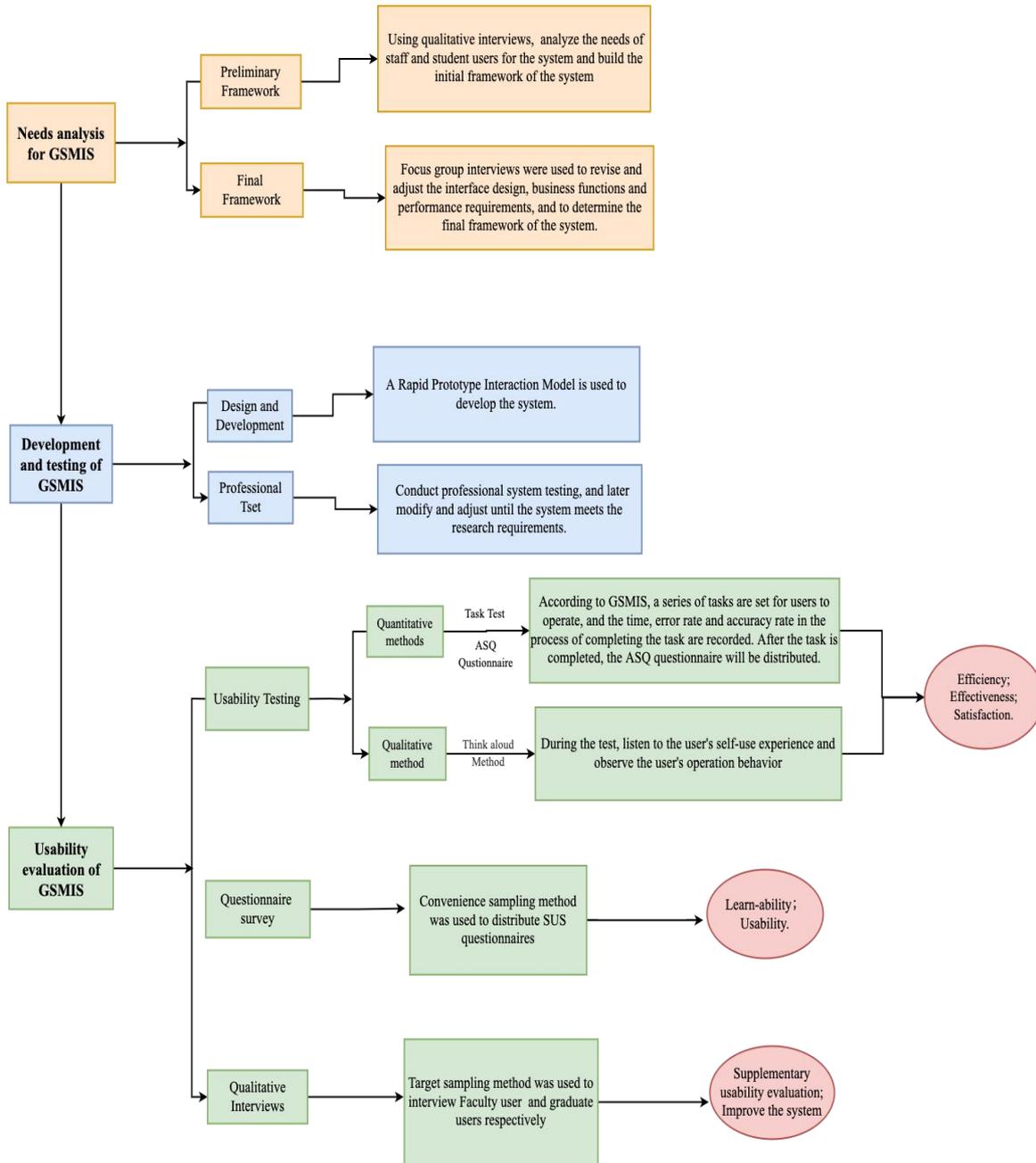
The initial framework was constructed based on the requirements of the first phase, and interviews were held continuously to contact users and modify, adjust, and determine the modules, contents, and functions of the system. Applying the development model of rapid prototype interaction and using ASP.NET web development technology, SQL Server database

management system, and B/S web architecture model, we can realize the convenient use of multiple users, such as faculty, staff, and student personnel.

### (3) Phase III: Usability Evaluation of GSMIS

The mixed evaluation method of usability test, questionnaire and qualitative interview was used to conduct a more comprehensive and objective usability evaluation of the successfully developed GSMIS. Researcher will understand the users' feelings and experiences of the system, analyze the strengths and weaknesses of the system, and discuss its actual usability.

### 1.6 Technology Roadmap



Figuer1-5 Research technology roadmap

## 2 Theoretical Foundation

### 2.1 Interaction Design

#### 2.1.1 The concept of interaction design

Interaction Design arose in the 1980s as a new discipline for communicating interactive experiences, and Bill Moggridge was the first to realize that software interfaces and industrial design had equal importance, using the term Soft face to describe it to distinguish software from interface<sup>[44]</sup>. As an industrial designer In the mid-1980s, working with Bill Verplank, he began to focus on the design of interactive behavior and began to call it interaction design.

Interaction design is the design and definition of the behavior of artifacts, environments, and systems, as well as the form elements that convey that behavior. Unlike traditional design disciplines that focus primarily on form, and more recently on content and substance, interaction design aims first to map and describe how things behave, and then to describe the most effective forms of yin to communicate that behavior. Interaction design is a technique for making products easy to use, effective and enjoyable, and is dedicated to understanding the target users and their expectations, how they behave with each other when interacting with products, and the psychological and behavioral characteristics of "people" themselves.<sup>[44]</sup> It also draws on theories and techniques from art and design, psychology, and ergonomics. Interaction design is a synthesis of methods and practices for studying product design, not just an overlay of some methods, but also an engineering discipline with a different approach from other scientific and engineering disciplines.

#### 2.1.2 Content of interaction design

Interaction design consists of the following four aspects.

##### (1) User needs

Before developing a system, it is important to understand the target users and know what they need before you can design a product for them. Of course, it is necessary to find out who the real users are and to explore how to find their needs. The user's needs are the prerequisite for designing the software, and this is the principle of user-centered design.

##### (2) Design solutions

Once have the user's needs, researchers need to design a viable solution. With a detailed design, it is possible to know what functions the product has and whether it can meet the

user's needs. This requires the design to include every detail and every step of the user's operation. There is not only one fixed design solution, but also a variety of feasible solutions for different users to find the most suitable one.

### (3) Prototyping

The best way to evaluate an interaction design is to let users interact with the product and let them feel it. The interaction design process requires that we translate the design into an interactive version, or a prototype of the product. These prototypes do not have to be real software versions that work, and there are many techniques researcher can use to achieve what researcher call "interaction". Prototyping can be done using hand-drawn paper prototypes or by using systems designed to more closely resemble the actual system. Using a prototype design, research can simulate various characteristics of the system.

### (4) Test evaluation

For the developers, it is difficult to find out the errors and problems that the end users may have in using the system because the whole design process involves professionals, but the products of the developers or experts may not be suitable for most users. Therefore, before the final release of the system, it is necessary for users to try it out, for example, if they are not used to certain areas or need to modify certain areas. We can let them put forward their opinions, and the developers will sort them out and modify them, so as to get feedback from users and enhance the user experience of the software.

## **2.2 User Experience**

### 2.2.1 Concept of User Experience

The ISO 9241-210 standard defines user experience as "the perceived impressions and responses of people to a product, system, or service that they use or expect to use"<sup>[45]</sup>. The supplement to the ISO definition explains that user experience is the totality of the user's feelings before, during, and after the use of a product or system. It includes all aspects of emotions, beliefs, preferences, cognitive impressions, physiological and psychological responses, behaviors and achievements. Therefore, user experience is purely subjective, with certain uncertainties, and individual differences make user experience different.

In addition, Lucas Daniel defined user experience in 2000: User experience is what users do, think, and feel when they operate or use a product or service, and involves both rational

values and emotional experiences provided to users through products and services. The core of design is to highlight the importance of perceptual value, which tries to bring more vivid products to users and create a better experience for them.<sup>[46]</sup>

The essence of UX is innovation, and the biggest difference between UX design and traditional design is that traditional design only focuses on the design object itself, cutting off the connection between the design object and its operators, users and purchasers, and the design is only the intention imposed on users by designers.<sup>[44]</sup> . UX design only states a process that occurs as a whole, in which users interact with each other through a series of operations.

User experience design emphasizes the concept of process, which creates interaction between users and the process of interaction, and the field of user experience was established to analyze and perspective the feelings of a person when using a system. The focus of the research is on the pleasure and value of the system rather than the performance of the system.

## 2.2.2 Classification of User Experience

Hua K, through the “HUMAN BRAIN WHITE MATTER ANALYSIS USING TRACTOGRAPHY —AN ATLAS-BASED APPROACH” and the psychosocial theory, divided the consumer experience into five experience systems: sensory, thinking, innovation, behavior, and association.<sup>[47]</sup> The user experience in a website has the following five main aspects.

(1) Sensory experience: present users with audio-visual experience, emphasizing comfort. Mainly including: conform to the aesthetic habits of the target users and have a certain guidance; ensure the clear and reasonable display of the website Logo; try to ensure that the page can be opened within 5 seconds, preferably no more than 15K; the page layout is focused, prioritized and illustrated; the page color is unified with the website style, no more than three colors; the page navigation is clear and hierarchical; the page size is suitable for most browsers.

(2) Interactive experience: present to the user the operational experience, emphasizing ease of use/usability. This includes: a clear and concise member registration process; filling out and submitting forms to improve personal information; buttons must be clear and prominent; click hints and error alerts; support for page refresh, etc.

(3) Emotional experience: presenting users with a psychological experience, emphasizing friendliness. This includes: simple and clear naming of columns, with a maximum of three levels; no confusion in content classification, rich and original content; stable update frequency and inverted pyramid structure for information writing; special markers for new articles and recommendations for exciting content; orderly arrangement of text, distinguishing headlines and text; easy-to-read fonts; page background colors that do not interfere with the reading of the subject page; moderate page length; and fast population for users with clear purposes. The length of the page is moderate; provide a quick population for users with a clear purpose.

(4) Browsing experience: presenting users with browsing experience and emphasizing attractiveness. This includes: clear user classification; friendly prompts for each operation; communication among members; after-sales tracking; member benefits and member activities; a Q&A section with experts and a site map to allow users to browse and select information independently.

(5) Trust experience: present to the user a trust experience, emphasizing reliability<sup>[48]</sup>. Include: search engine humanization; authentic and reliable information release; indicate the source, editor or author for the quoted articles to improve the credibility of the articles; provide accurate and effective contact information and service hotline as well as effective complaint channels; have a legal statement, website filing; have relevant links to better provide help for users.

### 2.2.3 User Experience Objectives

Rubioff wrote an article "Integrating Text Planning and Linguistic Choice Without Abandoning Modularity: The IGEN Generator " in 2000. The article is mainly used to evaluate the user experience of a website and proposes that user experience consists of four dimensions: brand, usability, functionality and content.<sup>[49]</sup> Combined with SMIS, a good user experience should be able to meet most of the user's requirements, improve office efficiency, and at the same time be informative and easy to use.

Specifically, design goals that should have the following characteristics.

#### (1) Practicality

We developed GSMIS to be used for student management, and usability is the essence of the system. It is up to the users to judge whether the system has the essence of usability. It is only when the user's needs are met that it can be practical.

### (2) Ease of use

The GSMIS was designed to be practical and easy to use. For the developers, it is not difficult to use because they are involved in the planning and development of the software and know every detail of its use, but they are not the end users. For the user, the system needs to be designed to be easy to use, so that it can be used without reading any instructions. Of course, if a system is developed to be complex enough that users need to read the instructions carefully before they can use it, the developers need to make detailed instructions so that users can understand it quickly and put it into use immediately, so that a good user experience can be achieved.

### (3) Friendliness

An e-learning system with a good user experience should be able to meet the daily habits of users, who feel comfortable with the whole system design from the beginning of use.

### (4) Aesthetics

The interface should meet the aesthetics of the general public and provide users with convenience, which is the most basic user experience principle. In order to make users truly experience the quickness of the system, the design should focus on expanding the convenience and optimizing the operating system; making it very convenient for users to get the information they need.

## 2.2.4 Methodology of User Experience Research

User-centered empirical interception and life studies are commonly referred to as "user research". Through user research, users' habits and consumption patterns are understood, their energy and feelings about using the product are clarified, and their motivations are effectively identified, so that user models can be built. Dave Rogers and Chris Fahey agree that scientific user research is difficult, and user research results are difficult to implement in design. While user research is unlikely to be truly scientific due to budgetary, human, and time constraints, it does help designers understand the user experience .<sup>[50]</sup>

Doing a good user research is the key to a good interface design for the academic affairs management system, and after the survey, the data and information from the survey need to be integrated and analyzed. Numerous studies have found that what people say in research is usually not exactly what they encounter, because when they recall the details of the Internet,

they often recall the general situation, but often forget the real details, so it is not only from written research, but also to observe their actions<sup>[49]</sup>.

#### (1) Questionnaire research

It is a general market research method in which questions are asked in writing to a specific group of people and the respondents are asked to respond in writing or orally to collect information.

#### (2) Interview Research

Unlike questionnaires, interview research allows for longer and more in-depth communication with users, and can be conducted directly with users through face-to-face communication and telephone. The interview method is easy to operate and can explore the interviewee's heart and opinion deeply, so it is easy to achieve the desired effect.

#### (3) Focus Groups

Gloria Bader, argues that focus group interviewing is a label given to a particular type of group interview that is designed to be constructed to gain detailed perspectives and insights on a particular topic from selected individuals.<sup>[50]</sup> It belongs to the category of qualitative research methods, which focus on the uniqueness of the individual. Because each individual has different experiences, different perspectives, and different environments, they have different perceptions of certain things, and by conducting focus group interviews with these individuals, common elements can be extracted from their experiences. The advantage of focus group interviewing is that it is quicker to obtain information from a group of people, less expensive than conducting individual in-depth interviews with the same number of people, and easier to conduct than a large-scale survey.<sup>[51]</sup> Through focus group interviewing, researcher can obtain "localized concepts" from different groups of users based on their needs.<sup>[52]</sup> Therefore, the generalized questions constructed through focus group interviews are more relevant to reality. It is possible to express the user's needs in a more realistic way.

#### (4) Situational Survey

Contextual Design: Defining Customer- Centered Systems, by Hugh Bayer and Karen Holtzblatt, defines contextual research as a field method of data collection based on anthropology and ethnography. The research method involves visiting users and observing them at work<sup>[53]</sup>. Situational research can reveal more accurately what users actually do, how they define what is valuable to them, and what unexpected competitors are investigated.

#### (5) Usability Testing

Usability testing is a structured interview about the specificity of the interface prototype. Usability testing has the advantage of being the easiest and fastest user testing in the

preliminary phase before releasing the product. Since usability testing is critical to the usability evaluation of the system, the details will be described in detail below.

## **2.3 User-centered design (UCD)**

### **2.3.1 Theoretical Sources**

The theory of UCD (User-centered design) originated from Norman and Draper's book *User-Centered System Design: New Perspectives Human-Computer Interaction* in 1986, and was further refined in Donald Norman's book *The Psychology Of Everyday Things* in 1988, which further refined this concept by stating that the design process should be centered on the user's needs, rather than designing the product and then forcing the user to accept it.<sup>[54]</sup> 1) In the initial product phase, user needs, goals, and motivations are identified. 2) In the design development phase, user research and user data are used as a basis for decision making; in the product evaluation phase, user testing is used as an important method. 3) In the product maintenance phase, user feedback is collected. User-Centered Design (UCD) throughout the design process directly engages the end user and helps develop the tools that provide the most beneficial results.<sup>[55]</sup> User-centered design is the process of putting into action the core ideas and emphasizing user research, including user characteristics, user needs analysis, etc.

UCD design always starts from the user's perspective, and there are multiple phases in the design process, each with its own design approach. The designer not only needs to analyze and anticipate the possibility of users using the interface, but also needs to verify the validity of the hypothesis through user testing.<sup>[56]</sup> User-centered interface design of college website is to meet the study and work needs of college website users from the perspective of college website users, to meet the behavior habits of users, and to bring users a good experience.

### **2.3.2 Design Process and Methods**

The theory of UCD (User-centered design) has been widely used in the field of computing in practice and academic research, mainly in the design of Internet products, but now it is also gradually applied in different fields.

#### **1. Start from studying users and user tasks**

In user-centered design, the main thing is to design around the key point of "user", including the need to analyze the characteristics of users, types, needs and so on. This requires the use of research, observation, and other methods to assist designers in facilitating user research.

## 2. Experience measurement

In the early stage of design, the designer should pay attention to observe the user's behavior when using the product or service and the environment, and make accurate analysis of the user based on the accumulation of data for many times. In the post-design period, the designer should pay attention to observe the interaction process between users and the product or service and record it as a basis for research.

## 3. Iterative design

The "user-centered" design process requires user participation and testing and evaluation, and the designer can modify the design based on user feedback from testing and evaluation, and improve the design through repeated testing and evaluation. The overall design process is based on the "design-test-evaluate-re-design process", i.e., iterative design.

## **2.4 Usability**

### 2.4.1 The concept of Usability

The ISO 9241-11 international standard defines usability as the effectiveness, efficiency, and subjective user satisfaction of a product when used for a specific purpose by a specific user in a specific use environment. According to usability expert Jakob Nielsen, usability includes ease of learning, efficiency of interaction, memorability, frequency of errors, severity, and satisfaction.<sup>[31]</sup> Usability testing occurs at any stage of the product design and development process, including early prototypes on paper before they take shape, rapid prototypes, and later finished products.

### 2.4.2 The Methodology of the Usability

Evaluating the usability of a system or product is an important and indispensable step before bringing it to market. Throughout the design of popular products and systems, many usability studies have been conducted to improve the weaknesses and build on the strengths, leading to a successful release. One of the key components of a usability study is the usability evaluation method. Usability evaluation methods are like a ruler used in the engineering measurement process and provide an important reference point for measuring the quality of a product or system's usability.

Through a review of domestic and international literature<sup>[57-59]</sup>, there are many testing methods used for usability, including two quantitative research methods: questionnaires and

task completion, and four qualitative research methods: Out-Of-Speech Thinking tests, Interviews, Focus Groups, and Heuristic assessments.

These usability evaluation methods are now widely used in the process of usability research of various products and systems. Some scholars use a single method, while others combine multiple methods for usability research. Nielsen, the father of usability in the United States, recommends that usability studies be conducted using more than one usability evaluation method and that a combination of methods increase the reliability of the study.<sup>[60]</sup> After all, a single usability evaluation method may have a narrow scope and less focus, and usability research can be better served by adopting the characteristics of various methods to complement each others' strengths and weaknesses. In recent years, researchers have become aware of the problem of subjectivity and lack of objectivity in usability evaluation methods. Therefore, some objective tools are slowly introduced into usability research.

The usability evaluation method is at the forefront of usability engineering and is a key step in the design of usability research methods. It is also an indispensable tool for evaluating the usability of a product or system. The usability evaluation methods have their own advantages and disadvantages. In the process of practical application, it is necessary to select the most suitable usability evaluation method considering various resources such as scenarios, time, users and cost, and to consider the usability level of products and systems from qualitative and quantitative perspectives so that the method can play the best role in the process of usability research.

### 2.4.3 Usability Testing

Usability testing methods are another focus of usability research. Usability testing generally involves having selected users as test subjects perform tasks set by observers in the product and system under study, and the observers should record and evaluate the various types of data and resources that occur during the test.

(1) Dumas and Redish<sup>[26]</sup> describe in detail five aspects of usability testing methodology.

- ① The test subject must be a real user.
- ② The need for the test subject to complete authentic tasks.
- ③ The observer is required to observe and record everything that the test subject does and says.

- ④ Later, the data should be analyzed to find out where the problems lie and suggestions for improvement should be given accordingly
- ⑤ The main role of usability testing is to improve the level of usability of a product or system

(2) Usability testing methods are generally divided into three phases:

① Preparation phase

You need to write a plan and design test tasks and scenarios. 1) Write a plan. Before conducting usability testing on the product, you need to have a general idea of the testing objectives of the product. 2) Designing test tasks and scenarios is the core task in the preparation stage, which can prepare for the smooth implementation of the test later. If the tasks and scenarios are not designed properly, usability testing may be impossible or the effectiveness of the test results may be reduced. The number of tasks and time required for this part of the work should be thought out in advance, and the design should also be integrated with the actual situation. It is best to conduct pre-tests to find out the problems in the plan before starting the test.

② Test implementation phase

The successful implementation of usability testing requires the recruitment of a certain number of test subjects.

1) Recruit test subjects. If you want the test results to be of the highest value, the test subjects must be real users of the product. This is because the experience and behavior of the target users is what usability testing is most concerned with. When finalizing the number of test subjects, it is appropriate to refer to Nielsen's theory of usability testing<sup>[31]</sup>, the father of usability in the United States, and select five people, because five users are enough to find serious usability problems in the product or system. If performance measurement is also required, then five is not the right number and more users should be selected for testing to facilitate statistical analysis of quantitative metrics.

2) Perform usability testing. Do not disclose information during the test, do not tell the test subject the purpose of the test, do not tell the test subject the correct operation method, do not tell the test subject the experimental observation, etc. Do not interfere with the test subject during the test. Do not interfere with the test subject's operation during the test, and let the test subject complete the test on his or her own. At the same time, you should record what the test subject did and use the audible thinking method so that the test subject can express his or her

feelings about using the device in the moment. Whether you are watching the video later or observing it in real time, you need to remember to collect as much information as possible about the test subject's use of the product or system when you are recording.

③ Conclusion phase

1) Organize and collect test data, write summary report, and finally make constructive suggestions based on the report. After the usability test is finished, it is necessary to organize and collect the relevant information, and the test data should be entered and backed up in time, and the test contents that were not recorded in time should be annotated and supplemented.

2) Write the summary report. By analyzing the collected test data in conjunction with the purpose of usability testing, usability problems are extracted and classified. Suggest constructive solutions according to the usability problems identified.

#### 2.4.4 The relationship between User Experience and Usability

As mentioned earlier, interaction design can be specifically divided into "usability goals" and "user experience goals". Usability goals are about meeting specific usability criteria, while user experience goals examine the degree to which the user's intuition arrives during the experience.

Being usable does not mean having a good experience. But a good experience must be based on usability as a prerequisite. A product created must be useful to meet people's needs and solve their problems, which is not only limited to functional needs and problems, but also includes people's psychological, emotional and aesthetic needs. In a word, from usability to experience, it is a process of "Foundation - Improvement - Expectation".

### **3 The Need Analysis of Nursing GSMIS Research**

In a B/S system, users interact with the system through a browser. The system can be divided into management staff, graduate supervisors and graduate students in terms of user status. The system will focus on the interface design and functions on users, and user research will be conducted in the form of semi-structured interviews to understand the initial needs of users, and after the initial completion of the system, focus group interviews for secondary demand will be conducted to improve the constructions of the system, and then build a graduate management information system that truly meets the needs of users.

#### **3.1 Research Purpose**

To conduct student and faculty research in the form of semi-structured interviews to find out:

1) the current status of graduate student management in the School of Nursing. 2) the opinions on the construction of GSMIS.

#### **3.2 Research Objects**

The sampling method is target sampling, using the maximum difference method, and the faculty level may include graduate management teachers and graduate instructors, and the graduate level includes all levels of graduate students, such as doctoral students and master's students, and master's students include academic degree and professional degree students.

(1) Inclusion criteria for Faculty users of the School of Nursing:

- ① Active student management staff of the college
- ② More than 3 years of participation in student management
- ③ Bachelor's degree or above
- ④ Proficiency in the use of student information system

(2) Inclusion criteria for Graduate Nursing Student users:

- ① Current master's and doctoral students aged >18 years old
- ② Rich experience in using information system
- ③ Agree to accept this survey.

Exclusion criteria: All have no experience in using information system; Do not agree to accept this survey.

### **3.3 Research Methods**

#### **3.3.1 Interview Outline**

The outline of the interview questions was designed according to the pre-conception and the purpose of the study.

1) What do you think about the current situation of information management of graduate students in this institute?

2) What do you think about the construction of graduate student information management system?

#### **3.3.2 Data Collection**

The researcher conducted a face-to-face interview, explained the purpose and process of this interview, informed that the interview would take about 10-20 minutes, and recorded the interview data automatically after obtaining their informed consent. In the process of conducting the formal interview, the researcher needs to make appropriate adjustments according to the actual order of questions to ensure the coherence of the interview.

#### **3.3.3 Data Processing Methods**

Two-person entry verification was taken and data processing was performed using SPSS 21.0 statistical software. The information of the study subjects was statistically described using percentages and composition ratios.

The data were processed using the Colaizzi content analysis method<sup>[61]</sup> within 24 hours after the end of the interview by carefully reading all the data; analyzing the significant statements; coding the recurring ideas; assembling the coded ideas; writing a detailed, non-missing, and complete description; identifying similar ideas; and returning to the participants for confirmation. The sample size was determined to be saturated with information, i.e., the information was repeated in the interviews and no new themes were presented. The researcher himself repeatedly listened to the recordings, converted them word by word into textual

content, repeatedly read the original materials and recalled the observations until he really penetrated into the materials, carefully studied them, extracted meaningful statements, and organized them in an excerpt to obtain an overall understanding of the phenomenon described by the research subject.

### 3.4 Research Results

#### 3.4.1 Basic information of research subjects

A total of twelve people were included in the interview, and this information is shown in Table 3-1 and Table3-2.

Table 3-1 Basic information of faculty users

Number	Name	Position	Years of work	Degree
Y1	Teacher. G.	Academic Affairs Office	13	Bachelor
Y2	Teacher. Y.	Master's degree supervisor	10	Bachelor
Y3	Teacher. Z.	Academic Affairs Office	4	Master
Y4	Teacher. J.	Graduate Student Office	11	PhD
Y5	Teacher. G.	Office of Scientific Research	20	PhD

Table3-2 Basic information of student users

Number	Grade	Name	Gender	Years of computer use
T1	1	Yu	Male	16
T2	2	Zen	Female	14
T3	3	Sun	Female	16
T4	2	Bai	Female	17

T6	3	Hu	Female	18
T7	1	Wang	Female	14

### 3.4.2 Interviews Results

1. Students and faculty members of the college all said that the college's information technology construction is not perfect, mostly relying on the school's system well, Information management is a very important step in the progress of the college and the discipline.

2. Students and faculty members of the college all expressed a great need for a platform for standardized management of graduate students in the college at present. It should include information collection and tracking of courses, research, academic, clinical, etc.

Three themes were summarized through the analysis of the interview data.

(1) Theme 1: Weak information management of graduate students

*Y1: At present, our college still relies on the school's system, and the information collected by this system is more basic and not fully applicable to nursing students. The management of graduates is a comprehensive process, and there is a time process for the opening, research, mid-term and clinical, etc., which are currently collected by the college itself, and it is very inconvenient to track.*

*Y3: The clinical study stage of medical students is a more important stage, and the system of Fudan University Information Office cannot complete the docking and recording related to the clinical work of nursing graduate students, which is not conducive to the management of both curriculum and practice of students.*

*T3: The status is not good enough, or can even be said to be absent. Student information does not circulate and cannot be dynamically managed, nor can information about courses, clinical and research be tracked.*

*Y4: Not good enough, currently a lot of information from faculty and various departments cannot be connected and strung together.*

*Y5: As a graduate student manager, it is now more of a manual office, and a lot of collected information still relies on WeChat to fill in, and there is no information platform to export relevant information of students with one click.*

*T6: As a student, I have little experience with information management, but from the student's point of view, the current management of our college still relies on human processing.*

(2) Theme 2: The Need of GSMIS

*Y1: From the school's point of view, it is vertical management from top to bottom, missing horizontal management, and this system built out would be a little more appropriate for the college to use internally.*

*Y2: The basic information of students is very important, and the system should have a module for unified management of students' data.*

*Y3: A course management module can be built to manage students' course information, and instructors can also master students' training plans*

*Y4: A module that can record students' social practice, academic practice, clinical practice, teaching practice and academic lectures attended during their school years is needed.*

*Y5: As a medical school, a module that can record students' clinical cases is needed. It is suggested that a case library that can be used for university-wide discussion can be built for faculty and students to learn and exchange.*

*T3: It is also important to collect information on research papers, research projects, written works, and research awards during the graduates' school years*

*T4: It would be better if the system could be fully linked to the financial system; I would also like to have a feedback function.*

*T5: I hope there can be a corresponding training program, so that I can know my graduation requirements and graduation progress.*

*T7: I hope to strengthen the connection with instructors and hospitals.*

### **3.5 Discussion**

1. The system construction of second-level colleges should combine inheritance and innovation

The key to secondary management is to further decentralize the autonomy of school running, to fully trust the college, and to give the college relatively independent and autonomous power of school running from both administrative power and academic power. The sharing

and rapid integration of educational information resources with the original information system of the university not only improves the vitality of college management and diversification of postgraduate education management means, but also provides materials for the construction of an objective and scientific clinical competence assessment and evaluation system in line with the postgraduate education of nursing degree, which is of great significance to achieve the cultivation goals and improve the quality of postgraduate nursing education.

## 2. GSMIS should target the personalized management needs of nursing graduate students

Clinical practice is an important part of practical teaching in medical schools, a key turning point for students to move from theoretical classroom to clinical practice, and an effective way to cultivate clinical application-oriented medical and nursing talents. Postgraduates with master's degree in nursing are the leading talents and the backbone of China's clinical nursing development in the future, and are the driving force to promote the development of nursing career. China's nursing master's degree education started late, and there are differences between the current situation of faculty and information management and other disciplines.

In order to ensure the realization of cultivation goals in the information era, the actual needs of nursing master's degree students should be fully considered and a system that meets the individual requirements of nursing schools should be built.

## 3. GSMIS should build the collaboration between "students, instructors and faculty".

The system is designed to provide convenient information management services to the school, hospital and students for the management of nursing postgraduates, and the school, supervisor and students are independent parties without interference and data overlap. The entire management system facilitates information collection and processing, internship orientation supervision, and forms a unified and diversified evaluation system for the whole process. By building GSMIS, our school can promote the management of clinical practice teaching on a new track of specialization, standardization, scientific and network informatization, which also provides a referenceable basis for the reform and concept change of today's clinical teaching mode.

### 3.6 Preliminary Framework of GSMIS

The preliminary framework of the graduate student information management system was constructed based on the results of needs.

Table3-3 The preliminary framework of GSMIS

Module	Content
Admissions Information Module	1) Name, gender, age, ethnicity, political appearance, degree type, work experience and other basic information for admission
Training Process Module	2) Cultivation process; 1. course study 2. social time activities 3. academic practice activities 4. clinical practice activities 5. teaching practice activities
Clinical Case Module	3) Scientific research achievements: 1. research paper statistics 2. research project statistics 3. writing monographs 4. research awards 5. other awards
Alumni Career Development Module	4) Basic patient information, assessment, medical diagnosis and treatment and principles, care, implementation effect and evaluation

## 4 The Final Construction Framework of Nursing GSMIS

### 4.1 The Improvement of GSMIS

#### 4.1.1 Research Purpose

According to the user experience study in Chapter 2, the building elements of GSMIS are divided into 1) recognizing user groups and needs, and 2) determining the system's theme style, layout, column design, module organization, and navigation design.

The preliminary framework had been constructed earlier, and the interface design, functional requirements, business functions and performance requirements of the system still needed to be determined, so the author convened a focus group interview to organize a team of experts, and in forming the team, information-rich people were to be selected. An information-rich person is someone who can provide the researcher with a large amount of information that is useful for the purpose of the study. <sup>[62]</sup> The author considered four faculty members with extensive experience in student management systems and familiarity with the processes and content of student management systems to be "information-rich" and therefore selected four faculty members with extensive management experience. In order to make the interviewees representative, the author also selected three instructors and one administrative staff to ensure that the information collected would reflect the users' views more comprehensively and truly

#### 4.1.2 Research Objects

Based on the results of the literature review and the analysis of the needs analysis in the previous sections, this section uses the expert focus group method to justify the content of the framework. Experienced in student management system, more familiar with the process of student management, and the content of the system.

Inclusion criteria.

- ① Experts in nursing student management with more than 10 years of work experience
- ② Familiar with the process of student management, the content of the system
- ③ Rich information ability and strong thinking power

#### 4.1.3 Research Methods

4.1.3.1 Interview Outline:

- ① What are your suggestions/recommendations for improvement?

② What is your opinion on building GSMIS? (Discussion from three aspects: Interface , function and System performance)

#### 4.1.3.2 Method of organization

The focus group interview is a comprehensive and interactive communication model in which groups speak, communicate and exchange ideas around "The improvement of GSMIS". The organization format is that the participants and the facilitator sit around a round table, and the focus group discussion requires a high level of facilitation, not only to gain the recognition and trust of the group, but also to continuously encourage and promote a high level of participation of the participants. It is important to create a relaxed and free atmosphere for the participants, but also to ensure that the group talks do not deviate from the topic.

As a result, Ms. Ge, a graduate student manager, was chosen to moderate the focus group. Ms. Ge is very familiar with the content of the student system, has strong language skills, and has been the moderator of many large meetings. Therefore, she was the best candidate for this focus group discussion in terms of both professionalism and ability.

#### 4.1.3.3 Data collection

The author distilled and summarized the recorded contents and found that the users preferred the business functions of the system and the system to the functional module construction. In order to improve the practical value of the research findings, the generalized issues mentioned by the users in the focus group discussion were extracted and summarized, following the principle of generalized issue construction and using language that is acceptable to the public.

### 4.1.4 Research Results

4.1.4.1 Basic information is shown in Table 4-1.

Table4-1 Basic information of focus group members

Number	Name	Position	Identity of group	Academic qualifications
M1	Teacher G	Scientific Research Office	Hosts	Master

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M2	Teacher Y	Master's degree supervisor	Participant	Master
M3	Teacher Z	Academic Affairs Office	Participant	Undergraduate
M4	Teacher J	Vice President	Participant	PhD
M5	Teacher C	Scientific Research Office	Participant	PhD
M6	Student K	Graduate Students	Recorder	Master
M7	Teacher S	Academic Affairs Office	Participant	Undergraduate
M8	Teacher L	Administration Office	Participant	PhD

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#### 4.1.4.2 The improvement of GSMIS

##### 1) Modular design

① Student information management module: *The basic information of students is very important, and the system should have a unified management of student data.*

② Course management module: *The module can be built to manage students' course information, and instructors can also grasp the students' training plan*

③ Practice management module: *Students' social practice, academic practice, clinical practice, teaching practice and academic lectures during their school years are very important records, which cannot be recorded in the original system.*

④ Academic Achievement Management Module: *It is also very important to collect the information of scientific research papers, scientific research projects, publications and scientific research awards during the graduate period.*

⑤ Clinical Case Library Module: *As a medical graduate student, writing clinical cases is a very basic ability, and users also suggest building a case library that can be used for university-wide discussion for teachers and students to learn and exchange.*

⑥ Employment Tracking Module: *We want to track the work situation of graduates, which is beneficial to the later investigation of the college.*

## 2) Interface design

① Layout: *To control the overall layout, highlight the key points; in the body of the page using the standard format, to achieve a mixed but not chaotic.*

② Text: *The text design is required to be easy to identify and easy to read. Pay attention to the relationship between the title, information, and text links. There should not be too much variation in the font; the title or suggestive text involving typography can be changed appropriately.*

③ Color: *In the color design, researcher should start from the connotation and characteristics of the school, and accurately grasp the main color tone and auxiliary color tone of the connotation of the college, so it is recommended to unify with the college website.*

④ Graphics: *Mainly including title, main image, background, link icons, etc. Using images as titles or links can make the web pages have better visual effects and attract users' attention more.*

## 3) Function requirements

① User log-in: *Basically, enter the user name and password, and then fill in the informed consent form to enter the system.*

② Password setting: *Must have the function of forgetting password and password retrieval.*

③ User management: *Instructors and managers must manage and review the information filled in by students.*

④ Data maintenance: *We require import and export, backup and restore functions.*

⑤ User-defined query: *We need to have a filtering function, for example, we can filter students by degree and grade, which is convenient for management.*

⑥ Audit: *It is better for someone to audit the clinical cases and other information submitted by students.*

⑦ Information notification: *After receiving the corresponding task, we can receive information prompt and view it in the corresponding user system; after completing the task and submitting it, we can receive prompt and view the result in the corresponding system.*

#### 4) System performance

① Real-time: *The system needs a lot of data processing in the process of operation. For example, in case students register their information at the same time, during this period, the burden on the system background functions increased, so the system's response time should be as short as possible.*

② Extensibility: *It is easy to carry out secondary development of the system to meet the demand for expansion of system functions or to improve system performance and the corresponding security control.*

③ Operability: *The system is for school staff and student users, the system layout should be simple and clear, using a control-type page layout, making various operations easier, many operations can be completed by the user with just a mouse click, reducing the complexity of user operations and improving user operability*

④ Stability: *The system is the lifeblood of the entire school information management, and after it is put into use, it has to serve teachers and student users continuously. Therefore, it is necessary to minimize the occurrence of abnormal errors and overall collapse of the system to ensure the stable operation of the system.*

## 4.2 Discussion

In conclusion:

1) The business function modules of GSMIS system include faculty management, student information (registration) management, course elective (course selection) management, grade management, course settings, academic affairs management (statistical queries and reports) and other specific business functions.

2) System functions: password setting, user management, data maintenance (import and export, backup and recovery, etc.), custom queries, log management and other system functions.

3) The performance requirements of the system can be summarized as follows: clear and complete data structure, high data consistency, low redundancy, data sharing, and meeting the business needs of academic affairs management and information security.

4) The interface is recommended to be friendly and beautiful, simple and easy to use, with high satisfaction of user experience. 5) It is suitable for the actual needs of current academic affairs management, and the system is scalable and dynamically adaptable.

## 5 Development and testing Results Study of Nursing GSMIS

### 5.1 Research Purpose

Based on the formal ideas of module content and functionality, the researchers and the software development team used the Rapid Prototype Method, and the development process is shown in Figure 5-1. Building the platform prototype (Rapid Prototype Model).

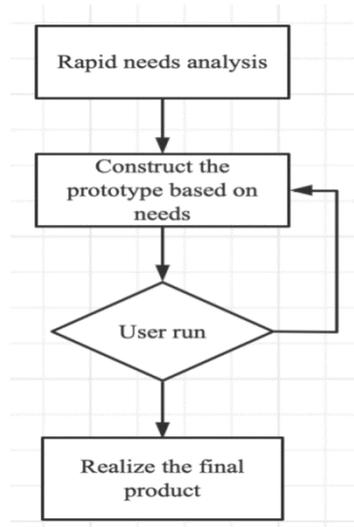


Figure 5-1 Rapid prototype development process

### 5.2 Research Methods

#### (1) Rapid analysis of requirements phase:

The researcher and the engineers communicated and discussed the final framework several times. In order for the engineers to better understand the needs of the college, during the system development process, the researcher and the engineering team participated and communicated with each other to jointly complete the design and development of the system.

#### (2) Construction of prototype:

According to the requirements, the interface of the system is designed, the content of the modules, and the performance and functional requirements that the users want.

#### (3) Operational testing:

After understanding the core functions and requirements of the system, a preliminary prototype of GSMIS is developed and handed over to the faculty staff for testing and suggesting changes and new requirements, and on this basis a corrected system is developed and handed over again to the faculty staff for testing and use, and the development of a new version of the prototype continues after obtaining test feedback.

(4) Evaluation:

In response to the feedback from users (faculty administrators and students) during the trial, the developers quickly adjusted the development plan, modified and improved the system, and delivered the final product to users.

### 5.3 Research Results

#### 5.3.1 The Technical Development Points of the Terminal

Table5-1. Technology development highlights

Development points	PC-based
Development language	C#
Development environment (computer)	NET
Development tools	VS2019
Development frameworks and technologies	MVC
Coding method	UTF-8

#### 5.3.2 Function Introduction

After the software engineers completed the system development and the researchers discussed and revised the software for many rounds, GSMIS finally has a registration log-in page, informed consent notification page, information notification page and 6 main modules:

(1) Registration and log-in page: Users need to register their accounts and associate with third-party software (email or SMS) to retrieve passwords.

(2) Informed Consent Notification Page: The utility is equivalent to the paper version of informed consent.

(3) Home page: Including important information announcement (updated regularly) and the content of 6 main modules: basic information of admission, training process, research results, clinical cases, graduation tracking, alumni tracking.

(4) Admission basic information module: System administrator or user with student information management authority logs into the system and imports student information, or manually enters student information function. Student information management system is

mainly for adding, deleting and modifying student information. In addition, to improve the efficiency of student information management, the system is designed to import and export student information. For example, at the beginning of a new semester, new students need to be added to the system in batches, and it would be a huge workload to add them one by one. The export function of student information is also necessary.

(5) Cultivation process module: Cultivation management is an important part of conducting graduate education, and all other work is closely focused on this work. Each part will be elaborated as follows.

① Course learning: you can add new course learning, you can view modify delete or submit course learning and list it, you can choose the nature of the course into degree public subjects, degree core courses and elective courses; fill in the course name and grade level.

② Social practice activities: you can add new social practice activities, you can view modify delete or submit social practice activities and list them, you can fill in the date, content, organizer, participant, person in charge, and grade of completion. As for the content, such as volunteer activities and other social practice categories can be filled in.

③ Academic lectures: you can add participation in academic lectures, you can view modify delete or submit participation in academic lectures and list them, you can fill in the time, place, organizer, content, main form.

④ Domestic academic conferences: you can add participation in domestic academic conferences, you can view modify delete or submit to participate in domestic academic conferences and list, you can fill in the name of the conference, time, location, organizers, communication form (oral presentation, poster communication), communication topics.

⑤ International academic conference: you can add to participate in international academic conferences, you can view modify delete or submit to participate in international academic conferences and list them, you can fill in the conference name, entry and exit time, location, organizer, exchange form, exchange project name, funding category, funding amount.

⑥ Foreign study and exchange: you can add participation in foreign study and exchange, you can view modify delete or submit to participate in foreign study and exchange and list it, you can fill in the time of going abroad/exit, country, unit, main funding category, funding amount, project name.

⑦ Clinical practice activities: you can add new clinical practice activities, you can view modify delete or submit clinical practice activities and list them, you can fill in the practice department, starting and ending time, practice content and assessment method.

⑧ Teaching practice activities: you can add new teaching practice activities, you can view modify delete or submit teaching practice activities and list them, you can fill in teaching and research department/department, time, course content, theoretical teaching/practical teaching, and credit hours.

(6) Scientific Research Activities Module:

Tracking students' scientific research activities is an important task for conducting the college's training of graduate students, and each part will be elaborated as follows.

① Research paper statistics: you can add new research paper statistics, you can check the statistics of modified deleted or submitted research papers and list them, you can fill in the paper, first author, corresponding author, year and month of publication, name of published journal, etc.

② Research project statistics: you can add new research project statistics, you can view modify delete or submit research project statistics and list them, you can fill in project source, project category, subject name, fund number, person in charge, name of participating graduate students, ranking of participating graduate students, funding, etc.

③ Monographs statistics: you can add new monographs, you can see the revision and deletion or submit the monographs and list them, you can fill in the name of monographs, textbooks, authors, editors, publishers, publication year and month, ISBNB, word count, editors-in-chief/associate editors/editors-in-chief, etc.

④ Scientific research awards: you can add new scientific research awards, you can view modify delete or submit scientific research awards and list them, you can fill in the award category award level, award name, awardee, name and ranking of graduate students, certificate number, awarding unit, award year, etc.

⑤ Other awards (including political science): you can add other awards (including political science), you can view modify delete or submit other awards (including political science) and list them, you can fill in the award category, award level, award name, awardee, name and ranking of graduate students, certificate number, awarding unit, award year, etc.

(7) Clinical Cases Module:

As a graduate nursing student, the ability to write and study clinical cases is very important, and this module will allow students to select cases worth studying and exploring.

The case management of nursing graduate students in the clinic is carried out in accordance with the requirements of nursing procedures, including nursing assessment, nursing diagnosis, nursing intervention and nursing evaluation, reflecting the ability of nursing graduate students to analyze and solve practical clinical nursing problems by applying theories, knowledge and methods of nursing and related disciplines.

① New clinical cases: You can view modify delete or submit clinical case library and list them, there are five major modules, which are basic patient information, assessment, medical diagnosis and treatment principle, nursing care, implementation effect and evaluation. (Only professional degree graduate students can register the clinical case library.)

② Clinical Case Bank: Students' cases must be submitted to their supervisors first, and can only be placed in the shared case bank for the whole university to view after the supervisors' review.

(8) Graduation tracking module:

The employment information of graduates can be registered so that tutors and colleges can view it conveniently.

(8) Alumni tracking module:

The main contents are work unit, technical title, current position, current education, main education experience in the past 5 years, main work experience in the past 5 years, academic achievements in the past 5 years, honors received in the past 5 years, etc.

### 5.3.3 Interface Design

When building a large website, the designer should keep the overall design of the sub-sites consistent with the total website when designing the sub-sites. Therefore, the overall interface layout design in this system is borrowed from the official website of the College of Nursing, as shown in Figure 5-2, with the color purple, and the visual elements such as text and icons are expressed using professional aesthetic design rules.



Figure 5-2 Interface design of the official website of the School of Nursing

### 5.3.3.1 Layout

The system is based on the Chinese reading habits, following the "left-to-right, top-to-bottom" principle, which should also be followed when designing the interface of the system. It is important to keep the interface of the system simple by leaving blank spaces and refining the design elements of the website interface.

### 5.3.3.2 Text and Color

Use Song and bold fonts for the body text in the interface. For example, yellow and orange give people a healthy, sunny feeling and are a cheerful, bright color; red is a symbol of good luck in China, which makes people's heart beat faster, excited and joyful; blue looks The appropriate choice of colors in the website interface design, such as the selection of appropriate text color, link color, background color, etc., will play a complementary role to the overall design of the website interface and improve user satisfaction.

### 5.3.3.3 Icon Introduction

The iconic elements of the GSMIS interface consist of graphics, text and colors. They are used to improve user efficiency, represent visual and spatial concepts, save space, speed up searches and facilitate the standardization and standardization of the interface.

① Graphics: Graphics are one of the most important design elements in the system interface. It accounts for a large proportion of the visual composition of the interface layout of the academic affairs management system, and has a strong visual impact compared to text of

the same area. The use of graphics not only increases the aesthetics of the interactive interface, but also conveys certain information about the interface, and has two major functions of highlighting the visual effect and guiding reading, thus making it easier to form the center of visual information.

② Text: Text in the interface of the academic affairs management system can convey information intuitively and is easier for users to recognize and read. The text link button is a common link in academic management websites, which can visually display the linked subject information and allow users to easily retrieve the required information and complete their work.

③ Color: Color is also a language of interactive interface design, and is an important element in the interface design of the academic affairs management system as a means and way to convey visual information. Color has a role in guiding the flow of visual information in the interface of the academic affairs management system, making it easy to read and at the same time highlighting the theme of the academic affairs management system and enhancing the attractiveness of users.

#### 5.3.4 Presentation of the Design Results of the GSMIS

Based on the above needs analysis, development and testing, the final results of this department are presented in *Appendix 6*.

## 5.4 Professional System Testing

### 5.4.1 Test Purpose

*Shanghai Institute for Integrated Application of Network Technology* provides basic research and services for related sectors and social applications. The Institute's work is mainly directed at research and development of Internet-related security products, data acquisition and big data analysis, and research and development of network security vulnerability search, warning and monitoring technologies, as well as participation in Internet-related network security environment testing and assessment.

### 5.4.2 Test Methods

*Shanghai Institute for Integrated Application of Network Technology* was commissioned by Nursing school of Fudan University to conduct a system security assessment of GSMIS from December 21, 2021 to December 28, 2021. This security assessment was conducted in terms of secure computing environment by security scanning and configuration checking of 1 server, 1 database system and 1 application system of GSMIS.

### 5.4.3 Test Results

The following is a summary of the Test Results.

The GSMIS of Fudan University should be measured 22 items, 11 items (50.00%) are conformed, 6 items (27.28%) are partially conformed, and 5 items (22.72%) are not conformed. The compliance and partial compliance rate reached a total of 77.28%, and no high-risk issues were found during this evaluation.

In summary, the assessment of this security assessment concluded that the security assessment basically complied with the demands of the standards related to the security of the secure computing environment in GB/T 22239-2019 "*Basic Demands for Network Security Level Protection of Information Security Technology*" Level 2 (S2A2G2), and the security functions possessed by GSMIS met the project acceptance demands. Analyzing the measurement results, the main security risks in GSMIS were found to be as follows:

- 1) The application system has no authentication information complexity verification mechanism, and no regular password change is set.
- 2) No log-in failure handling function in the application system.
- 3) No encryption measures are used for remote management of intranet systems.
- 4) Database, server not renamed or system default account disabled.
- 5) The application, server, and database do not grant different accounts the minimum required to complete their respective tasks. Permissions.
- 6) Failure to protect and regularly back up the audit records of servers and databases, and failure to avoid being exposed to expected deletions, modifications, overrides.
- 7) The server does not restrict the source address for remote access.
- 8) Failure to conduct regular security scans of database systems, application systems, servers and other equipment.
- 9) The intranet system does not use cryptography for communication integrity verification.

- 10) important data of databases and servers are not tested for recovery.
- 11) Off-site data backup function is not provided.

## 6 Usability Evaluation of Nursing GSMIS

Usability evaluation is an indispensable part of the product development process and is one of the key factors for a successful GSMIS. In this part of the study, a mixed evaluation method of usability testing, questionnaires and qualitative interviews is used to conduct a comprehensive and objective usability evaluation of the successfully developed GSMIS based on the target users and the information problems to be solved.

### 6.1 Usability Testing Method

#### 6.1.1 Research Purpose

This study will use a mixed method to explore the usability of the system in the practical management, understand the user experience, analyze its advantages and shortcomings, and provide a reference basis for the information management of the nursing school.

#### 6.1.2 Research Objects

When choosing the number of people to be tested, refer to Nielsen usability testing theory, the father of usability in the United States<sup>[64]</sup>, it is appropriate to choose five people because five users are enough to find serious usability problems in the product or system.

The participants were included by Target sampling method:

① The graduate students who are familiar with information system were selected as the participants, a total of 5 participants were included.

#### 6.1.3 Research Methods

##### 6.1.3.1 Evaluation indicators

According to the international standard ISO 9241 (Nielsen, 1994), the goal of usability design and evaluation is to enable users to achieve the desired purpose in a given usage environment.<sup>[26]</sup> This definition explains how usability can be tested in terms of both user operation and satisfaction, in three areas: 1) the extent to which the intended purpose of use can be achieved; 2) the resources consumed to achieve the purpose; 3) the extent to which the

user accepts the use of the product. The specific evaluation is summarized in three factors: effectiveness, efficiency, and satisfaction, as shown in Figure 6-1.

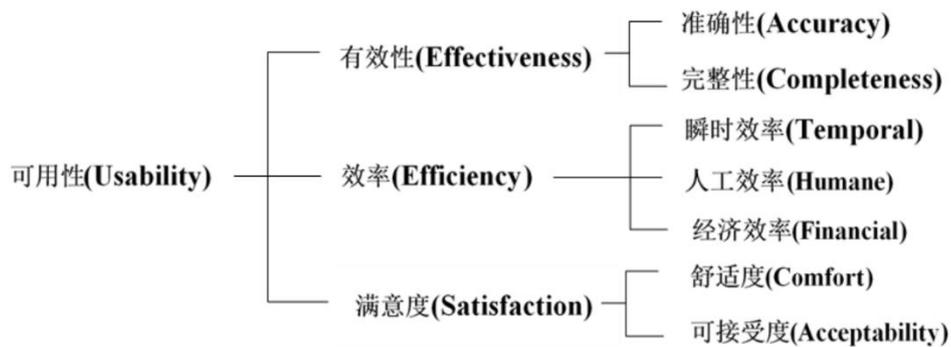


Figure 6-1 Objectives of usability evaluation

① Effectiveness. the extent to which users use the system to accomplish specific tasks to achieve their purpose, and the quality of the output of those tasks. Two main factors are measured: the accuracy and completeness of the purpose achieved by the user. This study tested users' completion and error rates by setting expected task goals.

② Efficiency: The ratio between how correctly and completely a user completes a task and the resources (time) used.

③ Satisfaction: the subjective level of satisfaction and acceptance felt by the user during the use of the product. The ASQ (see appendix 2) was used to assess the user's perceived satisfaction with the system. The ASQ consists of 3 questions that assess the overall ease of completing the task, completion time, and satisfaction with satisfaction with the supporting information.<sup>[63]</sup>

### 6.1.3.2 Implementation Process

① The test session lasted about 20-30 minutes and was conducted by the researcher one-on-one with five users, who followed the following test list (Table 6-1) according to the researcher's instructions) to complete the test task. During the test, the whole process was recorded with the consent of the study participants, and the content was transcribed by two researchers after the test was completed to summarize the feedback questions, as shown in Figure 6-1.

Table6-1 Usability testing tasks

Task	Testers' tasks	Observation Points
1	User Log-in	Find the log-in platform Log-in Platform
2	Courses	New Course Information
3	Personal Center	Go to Personal Center View basic admissions information
4	New information added	New research papers New Research Awards New clinical practice activities
5	New Case Library	Simply fill in the basic information of the case
6	Modification	Delete an item of information
7	Exit	Safely exit

② Test preparation: prepare a vacant classroom with good network signal before the test to facilitate single-person testing, a classroom for the testee to rest and prepare before the test, laptops (Microsoft, connectable to campus network), recorders, notebooks, and smart phones for the testers to record and observe.

③ Test explanation: Gather the test subjects in the previously prepared break room, explain the purpose of the usability test to the test subjects, and express your gratitude to them. Arrange the testing order for the participants, and the testers should enter the testing room in order to conduct individual tests. During the testing process, the test subjects should follow the instructions given by the tester and make corresponding operations, and they can clearly express their feelings or concerns at any time. After completing the test, the test subjects can return to the lounge, but please do not inform others about the test.

④ Start the test: A recorder, a tester, and a testee are ready in the test room. The testee needs to follow the instructions of the tester to complete each operation test and speak out loud about his or her feelings while testing. The tester needs to control the process of the test, and the recorder needs to record in detail the test subject's various operation behaviors, words, expressions, etc., and use a stopwatch to record the time used by the test subject for each task. To ensure the accuracy of the test, the tester and the recorder are not allowed to help the testee to perform the operations.

⑤ Post-test scoring: A rapid assessment of perceived usability will be conducted immediately after the evaluation task is completed, i.e., using a retrospective analysis completed by the researcher and the study participant together after the evaluation task is completed. We usually conduct a rapid assessment of perceived usability immediately after the participant completes the test, i.e., using a standardized questionnaire for task evaluation. ASQ is a common type of standardized questionnaire for task evaluation. It consists of 3 questions that assess overall ease of task completion, completion time, and satisfaction with supporting information, and the overall ASQ score is the average of the 3 question scores. The overall ASQ score is the average of the three question scores. The reliability range of the ASQ measure was found to be 0.9-0.96.

#### 6.1.3.3 Data Collection

① Observation: The recorder needs to record in detail the various operational behaviors, words, and expressions of the tested person.

② Audio recording: The entire test was recorded, and the content was transcribed by the researcher after the test was completed to summarize the feedback questions.

③ Timekeeping: The recorder uses a stopwatch to record the time used by the test subject to perform each task.

#### 6.1.3.4 Data Analysis

User action indicators are analyzed by descriptive statistics. Categorical data were analyzed as counts and percentages, and continuous data were expressed as means. Two researchers independently analyzed the interview data through the Colaizzi method<sup>[61]</sup>.

### 6.1.4 Research Results

#### 6.1.4.1 Quantitative results

Table6-3 Basic information of test users

Number	Grade	Name	Gender	Years of computer use
W1	1	Yu	Male	16
W2	2	Zhang	Male	15

W3	3	Sun	Female	16
W4	2	Bai	Female	17
W5	3	Hu	Female	18

① Effectiveness:

Table6-4 GSMIS test task completion rate

	Task1	Task2	Task3	Task4	Task5	Task6	Task7
Completion rate	100%	100%	100%	60%	60%	100%	100%
Number	5	5	5	3	3	5	5

② Efficiency:

The recorder recorded the time in seconds that the student users took to complete each task in the usability test. The logger tallied the total time, average time, shortest time, and longest time taken by the users to complete each task, and the results are shown in Table 6-5.

Table6-5 GSMIS Test Task Completion Time (unit/s)

	Task1	Task2	Task3	Task4	Task5	Task6	Task7
Total	281	361	156	1121	379	165	27
Number	5	5	5	3	3	5	5
Average Time	56.2	72.2	53	225.2	75.8	33	5.5
Max Time	79	85	65	707	97	38	8
Min Time	50	58	37	59	56	27	3

③ Satisfaction:

The ASQ score is 1-7 (1 being very satisfied and 7 being very dissatisfied), with smaller scores indicating higher satisfaction with the difficulty, time spent, and support information for the tasks, and an overall GSMIS score of 1.24, indicating high satisfaction with the new system for the tasks set.

Table6-6 Satisfaction after using the system

	Difficulty	Time spent	Support Information	Overall
GSMIS	1.215	1.125	1.375	1.24

#### 6.1.4.2 Qualitative results

The usability test included an -thinking method that allowed the test subjects to speak their thoughts and feelings out loud during the operation of the task, and the recorder took notes accordingly to achieve a qualitative analysis of the usability of GSMIS. The usability test included an audible thinking method that allowed the test subjects to speak their thoughts and feelings out loud during the operation of the task, and the recorder took notes accordingly to achieve a qualitative analysis of the usability of GSMIS.

The usability of GSMIS is then analyzed from the user's point of view by combining the quantitative statistics. A summary of the ideas expressed by the test subjects during the tasks is shown in the tables6-7 below.

Table 6-7 Summary of the ideas

Task	User Description
1	No third-party accounts to log-in Seems to lack the "informed consent" function I use the school's system every day, and I'm already familiar with it.
2	Don't want to spend time registering for classes Spend a long time looking for icons for relevant navigation It's not hard to add, but it's time consuming
3	This module is eye-catching, easy to find, and full of information This is a teacher import, no need to register yourself, very good

---

4	<p>This module is very important for the management of graduate students, so we don't have to bother our teachers to report every year.</p> <p>The content is very comprehensive, and the operation is not difficult</p> <p>Navigation and filling out the tips are very thoughtful</p>
5	<p>Writing clinical cases is a basic writing skill that every nursing student must master, but it is quite troublesome to type your own cases by hand again</p> <p>Not quite complete yet</p> <p>This case library is good to see the cases you are interested in</p>
6	<p>Some of the module's modify and close icons are hard to find</p>
7	<p>Easy and fast exit function</p>

---

## 6.2 Questionnaire Method

### 6.2.1 Research Purpose

After completing the task test, users were invited to try out the GSMIS, and then the system usability scale SUS was used to evaluate the usability of the GSMIS. SUS is a simple questionnaire for usability evaluation proposed by John Brooke in 1986 at<sup>[64]</sup>, and is now widely used for product usability evaluation.

### 6.2.2 Research Objects

(1) Sample: In this study, a convenience sample of current graduate students in the School of Nursing was selected for the questionnaire survey.

(2) Inclusion criteria:

- ① Age >18 years old for current master's and doctoral students
- ② Voluntary participation in this study
- ③ Proficiency in using information systems

### 6.2.3 Research Methods

#### 6.2.3.1 Research tools

(1) SUS Questionnaire

SUS consists of 10 subjective items, including 5 positive and 5 negative items, and all items are rated on a 5-point scale (1-5, with 1 being strongly disagree and 5 being strongly agree), and the subjects' scores are converted to a percentage scale. Several empirical studies have shown that SUS questionnaire has a good evaluation effect with a small sample size requirement, which also showed that the usability of the evaluated system was acceptable when the SUS score was >70.<sup>[65]</sup>

#### 6.2.3.2 Data collection

(1) The questionnaire was distributed through online (Questionnaire star). Once participants have done a series of tasks, they can quickly score the SUS.

(2) Total score: SUS consists of 10 questions, of which 1, 3, 5, 7, 9 are positive questions and 2, 4, 6, 8, 10 are negative questions with high correlation between the items, using the Likert 5-point scale, where 1 is strongly disagree and 5 is strongly agree, the score for the

positive question is obtained by subtracting 1 from the corresponding score for the option, and the score for the negative question is obtained by subtracting 5 from the score for the side item.<sup>[65]</sup>

(3)The SUS score is a measure of overall usability, and the relationship between words, letters, acceptable range, and SUS scores has been derived by Bangor<sup>[66]</sup> in their study:

- ① 0-50 : F
- ② 60-69 : D
- ③ 70-79 : C
- ④ 80-89 : B
- ⑤ 90-100 : A

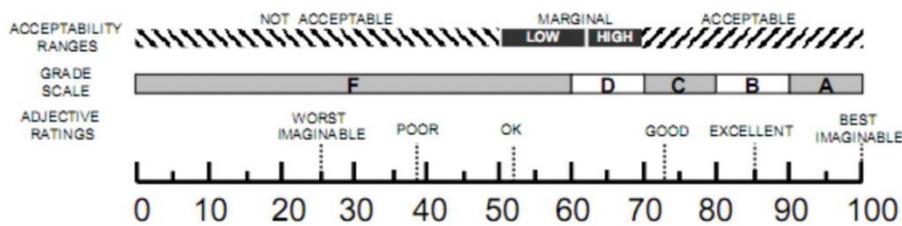


Figure 6-2 Level of SUS Score <sup>[66]</sup>

(3) Sub-scale scores: In addition to the total SUS score, subscale scores can be obtained for items 4 and 10 of the SUS as "Learn-ability" and for the other 8 items as "Usability ". In order to make the ease of learning and usability scores compatible with the overall SUS score, which also ranges from 0 to 100, the original scores need to be converted: the sum of the converted scores for the ease of learning scale is multiplied by 12.5, and the usability scale is multiplied by 3.125.<sup>[66]</sup>

### 6.2.3.3 Data analysis

Double entry verification was taken and data were processed using SPSS 21.0 statistical software. Means  $\pm$  standard deviations ( $x \pm s$ ), frequencies, percentages, and composition ratios were used for statistical description.

## 6.2.4 Research Results

A total of 40 questionnaires were collected through the Questionnaire Star platform, all of which were valid.

## 6.2.4.1 Description of basic information

Table6-8 User Basic Information

Characteristic	Description
Age	26.15±3.97
Gender	
Female	36(90%)
Male	4(10%)
Grade	
Grade1	10 (25%)
Grade2	25 (62.5%)
Grade3	5 (12.5%)

## 6.2.4.2 SUS score

A total of 40 users completed the SUS with a mean score of 70.23. Among them, the usability sub-scale scored a mean of 71.59 and the ease of learning subscale scored a mean of 64.77, with scores ranging from 60 to 70, and the usability of the system was evaluated as good. In this study, the Cronbach '  $\alpha$  of SUS was 0.713, and the results are shown in Table6-9.

Table 6-9 The Score of SUS

	N	Total	Mean±SD	Min	Max
SUS	40	772.5	70.23±7.7	57.5	87.5
Usability	40	787.5	71.59±8.93	56.3	90
Learn-ability	40	712.5	64.77±7.53	50	75

## 6.3 Usability Interviews

### 6.3.1 Research Purpose

Considering that the design and development process of the Student Information Management System is an extremely complex and tedious ergonomic process, it is necessary and important to continuously improve and test the system during the development process. At the same time, the usability of the GSMIS will be improved. Based on this, user interviews were conducted again to further supplement the usability test results and to explore the users' real feelings and experiences in the process.

### 6.3.2 Research Objects

Using targeted sampling methods and the maximum difference method, the faculty level may include graduate management teachers and graduate instructors, and the graduate level includes all levels of graduate students, such as doctoral students and master's students, and master's students include academic degree and professional degree students. Then in-depth interviews were conducted with faculty, staff, and graduate students in the School of Nursing through the use of a phenomenological study. The participants of this in-depth interview were users who did not participate in the usability test.

Inclusion criteria.

- (1) Inclusion criteria for School of Nursing faculty and staff users.
  - ① Current student administrators of the College
  - ② More than 3 years of participation in student management
  - ③ Bachelor's degree or above
  - ④ Proficiency in the use of student information systems
  
- (2) Inclusion criteria for graduate users of the School of Nursing
  - ① Age >18 years old for current master's and doctoral students
  - ② Extensive experience in using information systems
  - ③ Agree to accept this survey.

Exclusion criteria: All had no experience in using information systems; disagreed with this survey.

### 6.3.3 Research Methods

#### 6.3.3.1 Interview Outline

The validity of the results of qualitative research does not lie in the size of the sample, but in whether the sample can answer the research questions relatively completely and accurately. Therefore, the researcher considered general information such as the occupation, years of work, and education of the study participants according to the purpose of the study to make them as representative as possible.

Based on the research objective of "exploring users' experiences and needs, perceived advantages and disadvantages, facilitators and barriers, and improvement measures and suggestions", the researcher reviewed the literature to understand in detail the scope and connotation of users' experiences, conceived the interview outline, and invited an expert who is familiar with GSMIS and specializes in qualitative research to revise the preliminary interview outline, and finally determined the interview outline. The interview outline was finalized as follows. The researcher introduced the functions of the information system to the research subjects and then let them try out the system for 30mins to 1h.

Then the interviews were conducted:

- (1) How was your experience with the GSMIS? Based on your previous experience, do you feel that GSMIS is important for the development of the nursing discipline?
- (2) How do you rate the content and functionality of GSMIS?
- (3) What are the main advantages or benefits of your use of GSMIS?
- (4) What are your main shortcomings or obstacles in using GSMIS and do you have any suggestions for improvement?

#### 6.3.3.2 Data collection

The researcher invited the interviewees to conduct face-to-face or telephone interviews through the Internet, and then obtained the trust of the users after learning about them in detail, explained the purpose and process of this interview, informed them that the interview would take approximately 30mins to 1h, and obtained their informed consent before recording the interview data automatically. In the process of conducting the formal interview, the researcher needs to make appropriate adjustments according to the actual order of questions to ensure the consistency of the interview.

### 6.3.4 Research Results

Within 24 hours after the interviews were completed, the audio recordings and notes were compiled, and the researcher repeatedly extracted the recordings, converted them into text word by word, and repeatedly read the original materials and recalled the observations until he or she really penetrated into the materials, studied them carefully, extracted meaningful statements, and compiled excerpts to obtain an overall understanding of the phenomena described by the research subjects.

#### 6.3.4.1 Basic information

In this part, 10 users were interviewed, 5 students and 5 staff users, 3 interviews, no repeat interviews or secondary interviews, the longest interview time was 46 minutes, the shortest was 25 minutes, and the average was 35.5 minutes, and the general information of users is shown in Table 6-10.

Table 6-10 General characteristics of student interviewee

Number	Grade	Gender	Years of computer use
U1	1	Male	12
U2	2	Male	13
U3	3	Female	15
U4	2	Female	17
U5	3	Female	18

Table 6-10 General characteristics of Faculty interviewee

Number	Position	Years of work	Degree
Z1	Academic Affairs Office	14	Master
Z2	Supervisor	12	Master

Z3	Academic Affairs Office	5	Undergraduate
Z4	Graduate Student Office	20	PhD
Z5	Supervisor	15	PhD

#### 6.3.4.2 Results of the interviews

Through repeated reading and analysis of the interview content, the researcher used subjective evaluation as the criterion, and the study can be divided into three aspects: overall evaluation, content and function evaluation, and deficiency and improvement.

##### (1) Theme1: Overall evaluation

The research subjects responded that the system has a clear interface, reasonable structure, convenient operation, smooth use and comprehensive content, which is conducive to the information management of graduate students in the School of Nursing.

*U1: Simple interface, smooth operation, systematic and scientific content, and strong guidance.*

*U5: The program is relatively smooth to use, with fast clicking speed and a clear interface that is suitable for most people.*

*U2: The system is very easy to use, the interface is very clean and nice.*

*U3: The building process of your software is not only for students, but also for student managers, instructors and software engineers, which ensures the scientific rigor of the build and provides great guidance for students and information management.*

*Z1: The module content is complete and all the information is available, which is a great progress of informatization of the college.*

*Z2: The modules are all well built, and the systems that I've come across before are pretty much all-inclusive.*

*Z5: Overall, it is very easy to operate and the interface is very clean. Our college really needs its own system, and it will be very convenient to count students' research information in the future.*

##### (2) Theme 2:Worry

*U2: I have doubts about the role of some modules, and I am also worried about the stability of the system and whether it can bear the simultaneous operation of many people.*

*Z3: Now the network security is very strict, worry whether it can be used normally online.*

*Z4: There are advantages and disadvantages in the era of big data, whether the security of data can be guaranteed, for example, whether one's account number and the funds involved in the subject are private information, and whether the security of the information can be guaranteed.*

### (3) Theme 3: Shortcomings and improvements

*U1: It would be better if the system could be fully linked to the financial system; I also hope there is a feedback function.*

*U2: I hope there can be an additional publicity module, which can promote a little more stories about the employment or research of outstanding graduates to strengthen the positive energy.*

*U3: I hope there will be a corresponding training program, so that I can know my graduation requirements and graduation progress.*

*U5: We hope that we can connect with the system of affiliated hospitals, and strengthen the connection between the college and instructors and hospitals.*

*U6: We hope to increase the functional content and functions of pushing and publicity.*

*Z1: It is possible to add a scheduling system and a process of leave system; it is recommended to set up different modules of training programs according to grades.*

*Z2: It is recommended to have the ability to track students' clinical information and to focus on the connection with the supervisor, for example, the registration of students' clinical cases needs to be reviewed by the supervisor before they can be included in the university-wide case pool.*

*Z3: It is suggested that the system should pay attention to the dynamic flow management of students; there should be a platform for timely reporting and networking of the whole college when there are foreign teachers in the graduate courses.*

*Z4: Nowadays, there are many lectures on Civics activities. It is suggested to increase the information registration of students' Civics, such as the registration and evaluation of party classes and party political activities.*

### (4) Discussion

#### 1) High acceptance of nursing graduate information system

By constructing an informatization network platform for the cultivation process of

nursing postgraduates, the college can promote clinical practice, teaching management and embark on a new track of professionalization, standardization, scientificization and network informatization, which also provides a reference basis 2 ) for the reform and conceptual change of today's clinical teaching mode. According to the users' evaluation, it is believed that through a series of rectification and optimization, the network platform of clinical practice management will play a more advantageous role in practice management. The development of information technology is changing rapidly, and the demand for talents in society is increasing. It is very important for medical schools to adapt to the rapid development of economy and science in modern society and to train professional medical talents for the society. Teachers can no longer limit the management of students to the mere routine management of life and study, but need to expand more to the overall guidance of students' life and study and clinical.

## 2) Adopting opinions according to the actual management of the college

Many useful suggestions have been made by students and faculty members about the system. However, the implementation of a system does not happen overnight, and involves complex computer language and technical operations. For example, it is difficult to realize the interface with the hospital system of the university, because it involves the actual situation of both parties. However, the optimization and improvement of various system functions mentioned, as well as the consideration of the security of the system, all indicate that the school users have a high level of network literacy, which is important for the actual management in the future, and will be based on the actual use of the nursing school's academic affairs management in order to better adapt to the development of higher medical school education.

## **6.4 Discussion**

### **6.4.1 The Overall Rating of GSMIS Usability is Good**

During the usability evaluation and testing phase, there were no obvious faults or bugs, and the system was divided into six functional modules with the main interface, and the modules were classified according to the needs of each function and content, with subject categories and text descriptions to facilitate users to find information.

During the usability test, questionnaire survey and interview, the study participants were cooperative and had a good feeling about the interface, content and functions of the GSMIS, which indicates that the system has good usability and can be used as a tool for graduate information management in the School of Nursing.

#### 6.4.2 A Comprehensive Grasp of GSMIS Usability Issues

In recent years, mixed methods research has been used more and more frequently as a methodology in the study of information systems. Mixed methods research is defined as a research approach that collects, analyzes, and integrates quantitative and qualitative information, allowing researchers to derive interpretations based on the strengths of both types of data and explore complex phenomena in detail to produce a research value of  $1 + 1 > 2$ <sup>[67]</sup>.

① Usability testing is the most common method for evaluating the usability of a system.<sup>[68]</sup> Researchers typically ask target users to use the system while continuously expressing their thoughts on the system based on a test checklist, that is, simply verbalizing their thoughts as they move through the system interface. Usability testing provides a means of gaining a relatively in-depth understanding of how users interact with the product, identifying key usability issues they encounter and are likely to encounter, and gathering solutions to address them during the system update phase.

② This study provides an overall understanding of the user's overall impression of the GSMIS, the user's errors during operation, and the effectiveness and efficiency of the user's interaction with the GSMIS through out-of-speech thinking. "Effectiveness" refers to the degree of correctness and completeness of the user in completing a specific task and achieving a specific goal, and "efficiency" refers to the ratio between the degree of correctness and completeness of the user in completing a task and the resources used (e.g., time). The effectiveness was mostly at 100% in the usability test, with efficiency of 56.2 min/s, 72.2 min/s, 53 min/s, 225.2 min/s, 75.8 min/s, 33 min/s, and 5.5 min/s, respectively, Which indicates that the system is not difficult to operate and meets the interaction needs of the users.

③ User experience needs to follow the cycle of "Test--Modify--Test again", and this process will make the user interface of information system more and more close to users' expectation, and improve the usability of information system. Based on this, this study then used qualitative interviews to further supplement the results of usability testing and to explore

the real feelings and experiences of users in the process of use. By combining the three methods, this study obtains an overall view of the usability of the system and provides a clearer goal for the subsequent update and improvement of the GSMIS.

## **7 Conclusion**

### **7.1 Research Findings**

(1) Improve the practical value of system functions through in-depth investigation of user needs.

There is a lack of surveys and analyses of such systems conducted from the user's perspective at home and abroad. This study provides a unified and convenient application service platform for the whole process of graduate education management through the newly designed functions by mixed methods such as focus group interview, questionnaire survey, in-depth interview and usability test, so that the daily affairs processing of graduates can realize the transformation from management informatization to service informatization through the application platform and promote the improvement of the efficiency and management level of graduate management departments. It also provides timely and scientific decision-making analysis tools for university leaders and users of related departments to improve the quality of graduate teaching and management.

(2) The user experience design method and goal of the system are proposed, which effectively improves the user experience of the system

At present, the user experience design level of mainstream websites has been higher, and the related design concepts and principles are richer and more comprehensive, but there is a general lack of user experience designers in the design of graduate information management system, which leads to a poor overall user experience. Based on the existing theories, this study proposes the user experience design methods and objectives of such websites based on the user needs and usage characteristics of the system, which effectively improves the design level of the system and has the value of reference for the design of similar websites.

### **7.2 Innovation Points**

(1) Research topic: This study applies the theories of user experience, interaction design and other disciplines of art and management to the education industry, and uses information technology to solve the management problems of graduate students, which is conducive to multidisciplinary integration.

(2) Research method: This study uses a mixed methods approach to develop and evaluate GSMIS, combining qualitative analysis and quantitative descriptions to gain insight into users' perceptions and experiences of the system, analyze its strengths and weaknesses, and explore its practical usability.

(3) Research significance:

① This study develops GSMIS for information management of graduate students in secondary colleges. By recording and saving the cultivation process of graduate students in real time, in order to achieve early warning and dynamic monitoring of graduate students' academics, which improves the overall information management quality of the college, and also provides some reference for the future information management direction of secondary colleges.

② The design method of the system has certain universal application value. Besides applying to the management of graduate students, the researcher analyzed and found that the internal management system of enterprises also has similar characteristics to this system, for example, the use of functions of tool-based products also has needs such as periodicity and interval, and the user experience design method proposed in this study is also applicable to such enterprise management systems. Therefore, the user experience design method proposed in this paper has certain significance for the design optimization of such systems.

## **7.3 Limitations and Prospects**

### **7.3.1 Limitations**

(1) Since the users who participated in this study were more active users, the researcher was unable to comprehensively identify the hindering and facilitating factors for users to use the system.

(2) Due to the limited number of test participants, the researcher could not expect to find all possible usability problems in this way, which may have caused researcher to miss finding critical usability problems.

(3) Due to time limitation, this study only evaluated the usability of the system and did not evaluate the effectiveness.

### 7.3.2 Prospects

Nursing GSMIS, as the initial construction of informatization in the School of Nursing, has focused on the expectations of the teachers and students of the School. At present, the system design and implementation have achieved certain success, making the informatization construction another welcome step on the way forward, but due to various processes and functions that are still insufficient, the system still needs part of the time to be modified.

In order to follow up the real application of the system to the management of graduate students, the following work needs to be done in the future:

- ① The development of the information system needs to continue to be modified in terms of functionality, interface and user-friendly use.
- ② Modify the existing modules according to the business process of the university, and continue to optimize the modules already developed.
- ③ Realize multiple terminal log-in and uniform backstage management, realize the synchronization of terminal processing and other functions, and enhance the intelligent use experience.
- ④ Realize data visualization, to provide visualized comparative analysis, intelligent retrieval and statistical reports on discipline construction, enrollment, cultivation and degree.
- ⑤ Cultivation status background posting, through conditional judgment and data analysis, the business and data of graduate cultivation process management are monitored, pushed and warned in a timely manner.

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## Appendix

### Appendix1 Interview Outline of Demand Analysis

#### I. Purpose of the interview

To understand the current situation of information management in the School of Nursing and the idea of building the system

#### II. Interview method

Face-to-face interviews

#### III. Interview subjects

Current faculty and staff of the School of Nursing or current students

#### IV. Question outline:

##### ① Demand research: Faculty users

Hello, I am glad that you can join us for this interview. This interview is mainly to understand your views on the current situation of information management of graduate students and the construction of information management system for graduate students as a student manager, and the interview will take about 10-20 minutes.

1) What do you think is the current status of information management of graduate students in this school?

2) What is your opinion on building a graduate information management system?

##### ② Demand research: Student users

Hello, thank you for taking your valuable time to complete my interview. The main purpose of this interview is to understand the ability of using information system of graduate students, their acceptance of graduate information system and the demand of this system, so as to provide reference basis for the content and function of the subsequent construction system. This interview will last for 10-20 minutes, and you are free to state your ideas according to my guidance.

1) What do you think is the current status of information management of graduate students in this school?

2) What are your suggestions on the functional design of the graduate student information system?

## Appendix2 Demands Research: Focus Expert Group Interview Structure

Topic	The improvement of GSMIS
Research Location	Conference Room 1, School of Nursing, Fudan University
Time	2021-1-20, 13:30-17:00
Interview Outline	<p>① What are your suggestions/recommendations for improvement?</p> <p>② What is your opinion on building GSMIS? (Discussion from three aspects: Interface , function and System performance)</p>

## Appendix3 ASQ Questionnaire

Strongly agree Strongly disagree Not applicable

		1	2	3	4	5	6	7
1	Overall, I'm happy with the ease of completing tasks in this scenario							
2	Overall, I'm happy with the time it took to complete the task in this scenario							
3	Overall, I was satisfied with the information I had when completing the task							

## Appendix4 SUS Questionnaire

Dear Nursing School Student:

I would like to enlist your help. The purpose of this study is to assess GSMIS according to user perceptions. This study is important because it helps both to decide whether GSMIS can be used effectively and to define features that must be improved. Since you are one of users of GSMIS, would you please help me by completing the following survey, telling me your thoughts about GSMIS.

Thank!

	Strongly disagree		Strongly agree		
	1	2	3	4	5
1. I think that I would like to use this system frequently					
2. I found the system unnecessarily complex					
3. I thought the system was easy to use					
4. I think that I would need the support of a technical person to be able to use this system					
5. I found the various functions in this system were well integrated					
6. I thought there was too much inconsistency in this system					
7. I would imagine that most people would learn to use this system very quickly					
8. I found the system very cumbersome to use					
9. I felt very confident using the system					
10. I needed to learn a lot of things before I could get going with this system					

## **Appendix5 Interview Outline for Usability Evaluation**

### I. Purpose of the interview

To get your real thoughts and opinions after experiencing the system

### II. Interview method

Face-to-face interviews

### III. Interview subjects

Current faculty and staff of the School of Nursing or current students

### IV. Question outline

Hello, thank you for taking your valuable time to complete my interview. The purpose of this interview is to get your real thoughts and opinions after experiencing the system, and this interview will last for 30-60 minutes, and you are free to state your ideas according to my guidance.

(1) How was your experience with the GSMIS? Based on your previous experience, do you feel that GSMIS is important for the development of the nursing discipline?

(2) How do you evaluate the content and functionality of the GSMIS?

(3) What are the main advantages or benefits of using GSMIS for you?

(4) What are the main shortcomings or obstacles to your use of GSMIS and do you have suggestions for improvement?

## Appendix6 Presentation of the Design Results of the Nursing GSMIS

### (1) Home



Figure 5-3 Home

### (2) Application module for admission information

入学基本信息编辑

I II

关闭

学号:	10000001	姓名:	张学生
姓名拼音/ 英文护照名*:	Zhang Xuesheng	出生日期*:	2000-01-01
性别*:	男	民族*:	汉族
政治面貌*:	群众	年龄:	22
入学前 最高学历*:	本科	入学前 最高学位:	学士
学校名称*:	上海大学		
研究方向*:	机器人研究	学制*:	4 年
入学方式*:	全国统考	学习方式*:	全日制
导师 姓名*:	唐导师	导师 技术职称*:	正高级

Figure 5-3 Application for Admission

## (3) Cultivation Process Module

## ① Course Study



新增课程学习信息

关闭 | 保存后关闭

课程名称\*:

课程性质\*: 请选择 成绩:

Figure 5-4 New Course Learning

## ② Social Practice



新增社会实践活动信息

关闭 | 保存后关闭

提示: 志愿者活动和其他社会实践类都可填写; 结项为非必填, 没有可填无

日期\*: 请选择日期 主办单位\*:

内容\*:

负责人\*: 结项等级\*:

Figure 5-4 New social practice

## ③ Academic Lectures



The screenshot shows a web form titled "新增参加学术讲座信息" (New Academic Lecture Information). The form has a purple header bar with the title and window control icons. Below the header, there are two buttons: "关闭" (Close) and "保存后关闭" (Save and Close). The form contains several input fields:

- 时间\*:** A date picker field with the placeholder text "请选择时间" (Please select time).
- 地点\*:** A text input field for the location.
- 主办单位\*:** A text input field for the organizing unit.
- 主要形式\*:** A dropdown menu with the placeholder text "请选择" (Please select).
- 内容\*:** A large text area for the lecture content.

Figure 5-5 New academic lectures

## ④ International and domestic academic conferences



The screenshot shows a web form titled "新增参加国内学术会议信息" (New Domestic Academic Conference Information). The form has a purple header bar with the title and window control icons. Below the header, there are two buttons: "关闭" (Close) and "保存后关闭" (Save and Close). The form contains several input fields:

- 会议名称\*:** A text input field for the conference name.
- 时间\*:** A date picker field with the placeholder text "请选择时间" (Please select time).
- 地点\*:** A text input field for the location.
- 主办单位\*:** A text input field for the organizing unit.
- 交流形式\*:** A dropdown menu with the placeholder text "请选择" (Please select).
- 交流题目\*:** A text input field for the exchange topic.

新增参加国际学术会议信息

关闭 | 保存后关闭

会议名称\*:  地点\*:

出国出境时间:  入国入境时间:

主办单位\*:  交流形式\*:

交流项目名称\*:

资助类别\*:  资助金额\*:  元

Figure 5-6 New domestic and international academic conferences

## ⑤ Study and exchange abroad

新增参加国外学习交流信息

关闭 | 保存后关闭

项目名称\*:

出国出境时间:  入国入境时间\*:

国家\*:  单位\*:

主要资助类别\*:  资助金额\*:  元

Figure 5-7 New foreign study exchange

## ⑥ Clinical Practice Activities

Figure 5-8 New clinical practice activities

## ⑦ Teaching practice activities

Figure 5-9 New teaching practice activities

## (4) Research Results Module

## ① Research Paper Statistics

新增科研论文统计信息

关闭 | 保存后关闭

论文题目\*:  发表年月\*:

第一作者:  通讯作者:

期刊类型\*:  影响因子:

发表刊物名称\*:  文章性质\*:

Figure 5-10 Adding paper

## ② Scientific Research Projects

新增科研项目统计信息

关闭 | 保存后关闭

项目来源:  项目类别:

课题名称\*:

基金编号:  负责人:

资助经费:  研究生参与排名:

项目开始年月\*:  项目结束年月\*:

立项年度:  项目下达部门:

Figure 5-11 New Research Projects

## ③ Monographs

新增撰写专著信息

关闭 | 保存后关闭

专著、教材名称\*:

参编情况\*: 请选择

出版社\*:

出版年月\*: 请选择出版年月

ISBN\*:

撰写字数\*:

其他:

Figure 5-12 New monographs

## ④ Research Awards

新增科研获奖信息

关闭 | 保存后关闭

奖项名称\*:

获奖等级:

获奖人\*:

研究生排名:

证书编号:

颁奖单位:

获奖年度: 请选择获奖年度

Figure 5-13 New Research Awards

## ⑤ Other Awards

新增其他获奖 (含思政类) 信息

关闭 | 保存后关闭

获奖名称\*:

获奖等级: 获奖人\*:

研究生排名: 证书编号:

颁奖单位: 获奖年度: 请选择获奖年度

Figure 5-14 Added other awards

## (5) Clinical Case Bank Module

新增临床案例库信息

关闭 | 保存后关闭

患者基本信息

卡号\*: 姓名\*:

年龄\*: 性别\*: 请选择

身高\*: CM 体重\*: KG

其他:

评估

主诉\*:

Figure 5-15 New clinical cases

## (6) Graduation Tracking

就业信息编辑

关闭 保存后关闭 提交后关闭

就业类型\*: 请选择

单位类型\*: 请选择

单位地域\*: 请选择

Figure 5-16 Editing Employment Information

## (7) Alumni Tracking

校友基本信息编辑

关闭 保存后关闭 提交后关闭

工作单位:

部门:  技术职称\*: 请选择

现任职务\*: 请选择 当前学历\*: 请选择

近5年主要教育经历

请填写近5年主要教育经历

近5年主要工作经历

请填写近5年主要工作经历

Figure 5-17 Edit alumni information

## Acknowledgments

This is the end of the paper. Although I have imagined the scene of writing "Acknowledgements" for countless times, the farewell is coming quietly, and my postgraduate life will come to an end in the summer.

I would like to express my gratitude to all those who have helped me in the process of writing this thesis. I would first like to thank my supervisor, Teacher Xiaoli Yang, for her constant encouragement and guidance. She has helped me in all stages of writing this thesis and has always been patient with me. I could not have completed this thesis without her consistent and inspiring guidance. Secondly, I would like to thank Teacher Xiangyu Ge for her guidance on my thesis, which was always to the point and endlessly inspiring.

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The thesis was completed in the third spring of Covid-19. I wish that next year, the world will be back to its original shape. May the mountains and rivers be unharmed, friends and relatives be well, and I hope that my youth will not dissipate and my heart will not change.

I believe that *Something you keep in mind will blossom someday.*