Development of an Online Matching System (OMS) for Studying in the Graduate Program

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***Abstract*—Database management systems are essential for achieving competitiveness, enabling organizations to formulate proactive strategies matching their target audience effectively. Thus, this study aimed to develop an online matching system (OMS) for studying in the Graduate Program at Srinakharinwirot University. In this case, we used the System Development Life Cycle (SDLC), a conceptual model that includes system planning, analysis, design, development, and implementation as well as operation. System efficiency evaluation by three experts and satisfaction with system evaluation by 60 users evaluated the system performance of the research instruments. According to the findings, the OMS for studying in the Graduate Program received an excellent rating ($\bar{X}$ = 4.72), and the overall satisfaction of using this database system was high ($\bar{X}$ = 4.28). The OMS for studying in the Graduate Program is critical toward value creation that suits the requirements of the students and enhances marketability to reach the target effectively.**

***Index Terms*—Online matching system, studying, graduate program, systems development life cycle.**

I. Introduction

Currently, the world is hurtling toward disruptive technology. In particular, Thailand has been transitioning into an economic and digital society by utilizing digital technology in its development of infrastructure, innovation, information, and human capital for propelling the domestic economy and society toward stability, prosperity, and sustainability. It is also part of the Thailand 4.0 model, the government's 20-year strategy to enhance the nation's competitiveness and to promote and support technological innovation, value and service creation, research and development based on market trends, and higher technologies. All of these can increase the long-term sustainable wealth and well-being of Thai society [1].

The Graduate School at Srinakharinwirot University (hereafter referred to as the Graduate School) comprises of 26 Ph.D. programs, 71 master's programs, and nine certificate programs that meet the needs of students interested in the arts and sciences or cutting-edge technology. The Graduate School is also available for delivering information to students desirous of admission, advising them (either directly or online) on educational plans, and providing additional information about the various programs. Moreover, it not only provides international education services based on national and international standards but also is prepared to modify the programs to suit the needs of twenty-first century Thai economy and society. For example, it regularly assesses the quality of its programs by reexamining its strategies, its media exposure, and students' opinions based on student evaluations [2].

For the literature review, no study to date has focused on the development of an online matching system (OMS) for studying in the Graduate Program. In fact, most research has been divided into three categories:

The first category includes technology or information systems for graduate students, such as educational data management information system development [3], management information system development for research [4], information technology development for learner-centered instruction [5], information system for thesis and independent study management [6], information system for graduate thesis advisory [7], and a digital wisdom repository model for improving research proposal skills [8].

The second category includes educational management for graduate students, such as administration strategy development toward excellence of graduate program educational management [9], a development model of educational management according to higher education standards [10], the development of guidelines for teaching and learning management through long-distance media [11], an educational services model for learning success in distance education [12], the visualization of a scenario of producing graduates in the next decade [13], a proposition on the strategic administration of graduate studies [14], and the learning preferences of students at the school of anti-aging and regenerative medicine [15].

The third category includes admission to the Graduate School, such as factors that affect decision-making [16]-[18], a discriminant factor analysis of choosing to study [19], the influence of digital marketing media on decision-making for graduate study [20], study needs [21], [22], and the organizing of special events and public relations for continued graduate study [23]. In this regard, the present study differs from the aforementioned research.

Thailand's national policy has been focusing on innovation to create value for goods and services, enhance competitiveness, and improve the strategic focus of the Graduate School in a bid for digital globalization. In this regard, developing online matching for admission to graduate studies is critical for enhancing the marketability of the school to the target.

Hence, the objective of the research is to develop an OMS for studying in the Graduate Program at Srinakharinwirot University.

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II. Conceptual Framework

The development of the OMS for studying in the Graduate Program used James Wetherbe's (1984) System Development Life Cycle (SDLC), a conceptual model including the following system aspects: i) planning; ii) analysis; iii) design; iv) development; and v) implementation as well as operation [24], [25] (see Fig. 1).

Fig. 1. Conceptual framework.

III. Research Method

A. Targeted Populations

In this study, the postgraduate curriculum administrator at Srinakharinwirot University and 50 administrators were interviewed to consider significant information about the OMS and the curriculum. A total of 10 potential graduate students (a final-year undergraduate or a graduate) were also interviewed

The interviewer established the minimum sample in this qualitative research study by selecting which units could provide the most diverse information. The sample size was only set once the information was deemed clear and it covered the issues at hand [26]. In this case, the target group of 10 potential graduate students was established.

Information system experts with more than 10 years of experience in database system development, to assess the efficiency of the system, and 60 users, to assess the satisfaction of the requirements form and the system were the targeted populations for assessing system efficiency.

B. Research Instruments

The research instruments for system performance evaluation consisted of the following: an evaluation of system efficiency by the information system experts and the evaluation of system applications by the users for assessing satisfaction with system efficiency. The questions were based on a Likert-type scale.

There were two processes for assessing the efficiency of the OMS: Toward assessing the efficiency of the system based on the three information system experts, we used five-element assessment criteria, consisting of the following: 1) a function requirement test; 2) a functional test; 3) a usability test; 4) a security test; and 5) a performance test [27]. Toward assessing the satisfaction with the system application based on the 60 database users, we used a four-part assessment criteria consisting of the following work system aspects: 1) ability; 2) work system use; 3) work system accuracy; and 4) work system security.

The Likert scale, mean range, and verbal interpretation are shown in Table I [28].

TABLE I: Scale, Mean Range, and Verbal Interpretation

Scale	Mean Range	Verbal Interpretation
1	1.00 – 1.80	Poor/Very Unsatisfied
2	1.81 – 2.60	Improvement/Unsatisfied
3	2.61 – 3.40	Moderate/Satisfied
4	3.41 – 4.20	Good/Very Satisfied
5	4.21 – 5.00	Excellent/Highly Satisfied

For the validity and reliability of the instruments, the researcher examined the performance quality of the database system, using the system performance assessment usage form and the system assessment form.

Three IT specialists (with more than 10 years of experience) in database system development assessed content validity. Then, the researcher used the value to calculate the index of congruence, which was 0.6–1.0. As the passing criterion was 0.5, the assessment model was appropriate [29]. Regarding the reliability of the instruments, the Cronbach's alpha coefficient regarding the efficiency of the system was.960. In addition, Cronbach's alpha coefficients were.894 for system usability,.946 for system safety, and.902 for system ability. In this case, all of these aspects passed the criterion of.7, indicating that the assessment model was appropriate [29].

The development of the OMS, based on the SDLC, consisted of research methods, data collection, data analysis, and results, as shown in Table II.

TABLE II: Development of the OMS

SDLC	Data Collection/ Targets/Instruments	Data Analysis	Results
1. System Planning To study curricula information and the desires of system users. **2. System Analysis** To analyze the desires of system users.	1. In-depth interviews with 10 postgraduate students to study their demands 2. Assemble the course description from websites, documents, and interview 50 postgraduate course administrators	Create the induction by typologic al analysis	Curricu la informa tion structur e and user demand s
3. System Design Making an online application. **4. System Development** 4.1. Writing program 4.2. Testing database 4.3. Assessing the database system efficiency 4.4. Improving the database system **5) System Implementation and Operations**	1. Design and develop the system by making the instrument developments, which are the following applications: the MySQL Database software and the PHP language program. 2. The staff imports information into the system. The administrator tests the system. 3. Assessing system efficiency by three database experts and 60 users.	Assess the efficienc y by using mean and standard deviation	An Online Matchi ng System (OMS) for studyin g in the Graduat e Progra m

The development of the OMS for studying in the Graduate Program used the SDLC, which included the following:

1) system planning – by studying curricula information and the desires of system users;
2) system analysis – by analyzing the desires of system users, where the results of these two methods were shown in *A. Curricula Information Structure and User Demands*;
3) system design – by highlighting the OMS architecture,

the Data Flow Diagram (DFD), and the Entity Relationship Diagram (ERD), shown in *B. Online Matching System* Design *and Development*;

4) system development – by testing the efficiency of the database. The database system efficiency is assessed by three database experts and 60 users. The result of this step is reflected in *C. The System Efficiency Assessment*. Then, the researcher improves the database system; and
5) system implementation and operation – by installing the system on the Graduate School's website.

IV. Results and Discussion

A. Curricula Information Structure and User Demands

The most important piece of information used in developing the OMS for studying in the Graduate Program was curricula information, according to the demands of the users. Such information consisted of educational levels, study plans, study times, study durations, job opportunities, course strengths, scholarships, eligibility requirements, examination subjects, course expenses, number of enrollments, study locations, access to a faculty/major's website and course structures. In addition, the website should facilitate the demands of the users, such as a convenient login, attractiveness, security, warnings about data errors, quick results, and a comprehensive manual.

B. Online Matching System Design and Development

To design the OMS, the researcher used an application that followed the system architecture (see Fig. 2) as well as created applications on MySQL and PHP. Overall, the OMS design included a subsystem based on DFD and ERD (see Figs. 3 and 4.), and the OMS for studying in the Graduate Program is shown in Fig. 5.

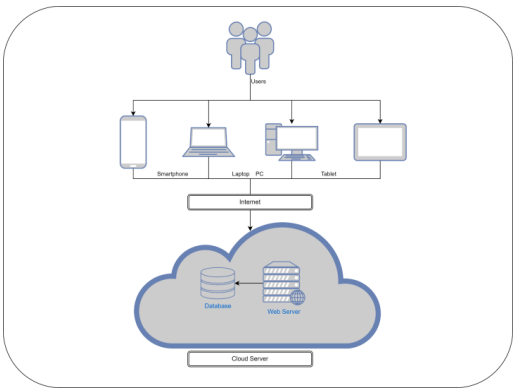

Fig. 2. The OMS architecture.

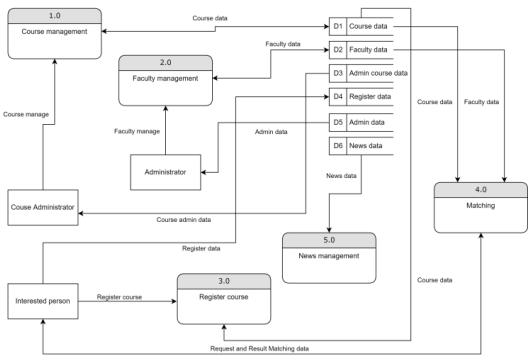

Fig. 3. The DFD for designing the OMS.

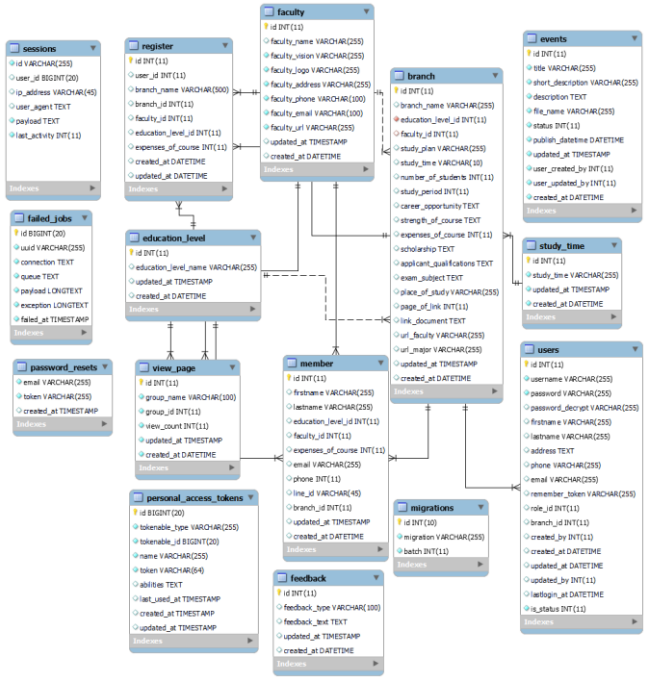

Fig. 4. The ERD for designing the OMS.

The OMS for studying in the Graduate Program can be accessed at https://match.swu.ac.th/.

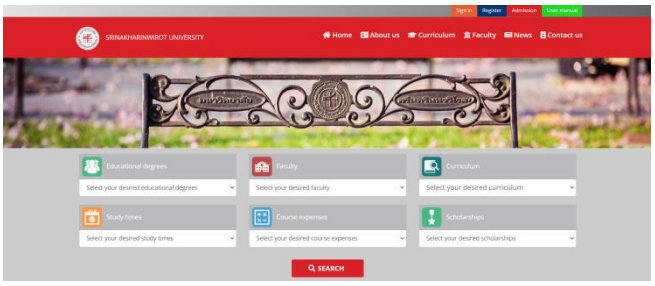

Fig. 5. The OMS for studying in the Graduate Program be accessed at https://match.swu.ac.th/

In addition, the researcher created three user manuals for the convenience of users: 1) an administrator manual wherein an administrator can add, delete, and edit background information and a user can save data; 2) a system operator manual, wherein the operator can add, delete, and edit data and browse information as well as search for information; 3) a user manual, wherein a user can search the curricula for degrees, study plans, study times, study periods, work opportunities, curricula strengths, scholarships, application qualifications, subjects for examinations, course expenses, number of exposures, locations, faculty websites, major websites, and course structures and details.

C. The System Efficiency Assessment

The OMS efficiency assessment included two processes: 1) an evaluation of the system's efficiency by information system experts and 2) an evaluation of the system's application by users.

According to Table III, which presents the results of evaluation of the system's efficiency by the information system experts, the database system was excellent ($\bar{X}$ = 4.72). In fact, every section was excellent, including the performance test ($\bar{X}$ = 4.92), usability test ($\bar{X}$ = 4.71), function requirement test ($\bar{X}$ = 4.67), functional test ($\bar{X}$ =

4.67), and security test ($\bar{X}$ = 4.67).

TABLE III: SYSTEM EFFICIENCY BY THE EVALUATION OF INFORMATION SYSTEM EXPERTS

Criteria	$\bar{X}$	SD	Verbal interpretation
Function Requirement Test	**4.67**	**0.47**	**Excellent**
1. Facilitating to search information	5.00	0.00	Excellent
2. Practical and appropriate	5.00	0.00	Excellent
3. Can be searched, modified, deleted by request	4.33	0.47	Excellent
4. Showing information entirely	4.33	0.47	Excellent
Functional Test	**4.67**	**0.47**	**Excellent**
1. Figuring out correctly	4.67	0.47	Excellent
2. Showing information entirely	4.67	0.47	Excellent
3. Can be added, modified, deleted correctly	4.67	0.47	Excellent
Usability Test	**4.71**	**0.45**	**Excellent**
1. Convenient to log in	4.67	0.47	Excellent
2. Appropriate design	4.67	0.47	Excellent
3. Appropriate arrangement	4.33	0.47	Excellent
4. Appropriate font and size	4.67	0.47	Excellent
5. Obvious language	5.00	0.00	Excellent
6. Appropriate information ordering	4.67	0.47	Excellent
7. Appropriate information saving	5.00	0.00	Excellent
8. An appropriate and comprehensive manual	4.67	0.47	Excellent
Security Test	**4.67**	**0.47**	**Excellent**
1. Appropriate access ability	5.00	0.00	Excellent
2. Appropriate admin and staff login	5.00	0.00	Excellent
3. Appropriate data entering error warning	4.00	0.00	Good
4. Information access security	4.67	0.47	Excellent
Performance Test	**4.92**	**0.28**	**Excellent**
1. Data showing standard	5.00	0.00	Excellent
2. Rapidly showing the system results	5.00	0.00	Excellent
3. Information is not redundant	5.00	0.00	Excellent
4. Appropriate matching	4.67	0.47	Excellent
Total	**4.72**	**0.45**	**Excellent**

However, the information system experts did offer the following recommendations for improvement:

1) A course research function should be added as a simple search because when multiple conditions are selected, the matching results are sometimes not displayed;
2) The main page or the "About us" page should include the purpose of the system;
3) The "About us" page should have the university links;
4) The "Curriculum" tab should show the results of the courses separated into master's and doctoral degrees;
5) The "Class time" checkboxes indicating choices should be divided into two groups, namely, "During office hours," "After hours," or "Monday to Friday" and "Saturday to Sunday";
6) As the "Costs throughout the course" box is quite frequent, it should be more broadly defined. However, this is not a huge limitation;
7) If the password for logging in is entered incorrectly, then the system should provide an alert; and
8) It will be very helpful for those who may want more information on other courses if there is a "Course of Interest" button that sends such information via email. This is similar to the "Courses that match you" section. Based on these recommendations, the researcher made amends and requested the users to assess the system.

The researcher also designed and developed the system according to the SDLC. Based on the evaluation of the system's efficiency by the information system experts, the overall database system was excellent. Additionally, every section was excellent. According to Al-Khalidi (2014), good development of measuring instruments must be aware of the needs, design, and development of the users for them to be easy to use and efficient [30]. Also, according to Siripipattanakul (2017), database design and development should analyze the demands of the users to create a user-friendly and efficient system [31].

TABLE IV: SYSTEM EFFICIENCY BY SYSTEM USERS

Criteria	$\bar{X}$	SD	Verbal interpretation
System Ability	**4.23**	**.57**	**Highly Satisfied**
1. Appropriate and practical	4.33	.66	Highly Satisfied
2. Complete information	4.10	.73	Very Satisfied
3. Facilitating demand	4.18	.75	Very Satisfied
4. Can be added, modified, deleted by demand	4.10	.68	Very Satisfied
5. Showing results correctly	4.27	.71	Highly Satisfied
6. Showing results rapidly	4.40	.67	Highly Satisfied
System Usability	**4.32**	**.61**	**Highly Satisfied**
1. Appropriate and convenient login	4.35	.78	Highly Satisfied
2. Appropriate design	4.38	.69	Highly Satisfied
3. Appropriate arrangement	4.35	.76	Highly Satisfied
4. Appropriate font and size	4.25	.65	Highly Satisfied
5. Obvious language	4.33	.73	Highly Satisfied
6. Appropriate information ordering	4.40	.64	Highly Satisfied
7. Appropriate and comprehensive command menu	4.23	.70	Highly Satisfied
8. An appropriate and comprehensive manual	4.27	.76	Highly Satisfied
System Safety	**4.26**	**.68**	**Highly Satisfied**
1. Appropriate access ability	4.28	.72	Highly Satisfied
2. Information access security	4.33	.66	Highly Satisfied
3. Appropriate error warning on data entry	4.15	.86	Very Satisfied
Total	**4.28**	**.56**	**Highly Satisfied**

Table IV presents the results of the system's efficiency as rated by the system users. In this case, the users were highly satisfied with the database system ($\bar{X}$ = 4.28). In fact, the users were highly satisfied with every section, including system usability ($\bar{X}$ = 4.32), system safety ($\bar{X}$ = 4.26), and system ability ($\bar{X}$ = 4.23).

However, the users did offer the following recommendations: i) The course information displayed after clicking "Search Course" should show the cost and study time on the first page instead of forcing users to click to see more details. ii) Once logged out, a user is stuck on the login page. If there is a button for clicking back to the main page, it will be more convenient. iii) An "Apply" button should be added on the webpage after signing in. This will allow a user to choose and apply for a course.

The users were highly satisfied ($\bar{X}$ = 4.28) with the system's efficiency. In addition, the users were highly satisfied with every section, including: system usability ($\bar{X}$ = 4.32), system safety ($\bar{X}$ = 4.26), and system ability ($\bar{X}$ = 4.23). As the system met the demands of the users, it was deemed convenient and easy to use. According to Sripaisan (2022), although a good database should be up-to-date, it should include a good design. In this regard, a well-designed database can effectively meet the demands of users. In a related study, Pattrawiwat, Siripattanakul, and Wiriyasuttiwong (2017) studied the Development of Measuring Instruments Database System in Behavioral Science of the Behavioral Science Research Institute. They

used the SDLC to develop the measuring instruments database system by creating application software on MySQL and PHP. The performance evaluation measurements found the database system to be excellent ($\bar{X}$ = 4.81), and database satisfaction was high ($\bar{X}$ = 4.28) [32]. Moreover, Pattrawiwat, Siripattanakul, and Asavaroungpipop (2020) studied the development of an OMS for the productive aging labor market. They used the SDLC as well to develop the system by creating application software with the MySQL and PHP programs. Based on the results, the database system was excellent ($\bar{X}$ = 4.30), and the users (in this case, entrepreneurs and elderly workers) were highly satisfied ($\bar{X}$ = 4.43 and $\bar{X}$ = 4.47) [33].

V. Conclusion

In this study, the development of the OMS, using the SDLC consisted of the following:

1) System planning – by studying curricula information and the desires of system users;
2) System analysis – by analyzing the desires of system users;
3) System design;
4) System development – by testing the database, assessing the system's efficiency, and improving the database system; and
5) System implementation and operations – by installing the system in the Graduate School's website.

By using the SDLC, the OMS for studying in the Graduate Program is critical for value creation that suits the requirements of the students and enhances marketability to reach the target effectively. Regarding the database system itself, the information system experts rated it excellent in every section, including the performance, usability, function requirement, functional, and security tests. Additionally, the users were highly satisfied with every section of the system, including system usability, system safety, and system ability.

Despite the positive findings, to achieve completeness and maximum efficiency, the researcher recommends that the applications in the OMS be monitored and evaluated in real-life situations. The results of the OMS in the Graduate Program should be studied and promoted so that other graduate schools, faculties, and institutions in Thailand could be more proactive in their public relations efforts. Furthermore, to accept more international students into the Graduate School, the database should include a bilingual search engine available in both Thai and English.

Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Kanchana Pattrawiwat conducted the research, designed the system, collected and analyzed the data, wrote the paper, and approved the final version.

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