THE RECOMMENDATION SYSTEM DEVELOPMENT OF STUDENT REGISTRATION WITH COLLABORATIVE FILTERING

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ABSTRACT

Backgrounds: *Recently, most students register for classes without any information and options to support their decision because the systems used do not recommend the registration instructions of each class and the number of students is increasing. Moreover, most teachers have a lot of and limited tasks, and most office staff are responsible for paper documents which can be easily lost and the right time of making an appointment between teachers and students is also limited.*

Aims: *The purposes of this research were 1) to design the recommendation system of student registration with collaborative filtering, 2) to develop the recommendation system of student registration with collaborative filtering, and 3) to assess the competency of recommendation system of student registration with collaborative filtering.*

Findings: *The results of the research revealed that the research instrument used was the model of assessment system. The sample group of subjects was the students of King Mongkut's University of Technology North Bangkok with simple random sampling. The data was analyzed by simple statistics: percentage and standard deviation (S.D.).*

Conclusion: *This research could be concluded that the success found that 1) the participants of the recommendation system of student registration with collaborative filtering were divided into three groups: students, teachers and office staff, 2) the recommendation system of student registration with collaborative filtering consisted of four development phases: planning, analysis, design, implementation, and 3) the overall efficiency of the recommendation system of student registration with collaborative filtering was at a high level ($\bar{x} = 4.51$) and the standard deviation (S.D.) was of 0.61. This showed that the performance of the recommendation system was efficient.*

Practical Implications: *The students had the guideline for course enrolment through the smart registration system and the system could enhance the student's learning outcomes. The teachers could reduce the procedures and time of consultation or finding some more information to enhance the students' learning efficiency.*

Originality/Value: *This research studied the recommendation system of student registration with the data of the students' learning outcomes by implementing the theory of data recommendation and the collaborative filtering to recommend and predict the students' learning outcomes.*

Keywords: Recommendation System, Collaborative Filtering.

INTRODUCTION

Today education is essential for students at all levels. The information and communication technology (ICT) or digital technology is implemented to enhance the learning competency. This is in accordance with the Strategy of Ministry of Education (2020-2022) stating in Part 5 that digital technology of education must be developed and promoted and the learners must access the digital platforms to meet the most updated learning (Bureau of Policy and Strategy, Office of Permanent Secretary, Ministry of Education, 2020).

Therefore, the division of registration and evaluation, which supports and promotes the teaching and learning tasks of the institutions, needs to apply the technological knowledge for registration system of added subjects to meet the office staff and all involved personnel's needs. Additionally, it is necessary to develop and improve the service quality all the time (Musiri et al., 2019). Moreover, the recommendation system of student registration is implemented to access the smart education information effectively.

At present, most students register for classes without any information and options to support their decision because the systems used do not recommend the registration instructions of each class and the number of students is increasing. Moreover, most teachers have a lot of and limited tasks, and most office staff are responsible for paper documents which can be easily lost and the right time of making an appointment between teachers and students is also limited. Therefore, the system with a calculating formula was developed to support the operations of each individual, to help decision making, and provide some more channels of consulting and recommendations, especially collaborative filtering based on the former data to analyze and recommend the information, expectations or possible proximity to provide the information or information recommendations to the users for decision making (Bobadilla et al., 2013).

In this research, the researcher implemented the theory of collaborative filtering to develop the recommendation system with the students' data for enhancing the accuracy of both similarity calculation and the prediction of the students' learning outcomes through enhancing the traditional system with mostly the business purpose not the educational purpose (Salamzadeh, 2020), and strengthening the students' competency through the substantial consultations provided with the environmental conditions of the students (Salamzadeh et al., 2014). The efficient system implemented to manage the course recommendations affects the proper decision making for enhancing the outcomes (Ginting et al., 2018).

Due to the problems mentioned above, the researcher had the idea of creating and developing the recommendation system of student registration with the collaborative filtering to solve the problems of registration to analyze the educational data, calculate the proximity, predict, and create the instructions of registration to enhance the learning proficiency.

Objectives

The objectives of this research were 1) to design the recommendation system of student registration with collaborative filtering, 2) to develop the recommendation system of student registration with collaborative filtering, and 3) to assess the competency of recommendation system of student registration with collaborative filtering.

Scope of the Study

The population was the students of King Mongkut's University of Technology North Bangkok who used the recommendation system of student registration.

The sample group of subjects was 30 students of King Mongkut's University of Technology North Bangkok with simple random sampling.

LITERATURE REVIEW

As (Sriphalang and Sriurai, 2017) mentioned above, the recommendation system of student registration with collaborative filtering consisted of four steps: 1) calculation procedure of data similarity by collecting data of the two users in tabular form, see the calculation in Figure 1, 2) selection procedure of similar members by considering subset of users on the system for the prediction, 3) prediction process as the anticipation of users' authorizations by considering the endorsements and similarities of the other items and ranking the similar items selected, as shown in Figure 2, and (4) creation of recommended items as the last step by prioritizing the recommended items from the highest prediction values to the lowest prediction values. The users could customize the items to be displayed based on their preferences.

$$sim_{t,c} = \frac{\sum_{k=1}^{n}(r_{a,j} - \bar{r}_a)(r_{u,i} - \bar{r}_u)}{\sigma_{u_i} \times \sigma_{u_j}}$$

Where, $sim_{t,c}$ is the value of similarity between users a and u

$r_{a,j}$ is the value of preference of user a to textbook i

$\bar{r}_a$ is the mean value of preference of user a to all textbooks

$r_{u,i}$ is the value of preference of user u to textbook i

$\bar{r}_u$ is the mean value of preference of user u to all textbooks

σ_{ui} is the variance of preference values of user a

σ_{uj} is the variance of preference values of user u

$$P_{a,i} = \frac{\sum \text{all}_{similar\_item}(sim_{t,c}) \times r_{u,i}}{\sum \text{all}_{similar\_item}(|sim_{t,c}|)}$$

Where, $P_{a,i}$ is the prediction value of textbook i of user a

$r_{u,i}$ is the value of textbook i of user u

$sim_{t,c}$ is the similarity value between user a and user u

METHODOLOGIES

The research methodology was the system development life cycle (SDLC) according to the four development phases: planning, analysis, design, and implementation (Jariyapoom, 2018).

Planning Phase

1. Planning was the first phase to develop the recommendation system of student registration with collaborative filtering. The developer must have a sound understanding on the system to meet the necessity of creation and development in use. The researcher, therefore, divided the people involved in the system into three groups according to the following steps: 1) studied the data of the recommendation system of registration and the theories related to collaborative filtering, 2) analyzed and synthesized the data, 3) created the interview model with the system components and needs, 4) collected the system needs from the system specialists, 5) summarized the data of the system, 6) analyzed the system, 7) designed the system, (8) developed the system (9) tried the system, and 10) implemented the system. The subjects involved were divided into three groups as follows:
2. Students: The students can access the system and register the assigned courses and then the system will process the GPA through the prediction formula. After that the students can make an appointment with the counselor through the calendar on the system and consult with their counselor through other channels and then the students can register and confirm their registration.
3. Teachers: The teachers can check the schedule of student registration on the system after that they can make an appointment with their students through the calendar on the system. After the appointment is confirmed, the teachers will provide the recommendations to the students through various channels both online and offline and then the stunts can register and confirm their registration.
4. Office staff: The office staff can add, delete, and correct all the data on the system and also check the schedules of students and the results of student registration.

Analysis Phase

The data analysis was done after the planning phase. The researcher analyzed the data with the previous and current recommendation systems as shown in Table 1 below.

Table 1
THE ANALYSIS OF ORIGINAL AND CURRENT OPERATIONAL SYSTEMS

Subjects involved	Original operational system	Current operational system
Students	- find the information of each course - register on the system - make an appointment with the counselor for recommendation of registration at the right time and meet the counselor at the university to ask for recommendation. - discuss about the registration with their counselor - add or withdraw the courses to meet the student's need and get the counselor's signature	- access the ready system to register - The system analyzes and processes the data with collaborative filtering in the database. - make an appointment with the counselor for recommendation of registration online or face to face - Both the counselor and the student discuss on the registration for at least 5 courses. - can add and change the courses and confirm the registration immediately
Teachers	- make an appointment with the students - provide some recommendation when the students ask for - study the information of each course - help the students to select the courses to register	- the calendar available in the system to make an appointment at the right time - There are a lot of channels of recommendations both online and face to face. - The data is analyzed and processed with collaborative filtering in the database. - At least 5 courses are analyzed to select for registration.
Office staff	- follow the paper work from the first step until the final step	- follow the computer system, website and internet network from the first step until the final step

Table 1 shows the data analysis of the original and current operational systems and three people involved: students, teachers and office staff. The system operates through the implementation of the students' relationship management, database system, data cloud, internet

and communication network, and also the tools to comfort the learning of the students and teachers.

Design Phase

1. The design phase was the step that the developer of recommendation system of student registration with collaborative filtering must design the new system after the data analysis phase to show the relationship of the structure on the system as follows.
2. The office staff can manage and check the students' data, course details, contents of the lessons, appointment calendar, face to face recommendations, online recommendations, recommendation system of student registration, and electronic bulletin board.
3. The teachers can check the students' data, course details, contents of the lessons, appointment calendar, face to face recommendations, online recommendations, recommendation system of student registration, and electronic bulletin board.
4. The students can check their personal information, course details, contents of the lessons, appointment calendar, face to face recommendations, online recommendations, recommendation system of student registration, and electronic bulletin board.

Implementation Phase

1. The implementation phase was to create and enhance the system to meet the requiement and consistency of the system design. At this step, all parts of the program were developed for implementation and it could be explained as follows.
2. After the codes were put in the system, the three groups of people involved including students, teachers, and office staff were authorized to access the system. The development of the recommendation system of student registration with collaborative filtering consisted of two formulas of programming, i.e., similarity calculation and learning outcome prediction using the language and data of the Code Editor program. After that, the new system was designed and developed by using the programming languages of HTML, MySQL and jQuery to enhance the total operations of the recommendation system of student registration with collaborative filtering. The researcher developed the system with the implementation of prediction procedure to help the students see the results of their learning outcome prediction. The system could show the results at least five subjects as shown in Figure 3 below.

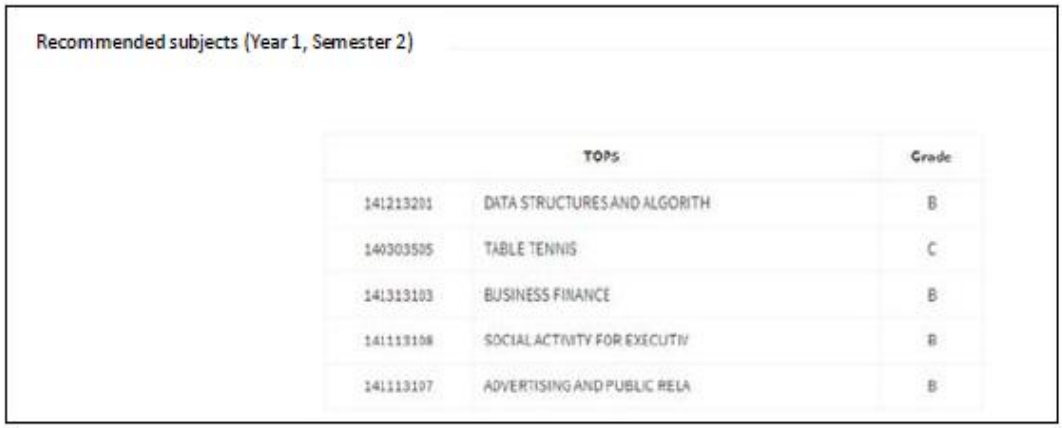

FIGURE 1
LEARING OUTCOME PREDICTION

RESULTS

After the recommendation system of student registration with collaborative filtering was developed through the formulas of similarity calculation and learning outcome prediction, the data, outputs and the system performance were displayed in accordance with the following objectives.

Objective 1, the recommendation system of student registration with collaborative filtering based on the architectural design with the system performance and all the other parts related to the system as shown in Figure 2 below.

Figure 2 shows that the recommendation system of student registration with collaborative filtering was developed for the operations of the three groups of the authorized people: students, teachers and office staff.

The students can access the recommendation system of registration and register the required courses. And then, the system processes the registration through the collaborative filtering with the two formulas of similarity calculation and learning outcome prediction. When the system finishes the registration calculation, the results of the recommendation system of student registration are displayed. After that the students can make an appointment through the appointment calendar with their counselors and ask for some more information from their teachers through channels of both online conference and face-to-face consultation. They can register and confirm the registration in the system.

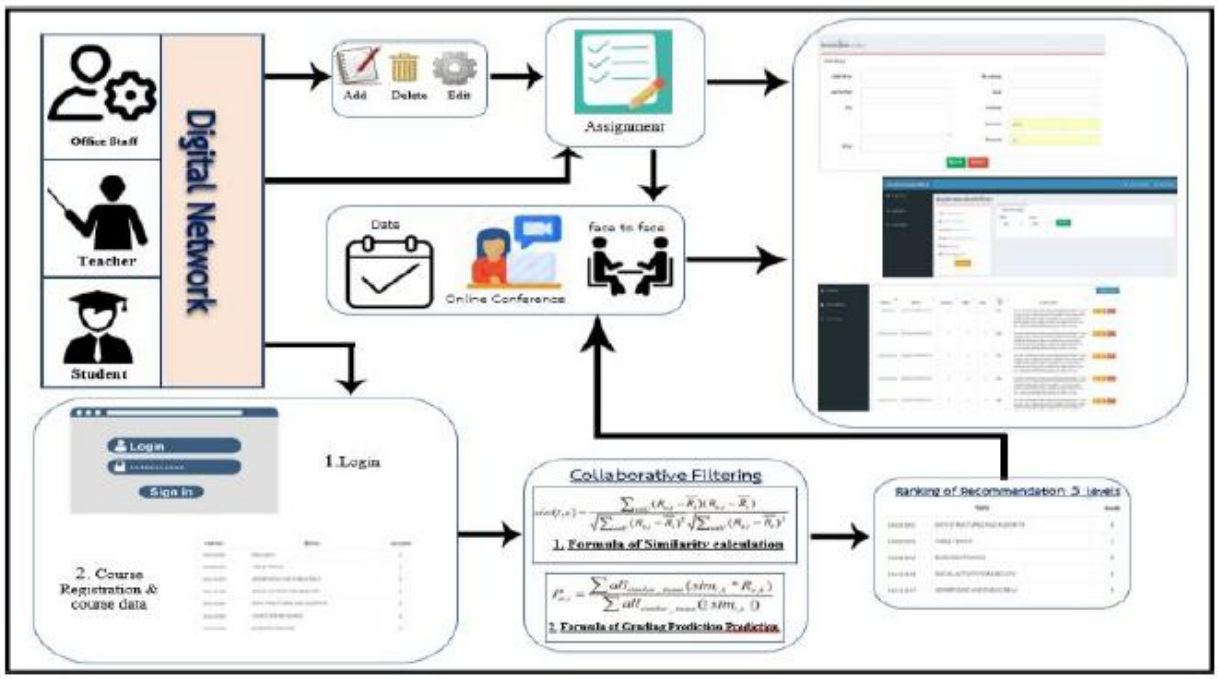

FIGURE 2
ARCHITECTURAL DESIGN

The teachers can access the system by using their own code provided and check the students' registration calendar of the recommendation system of student registration with collaborative filtering. And then, the system processes the registration through the collaborative filtering with the two formulas of similarity calculation and learning outcome prediction. When the system finishes the registration calculation, the results of the recommendation system of

student registration are displayed. After that the teachers can confirm the appointment with the students through the appointment calendar. Then the teachers can provide recommendations to the students through both online conference and face-to-face consultation. They can register and confirm the registration in the system.

The office staff can add or delete or edit the recommendation system to facilitate the users including the students.

Objective 2, after the recommendation system of student registration with collaborative filtering was developed with the two formulas of similarity calculation and learning outcome prediction. The students can register as usual through the operational system. Before the recommendation system of student registration processes, the learning outcome prediction database and course database are available on the system. When the students register, the system processes the students' registration and displays the recommendation of at least five courses.

Objective 3, the researcher used the purposive sampling method to divide the users into three groups: students, teachers, and office staff. The questionnaire with five-level Likert scale was implemented and the results of the system quality were evaluated by the seven experts as shown in Table 2 below.

Table 2
RESULTS OF THE SYSTEM QUALITY EVALUATED BY THE EXPERTS

Evaluation items	Quality level	
	$\bar{X}$	S.D.
Overall	4.51	0.61
1. Performance Test	4.43	0.79
2. Functional Test	4.57	0.53
3. Reliability Test	4.71	0.49
4. Usability Test	4.57	0.53
5. Security Test	4.29	0.76

Table 2 shows the results of evaluating the quality of the recommendation system of student registration with collaborative filtering. It revealed that the overall mean of the system quality was of 4.51 and the standard deviation (S.D.) of 0.61. Therefore, the quality of the recommendation system of student registration with collaborative filtering technique was at the highest level.

DISCUSSION

In this research, the researcher developed the recommendation system of student registration with collaborative filtering and the results of this research were discussed as follows.

The Development of Registration System and Data Processing

The current situations cause the social distancing and the government manipulates the policy to enhance the quality of the communication and internet projects for the better online access and benefits of both students and teachers. This is in accordance with the study of Jareonsettasin (2020) stating that the communication system management during the crisis of situations is necessary for the development of the future educational management and the design of educational administration after the critical situations. Therefore, effective communication and

fast operations are important for all the sectors to get the highest benefits (Thongkaew, 2020) and this is also in accordance with the study of Ausawawiwatkul & Kijmee (2013) on *"The Development of Registration and Data Processing of Chiang Mai Commercial Technology College"* stating that problems of registration and data processing of Chiang Mai Commercial Technology College are the redundant works and multiple operational steps which can delay the documentation and increase the workload, and in accordance with the study of Weerapalin et al. (2018) on *"The Development of Registration Information System and Data Processing of Phitsanulok University"* stating that the data management through the application platform and the linkage of different databases are important for the effective functions of the data processing of the collaborative database of students' admissions and records, and also in accordance with the researches of Sitti & Sopeerak (2015) and Jugo et al. (2016) which studied the guidelines for network learning as the process of analyzing the knowledge management affecting the efficiency of the learning process. This is also in accordance with the study of Jafari et al. (2012) on *"Challenges of Entrepreneurship E-education: Evidences from a Developing Country"* with two sampling groups, i.e., students and teachers. This can show the changes in the system implementation and educational difficulties of budgets and teaching methods.

The System Development Life Cycle

The system of development life cycle consists of four phases. The formulas were calculated through the collaborative filtering and the system development must be conducted from the beginning to the end. This is in accordance with the studies of Ricci et al. (2010); Jannach et al. (2011); Ghauth & Abdullah (2010) stating that the collaborative filtering consists of four steps, i.e., 1) similarity calculation of the data by implementing the tabulated data of the two users , (2) selection process of the similar members by looking at a brief data of the users on the system for further prediction, (3) prediction process as the anticipation of users' authorizations by considering the endorsements and similarities of the other items and ranking the similar items selected, and (4) creation of recommended items as the last step by prioritizing the recommended items from the highest prediction values to the lowest prediction values, in accordance with the study of Capron & Johnson (2004) stating that the system development consists of five steps, i.e., (1) system planning, (2) system analysis, (3) system design, (4) system creation, and (5) system implementation and support. This is also in accordance with the studies of Daengdech (2007) and Aiemsiriwong (2004) stating that the development of content management system using the network diagram or NBCLMS with collaborative filtering consists of five steps, i.e., system planning, system analysis, system design, system development and system implementation. The results of the system development were in accordance with the assigned objectives and the experts evaluated the system quality at a high level.

The Evaluation of System Quality

The evaluation of system quality consists of five tests, i.e., performance test, functional test, reliability test, usability test and security test for the rapid and comfortable access of the system users in various dimensions. This is in accordance with the study of Barron & Ivers (1996) stating that the advantages of implementing the educational internet network are: the reduction of paper use, cost saving, effective data recording, simplicity of data preparation and document delivery and also the development of updated data. The internet network is the

effective data link between the teachers and the students through various communication channels.

Recommendations

At the macro level, the recommendations are as follows:

1. The national government should have the national strategic plan for education to promote the implementation of the recommendation system of student registration with collaborative filtering.
2. The academic institutions should implement the recommendation system of student registration with collaborative filtering for the social distancing situation and the control of the COVID-19 pandemic.

At the micro level, the recommendation is that the communication and network systems are essential for the operational process of the recommendation system of student registration with collaborative filtering to support the simultaneous communications of all the users.

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