

## AN INTELLIGENT RECOMMENDATION SYSTEM FOR STUDENT RELATIONSHIP MANAGEMENT

*Kanokwan Kongsakun, Chun Che Fung and Wudhijaya philuek*

School of Information Technology, Murdoch University, Murdoch, WA, Australia  
[kokoya002@yahoo.com](mailto:kokoya002@yahoo.com), [L.fung@murdoch.edu.au](mailto:L.fung@murdoch.edu.au) and [woodiefamous@gmail.com](mailto:woodiefamous@gmail.com)

**Abstract** Many universities have implemented innovative information systems and services to help their students and to support academic management processes. This paper proposes a conceptual framework to support Student Relationship Management (SRM) for Thai universities in the new electronic era. This conceptual framework assists students to choose appropriate course and subjects for their studies. The objectives of this article aim to broaden an understanding of SRM and related issues focus on recruitment, enrolment and course counseling. An Intelligent Recommendation System framework (IRS) has been designed using data mining and artificial intelligent techniques such as clustering, association rule and fuzzy logic. These techniques will be used to assess the performance of the students and to provide appropriate recommendations for their choice of courses and subjects.

**Index Terms**—Recommendation System, SRM and student issues

### 1. INTRODUCTION

One of the performance criteria of an educational institute is the number of successful completions by the students. However, records have shown that not all students enrolled as freshmen will succeed [1]. The failures can be attributed to high rates of drop-outs from the courses or other factors faced by the students. This is highly undesirable as this means wasted resources and reduced number of graduates to meet the demands by the industry and the community. There are many causes to this problem, and they could occur anytime during the course of study. One of the factors may be due to the enrolment process where a student has not selected or has not received recommendations for courses that are more suitable for the student.

With limited resources and increasing competition for students in the education sector, higher education institutes are focusing on efforts to increase the rate of student retention and completion. In addition, a university's performance is also increasingly being used to measure its quality and "reputation" [2]. One aspect of such measurement is based on factors which affect a student's satisfaction. For instance, Gatfield [3] has concluded that it

is significant for higher education institutes to concentrate on the issue of quality, through accreditation processes and various aspects of quality services from the students' perspectives. Another aspect of student services is counselling. Archer and Cooper [4] confirmed that provision of counselling services is an important factor contributing to students' academic success. In addition, Urata and Takano [5] stated that the essence of the student counselling should include advices on career guidance, identification of learning strategies, handling of interpersonal relation, along with self understanding of the mind and body. It can be said that a key aspect of student services is to provide counselling on course guidance as this will assist the students in their decision and future university experience. Many students choose particular courses of study just because of perceived job opportunities. However, issues may arise if a student is not interested in the career, or if the course is not suitably matched with the student's capability[6]. In the tertiary education sector, teaching staff may have insufficient time to counsel the students due to workload and there are inadequate tools to support them. Hence, it is desirable that some forms of intelligent recommendation tools could be developed to assist students in or before they enrol in the universities. This forms the motivation of this research.

The remaining sections of this paper are organized as follows. The next section gives the concepts of SRM. Section 3 discusses the issues faced by university students in Thailand. Section 4 focuses on current solution, then the proposed framework, which presents the main idea and the research methodology is shown in the section 5. This paper concludes with discussions on the work to be undertaken and future development.

### 2. STUDENT RELATIONSHIP MANAGEMENT

In general, business organizations and corporations rely on successful relationship with customers and they dedicate a lot of efforts to gain or maintain their customers, and to establish successful relationships with them [7]. Customer Relationship Management (CRM) is a management concept in order to enhance customer's satisfaction and the relationship with their customers [8]. Furthermore, CRM

has been defined as “a fundamental strategic orientation, which is pursued by all members of a company in order to increase customer satisfaction, customer loyalty and the benefit for the consumer as well as for the company during the entire supplier-customer-relationship”[9].

In the context of the educational institutes, the students may be considered having a role as “customers” (although it is arguable that whether this is acceptable from education perspectives) and the objective of Student Relationship Management is to increase their satisfaction and loyalty for the benefits of the institute. SRM may be defined under a similar view as CRM and aims at developing and maintaining a close relationship between the institute and the students by supporting the management processes and monitoring the students’ academic activities and behavior. Piedade and Santos [7] explained that SRM involves the identification of performance indicators and behavioral patterns that characterize the students and different situations under which they are supervised. In addition, the concept of SRM is “understood as a process based on the student acquired knowledge, whose main purpose is to keep a close and effective students institution relationship through the closely monitoring of their academic activities along their academic path”. SRM can be utilized as an important means to support and enhance a student’s satisfaction[10].

Understanding the needs of the students is essential for their satisfaction. It is necessary to prepare strategies in both teaching and related services to support Student Relationship Management. The significance of developing a strong relationship between university and student is a long term strategy.

### 3. ISSUES FACED BY UNIVERSITY STUDENTS

Prior studies have investigated issues faced by students during their time in the universities. The causes of the problems and issues are many. For example, depression is common and enfeeble problem among some tertiary students. It impacts the student behaviours as regard to their experience and affect the student’s motivation, concentration, feeling of self-worth, and mood [11]. From the perspective of the university, the issues are related to allocation of resources and how to recruit students of high calibre and who have high probability of completion. If management decisions are not made appropriately, this could lead to unfulfilled number places and lost of potential tuition fees. The problem of student retention in higher education could be attributed to low student satisfaction, student transfer and drop-out [12]. This issue leads to lose of students and revenue, and increasing cost of replacement. Moreover, it was found that the quality and convenience of support services are other factors that influence students to change educational institutes in higher education [13].

Therefore, in the recruitment and enrolment of students in higher education, it is necessary to meet the student’s needs and to match their capability. Understanding the student’s needs will enhance the student’s learning experience and increase their chances of success, and reduce wastage of resources due to dropouts, and change of programs.

### 4. CURRENT SOLUTIONS

An understanding of the existing information systems can assist student management, student services and market operation for the participants. It is important to develop strategy to maintain and enhance student satisfaction which is the key role in SRM. Among the researches and the paper concerning SRM, there are relevant proposals on solutions for the university management and students. Some examples of such solutions are as shown below.

Piedade and Santos [7] proposed a SRM system’s architecture which support the SRM concepts and techniques that assist the university’s Business Intelligent System. Moreover, the project provided a tool to aid the tertiary student for the decision-making process. The SRM strategy also provided the institution with SRM practices, including the planned activities to be developed for the students, as well other relevant participants. The study found that the technological support to the SRM concepts and practices were insufficient at the time of writing.

Another solution focused on the provision of counselling and careers services, which has been adopted by many universities. To enhance the university’s mission, the prominent services provided by universities are psychological counselling, careers and work-placement advice and financial assistance. In addition, feedback from students is vital is the process.

In business, focusing on customer retention is significant [14, 15]. In term of education systems, Ackerman and Schibrowsky [16] have applied the concept of business relationships and proposed the business relationship marketing framework. The framework provided a different view on retention strategies and an economic justification on the need for implementing retention programs. The prominent result is the improvement of graduation rates by 65% by simply retaining one additional student out of every ten. The researcher added that this framework is appropriate both on the issues of places on quality of services. Although some problems could not be solved directly, it is recognised that Information and communication technologies can be used and contributes towards maintaining a stronger relationship with students in the educational systems [7].

### 5. PROPOSED ARCHITECTURE OF RECOMMENDATION SYSTEM

There have been several solutions supporting SRM for university students; however, no system has focused on the

recommendation system for students using historic completed cases. A recommendation system could apply statistical, artificial intelligence and data mining techniques to the problem of making appropriate recommendation for the students.

background such as student preference, previous results, scores of each subject from each semester and the overall GPA from the enterprise database. The result will then be used to compare the profile of the new students. The recommendation system will then provide the most appropriate courses and subjects for students.

Figure 1 illustrates the proposed recommendation system framework. The proposal aims to analyse student

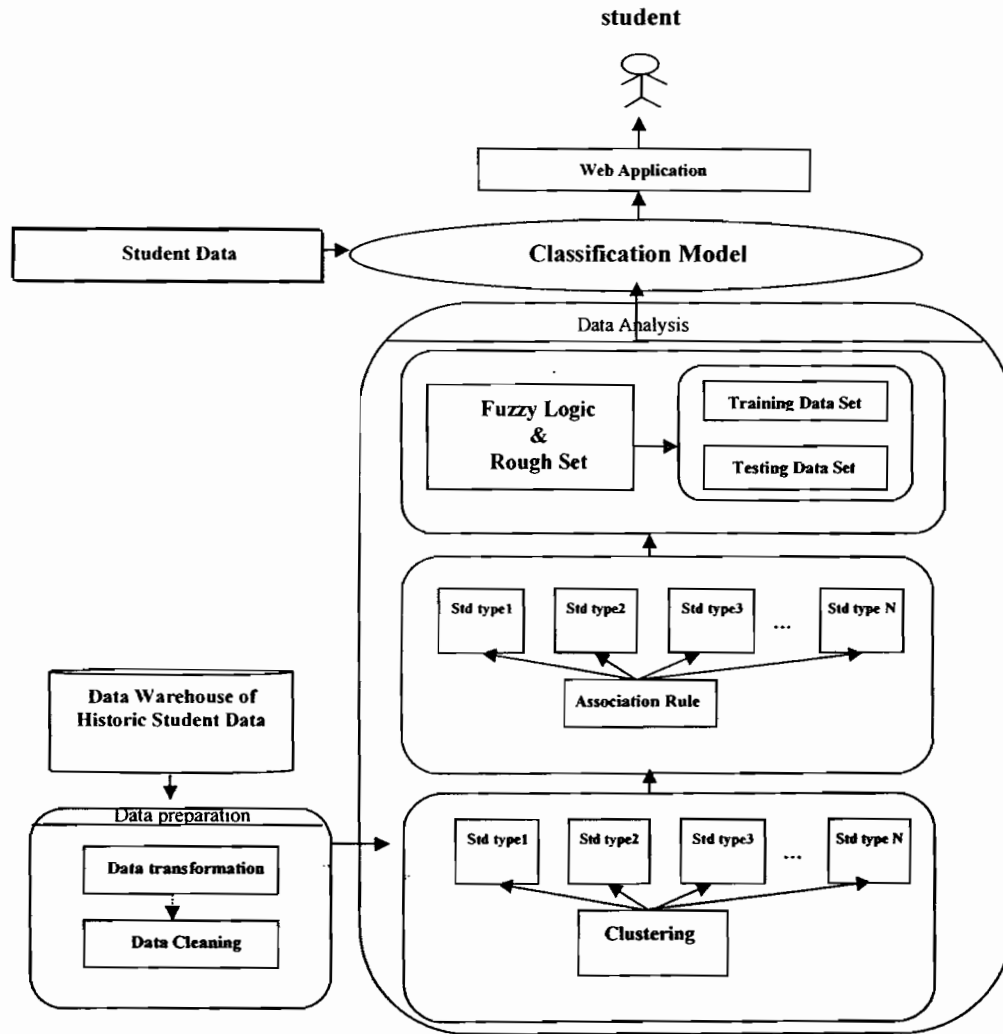


Figure 1: Proposed Recommendation System Framework in Support of Student Relationship Management (SRM)

This framework plans to use three main techniques: Clustering Technology, Association Rule and Classification using Fuzzy Logic and Rough Set. It is divided into three phases: Data Preparation, Data Analysis and Predictive Modeling. They are described in the following sections.

### 5.1 Data Preparation

After data collection, the data will be re-formatted in the stage of data transformation. In the cleaning process, the

parameters used in the data analysis will be identified and the missing data will be handled [17].

## 5.2 Data Analysis

Next, Clustering Techniques such as K-Means Clustering Algorithm will be applied to group the data [18]. The process of clustering has been used to describe target customer's behavior in marketing and CRM [19]. In this research, clustering is used to classify the target student's performance into the meaningful subgroups based on historic data. The set of data items from the clustering process will be applied in this process. Association rule will then be used to examine the relationships between the subgroups [19, 20]. For instance, this process will be applied to identify the student features that appear most often. The coverage of Association Rule is the number of instances that it predicts correctly [18]. The most common output will be analyzed and compared with the clustering output to ensure the prediction more correctly.

Next, the classification based on Fuzzy set theory and Rough Set will be applied [21]. Fuzzy set has been used for knowledge representation, system control and decision making. A typical fuzzy system consists of four basic modules which are fuzzification unit, inference module, fuzzy rule base and de-fuzzification unit. In this process, data will be selected by selective sampling process and the classification rules will be derived from the training set. For example, a simple fuzzy rule could be expressed as:

If GPA= "A" and Interested Subject1= "Math" and interested subject2= "computer" then recommend= "Computer Science"

To validate the accuracy of the rules from the training data set, an independent testing data set will be applied. The important point in this stage is the need to gather efficient training set to create classified rules. Rough set will also be used to find the minimal subsets of attributes and they will be applied to data with categorical values.

## 5.3 Prediction Model

The prediction model is an integrated process which evaluates the outputs from the previous stage and applies a weighted formula to determine the final recommendation. The weights will be determined or learnt from previous historic data and subject to human intervention based on the experience of the counselor or advisor.

## 6. CONCLUSION

The article describes a proposal on a recommendation system in support of SRM and to address issues related to the problem of course advice or counseling for university

students. The recent work is focusing on the development and implementation of each process in the framework. Once developed, the system will be tested and the prediction model will be refined. The recommendation system will be a useful service for students supporting a university's Student Relationship Management strategy.

## 7. REFERENCES

- [1] J. P. Bean, "Nine themes of college student retention," in *College Student Retention: Formula for student success*, A. Seidman, Ed. America: CT: Praeger, 2005, p. 29.
- [2] K. Jusoff, S. A. A. Samah, and P. M. Isa, "Promoting university community's creative citizenry," in *Proceeding of world academy of science*, 2008, pp. 1-6.
- [3] T. Gatfield, "A scale of marketing for higher education," *Journal of Marketing for Higher Education*, vol. 10, pp. 27-41, 2000.
- [4] J. J. Archer and S. Cooper, "Counselling and Mental Health Services on Campus," in *A handbook of Contemporary Practices and Challenges* Jossy-Bass, Ed. San Francisco, CA, 1998.
- [5] U. Uruta and A. Takano, "Between psychology and college of education," *Journal of Educational Psychology*, vol. 51, pp. 205-217, 2003.
- [6] D. T. Gamage, J. Suwanabroma, T. Ueyama, S. Hada, and S. Etsuo, "The impact of quality assurance measures on student services at the Japanese and Thai private universities," *Quality Assurance in Education*, vol. 16, pp. 181-198, 2008.
- [7] M. B. Piedade and M. Y. Santos, "Student Relationship Management: Concept, Practice and Technological Support," *IEEE Xplore*, pp. 2-5, 2008.
- [8] C. Jie and W. Mingzan, "The data Excavation model in CRM based on Fuzzy Rule," in *ICIEA 2007. 2nd IEEE conference*, 2007, pp. 742-745.
- [9] A. Hibert, K. Schonbrunn, and S. Schmode, "Student Relationship management in Germany-foundation and opportunities," *Management Revue*, vol. 18, 2007.
- [10] K. Harej and R. V. Horvat, "Customer Relationship Management Momentum for Business Improvement," *Information Technology Interfaces(ITI)*, pp. 107-111, 2004.
- [11] B. Andrews and J. M. Wilding, "The relation of depression and anxiety to life-stress and achievement in students," *British Journal of Psychology*, vol. 95, pp. 509-521, 2004.
- [12] A. L. Caison, "Determinates of Systemic Retention: Implications for improving retention practice in higher education," in *Journal of College Student Retention*. vol. 6, 2004-2005, pp. 425-441.

- [13] P. Helland, H. J. Stallings, and J. M. Braxton, "The fulfillment of expectations for college and student departure decisions," *Journal of College Student Retention*, vol. 3, pp. 381-396, 2001-2002.
- [14] P. C. Verhoef, "Understanding the effect of Customer Relationship Management Efforts on Customer Retention and Customer Share Development," *Journal of Marketing*, vol. 67, pp. 30-45, 2003.
- [15] R. N. Bolton, P. K. Kannan, and M. D. Bramlett, "Implications of Loyalty Program Membership and Service Experiences for Customer Retention and Value," *Journal of the Academy of Marketing Science*, vol. 17, pp. 45-65, 2000.
- [16] R. Ackerman and J. Schibrowsky, "A Business Marketing Strategy Applied to Student Retention: A higher Education Initiative," *Journal of College Student Retention*, vol. 9, pp. 330-336, 2007-2008.
- [17] K. W. Wong, L. C. C. Fung, T. Gedeon, and D. Chai, "Intelligent Data Mining and Personalisation for Customer Relationship Management," in *International Conference on Control, Automation, Robotics and Vision Kunming 8th China*, 2004, pp. 1796-1801.
- [18] I. H. Witten, *Data mining: Practical Machine Learning Tools and techniques*. United state of America: Elsevier, 2005.
- [19] S. Liao, T. Zou, and H. Chang, "An Association Rules and Sequential Rules Based Recommendation System," in *Wireless Communications, Networking and Mobile Computing, 2008.*, 2008, pp. 1-4.
- [20] A. Anand and D. Khots, "A data mining framework for indentifying craim overpayments for the health insurance industry," in *The 3rd INFORMS Workshop on Data Mining and Health Informatics 2008*, 2008.
- [21] K. W. Wong, C. C. Fung, and T. D. Gedeon, "Data Mining Using Neural Fuzzy for Student Relationship Management," in *International Conference of Soft Computing and Intelligent Systems*, Tsukuba, Japan, 2002.