

The System Architecture of Intelligent Student Relationship Management Based on Cognitive Technology with Conversational Agent for Enhancing Student's Loyalty in Higher Education

Nutthapat Kaewrattanapat¹, Panita Wannapiroon¹ & Prachyanun Nilsook¹

¹ Division of Information and Communication Technology for Education, Faculty of Technical Education, King Mongkut's University of Technology North Bangkok, Thailand

Correspondence: Nutthapat Kaewrattanapat, Division of Information and Communication Technology for Education, Faculty of Technical Education, King Mongkut's University of Technology North Bangkok, Thailand.

Received: November 11, 2022

Accepted: December 29, 2022

Online Published: March 26, 2023

doi:10.5539/ies.v16n2p103

URL: <https://doi.org/10.5539/ies.v16n2p103>

Abstract

This paper presents the conceptual framework, value chain model and the system architecture of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student's loyalty in higher education. The purposes were to synthesize the conceptual framework and apply it to develop the value chain model and the system architecture of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student's loyalty in higher education and assess the developed value chain model and system architecture. The questionnaire was employed as the instrument to assess and certify the value chain model and the system architecture by the experts. The 5 point-Likert scale was used to identify the level of agreement of the value chain model and system architecture certification assessment. The instrument was verified by five experts using content validity index (CVI). After that, the value chain model and the system architecture were verified based on the consensus assessments of seventeen experts using mean, standard deviation (S.D.), median, interquartile range and quartile deviation. The results revealed that the experts had a consensus on the value chain model developed based on the conceptual framework (Mean = 4.89, S.D. = 0.27, Median = 5, Interquartile Range: I.R. = 0.00, Quartile Deviation: Q.D. = 0.00). They also had a consensus to approve the system architecture developed based on the value chain model (Mean = 4.70, S.D. = 0.55, Median = 5, Interquartile Range: I.R. = 1.00, Quartile Deviation: Q.D. = 0.50).

Keywords: intelligent student relationship management, conversational agent, cognitive technology, student's loyalty

1. Introduction

At present, public and private educational institutions have started to drive student relationship management to maintain the student retention rate until graduation. It is because students are the best indicator of the quality of educational management, especially in higher education institutions where graduates are the products that play a role in the development of the country. Student relationship management (SRM) is the application of the customer relationship management (CRM) strategy to suit the specific context of student relationship management (Lechtchinskaia, Friedrich, & Breitner, 2012) by building and maintaining relationships between students and institutions, or students' loyalty. This is the issue that educational institutions at all levels should be aware of and prioritize, especially in the era of competition with knowledge and intelligent technology, which is different from the previous era which only competed with knowledge. Therefore, digital transformation and digital convergence are needed in various services of higher education institutions to create valuable experiences, including academic, professional and service experiences for students such as analyzing personal data for learning adaptation and providing valuable services, or recognizing and listening to voices or conversations between students and higher education institutions through digital storage. The implementation of the student relationship management system requires a highly efficient information management system because educational institutions have a large amount of information generated from teaching, research, administration, and student services. This information should be transmitted smoothly and efficiently to various departments (Maican & Lixandriou, 2016). Therefore, it is imperative that the academic records and relevant digital contents be carefully managed (Miah & Samsudin, 2017; Orawan & Thanyarat, 2011) to avoid data overlap in the student relationship management. Student relationship is a

new issue that educational institutions are starting to pay attention to. It also challenges in the field of education. However, it has been found that educational institutions still lack clear guidelines for student relationship management and face problems in managing the information used in the student relationship management system effectively.

Therefore, this paper proposes the way to increase the capacity of intelligent student relationship management based on cognitive technology with conversational agent, consisting of the concepts of intelligent student relationship management (i-SRM), conversational agent and intelligent information management (IIM). The conversational user interface (CUI) is employed to enable students to access information, and services of higher education institutions conveniently and efficiently by considering two factors of user perception based on the technology acceptance model (TAM), which are perceived of ease of use and perceived of usefulness (Adams, Nelson, & Todd, 1992). The conversational user interface (CUI), known as “Chatbot”, is now widely used through smartphones and web applications. The outstanding feature of Chatbot is the direct response through text messages, voice, or images from users. There is the conversation agent to understand the users’ intent and perform the services requested by the users. Higher education institutions provide academic services and other services to a lot of university students, resulting in a large amount of data and documents. Consequently, it is needed to have the intelligent information management (IIM) system that helps to manage large amounts of data and documents intelligently (Mancini, 2014, 2017) and to seamlessly connect to the conversational agent for providing services to students in higher education efficiently. For this reason, the researchers conducted a study to synthesize the conceptual framework and develop the value chain model and the system architecture of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student’s loyalty in higher education with the aim to be the guideline for increasing the capacity of intelligent student relationship management in higher education. It will be applied in higher education institutions or as part of the development of various service systems and information systems of higher education institutions. The intelligent student relationship management system will result in students’ satisfaction and loyalty and reduce the risk of dropping out of university.

2. Purpose

- 1) To synthesize the conceptual framework of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student’s loyalty in higher education.
- 2) To develop the value chain model of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student’s loyalty in higher education based on the synthesized conceptual framework.
- 3) To assess and certify the value chain model of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student’s loyalty in higher education.
- 4) To develop the system architecture of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student’s loyalty in higher education based on the developed value chain model.
- 5) To assess and certify the system architecture of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student’s loyalty in higher education.

3. Literature Review

3.1 Student Relationship Management: SRM

Student relationship management (SRM) is an application of the customer relationship management (CRM) strategy to suit the specific context of student relationship management. The definitions of student relationship management are defined as follows.

(Piedade & Santos, 2018) defined the definition of student relationship management as a process that uses students’ information to maintain relationships with educational institutions. There also is a process of tracking students’ activities and academic paths. (Vulić, Labus, & Despotović-Zrakić, 2014) defined the definition of student relationship management as a business system that maintains the relationship between students and the university. The key factors making the student relationship management system successful are the quality of services and the students’ satisfaction. (Lechtchinskaia, Friedrich, & Breitner, 2012) stated that “student relationship management is an application of the customer relationship management (CRM) strategy to fit the specific context of student relationship management, including the activities that build and maintain relationships between students and educational institutions.” (Radenkovic, Despotovic-Zrakic, Bogdanovic, Labus, & Milutinovic, 2013) stated that “student relationship management is the care and management of relationships with

students in the student life cycle. It is important to gather information for the adjustment of education and service management systems to be consistent with each student.”

From the aforementioned definitions, it can be concluded that student relationship management is the application of the customer relationship management (CRM) strategy to suit the educational context. The goal is to build and maintain the relationship between students and educational institutions, which will lead to students’ loyalty. However, building students’ loyalty is not an easy task, and takes time. Therefore, student relationship management should focus on creating students’ satisfaction in various fields, especially in terms of teaching and learning quality as well as providing various learning materials and services to students in a timely manner. This will result in students’ satisfaction and loyalty and reduce the risk of dropping out of university.

At present, the concept of intelligent technology has been proposed for student relationship management to make changes and increase the efficiency of student services according to the characteristics and behaviors of each student, such as offering learning resources, providing student services and automatic suggestions to provide support and assistance in a timely manner, offering places for professional experience practice that are aligned with the competency of each student. This will directly cause students to have satisfaction and loyalty to educational institutions. It can be done by applying intelligent technology with student relationship management, which is called intelligent student relationship management (i-SRM).

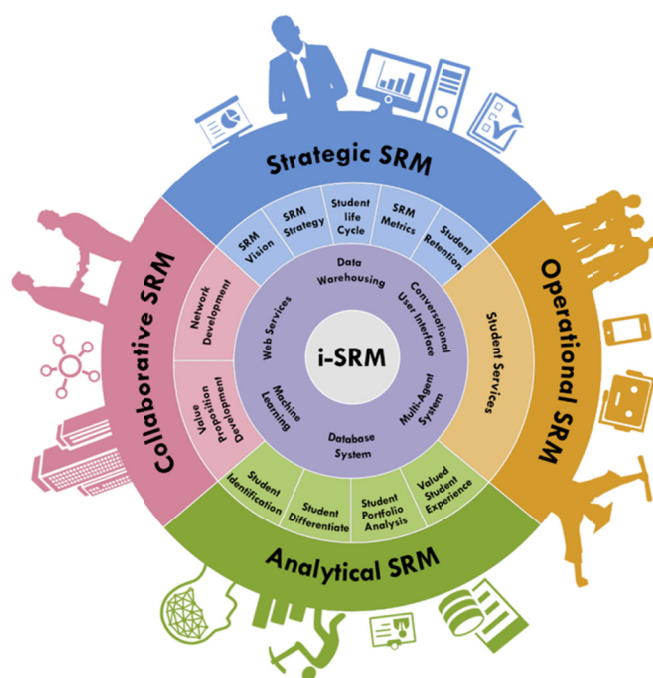


Figure 1. Intelligent Student Relationship Management Model: i-SRM (Kaewrattanapat & Wannapiroon, 2018)

3.2 Intelligent Information System: IIM

The Association for Information and Image Management (AIIM), which is the central agency to determine the direction of the development of technology document management industry, has defined the definition of enterprise content management (ECM) as strategies, methods and tools that are used to capture, manage and store the documents and preserve the content and transfer the content according to the organizational process (Maican & Lixandriou, 2016). This process requires appropriate hardware and software technology to effectively achieve the goal of managing large amounts of corporate content in the electronic form (Alalwan & Weistroffer, 2013; Tyrväinen, Päivärinta, Salminen, & Iivari, 2006). In June 2017, the AIIM replaced the term ECM with IIM. The term IIM stands for “Intelligent Information Management”. IIM differs greatly from traditional ECM. The scope of IIM includes managing both data and content in the organization and supporting the connection of various current and future intelligent systems effectively (Mancini, 2017).

Intelligent information management (IIM) refers to the change in the concept of information management from

separating the data and content of the organization to managing both data and content of the organization together (Mancini, 2014). Since the enterprise content management (ECM) separates data and document content, the analysis and processing are unsupported. So, ECM is beneficial to the organization only in data storage. It is difficult for the organization to manage and report summary data in making important decisions. Therefore, the intelligent information management (IIM) bridges this gap by integrating stored or linked information and content for the benefit of joint analysis, inspection and operation with humans and machines or robots. It also allows other software systems to access the digital resources of the organization, resulting in highly efficient collaboration. The intelligent information management (IIM) relies on various intelligent technologies that support data digital content and organizational processes such as cloud computing (Rodmunkong, Wannapiroon, & Nilsook, 2014), artificial intelligence (AI), machine learning, semantic technology to intelligently extract and classify data and documents and blockchain technology to secure and reduce the risk of storing data in one central location. The core competence of intelligent information management (IIM) proposed by the Association for Information and Image Management (AIIM) is published in a document, titled “THE NEXT WAVE: Moving from ECM to Intelligent Information Management” as shown in Figure 2.

WHAT	HOW			
Core IIM capabilities	For organizations to digitally transform, they need a much broader – and more “consumable” – content toolkit than was offered by ECM.			
Modernizing the information toolkit.	Cloud content management	Internal & external collaboration platforms	Low-code and “self-service” development platforms	Content integration & migration tools
Digitalizing core organizational processes.	Robotic process automation	Business process management	Multi-channel intelligent capture	High-volume process optimization
Automating compliance & governance.	Records management & digital preservation	eDiscovery & legal	Industry & geographic specific applications	Blockchain
Leveraging analytics & machine learning.	AI, content analytics & semantics	Data recognition, extraction & standardization	Metadata & taxonomy management	Document classification & PII identification

Figure 2. Key Intelligent Information Management capabilities (Mancini, 2017)

3.3 Enhancement of the Capacity of Student Relationship Management with Intelligent Information Management and Conversation Agent

The current management of student-educational institution relationships is in an era, known as Digital Darwinism, referring to the phenomenon in which technologies and social behaviors are evolving faster than any businesses can naturally adapt (Bughin, 2017). Educational institutions are also included. Therefore, educational institutions should have digital transformation. The digital transformation of educational institutions is required to change the thinking process to integrate all educational work processes with the digital convergence so that educational institutions can adapt to move forward and reduce the risks that may arise and in order to sustainably increase the competitiveness in the education industry both in the present and in the future. Consequently, enhancing the capacity of student relationship management with intelligent information management must be considered and developed in the near future. This capacity is important for educational institutions in using information, content, and documents to analyze and improve the operation and service quality of educational institutions for promoting student’s loyalty (Lerbin & Aritonang, 2014). Students’ loyalty comprises the following key factors: perceived quality of teaching service, emotional commitment, or a positive sense of affiliation with the educational institution, perceived service quality, student satisfaction, and reputation and image of the university.

Intelligent student relationship management (i-SRM) is a system that focuses primarily on maintaining student relationships and loyalty, so it relies on advanced competencies of intelligent information management. The intelligent student relationship management (i-SRM) with intelligent information management represents the convergence between the intelligent student relationship management (i-SRM) component model and the intelligent information management (IIM) core competency. This convergence creates efficiency in information and content management of educational institutions that can be utilized in accordance with the guidelines of student relationship management. Educational institutions can choose the components in the model and determine the process independently based on their context, budget, and goals.

The application of the components in the model will be an important capacity for the educational institutions that need to develop an intelligent student relationship management system, particularly for providing students with an intelligent conversational agent system that can always respond to student service work with high efficiency in order to provide students with convenient and efficient access to information and services of higher education institutions. Two factors of user perception based on the technology acceptance model (TAM), which are perceived of ease of use and perceived of usefulness, must be considered (Adams, Nelson, & Todd, 1992). The conversational user interface (CUI), known as “Chatbot”, is now widely used through smartphones and web applications. The outstanding feature of Chatbot is the direct response through text messages or voice or images from users. There is a conversation agent to understand the users’ intent and perform the services requested by the users. Higher education institutions provide academic services and other services to a lot of university students, resulting in a large amount of data and documents. Therefore, the intelligent information management (IIM) system is needed for managing large amounts of data and documents intelligently (John Mancini, 2014; John Mancini, 2017) and seamlessly connecting to the conversational agent for providing services to students in higher education efficiently. Providing services with intelligent technology that has already taken advantage of good information management will result in students’ satisfaction and emotional commitment and reputation and image of academic institution, which will lead to students’ loyalty (Kaewrattanapat, Wannapiroon, Piriyasurawong, & Nilsook, 2019), a valuable aspect of educational institutions.

4. Research Methodology

4.1 Phase1: The Synthesis of Conceptual Framework and Student Relationship Management Value Chain Model

The researchers studied research articles related to student relationship management at the higher education level, smart technology, conversational agent technology, data and document management and higher education students’ loyalty to synthesize the conceptual framework of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student’s loyalty in higher education. The value chain model of intelligent student relationship management based on cognitive technology was then developed with conversational agent for enhancing student’s loyalty in higher education from the synthesized conceptual framework. The value chain model certification assessment was developed, and the content validity index (CVI) was measured by five experts.

The instrument was then evaluated overall using the content validity index of the instrument with an average approach (S-CVI/Ave). This was the average of the precision index of the instrument, measured by applying the content validity index (I-CVI) of each item to the sum and dividing it by the total number of questions. The content validity was then evaluated by the number of experts who determined the content consistency to be at level 3 (Quite relevant) and level 4 (Absolute relevant) only and divided by the total number of experts. The 5 point-Likert scale (5 = Strongly agree, 4 = Agree, 3 = Neutral, 2 = Disagree and 1 = Strongly disagree) was employed to identify the level of agreement of the value chain model.

The instrument was then evaluated overall using the content validity index of the instrument with an average approach (SCVI/Ave). This was the average of the precision index of the instrument, measured by applying the content validity index (I-CVI) of each item to the sum and dividing it by the total number of questions. It was found that the item content validity index obtained from the experts was more than 0.8 regarding all items, while the content validity index of the instrument with an average approach was 0.99. It can be concluded that the experts agree that the questionnaire created by the researcher is accurate and can be used for further data collection.

After that, the value chain model and the value chain model certification assessment were verified based on the consensus assessments of seventeen experts using statistical analysis, including mean, standard deviation (S.D.), median, interquartile range (I.R.) and quartile deviation (Q.D.). The consensus was interpreted as presented in Table1.

Table 1. Statistics and definition of consensus in key studies

Statistics	Definition of Consensus	Reference
Mean		
4.50 – 5.00	Strongly agree	(Best, 1981)
3.50 – 4.49	Agree	
2.50 – 3.49	Neutral	
1.50 - 2.49	Disagree	
1.00 – 1.49	Strongly disagree	
Median		
≥ 4.00	High Level of Important	(Ab Latif, Dahlan , Mulud, & Nor, 2017)
≤ 3.50	Low Level of Important	
Standard Deviation: S.D.		
0.00 – 1.00	High Consensus	(Henning & Jordaan., 2016)
1.01 – 1.49	Moderate Consensus	
1.50 – 2.00	Low Consensus	
> 2.00	Without Consensus	
Interquartile Range: I.R.		
0.00 – 1.00	High Consensus	(Siraj & Ali., 2008)
1.01 – 1.99	Moderate Consensus	
> 2.00	Without Consensus	
Quartile Deviation: Q.D.		
0.00 - 0.50	High Consensus	(Fong, Ch'ng, & Por., 2013)
0.51 – 1.00	Moderate Consensus	
> 1.00	Without Consensus	

4.2 Phase2: The Development of System Architecture

The value chain model of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student's loyalty in higher education that was developed and certified by the experts was adopted to develop the system architecture of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student's loyalty in higher education. Afterwards, the system architecture certification assessment was developed, and the content validity index (CVI) was measured by five experts. The 5 point-Likert scale was employed to identify the level of agreement of the system architecture certification. After that, the system architecture and the system architecture certification assessment were certified based on the consensus assessments by seventeen experts using statistical analysis, namely mean, standard deviation (S.D.), median, interquartile range (I.R.) and quartile deviation (Q.D.). The consensus was interpreted as presented in Table1.

5. Research Result

5.1 The Research Results of Phase1: The Synthesis of Conceptual Framework and Student Relationship Management Value Chain Model

Based on the study of the research articles related to student relationship management at the higher education level, smart technology, conversational agent technology, data and document management and higher education students' loyalty to synthesize the conceptual framework of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student's loyalty in higher education, the synthesis results can be presented in Figure 3.

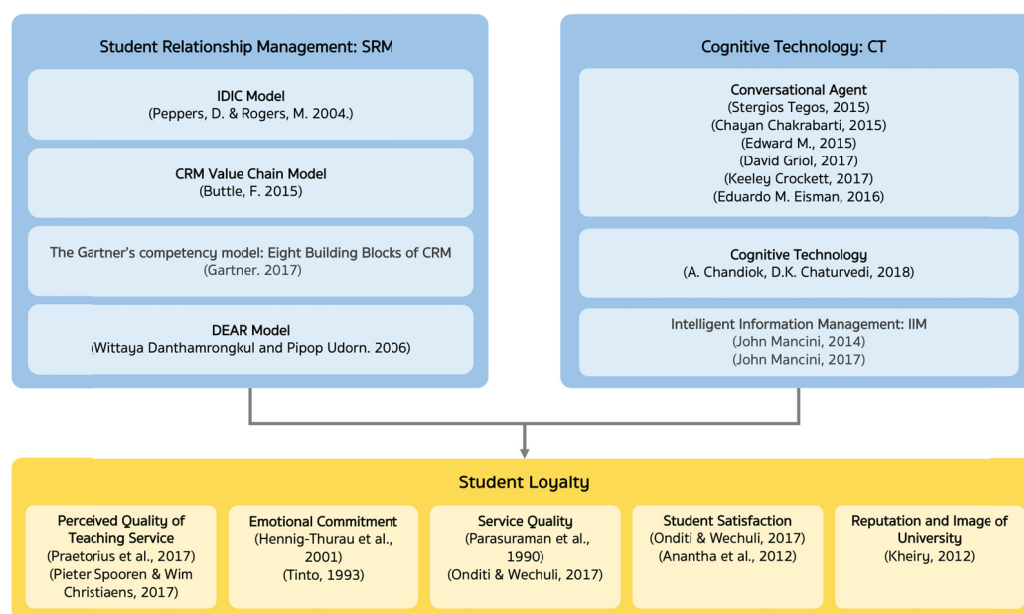


Figure 3. The conceptual framework of intelligent student relationship management based on cognitive technology with conversational agent for enhancing students' loyalty in higher education

According to the conceptual framework, the value chain model of intelligent student relationship management based on cognitive technology with conversational agent was developed for enhancing student's loyalty in higher education as shown in Figure 4.

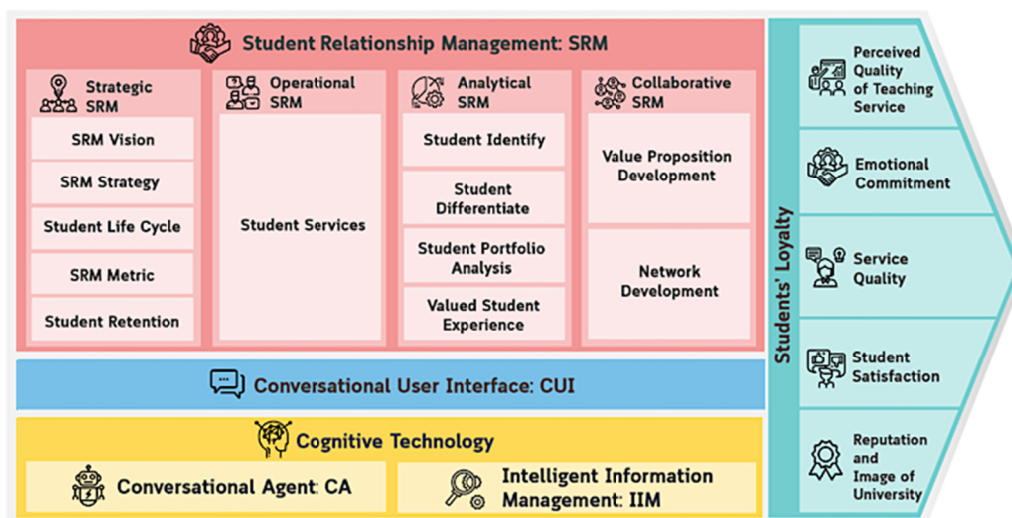


Figure 4. The value chain model of intelligent student relationship management based on cognitive technology with conversational agent for enhancing students' loyalty in higher education (SRM Value Chain)

Figure 4 shows the value chain model of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student's loyalty in higher education. The SRM value chain consisted of 1) primary value activities, which was student relationship management (SRM), consisting of strategic SRM operational SRM, analytical SRM, and collaborative SRM; 2) support value activities, including conversational user interface (CUI) and cognitive technology (CT), consisting of conversational agent and intelligent information management (IIM) and 3) competitive advantage which was higher education students'

loyalty, comprising perceived quality of teaching services and service quality to achieve students' satisfaction and emotional commitment and reputation and image of academic institution. This value chain model of student relationship management was assessed and certified by seventeen experts through the consensus. The results of the value chain model certification assessment are shown in Table 2.

Table 2. The results of the value chain model certification assessment

Indicators	Mean	S.D.	Quartiles			I.R.	Q.D.	Consensus Reached	
			Q1	Median	Q3				
Student Relationship Management: SRM									
Strategic SRM									
1. SRM Vision	4.94	0.24	5	5	5	0.00	0.00	High	
2. SRM Strategy	4.82	0.39	5	5	5	0.00	0.00	High	
3. Student Life Cycle	4.82	0.39	5	5	5	0.00	0.00	High	
4. SRM Metric	4.88	0.33	5	5	5	0.00	0.00	High	
5. Student Retention	4.88	0.33	5	5	5	0.00	0.00	High	
Summary	4.87	0.34	5	5	5	0.00	0.00	High	
Operational SRM									
6. Student Services – Teaching Services	5.00	0.00	5	5	5	0.00	0.00	High	
7. Student Services – Supporting Services	5.00	0.00	5	5	5	0.00	0.00	High	
Summary	5.00	0.00	5	5	5	0.00	0.00	High	
Analytical SRM									
8. Student Identify	4.88	0.33	5	5	5	0.00	0.00	High	
9. Student Differentiate	4.76	0.44	5	5	5	0.00	0.00	High	
10. Student Portfolio Analysis	4.94	0.24	5	5	5	0.00	0.00	High	
11. Valued Student Experience	4.76	0.44	5	5	5	0.00	0.00	High	
Summary	4.79	0.44	5	5	5	0.00	0.0	High	
Collaborative SRM									
12. Value Proposition Development	4.82	0.39	4	5	5	1.00	0.50	High	
13. Network Development	4.65	0.61	5	5	5	0.00	0.00	High	
Summary	4.74	0.50	5	5	5	0.00	0.00	High	
Conversational User Interface									
14. Conversational User Interface	5.00	0.00	5	5	5	0.00	0.00	High	
Cognitive Technology									
15. Conversational Agent: CA	4.94	0.24	5	5	5	0.00	0.00	High	
16. Intelligent Information Management	4.88	0.33	5	5	5	0.00	0.00	High	
Summary	4.91	0.29	5	5	5	0.00	0.00	High	
Students’ Loyalty									
17. Perceived Quality of Teaching Service	5.00	0.00	5	5	5	0.00	0.00	High	
18. Emotional Commitment	4.88	0.33	5	5	5	0.00	0.00	High	
19. Service Quality	5.00	0.00	5	5	5	0.00	0.00	High	
20. Student Satisfaction	4.94	0.24	5	5	5	0.00	0.00	High	
21. Reputation and Image of University	4.88	0.33	5	5	5	0.00	0.00	High	
Summary	4.94	0.18	5	5	5	0.00	0.00	High	
Summary	4.89	0.27	5	5	5	0.00	0.00	High	

Table 2 shows that the experts certified all components of the developed value chain model of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student's loyalty in higher education. The overall mean was 4.89, which was greater than 4.51, and the means of all components were greater than 4.51. This indicated that the experts strongly agreed on all components presented in the SRM value chain model. The overall standard deviation (S.D.) was 0.27, which was in the range of 0.00 - 1.00. Also, the standard deviation of all components was in the range of 0.00 - 1.00. This revealed that the experts had a high

consensus. The overall median was 5, which was greater than 4, and the median of all components was greater than 4. This indicated that it was considered a high level of importance by the experts. The overall interquartile range (I.R.) was 0.00, and the interquartile range (I.R.) of all components as in the range of 0.00 - 1.00. This pointed out that the experts had a high consensus. In addition, the overall quartile deviation (Q.D.) was 0.00, and the quartile deviation (Q.D.) of all components was in the range of 0.00 - 0.50. This revealed that the experts had a high consensus. It can be concluded that seventeen experts certified the conceptual framework of intelligent student relations management based on cognitive technology with conversational agent for enhancing student's loyalty in higher education.

5.2 The Research Results of Phase2: The Development of System Architecture Based on Student Relationship Management Value Chain Model

The conceptual framework that had been assessed by the experts was studied and synthesized for developing the system architecture of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student's loyalty in higher education. The results of the conversational agent synthesis are presented in Table 3.

Table 3. The results of the conversational agent synthesis

Components	(Tanana et al., 2019)	(Gupta et al., 2019)	(Glas & Pelachaud, 2018)	(Lee & Yeo, 2022)	(Liu et al., 2022)
<i>Conversational User Interface</i>					
Messaging application	✓	✓	✓	✓	✓
Integration with Conversational Agent	✓	✓	✓	✓	✓
<i>Conversational Agent</i>					
Natural Language Processing: NLP	✓	✓	✓	✓	✓
Natural Language Understanding: NLU	✓	✓	✓	✓	✓
Entity Extraction			✓	✓	✓
Intents and Context Matching	✓	✓	✓	✓	✓
Dialog Management	✓	✓	✓	✓	✓
Agent Communication via Web Hook		✓			✓

Table 3 shows the conversational agent components which were important and part of the system architecture of intelligent student relationship management based on cognitive technology with conversational agent. The researchers combined the synthetic conversational agent components with intelligent information management (IIM) in accordance with the Association for Information and Image Management (AIIM) guidelines (John Mancini, 2014) in order to develop the system architecture of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student's loyalty in higher education as shown in Figure 5.

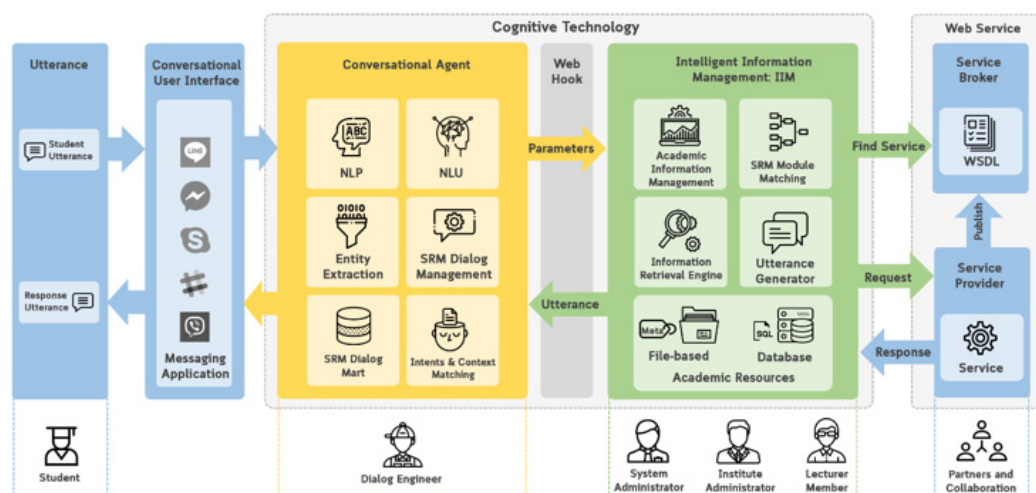


Figure 5. The system architecture of intelligent student relationship management based on cognitive technology with conversational agent for enhancing students' loyalty in higher education

Figure 5 shows the system architecture of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student's loyalty in higher education. The system architecture comprised 4 components as follows

5.2.1 Component 1: Conversational User Interface (CUI)

Conversational user interface (CUI) is where users can chat with conversational agents. The conversational user interface looks like an application or web application. It is designed in the form of a balloon message where one side is the user utterance, and the other side is the response utterance. The conversational user interface may be self-developed or integrated with conversational agents such as LINE Application, Facebook Messenger.

5.2.2 Component 2: Cognitive Technology.

Cognitive Technology, consisting of two important components as follows

Component 2.1: Conversational agent is the part of understanding the user's intent, consisting of the following components. 1) Natural language processing (NLP) is the processing of text, sound or images from the user. It is also an important process in analyzing language from users, such as word segmentation, stop word removing, or word tagging. 2) Natural language understanding (NLU) is important in understanding the user's intent. The ontology is used to compare different but synonymous words, such as "Hello" and "Hi" or "Yes" and "OK". 3) Entity extraction is the extraction of important information from the user utterance. The developers need to define a format so that the conversational agent can learn the training phrases and be able to extract important information accurately. 4) SRM dialog management adds, removes, improves, and maintains a dialogue structure for student relationship management. 5) SRM dialog mart is the source for storing conversational agent dialogs. 6) Intents and context matching is where the conversational agent decides to perform one task based on the understanding of the user's intent of the conversational agent.

Component 2.2: Intelligent information management (IIM) is information and document management of higher education institutions and various services designated by higher education institutions consisting of the following components. 1) Academic information management is a system for importing or updating information of higher education institutions so that students or conversational agent users will automatically receive the latest updates. 2) SRM module matching is connected to intents and context matching, where conversational agents work to meet students' needs through a module for student relationship management. 3) Information retrieval engine is used for searching or retrieving information or documents that the user has the right to. 4) Utterance generator is used for generating dialogs back to students or users based on the requested service. 5) Academic resources are resources for storing files and databases of higher education institutions for providing personal information such as portfolio, academic results, history of borrowing resources in the library, course registration history, appointments with instructors or booking services provided by higher education institutions.

5.2.3 Component 3: Web Service

Web services are important in connecting and exchanging information and services with external agencies. The objective is to co-create valuable services for students such as linking with the employment offices, allowing students or graduates to inquire about employment positions or suggesting or offering job positions to students or graduates through analysis of data obtained from student academic databases. The developed system architecture was evaluated and certified by seventeen experts based on consensus. The assessment results are shown in Table 4.

Table 4. The results of the system architecture certification assessment

Indicators	Mean	S.D.	Quartiles			I.R.	Q.D.	Consensus Reached
			Q1	Median	Q3			
Conversational User Interface								
1. Messaging application	4.94	0.24	5	5	5	0.00	0.00	High
2. Integration with Conversational Agent	4.82	0.39	5	5	5	0.00	0.00	High
Summary	4.88	0.33	5	5	5	0.00	0.00	High
Conversational Agent								
3. Natural Language Processing: NLP	4.76	0.44	5	5	5	0.00	0.00	High
4. Natural Language Understanding: NLU	4.71	0.59	5	5	5	0.00	0.00	High
5. Entity Extraction	4.71	0.59	5	5	5	0.00	0.00	High
6. Intents and Context Matching	4.76	0.56	5	5	5	0.00	0.00	High
7. SRM Dialog Management	4.59	0.80	5	5	5	0.00	0.00	High
8. SRM Dialog Mart	4.71	0.59	5	5	5	0.00	0.00	High
9. Agent Communication via Web Hook	4.59	0.62	4	5	5	1.00	0.50	High
Summary	4.69	0.59	5	5	5	0.00	0.00	High
Intelligent Information Management: IIM								
10. Academic Information Management	4.71	0.59	5	5	5	0.00	0.00	High
11. SRM Module Matching	4.59	0.51	4	5	5	1.00	0.50	High
12. Information Retrieval Engine	4.76	0.44	5	5	5	0.00	0.00	High
13. Utterance Generator	4.53	0.62	4	5	5	1.00	0.50	High
14. Academic Resources	4.59	0.62	4	5	5	1.00	0.50	High
15. Partner Collaboration based on Services-Oriented Architecture: SOA via Web Services Technology	4.71	0.59	5	5	5	0.00	0.00	High
Summary	4.65	0.56	4	5	5	1.00	0.50	High
Summary	4.70	0.55	4	5	5	1.00	0.50	High

Table 4 shows that the experts certified every component of the developed system architecture. The overall mean was 4.70, which was greater than 4.51, and the mean of all components was greater than 4.51. This indicated that the experts strongly agreed on all components presented in the system architecture. The overall standard deviation was 0.55, which was in the range of 0.00 - 1.00, and the standard deviation of all components was in the range of 0.00 - 1.00. This pointed out that the experts had a high consensus. The overall median was 5, which was higher than 4, and the median of all components was greater than 4. This indicated that the experts rated it at a high level of importance. The overall interquartile range was 1.00, and the interquartile range of all components was in the range of 0.00 - 1.00, which meant that the experts had a high consensus. The overall quartile deviation was 0.50, and the quartile deviation of all was in the range of 0.00 - 0.50. This pointed out that the experts had a high consensus. Therefore, it can be concluded that seventeen experts certified the system architecture developed based on the value chain model of intelligent student relations management based on cognitive technology with conversational agent for enhancing student's loyalty in higher education.

6. Conclusion and Discussion

The conceptual framework was synthesized for the development of the value chain model and the system architecture of intelligent student relationship management based on cognitive technology with conversational agent for enhancing student's loyalty in higher education. The assessment of the developed value chain model and system architecture was certified by seventeen experts using the value chain model and system architecture certification assessment with a 5-point Likert scale of level of agreement. The results revealed that the experts had a consensus on the value chain model and system architecture developed based on the conceptual framework,

including the concepts of student relationship management, conversational user interface, cognitive technology, conversational agent, and intelligent information management. The developed value chain model and system architecture represent the capacity and important future directions of educational institutions seeking to develop an intelligent student relationship management system. This capacity is important in enabling educational institutions to provide students with a range of services through conversational agents that can work with intelligent information management. Valuable conversational data can also be used to analyze and improve the operations of higher education institutions, leading to students' perceived quality of teaching services and service quality, resulting in students' satisfaction, emotional commitment and reputation and image of academic institution. These will finally lead to students' loyalty, which is an important aspect of educational institutions in terms of both quality of education and maintaining student retention rates. In addition, educational institutions at all levels should be concerned with and give importance to building and maintaining long-term relationships with students, especially in the era of competition with knowledge and intelligent technology. which is different from the previous era that only competed with knowledge. Therefore, digital transformation and digital convergence are needed in various services of higher education institutions to create valuable experiences, including academic, professional and service experiences for students such as analyzing personal data for learning adaptation and providing valuable services, or recognizing and listening to voices or conversations between students and higher education institutions through digital storage. These are part of the participation in the development of higher education institutions, resulting in a cycle of quality education development that affects the stability of educational institutions in terms of budget, quality of teaching and learning and student and staff retention rates, leading to the sustainable development of the country.

References

- Ab Latif, R., Dahlan, A., Mulud, Z. A., & Nor, M. Z. M. (2017). The Delphi technique as a method to obtain consensus in health care education research. *Education in Medicine Journal*, 9(3). <https://doi.org/10.21315/eimj2017.9.3.10>
- Adams, D. A., Nelson, R. R., & Todd, P. A. (1992). Perceived Usefulness, Ease of Use, and Usage of Information Technology: A Replication. *MIS Quarterly*, 16(2), 227-247. <https://doi.org/10.2307/249577>
- Alalwan, J. A., & Weistroffer, H. R. (2012). Enterprise content management research: A comprehensive review. *Journal of Enterprise Information Management*, 25(5), 441-461. <https://doi.org/10.1108/17410391211265133>
- Anantha, R. A. A., & Abdul Ghani, A. (2012). Service Quality and Students' satisfaction at Higher Learning Institutions. A case study of Malaysian University Competitiveness. *International journal of Management and Strategy*, 3(5), 1-16. <https://doi.org/10.5171/2011.855931>
- Aritonang, R., & Lerbin, R. (2014). Student loyalty modeling. *Market-Tržište*, 26(1), 77-91. Retrieved from <http://hrcak.srce.hr/123371>
- Best, J. W. (1981). *Research in education*. New Jersey: Prentice Hall. <https://doi.org/10.1177/001316447103100326>
- Bughin, J. (2017). *Digital Darwinism*. McKinsey Global Institute (MGI). <https://doi.org/10.5465/AMBPP.2017.15155abstract>
- Fong, S. F., Ch'ng, P. E., & Por, F. P. (2013). Development of ICT competency standard using the Delphi technique. *Procedia-Social and Behavioral Sciences*, 103, 299-314. <https://doi.org/10.1016/j.sbspro.2013.10.338>
- Glas, N., & Pelachaud, C. (2018). Topic management for an engaging conversational agent. *International Journal of Human-Computer Studies*, 120, 107-124. <https://doi.org/10.1016/j.ijhcs.2018.07.007>
- Gupta, K., Joshi, M., Chatterjee, A., Damani, S., Narahari, K. N., & Agrawal, P. (2019, August). Insights from building an open-ended conversational agent. In *Proceedings of the First Workshop on NLP for Conversational AI* (pp. 106-112). <https://doi.org/10.18653/v1/W19-4112>
- Henning, J. I., & Jordaan, H. (2016). Determinants of financial sustainability for farm credit applications—A Delphi study. *Sustainability*, 8(1), 77. <https://doi.org/10.3390/su8010077>
- Kaewrattanapat, N., Wannapiroon, P., Piriyaawong, P., & Nilsook, P. (2020). An Empirical Study of Critical Factors Relating to Higher Education Students' Loyalty in Thailand. In *The Impact of the 4th Industrial Revolution on Engineering Education: Proceedings of the 22nd International Conference on Interactive Collaborative Learning (ICL2019)—Volume 2* (pp. 391-401). Springer International Publishing.

- https://doi.org/10.1007/978-3-030-40271-6_39
- Lechtchinskaia, L., Friedrich, I., & Breitner, M. H. (2012, January). Requirements Analysis for a Student Relationship Management System—Results from an Empirical Study in Ivy League Universities. In *2012 45th Hawaii International Conference on System Sciences* (pp. 5132-5141). IEEE. <https://doi.org/10.1109/HICSS.2012.502>
- Lee, D., & Yeo, S. (2022). Developing an AI-based chatbot for practicing responsive teaching in mathematics. *Computers & Education*, 191, 104646. <https://doi.org/10.1016/j.compedu.2022.104646>
- Liu, H., Peng, H., Song, X., Xu, C., & Zhang, M. (2022). Using AI chatbots to provide self-help depression interventions for university students: A randomized trial of effectiveness. *Internet Interventions*, 27, 100495. <https://doi.org/10.1016/j.invent.2022.100495>
- Maican, C., & Lixandriou, R. (2016). A system architecture based on open source enterprise content management systems for supporting educational institutions. *International Journal of Information Management*, 36(2), 207-214. <https://doi.org/10.1016/j.ijinfomgt.2015.11.003>
- Mancini, J. (2014). *Content Management 2020: Thinking Beyond ECM*. AIIM Executive Leadership Council. Retrieved from https://www.project-consult.de/files/AIIM_Thinking_Beyond_ECM.pdf
- Mancini, J. (2017). *THE NEXT WAVE: Moving from ECM to Intelligent Information Management*. AIIM ebook. Retrieved from https://cdn2.hubspot.net/hubfs/332414/AIIM_Blog/Intel-info-Next-Wave-2017-updated.pdf
- Miah, S. J., & Samsudin, A. Z. H. (2017). EDRMS for academic records management: A design study in a Malaysian university. *Education and Information Technologies*, 22, 1895-1910. <https://doi.org/10.1007/s10639-016-9525-6>
- Nutthapat, K., & Panita, W. (2018). Intelligent Student Relationship Management Model. *Journal of Industrial Education (JIE)*, 17(1), 222-230. Retrieved from <https://ph01.tci-thaijo.org/index.php/JIE/article/view/140111>
- Orawan, W., & Thanyarat, P. (2011). *Competitive Advantage with Enterprise Content Management*. Executive Journal, April-June, Bangkok University (pp. 84-88). Retrieved from https://www.bu.ac.th/knowledgecenter/executive_journal/april_june_11/pdf/aw11.pdf
- Piedade, M. B., & Santos, M. Y. (2018). Student Relationship Management: Concept, practice and technological support. *IEEE International Engineering Management Conference, Estoril* (pp. 1-5). <https://doi.org/10.1109/IEMCE.2008.4618026>
- Radenković, B., Despotović-Zrakić, M., Bogdanović, Z., Labus, A., & Milutinović, M. (2013, October). Providing services for student relationship management on cloud computing infrastructure. In *2013 11th International Conference on Telecommunications in Modern Satellite, Cable and Broadcasting Services (TELSIKS)* (Vol. 2, pp. 385-388). IEEE. <https://doi.org/10.1109/TELSKS.2013.6704404>
- Rodmunkong, T., Wannapiroon, P., & Nilsook, P. (2014). The challenges of cloud computing management information system in academic work. *International Journal of Signal Processing Systems*, 2(2), 160-165. <https://doi.org/10.12720/ijsp.2.2.160-165>
- Siraj, S., & Ali, A. (2008). Principals projections on the Malaysian secondary school future curriculum. *International Education Studies*, 1(4), 61-78. <https://doi.org/10.5539/ies.v1n4p61>
- Tanana, M. J., Soma, C. S., Srikumar, V., Atkins, D. C., & Imel, Z. E. (2019). Development and evaluation of ClientBot: Patient-like conversational agent to train basic counseling skills. *Journal of Medical Internet Research*, 21(7), e12529. <https://doi.org/10.2196/12529>
- Tyrväinen, P., Päivärinta, T., Salminen, A., & Iivari, J. (2006). Characterizing the evolving research on enterprise content management. *European Journal of Information Systems*, 15(6), 627-634. <https://doi.org/10.1057/palgrave.ejis.3000648>
- Vulić, M., Labus, A., & Despotović-Zrakić, M. (2014). Implementation of CRM Concept in e-Education. *Innovative Management and Firm Performance: An Interdisciplinary Approach*, 347-369. https://doi.org/10.1057/9781137402226_18

Copyrights

Copyright for this article is retained by the author(s), with first publication rights granted to the journal.

This is an open-access article distributed under the terms and conditions of the Creative Commons Attribution license (<http://creativecommons.org/licenses/by/4.0/>).