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Implementation of a knowledge management system using semantic networks for academic information systems in higher education

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Abstract

A knowledge base is a component that is really needed in any field and agency. As is known, especially in the education sector, several educational institutions, both private and public, have different academic rules and systems. Likewise in universities, the academic system implemented has diversity which is usually influenced by the characteristics of the university itself as well as the curriculum applied. This research aims to create a knowledge management system that focuses on the knowledge base. The knowledge can be analyzed from the higher education academic system. The research method uses the Knowledge Management System Life Cycle (KMSLC) approach, also called the Knowledge Management System Life Cycle. The research stages that will be carried out including Analysis and Planning, Resource Identification, Knowledge Identification (where the sequence of stages is: Knowledge Creation, Knowledge Storage, Knowledge Sharing, and Knowledge Utilization), then KMS Design using a semantic network, Verification and Validation KMS, KMS implementation, after that the test and evaluation stage. The output of the research is a system model that can be developed into an information system in the form of a web-based application with the theme Knowledge Management System for academic systems in higher education.

Keywords

Knowledge management system, Semantic networks, Higher education

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Introduction

It is very clear that a university must have an academic system. The academic system is a process flow related to academic activities involving students and teachers and all aspects of education in it. The academic system is usually created based on the rules and policies implemented by universities as well as the curriculum used. The development of different academic systems in each university usually makes participants or potential users/registrants of that university curious. The question will arise as to how the academic system is implemented; this also influences the existence of a university in

recruiting prospective graduates. In the existing academic system, of course, there is a lot of knowledge that can be explored, and the knowledge that can be taken can produce information that can be utilized by users.

For example, knowledge of which students are the best graduates, or which students are still active students or not, and so on. Such a knowledge base can be developed and made into a knowledge system that has more useful value. One way is by developing a knowledge management system that can be applied in the academic system. A knowledge management information system or Knowledge Management System is a process of analyzing, selecting, identifying, searching for, and disseminating new information and knowledge from a system that is already/is running. So, in this case the researcher intends to explore and analyze a knowledge base in the higher education academic system which can be developed into a knowledge management information system for the higher education academic system. In its development, researchers will use a semantic network to create a knowledge base of the academic system which can be analyzed through the academic information system used, as well as from various other supporting document sources.

Academic information system

An academic information system is a system that manages data so that it becomes information related to the academic field [1]. Higher education is a means of education just like school. Apart from being required by a university, the Academic Information System can also be implemented in schools so that it can provide services or facilities related to the needs of students as well as parents and teachers [2].

It is important that an academic information system be made according to the design required by the educational facility itself, for example for schools it may only be made for processing grades, school schedules, and attendance. However, in general, academic information systems usually carry out a lot of academic administration activities, carrying out learning processes between students and teachers, then carrying out good academic administration processes regarding the completeness of documents and costs that arise during registration activities or daily operational activities of academic administration [3].

Knowledge management system

A Knowledge Management System (KMS) can also be called an integration concept between technology and mechanisms developed to support the process of managing knowledge [4]. This is also supported by the statement which states that KMS is an information system specification or information technology product that applies knowledge management in its development or preparation [5].

There are several studies that use KMS in their development, for example KMS SOP Navigator by Pangudi (2016) which creates a web-based application product using a graph database so that it creates an ontology form of SOP documents implemented at the Bogor Agricultural Institute (IPB) [6]. Then in 2017 there was the development of an

SOP knowledge management system that could be integrated with new systems, in this case the personnel information system. This research can distribute SOP document to each employee in the agency, so that employees can work according to their main duties and functions and can work according to the SOP applied [7].

Semantic network

The concept of semantic networks has been introduced since 1968 which is a classic artificial intelligence representation that makes information more proportional

A semantic network can be said to be a collection of data in the form of records or structures which is a new data type formed from a variable that represents several objects in it. There are two main components in a semantic network, namely, nodes which are descriptions of the objects to be represented and arcs or arrow directions which represent a relation or relationship between one object and another [9].

In analyzing semantic networks there are several relationships between concepts in the network created. These concepts can be objects that can be actors, issues or abstract values, and can be expressed in text form using names, common nouns, prepositions, or other words that can represent the concept [8].

Methods

The method used is the Knowledge Management System Life Cycle (KMSLC) method adopted from Awad E, Ghaziri H in 2004, consisting of analysis, knowledge, KMS and KMS validation stages. Where there are processes of Knowledge Creation, Knowledge Storage, Knowledge Sharing, Knowledge Utilization. With some adjustments, the research stages to be carried out can be seen in Figure 1.

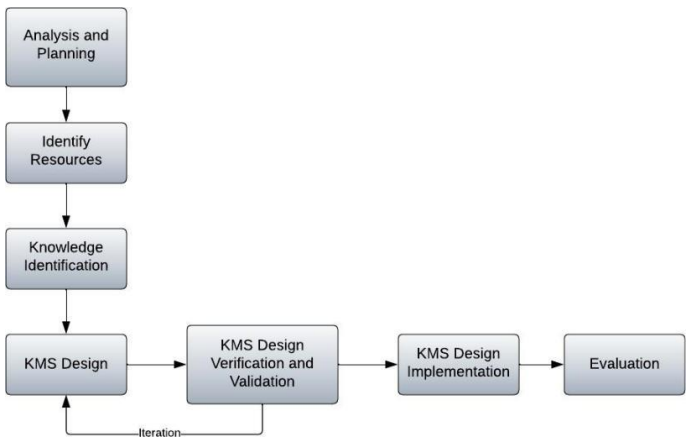

Figure 1. Research stages adopted based on KMLC

Results and Discussion

Analysis and identify resource

At this stage an analysis has been carried out to determine the planning stage in identifying some of the knowledge contained in the academic system. This stage is carried out with the aim that the knowledge obtained from an academic system can be

developed into a new knowledge management system. It should be noted that this research was carried out by taking one of the ongoing case studies at the Faculty of Computer Science, Singaperbangsa University, Karawang.

Apart from that, resource identification is carried out directly to analyze resources as well as other sources seen in Table 1, such as reference sources that can be developed and can be used for the development stage of academic knowledge management systems in higher education.

Table 1. List of Users Involved in the System

User	Role	Status
Lecturer	1. Lecturer teaches students 2. Lecturers guide students 3. Lecturers teach courses	Admin/ User
Student	1. Students are taught by lecturers 2. Students complete lecturer assignments 3. Students receive courses	Admin/ User
Administrative Staff	1. Administrative staff organizes all administrative activities for lecturers 2. Administrative staff organizes all administrative activities for students	Admin/ User

The Academic System in Indonesia according to the Regulation of the Minister of Education and Culture of the Republic of Indonesia Number 49 of 2014 concerning National Higher Education Standards states that National Higher Education Standards consist of:

1. Graduate competence standard;
2. Learning content standards;
3. Learning process standards;
4. Learning assessment standards;
5. Standards for lecturers and educational staff;
6. Standards for learning facilities and infrastructure;
7. Learning management standards; And
8. Learning funding standards.

The PDDIKTI Academic Information System allows the academic community, which includes lecturers, students and administrative staff at universities, to interact and collaborate with each other to support the standards of academic activities at the university. The implementation of this system is felt to have advantages which can be described as follows:

1. User Friendly. The menu display presented on the Academic Information System page is designed to be easy to operate without eliminating important information that will be conveyed.
2. In accordance with the needs of higher education institutions. This system is designed to accommodate the needs of higher education institutions for activities such as the input process for taking courses, grade transcript formats, managing student and lecturer data, managing study programs and so on.

3. Compatible with DIKTI report. Accommodates needs such as creating EPSBED (Self-Evaluation Based Study Program Evaluation) reports from DIKTI so that each semester can be created quickly because it has been taken from daily "transaction" activities carried out by your agency quickly and accurately.
4. Reducing operational costs. Cutting operational costs by implementing the system is a step that is considered effective for managing academic data, work effectiveness, and costs for purchasing office stationery.
5. Web/Network Based. Using a local network (LAN) or the internet, this Academic Information System makes work coordination and effectiveness easier.
6. Developed consistently. This system is continuously and consistently developed as an effort to improve its capabilities so that it adapts to the latest version of the EPSBED reporting system to DIKTI.

Analysis knowledge identification

Knowledge is divided into two, namely tacit knowledge and explicit knowledge, see the differences in Table 2. Tacit knowledge can be converted into explicit knowledge and vice versa. Someone who expresses his thoughts/knowledge in writing on a piece of paper indicates a change from tacit to explicit. Someone who reads a research article and can understand the contents of the research so that ideas/knowledge emerge in their brain indicates a change from explicit to tacit.

Table 2. Tacit and Explicit Knowledge

Stages	Knowledge	
	Tacit	**Explicit**
Creation	Cannot be seen/abstract	Visible/real
Storage	Human brain/mind	Paper, digital storage media (hard disk)
Sharing	Delivered orally, delivery can be delivered in discussion forums and so on	Delivered in the form of literature such as books, videos, sound recordings, other presentation media.
Utilization	Depends on memory	Depends on the durability of the storage media

In the search for knowledge that can be developed in a higher education aca-demic system. Apart from that, this stage is divided into several processes:

1. Knowledge Creation which is a process analysis in determining a decision knowledge. Apart from that, it can also be said to be a stage in entering new knowledge into a system.
2. Knowledge Storage is a stage in storing knowledge in something system which is an important element in the KMS process.
3. Knowledge Sharing is the stage where knowledge has been successful the analysis will be transferred to be disseminated or shared with other parties or systems.
4. Knowledge Utilization is the stage where utilization or development and implementation of the knowledge that has been successfully obtained an information system or application that has more usability.

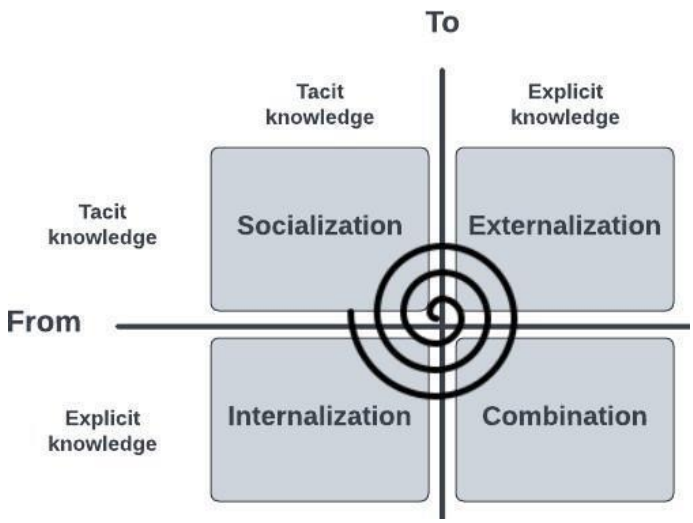

Figure 2. Nanako Knowledge Conversion Model

According to Nonaka and Takeuchi, knowledge creation always starts with the individual. This knowledge is collected and then standardized within a company so that it can become knowledge for other people. In this model there are four models of knowledge conversion, namely (Table 3).

1. *Tacit knowledge to tacit knowledge* is called the socialization process Socialization includes activities to share tacit knowledge between individuals [10]. The term socialization is used because tacit knowledge is spread through joint activities such as living together, spending time together and not through written or verbal instructions. Thus, in certain cases tacit knowledge can only be spread if someone feels free to become a bigger person who has tacit knowledge than other people.
2. *Tacit knowledge to explicit knowledge* is called a process externalization requires presenting tacit knowledge in a form more general so that other people can understand it [10]. At stage in this externalization, individuals have a commitment to a group and become one with the group. In practice, Externalization is supported by two key factors. First, tacit articulation knowledge is like dialogue. Second, translating tacit knowledge from experts into understandable forms such as documents, manual and so on.
3. *Explicit knowledge to explicit knowledge* is called a process combination includes the conversion of explicit knowledge into form a more complex set of explicit knowledge. In practice, phase combination depends on three processes, namely capture and integration new explicit knowledge includes collecting external data from within or from outside the institution and then combine the two data. Second, dissemination of explicit knowledge through presentations or direct meeting. Third, reprocessing explicit knowledge so that it is easier to reuse it, for example as a document plan, reports, manuals, and so on.
4. *Explicit knowledge to tacit knowledge* is called the internalization process Internalization of new knowledge is a conversion of explicit knowledge into the organization's tacit knowledge. Individuals must identify knowledge that is relevant to their needs in knowledge that organization. In practice, internalization can be

carried out in two dimensions. The first is by applying explicit knowledge in direct action or practice. Second, namely explicit mastery knowledge through simulations, experiments, or learning by doing.

Table 3. Tacit and Explicit Knowledge Management Academic System

Stages	Knowledge		
	Tacit	Explicit	Conversion
Creation	Building an academic system that represents the Indonesian government's regulations regarding academic system development standards depending on the needs of educational institutions	Create a mock-up to map system development by representing several entity relationships involved using a semantic network	Socialization, Internalization
Storage	All the ease of use of the new academic system is based on the ideas of each teacher and student	All the ease of use of the new academic system is based on the ideas of each teacher and student which are represented into a database that can be managed with the same information system	Externalization
Sharing	All activities specifically related to students and lecturers occur in the same forum	All activities specifically related to students and lecturers occur in the same forum with more diverse communication media	Externalization, Combination
Utilization	Depends on memory user	Depends on the durability of the storage media in the same academic system	Externalization, Combination

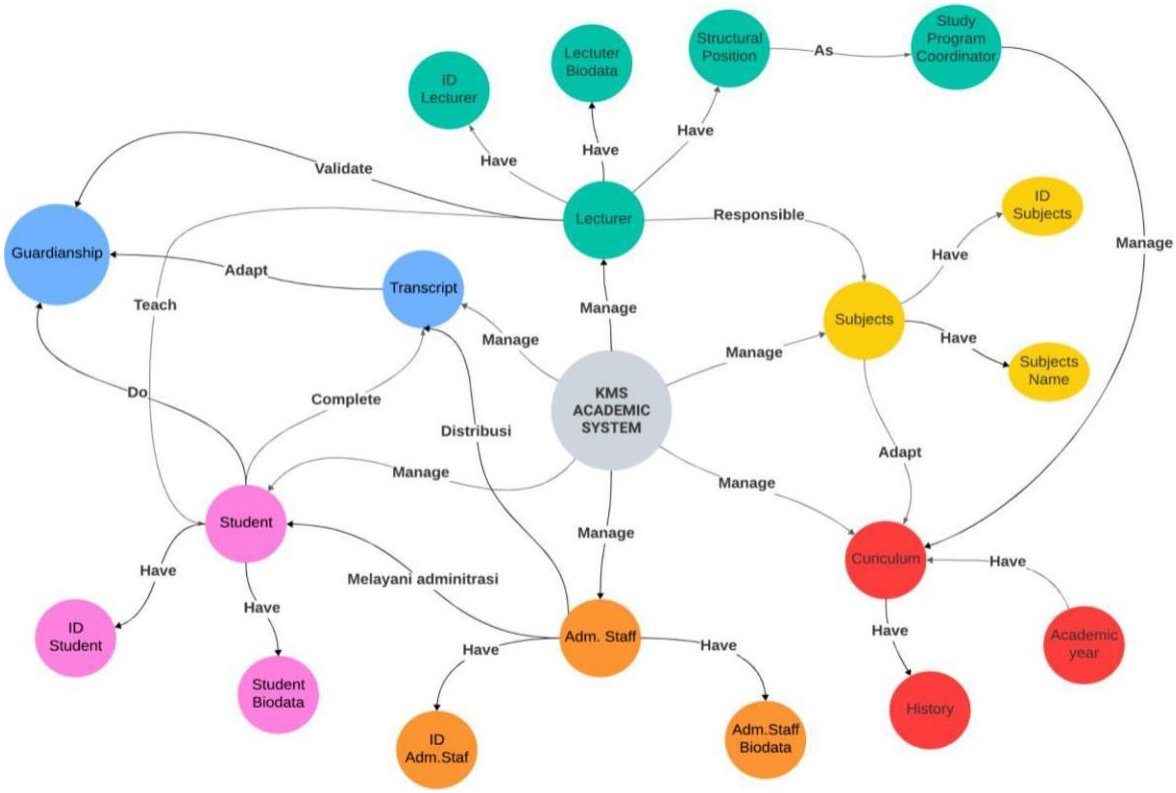

Figure 3. Representation Ontology Knowledge Academic System

Design representation is a common task in the design process to facilitate learning, analysis, redesign, communication, and other design activities [11]. Furthermore, the

results of the knowledge conversion according to Figure 2 are then mapped into a relationship in the form of an academic system knowledge representation using a semantic network in the form of an ontology which can be seen in Figure 3.

Implementation knowledge management system

The implementation carried out was by developing the KMS system into a web-based information system with a local host. The following features that have been developed can be seen in Table 4.

Table 4. Main Feature Knowledge Management Academic System

Main Feature	User	Identification
Login	All User in Table 1	Allows all users involved to enter the academic system that has been built
User Data	Admin (Study Program Coordinator)	The Study Program Coordinator is a system admin who can regulate user access rights for lecturers, students and academic information system that has been built
Faculty Data	Admin (Study Program Coordinator)	The Study Program Coordinator is a system admin who can manage faculty data contained in the academic information system that has been built
Study Program Data	Admin (Study Program Coordinator)	The Study Program Coordinator is a system admin who can manage study program data contained in the academic information system that has been built
Science Field Data	Admin (Study Program Coordinator)	The Study Program Coordinator is a system admin who can organize data in scientific fields according to the knowledge of each lecturer in the study program in accordance with the curriculum implemented in the academic information system that has been built

In accordance with Table 4, the implementation of the academic information system can be seen in Figure 4. Apart from that, in accordance with Table 4, the main task of the study program coordinator in mapping the academic system that has been built can be seen in Figure 5.

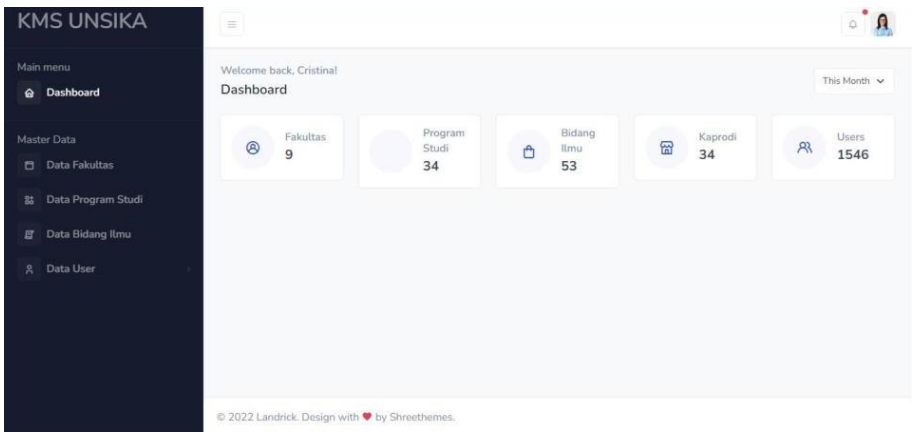

Figure 4. Knowledge Representation for the Main Menu in Academic Information Systems

All features displayed in the academic information system have been built using the CRUD (Create, Read, Update, Delete) method. Where all the features in the menu displayed can be added, changed and deleted.

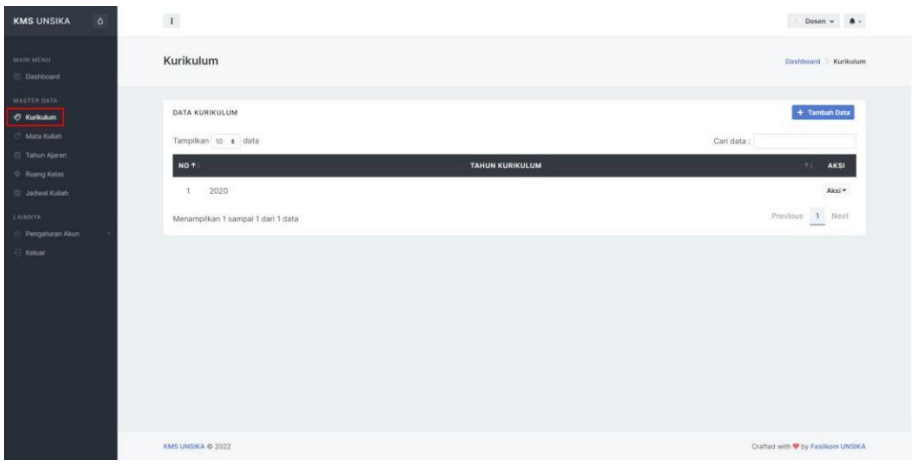

Figure 5. Main Menu for Study Program Coordinators

Conclusion

KMS verification and validation is carried out in prototype iterations, where what is carried out is a verification test on sources who understand the academic system. Apart from that, validation was also carried out using the same technique by directly interviewing relevant sources. Apart from that, we use black box testing, which is an application test that has been developed for KMS system users. Testing is carried out more on how the functionality in the application will be developed.

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