Synthesis of Digital Knowledge Engineering Repository Management System

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Abstract: Knowledge management in educational organizations is crucial and important that should be promoted and supported so as to lead teachers and learners to develop body of knowledge as best practice for facilitating and applying development through contemporary digital technology. The aim of this research was therefore (1) synthesis of digital knowledge engineering repository management system and (2) suitability evaluation regarding synthesis of digital knowledge engineering repository management system. In this study, the researchers used data analysis and synthesis methods approached from content analysis whereas the suitability evaluation of the synthesis was performed by five experts having a minimum of three years of experience in related field. The findings of the research suggested that (1) digital knowledge engineering repository management system consisted of (1.1) user management system, (1.2) knowledge management system and (1.3) learning management system in which knowledge management process on digital knowledge engineering was conducted in collaboration with knowledge verification on machine learning to increase efficiency of knowledge management, and (2) the result of suitability evaluation regarding synthesis of digital knowledge engineering repository management system was at the highest level ($\overline{X}$ =4.92, S.D. =0.27) which indicated that this study can be applied to development of knowledge repository management system

Key words: Knowledge management, digital knowledge engineering, repository management system.

1. Introduction

Information and Communication Technology (ICT) are used for education in digital age so as to facilitate knowledge transfer for learners according to philosophy of education "Lifelong Learning" where learners can access information anywhere and anytime [1]. Therefore, Thailand needs to implement technology to move the nation forward with digital innovation according to digital development project for economics and society implemented by the Ministry of Information and Communication Technology – 5th strategy involving workforce development to be ready for the era of digital economy and society. The project focuses on development of working people in every career from government and private sectors relating to creativity and digital technology usage in a smart way for career and personnel development in digital technology field based on international standards [2].

Today, demand for software usage is increasing, while achievement in software development, in contrast is decreasing [3]. According to Information and Communication Technology Industry Promotion Bureau's

findings concerning problems and obstacles in software production and development, they indicated that communication, understanding and language as well as communication between software developers and users were the most important problems that made a significant difference between usage demand and software production at 49.10% [4]. As such result, software engineering application is a basic need that every software entrepreneur should pay attention to. Additionally, software engineering competency model or SWECOM [5] is an essential element for personnel development in software production in order to provide staff with knowledge and skills in relation to software engineering competency, and then it can lead to development of digital knowledge engineering repository management system and become knowledge resources of technical skills in software engineering for universities.

1.1. Knowledge Repository Management

Knowledge repository management system is system that is developed in a form of information and communication technology via internet featuring functions of member management, knowledge sharing, social and business network & current information [6] to increase efficiency of knowledge acquisition processes for users so that they can publicize, disseminate and transfer knowledge to the system where they can access anywhere and anytime. Moreover, the system is compatible with all devices [7], [8].

1.2. Digital Knowledge Engineering

A form of learning that provides learners to access and find information and exchange their knowledge via the knowledge repository management system consisting of process and procedures of knowledge management created by experts for the best practices. It also assists learners in solving problem, performing jobs as well as simultaneous learning and usage of information technology and communication for knowledge management [9]-[11].

1.3. Machine Learning

From Gartner's study regarding application of artificial intelligence and advanced machine learning, it indicated that machine learning is a field of computer science that gives computers the ability to learn without being explicitly programmed. It also supports event prediction and decision-making based on a set of program [12]. Machine learning explores the construction of algorithms in which such algorithms operate by building a model from a set of inputs including information extraction, pattern recognition, and automatic extraction of useful knowledge hidden in text content by using text mining. The procedures of text mining consist of (1) text processing, (2) mining phase and (3) visualization phase [13], [14].

1.4. Software Engineering Technical Skills

Software engineering a field of study that focuses on project management concerning analysis, object-oriented software engineering development, techniques for producing, improving and testing of software as well as new software development. It also includes technical skills consisting of (1) Software Requirements Skills, (2) Software Design Skills, (3) Software Construction Skills, (4) Software Testing Skills, and (5) Software Sustainment Skills [5]

2. Objectives of Research

1) Synthesis of digital knowledge engineering repository management system
2) Suitability evaluation for digital knowledge engineering repository management system

3. Research Methodology

The research process was divided into four distinct stages as follows:

Stage I – Synthesis of digital knowledge engineering repository management system:
Synthesis of digital knowledge engineering repository management system gathering information from

documents, textbooks, academic papers and research articles from domestic and international sources. At this stage, the researchers conducted analysis and synthesis of derived information (content analysis).

Stage II - Study of demand for digital knowledge engineering repository management system usage comprised of the following process:

3.2.1. Questionnaire design regarding demand for digital knowledge engineering repository management system usage consisting of checklist items, 5 rating scales and reliability equivalent to 0.97.

3.2.2. Data collection from the sample group, higher education providers in Thailand including 20 instructors and 60 students from public universities, Rajabhat University and Rajamangala University of Technology and private universities.

3.2.3. Data analysis in relation to demand for digital knowledge engineering repository management system usage by using mean and standard deviation.

Stage III - Study of demand for context that support learning by using digital knowledge engineering repository management system comprised of the following steps:

3.3.1. Questionnaire design regarding demand for context that support learning by using digital knowledge engineering repository management system consisting of checklist items, 5 rating scales and reliability equivalent to 0.97.

3.3.2. Data collection from the sample group, higher education providers in Thailand including 20 instructors and 60 students from public universities, Rajabhat University and Rajamangala University of Technology and private universities.

3.3.3. Mean and standard deviation for data analysis in relation to demand for context that support learning by using digital knowledge engineering repository management system.

Stage IV - Suitability evaluation regarding synthesis of digital knowledge engineering repository management system comprised of the following steps:

3.4.1. Questionnaire design regarding suitability evaluation of synthesis of digital knowledge engineering repository management system consisting of checklist items, 5 rating scales.

3.4.2. Data collection from 5 experts having at least 3 years of experience in related field with purposive sampling method.

3.4.3. Mean and standard deviation for data analysis in relation to suitability evaluation of synthesis of digital knowledge engineering repository management system.

4. Research's Findings

Stage I - the following results of digital knowledge engineering repository management system synthesis were as follows:

4.1.1. Digital Knowledge Engineering Repository Management System

Table 1. Results of Digital Knowledge Repository Management System Synthesis

Research \\ Basic Features/System Boundary	Platz, M. and Van, Biljon, J. (2016) [6]	Cerchione, R. and Esposito, E. (2017) [10]	Hassan, H, C. (2013) [11]	Calumpang, J. C. (2017) [15]	Flynn, A. J. and etc. (2016) [16]	Maria, L. and etc. (2015) [17]	Knowledge Repository Management
User Management System	✓		✓	✓			✓

Knowledge Management System	✓	✓	✓			✓	✓	✓
Learning Management System	✓	✓	✓			✓	✓	✓
Retrieval System				✓				

According to the data in Table 1, the results were divided into three subcategorizes: (1) user management system, (2) knowledge management system, and (3) learning management system.

4.1.2. Knowledge Management Process on Digital Knowledge Engineering

Table 2. Results of Knowledge Management Process Synthesis on Digital Knowledge Engineering Repository Management System

Process / Procedure	Knowledge Management Process				Teaching Process on Digital Knowledge Engineering						KM Process on Digital Knowledge engineering
	Maneewan, S. and etc. (2017) [18]	Vangala, R. N. K. and etc. (2016) [19]	Tello-Leal, E. and etc. (2015) [20]	Nonaka, I. and Hirotaka, T. (1995) [21]	Vasconcelos, J, B. and etdc. (2017) [9]	Cerchione, R. and Esposito, E. (2017) [10]	Wang, M. and etc. (2017) [22]	Quintana-Amate, S. and etc. (2017) [23]	Weinreich, R. and Groher, I. (2016) [24]	Garcia, J. ang etc. (2011) [25]	
Knowledge Creation	✓	✓	✓	✓	✓	✓	✓				✓
Knowledge Storage	✓	✓	✓	✓		✓	✓			✓	✓
Knowledge Acquisition	✓	✓	✓	✓	✓			✓	✓	✓	✓
Knowledge Access	✓	✓	✓	✓	✓			✓		✓	✓
Knowledge Sharing	✓	✓	✓	✓	✓		✓		✓	✓	✓
Knowledge Application		✓		✓			✓		✓	✓	✓

The data as shown in Table 2 indicated that knowledge management process on digital knowledge engineering was divided into six steps as follows: (1) knowledge creation, (2) knowledge storage, (3) knowledge acquisition, (4) knowledge access, (5) knowledge sharing, and (6) knowledge application.

4.1.3. Knowledge Verification-based Machine Learning

Table 3. Results of Knowledge Verification-based Machine Learning Synthesis

Research / Process	Wichaikit, S. and Sodanil, M. (2015) [26]	Tipsena, R. and etc. (2014) [27]	Wongwilaisakul, W. (2013) [28]	Akewong, C. and etc. (2012) [29]	Haruechaiyasak, C. (2016) [30]	Knowledge Verification–Based Machine Learning
Transformation			✓		✓	
Selection					✓	
Preprocessing	✓	✓		✓	✓	✓
Filtration	✓	✓	✓	✓		✓
Stemming	✓	✓	✓	✓		✓
Indexing		✓	✓	✓		✓
Data Mining	✓		✓	✓	✓	✓
Interpretation/Evaluation	✓			✓	✓	✓

According to the data in Table 3, the synthesis consisted of three main steps: (1) Text preprocessing

divided into 4 subcategorizes: (1.1) preprocessing, (1.2) filtration, (1.3) stemming, and (1.4) indexing, (2) Mining phase by data mining method, and (3) Visualization phase by interpretation and evaluation methods.

Stage II - the findings of demand for digital knowledge engineering repository management system usage:

Table 4. The Data Shown Below Was the Findings of Demand for Digital Knowledge Engineering Repository Management System Usage

Demand for Digital Knowledge Engineering Repository Management System Usage	Instructors			Students		
	$\overline{X}$	*S.D.*	**Result**	$\overline{X}$	*S.D.*	**Result**
1. Basic Features of Knowledge Repository Management System	4.46	0.48	High	4.38	0.46	High
2. Content of Knowledge Repository Management System	4.52	0.55	Highest	4.30	0.53	High
3. Characteristics of Knowledge Repository Management System	4.57	0.55	Highest	4.42	0.46	High
Total Mean	**4.51**	**0.47**	**Highest**	**4.38**	**0.43**	**High**

According to the data in Table 4, demand for digital knowledge engineering repository management system usage for enhancing technical skills in software engineering was divided into two parts:

1) The overall demand for using the system among those instructors was at the highest level ($\overline{X}$ =4.51, S.D.=0.47) which was arranged in the following orders: (1) characteristics of knowledge repository management system, (2) content of knowledge repository management system, and (3) basic features of knowledge repository management system.

2) The overall demand for using the system among the students was at the high level ($\overline{X}$ =4.38, S.D.=0.43) which was arranged in the following orders: Characteristics of Knowledge Repository Management System, (2) Basic Features of Knowledge Repository Management System, and (3) Content of Knowledge Repository Management System.

Stage III - The findings of demand for context that support learning by using digital knowledge engineering repository management system

Table 5. The Data Shown Below Was the Findings of Demand for Digital Knowledge Engineering

Demand for Context that Support Learning by Using Digital Knowledge Engineering Repository Management System	Instructors			Students		
	$\overline{X}$	*S.D.*	**Result**	$\overline{X}$	*S.D.*	**Result**
1. Quality of Content	4.60	0.48	Highest	4.38	0.61	High
2. Efficiency of Knowledge Repository Management System	4.71	0.32	Highest	4.43	0.50	High
3. Promotion and Support	4.65	0.44	Highest	4.47	0.53	High
4. Organizational Culture	4.42	0.43	High	4.36	0.51	High
5. Learning Management	4.54	0.59	Highest	4.39	0.49	High
Total Mean	**4.60**	**0.35**	**Highest**	**4.41**	**0.44**	**High**

According to the data in Table 5, the results revealed that the demand for context that support learning by using digital knowledge engineering repository management system was divided into two parts:

1) The overall demand for context that support learning among the instructors was at the highest level ($\overline{X}$ =4.60, S.D.=0.35) which was arranged in the following orders: (1) efficiency of knowledge repository management system, (2) promotion and support, and (3) quality of content.

2) The overall demand for context that support learning among the students was at the high level ($\overline{X}$ =4.41, S.D.=0.44) which was arranged in the following orders: (1) promotion and support, (2) efficiency of

knowledge repository management system, and (3) quality of content.

Stage IV - The result of suitability evaluation of digital knowledge engineering repository management system synthesis

Table 6. The Result of Suitability Evaluation of Digital Knowledge Engineering Repository Management System Synthesis

Digital Knowledge Engineering Repository Management System	Suitability Level		
	$\overline{X}$	*S.D.*	**Result**
1. Boundary of Digital Knowledge Engineering Repository Management System	4.96	0.21	Highest
2. Digital Knowledge Engineering Repository Management Process	4.93	0.25	Highest
3. Knowledge Verification-Based Machine Learning	4.93	0.25	Highest
4. Digital Knowledge Engineering Repository Management Process-Based Machine Learning	4.80	0.41	Highest
Total Mean	**4.92**	**0.27**	**Highest**

The overall result concerning suitability evaluation of digital knowledge engineering repository management system synthesis as shown in Table 6 was at the highest level ($\overline{X}$ =4.92, S.D. =0.27) which was arranged in the following orders: (1) boundary of digital knowledge engineering repository management system consistent with studies of [6] [10], [11] [15]-[17], (2) digital knowledge engineering repository management process consistent with studies of [9], [10] [18]-[20] [22]-[25] as well as knowledge verification-based machine learning consistent with studies of [26]-[30], and (3) digital knowledge engineering repository management process-based machine learning.

5. Conclusions

According to the finding of the research concerning synthesis of digital knowledge engineering repository management system in which data was derived from theory, documents and related research papers as well as a study of demand for the use of digital knowledge engineering repository management system and demand for context that support learning by using digital knowledge engineering repository management system derived from the instructors and four groups of students from Thai universities for suitability evaluation regarding synthesis of such system performed by five experts, it revealed that the overall result of system suitability was at the highest level. Additionally, when standard deviation was taken into account, it indicated that a distribution of data was less than 1.00 which meant the experts' opinions and scores derived from evaluation of system suitability were the same. As a result, this research can now be applied to development of digital knowledge engineering repository management system, knowledge verification from creation and storage as well as assessment of students' knowledge application-based machine learning with the use of text mining so as to apply the developed system in a practical way among Thai university students.

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