Design of Prototype Expert System as a University Knowledge Management Tool for Academic Teaching Activity Evaluation

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Abstract. Knowledge management is a relatively young field of research in the era of the information society. Nowadays, organizations are increasingly aware of the vital importance and value of the knowledge they possess and they are in a constant race to manage their knowledge and to make it available for future use in order to maintain the value of the knowledge. The most suitable organizations that implement the knowledge management core concepts are universities. In this paper the main focus is to represent a model framework for the structure of the university knowledge management system and to give an overview for the design of prototype expert system for evaluating university teaching activities to enhance the university performance and decision making process.

Keywords: Knowledge management, University knowledge management system, Expert system, University teaching activity.

1. Introduction

For centuries, scientists, philosophers and intelligent laymen have been concerned with creating, acquiring and sharing knowledge and improving the re-utilization of knowledge. However, approximately two decades ago, i.e. in the 1990s, a field of research was born with basic goal to deal the concern with knowledge known as - *knowledge management (KM)*. Knowledge management represents one big complex area which by its nature is a subject of continuous development. The essential goal of KM includes creating and networking of individual knowledge, its transformation into collective and using different forms of knowledge in the process of creating value [1].

Nowadays so much attention is dedicated to this area that for a big number of organizations, where experts' knowledge is the key factor to their success and development, knowledge management represents a very important strategic area [2]. Since the interest of organizations for knowledge is growing rapidly, they become aware of the value that has the knowledge and if the knowledge is not shared and used within the organizations loses its value. Through integration of IT and the concept of knowledge

management it should be observed as an opportunity for creating information systems known as knowledge management systems (KMS), which efficiently and effectively manage knowledge and support the four process model by Alavi and Leidner that contains: knowledge creation, storage/access, transfer and application [3].

Universities are the most suitable type of organizations that easily and naturally implement the knowledge management concepts in the core of their functioning. By taking into consideration the idea of mixing universities with knowledge management the main objective in this paper is based on representing framework for a model structure of a university knowledge management system that covers three activities, under the St. Kliment Ohridski University in Bitola, including: research activities, teaching activities and university management activities. However, the spotlight of this paper is oriented on the design of a prototype expert system as a tool for evaluating the teaching activities.

The paper is organized as follows. Section 2 gives an overview of the importance of university knowledge management systems and also representing a framework for a model structure of a university knowledge management system. In section 3 examples of implementation of knowledge management by universities are briefly described. Section 4 presents the UKLOExS_TAs expert system that was developed as a university KM tool for evaluating teaching activity as well as details about the architecture of the system, ontology and the knowledge base. Section 5 briefly describe the future work. The last section concludes the paper.

2.   University Knowledge Management System

From the learning point of view, it seems like universities are the most suitable type of organizations for implementing ways of approaching and importance of knowledge management. Knowledge sharing is one of the most important feature of every university, while one of the main missions is the transmission of knowledge from teachers to students and the transmission of knowledge from the researchers to the academic communities. Because of that the implementation of university knowledge management system (UKMS) can be done by natural way, so that knowledge transmission within university community is a natural process.

Main reasons for implementing knowledge management into the core functioning of universities are: (1) universities mostly own modern IT infrastructure; (2) in general knowledge sharing with others is natural for teachers and professors; (3) gaining knowledge from accessible sources as fast as possible is a common will of all students; (4) existence of trustworthy atmosphere at universities, no one is afraid or doubting of publishing or expanding their knowledge.

Knowledge management at university level is considered of multiple strategies, methods, practices and identification tools, creating, sharing and application of knowledge for efficient and effective goals accomplishment. An efficient UKMS requires usage of intelligent software tools based on artificial intelligence techniques.

2.1.   Framework for a Model Structure of a University KMS

A University KMS incorporates three modules for the main activities performed by a
university: teaching, research and university management. Fig. 1 shows the structure of a
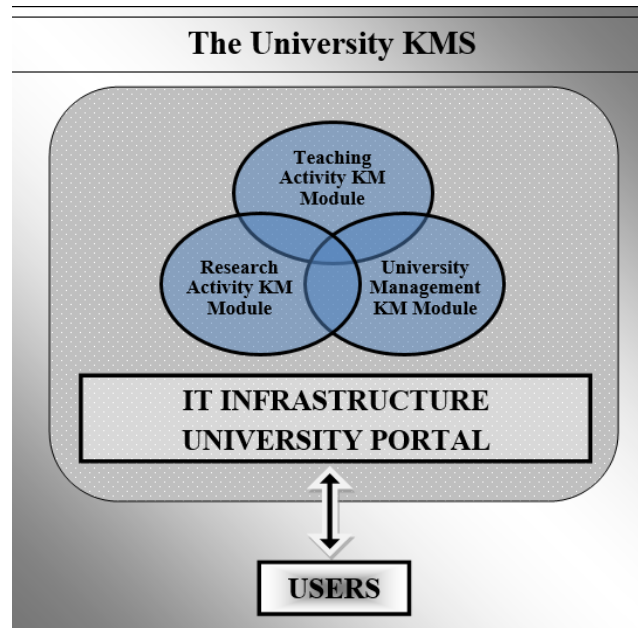generic university KMS.

Fig. 1. The structure of a generic university knowledge management system, adapted from
Mihaela Oprea, "A University Knowledge Management Tool for Academic Research Activity
Evaluation", 2011

The structure is composed of three modules: Teaching Activity KM Module – TKM,
Research Activity KM Module – RKM and University Management KM Module – UKM,
as well as some supporting modules: IT infrastructure (e.g. Internet) and university portal
that offers user interface for potential users: students (bachelors, masters, PhD candidates,
post PhD candidates), academic staff, potential students and other people interested in the
university activities.

The TKM module manages with the whole knowledge regarding the teaching activity
done under different programs of study, bachelors, masters, PhD, post PhD for different
domains of studies. The RKM module manages with all the activities related with
research done at the university by different departments. The UKM module manages with
all the activities related with administration actions done by the university, such as
strategic planning budget creating, administrative services (human recourses,
investments, accounting), public relations etc.

3. Related work

In the last decade, a major number of universities have started a development of their own knowledge management system, in direction of enhancing their performance and the decision making process, minimizing expenses, improved academic services, etc. Among many universities in this paper are presented the following examples.

Hradec Králové University, Czech Republic. The Faculty for management and IT recognized the key benefits in the area of knowledge management and put effort into their incorporation in the working practices of the faculty, and at the university level as well, in direction of improving the decision making process via KM. Using the SyllabusPlus by Scientia Ltd. they started their first steps towards creating an advance knowledge-based course planner and scheduler to enhance the decision making process where three actors have the main roles, i.e. university management, teaching and research staff and the students as well, that will be able to make fast but high quality decisions [4].

University Petroleum-Gas of Ploiesti, Romania. The IT department made efforts in the direction of developing a university KM tool for academic research activity evaluation. The result was development of prototype expert system (ACDI-UPG, developed in VP-Expert) used as an analysis support tool in the research module based on knowledge and decision support tool in the process of making new strategies for improving the research activity [5].

Tatung Institute of Commerce and Technology, Taiwan. In direction for improving the performance and quality of the high level education, a technical and organizational infrastructure was formed by an outsourcing Gweb e-KM software solution by the Lotus Domino system. Its main goal was creating a culture of sharing knowledge using organization-wide vocabulary. Also a knowledge management model that consists KM strategies was included as well as KM Road Maps, KM process and implementation, knowledge database, knowledge transmission, KM infrastructure and measurements and evaluation [6].

University of Education, Indonesia. The development of KMS is focused on collecting data in a form of digital files accessible online. The role of such a system is to improve the teachers' skills, abilities and experiences via e-learning and research. Therefore, the KMS was developed by considering the following matters: content management, experience management and process management. For developing the system, the Microsoft Sharepoint software was used. The KMS has seven layers as follows: (1) interface, (2) access and authentication, (3) collaborative intelligence and filtering, (4) application, (5) middleware, (6) transport and (7) repository [7].

4. UKLOExS_TAs expert system

Expert systems by their nature represent automatic judgement and reasoning systems that aim to mirror and imitate the behavior of human experts. The development of the prototype expert system is implemented in Exsys Corvid, software tool designed for generating expert system.

The goal of the designed UKLOExS_TAs expert system is to evaluate the activities related with the university (teaching activity as the main subject in this case; research activity and management activity) in direction of improving the university's

performances as well as improving the decision making process. As mentioned earlier the
UKLOExS_TAs expert system aims to help to evaluate the teaching activities including
teachers and students, helping the teachers to improve their performance and make the
student successful long life learners. It is important to note that the expert system is
developed to a stage where it only covers evaluation of teaching activities regarding the
professors, while the part related to learning activity under teaching activities regarding
the students it is considered as a future challenge.

The evaluation of the teaching activities will be conducted through evaluation of:
grading the students, grading the teaching methods used by teachers during the lectures,
as well as evaluation of the course description, aiming to grade the way of course content
defining and implementation of adequate materials through which the knowledge is
passed onto the students. The evaluation of these key factors will be done by defining
indicators for each, as well as creating IF-THAN rules, which when run through the
inference engine will result with making some decisions regarding the level of the
teaching activities being well graded.

4.1.   Architecture of UKLOExS_TAs Expert System

Fig. 2 shows the modules of the UKLOExS_TAs system architecture.
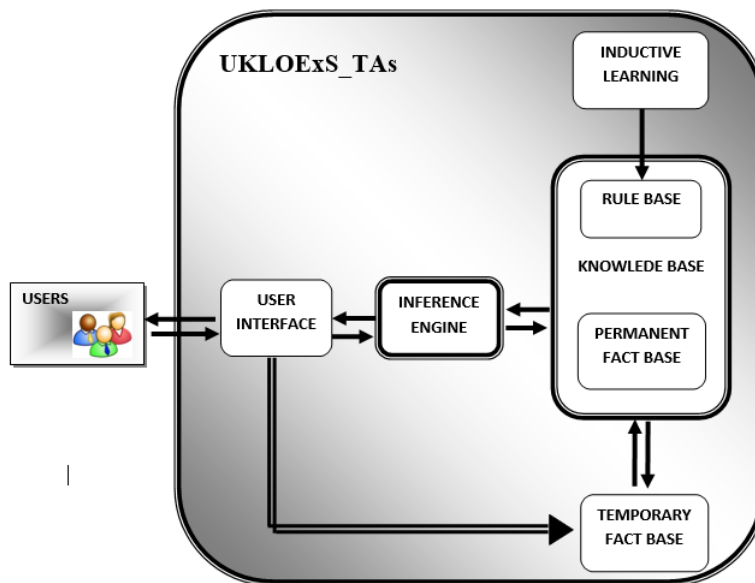

Fig. 2. Architecture of UKLOExS_TAs system

The main modules of the expert system are the knowledge database and the inference
engine. The knowledge database contain the knowledge that the system uses in a form of
IF-THAN rules which makes the database of logic rules and permanent facts that are used
during the evaluation of teaching activities. The inference engine is doing the evaluation
reasoning by using the knowledge from the database and the temporary facts that define

the context of system consulting. The temporary facts database is initialized by the user, through the user interface, with initial facts regarding the teaching activities evaluation done by the students.

4.2.   Ontology of UKLOExS_TAs system

Being the representation of all the terms for teaching activities, the ontology was used as a base for building the rules used by the system [5]. Its hierarchy is shown on Fig. 3 where teaching activities are divided it two sub activities: evaluation and lecture.
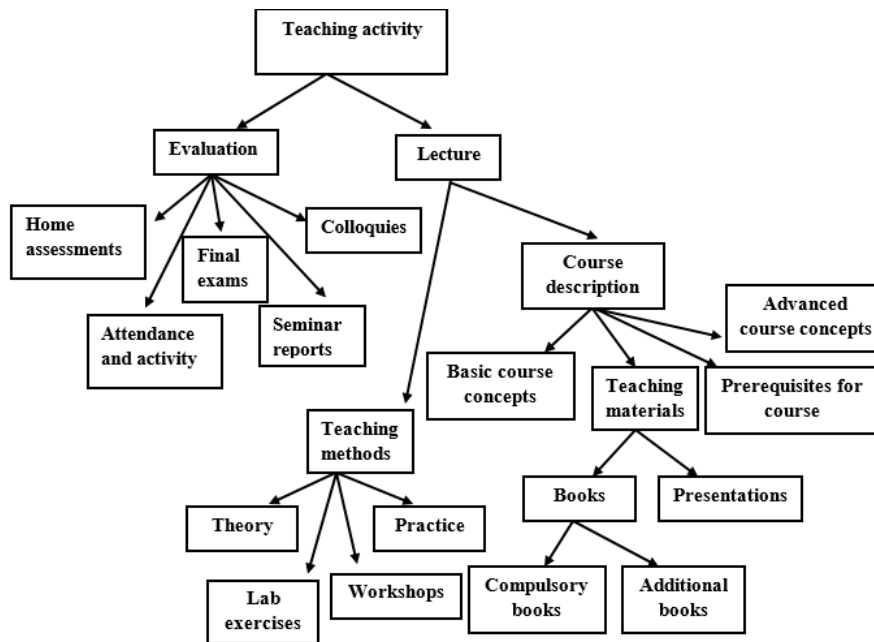

Fig. 3. Ontology for UKLOExS_TAs system

4.3.   Knowledge Base of UKLOExS_TAs system

The knowledge base contains the permanent fact base and the rules base. The permanent fact base is composed of all facts i.e. indicators related with the teaching activities and analyzed by the UKLOExS_TAs system. On the other hand, the rules base contains all the possible rules that the system uses in order to be able to evaluate the teaching activities. The total number of generated rules that are going to be used by the system is 828 rules including all possible combinations of the indicators and their measuring values (poor, good, very -good, excellent, none, small, medium and high). However, the Codification of the indicators and sub-indicators for quality of teaching activity analyzed by the UKLOExS_TAs system is given on Fig. 4.

Indicators for EVALUATION	
Suitable level of assigned homework	- SLAH
Grading suitability of attendance and activity toward the final grade	- GSAA
Quality of the seminar reports	- QSR
Objectiveness and measurement of the questions difficulty level	- OMQDL
Indicators for LECTURE	
Indicators for sub-indicator quality of the teaching methods under Lecture	
- QTM	
Suitable level of teaching methods regarding the theory	- SLTMRT
Level of effectiveness of the practice	- LEP
Efficiency level of workshop	- ELW
Suitability of lab exercises regarding the theory	- SLERT
Indicators for sub-indicator suitable level of course description under Lecture	
- SLCD	
Definition and development of the basic course concepts	- DDBCC
Definition and development of the advanced course concepts	- DDACC
Appropriately defined prerequisites for enrolling the course	- ADPEC
Indicators for sub-indicator efficiency of the teaching materials under course description	
- ETM	
Quality level of compulsory books	- QLCB
Quality level of additional books	- QLAB
Presentation quality level (organization and core lesson concepts delivery level to students)	- PQL

Fig 4. Codification of the indicators and sub-indicators for quality of teaching
activity analyzed by the UKLOExS_TAs system

The system has a goal to help rising the quality of students' gained knowledge. In that direction it values: the methodology of knowledge acceptance by the student (that is not a subject of consideration in this paper) and teacher's activities in that direction. However, in this paper are considered the quality of the teachers' activities for evaluating: (1) students' achievements: home assignments (their difficulty level, connectivity with teaching content, etc.); exams; attendance and activity; seminar reports and (2) quality of knowledge transmission: lectures; teaching materials; presentations.

5.   Future work

So far the effort was put on developing an expert system for evaluating the teaching activities regarding the teachers, what is planned as future work is developing a full expert system as a university knowledge management tool that will cover all of the university's activities. Such a system will be of a great importance since its benefits will improve the performances of the university as a whole, and not just the teachers themselves.

6.   Conclusion

In the last years, the development of university knowledge management systems becomes an important area to explore. Today, modern universities as business organizations with a big number of business activities on the education market, are aware that every method for increasing their competence is of a great importance to them. As education centers keeping up with the turbulent changes of the IT era, they become more aware of the value of the knowledge they own and that combined with the IT they can develop tools that will manage the knowledge and will minimize the chances of losing its value, in total. In this paper it has been developed an expert system for academic teaching activity evaluation that can be used as a tool for enhancing and maximizing the university performances and improvements in the decision making process as well. This tool on the one hand will help the teaching staff to become more experienced, effective and efficient in their field of knowledge, and on the other hand will help students to become long life learners to meet its designed goals.

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