e-FacultyPortal: Agent-based Mobile Knowledge Portal for e-Learning in Collaborative Environment

Hanim Risidi, Zaihisma Che Cob, Rusli Abdullah, Noor Hapidah Muhayat, Azizah Rahmat, Nur Atiqah Muhammad

Faculty of Computer Science and Information Technology, UPM, Department of Information System, College of IT, UNITEN

hanimr@putra.upm.edu.my, zaihisma@uniten.edu.my, rusli@fsktm.upm.edu.my, hapidah_01@yahoo.com, saari6466@yahoo.com, atiqahiqi@yahoo.com

Abstract

Nowadays, education has to be a process of sharing and acquisition of knowledge, experience and skills. E-learning gives the features for knowledge to be shared and spread widely. However, many of the e-learning systems are information based systems which functions as a channel to deliver course content and functions from various sources. This paper proposes the agent-based mobile knowledge portal, also called e-FacultyPortal which emphasize on the mobile knowledge management system as a learning platform for students. Intelligent agent enables the personalization of knowledge and keeping the user more alert on the latest knowledge and materials deposited in the system. Initial result from pre-development KMS survey shows the system is able to serve the communities of practices to be more productive in learning new knowledge. The development of this framework is expected to improve the flexibility of the e-learning conduct regardless the time, place and people.

1. Introduction

Nowadays, education has to be a process of sharing and acquisition of knowledge, experience and skills. E-learning gives the features for knowledge to be shared and spread widely. Derek Stockley [1] defines e-learning as “the delivery of a learning, training or education program by electronic means. E-learning involves the use of a computer or electronic device (e.g. a mobile phone) in some way to provide training, educational or learning material”.

E-learning system supports the learners and tutors regardless the constraints of time and space in order to use the learning materials and services. In [2], the advantages of using e-learning system for enterprises are cost efficiency, employee capability enhancement, digital content flexibility, timeliness and reliability and so on. However, many of the e-learning systems are information based - as a channel to deliver course content and functions from various sources [12] rather than being knowledge based system. Integrating the e-learning system with knowledge management system (KMS) can improve the productivity of learners by providing a study workplaces and learners may benefit with this working environment that provides them everything they need to do their job. With development and delivery of learning resources through various kinds of mediums, it is an advantage for knowledge management system to accomplish requirement of individuals and organization in order to fulfill their knowledge acquisition and knowledge sharing. Thus, collaboration tools are compulsory for them to work together in order to utilize the knowledge and also to generate new knowledge.

In this paper, we describe the agent-based mobile knowledge management system which also called e-FacultyPortal for the use of virtual class community of practices (CoP) to learn virtually in Faculty of Computer Science and Information Technology (FSKTM), UPM. We improve the current Virtual Class by putting the functionality of software agent, knowledge management process and mobile technology. This research aims to develop a dynamic intelligent e-learning system for the collaborative Virtual Class environment to give flexibility of learning and knowledge sharing at anytime, anyplace and anywhere in convenience way.
2. Literature review

KMS is a process creation of knowledge repositories, improvement of knowledge access and sharing as well as communication through collaboration, enhancing the knowledge environment and managing knowledge as an asset for an organization [11]. Knowledge taxonomy for KMS consists of knowledge acquisition, storage, dissemination and application.

Abdullah et al. [3] proposed the development of KMS for public higher learning in collaborative environment. They describe the theoretical concept and approach of KMS and how the prototype was developed using the Lotus Notes. Both knowledge management and e-learning are interrelated especially on collaboration process, in which the collaboration is a very critical process in each KM system activity. For communication and collaboration, the mediums that need to be presented should be in synchronous and asynchronous form using relevant tools to support the educational communities.

Marshall et. al. [4] proposed GetSmart system to help individuals, groups, and communities develop knowledge. This extensive project was created to apply knowledge management techniques in a learning environment. The design of the system is based on the analysis of learning theory, integrated search tools and curriculum support with concept mapping. Preliminary analysis of the collected data is used to derive knowledge representation patterns. KM system and educational system is similar in term of both involving creation of useful knowledge from information or data from repositories. KM allows effective control and management of the corporate memory-the knowledge that is within the organization [10].

Agarwal et. al. [5] presented the use of intelligent agents in the sphere of effective e-learning education. Intelligent agents perform specific tasks on behalf of educational community. Intelligent agents expected to be the basic technology to support the knowledge management [9]. The agent characteristics are intelligent, autonomous, mobile, rational, reactive, persistent and proactive. Likewise, the wireless technology and mobile devices also shows positively correlated with e-learning effectiveness [6]. Issack et. al. [7] proposed the mobile e-learning adaptive architecture designed to blend mobile and e-learning in a single integrated computer-based infrastructure.

Based on the literature review, we found that there is still lacking in implementation of e-learning system with knowledge management system, especially on the use of agent-based technology to automate the functionalities that e-learning offers.

3. Background study

Our research is based on the E-Faculty application of Faculty of Computer Science and Information Technology (FSKTM) in UPM which presented a combination of asynchronous and web-based learning which offers directed or self-paced learning to students. The system was developed using Lotus Notes 5.0, which comprises of two components: (1) Administration and Management and (2) Learning and Research.

In this case of research, the focus is set to be on Virtual Class, which is the sub component of the learning and research component of E-Faculty. In Virtual Class, every subject offered has its own web site, which consists of learning materials and also includes lecturers’ information, as well as forum facility to enable discussion on the subject matters. The learning materials are in the form of lecture notes, modules, reference notes, and relevant articles. Student can access the Virtual Class and download the required materials provided they have an Internet access.

4. Research methodology

In this section, we describe our research methods on how we will conduct the research. This research is organized into five phases. Phase one requires the critical evaluation of the literature review of existing framework in e-learning domain. This followed with pre-KMS development which we develop and distribute the questionnaire to the target respondent. Literature review and survey result enables us to produce the model and architecture of intelligent KMS with collaborative environment. The survey has been conducted by disseminated fifty questionnaires to the participants that we identified as the actors in community of practice as further describe in section 5.0. Target respondents are students, lecturers and administrators.

Phase two is implementation of KMS prototype. Then, another round of questionnaire is distributed to the target respondents as the post-KMS implementation to evaluate the system performance and usability. Comparison between Pre and Post KMS implementation is to revise the model and architecture. Lastly, phase five to conclude the study.
5. Community of Practice (CoP) model

Community of Practice (CoP) approach is fundamental of the collaboration in KM. CoP is a concept developed by Etienne Wenger, defined as “a group of people who share a common concern, a set of problems, or a passion about a topic, and who deepen their knowledge and expertise in this area by interacting on an ongoing basis”[8]. The existence of CoP in an organization can foster the knowledge sharing through collaboration between individual, teams and organisations. Having a group of people working together will create a collaborative environment that is essential for survival of any organization. This collaborative environment provides a framework for bringing heads together, organizing efforts, managing the process and producing outstanding results [2]. A model of collaboration was proposed by Anumba et. al.[13] as shown in Figure 1 below.

<table>
<thead>
<tr>
<th>Same place</th>
<th>Different Time</th>
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<tbody>
<tr>
<td><strong>Same time</strong></td>
<td><strong>Different Time</strong></td>
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<tr>
<td>Face-to-face collaboration (Synchronous)</td>
<td>Asynchronous Collaboration</td>
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<tr>
<td>Distributed Synchronous Collaboration</td>
<td>Distributed Asynchronous Collaboration</td>
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**Figure 1. Collaboration model**

In this research, we have identified the actors of CoP. These actors as a target respondent are very important as they will use and contribute the knowledge in order to ensure the successfulness of the system development. Figure 2 shows the proposed model of CoP in e-FacultyPortal. In this case, members in the CoP who are involved in this project may have their own roles and responsibilities as describes below.

- **Student**: Enrolls or attends classes in a school, college, or university. They study, accept and review the knowledge at the public higher learning institution.
- **Administrator**: The people who administer all aspects of the public higher learning institution tasks such as course registration, student registration, financial management and others.
- **Lecturer**: Their roles are as teachers and designers of learning experiences, processes, and environments. They are concerned with identifying and then transmitting intellectual contents and more focused on inspiring, motivating, and managing active learning process.
- **System analysis/programmer**: The people who are involved in KMS development which may help validate and develop KMS architecture and framework to ensure the system is successfully.

![e-FacultyPortal CoP](image)

**Figure 2. e-FacultyPortal CoP**

6. Proposed Solution

In this section, we describe our proposed architecture. We design architecture of e-FacultyPortal based on the literature review and pre KM implementation survey as discussed in research methodology section. Then, we develop e-FacultyPortal prototype based on the architecture proposed. E-FacultyPortal is designed to help educational CoP to manage knowledge. Thus, the possibility to learn in the community may increase opportunities for more interaction with other students and lectures. The high level architecture of our e-FacultyPortal is shown in Figure 3 which shows that members of educational community could interact with the system either from personal computer or from mobile devices.

The framework is the adapted from framework by GetSmart project [4] that has been proven successful in applying knowledge management techniques in a learning environment. We extend the framework and add new intelligent and mobility features. We propose intelligent mechanism into the intelligent agent scope. Intelligence in our context refers to the ability of the agent to assist user on their behalf, capture and apply application domain specific knowledge and processing to solve problems [14]. We apply the agent-based technology to automate some functionality so that the e-FacultyPortal can behave intelligently to serve educational community.
Key benefit of e-FacultyPortal is that it allows the CoP to interact and communicate between users on PC with user on mobile device. When members of CoP post new knowledge to the portal using PC, it can be instantly accessed using mobile devices and members with mobile devices could exchange knowledge with other members using PCs or notebook. This mobile environment is a good start for CoP of e-learning to get flexibility of learning and knowledge sharing at anytime, anyplace and anywhere. E-FacultyPortal also allows learners to choose their own learning materials based on their learning patterns and specific environment.

**IT Infrastructure.** E-FacultyPortal is a browser-based system so that members can access it through Internet or Intranet via computer or mobile devices, especially within university compound. JSP and Java servlet technologies are used in the middleware and run on a web server. Messages are passed between client and server using XML format to enhance modularity and to support future interfaces for knowledge sharing. Most program logics for message parsing and authentication are written as stored procedures in the database. E-FacultyPortal uses Microsoft SQL Server.

**KMS Activities.** We discuss the usability of the e-FacultyPortal based on four activities of KMS. The descriptions of the activities are as follows:

- **Knowledge Acquisition**
  Knowledge acquisition is used to deposit new knowledge that captured by users. Knowledge acquisition requires the details information of the course information in order to classify and categorize them using ontology in order to support the ease of searching done by users. At this stage, personalization of information based on the interest and requirement of individual user can be done using the profile agent. When the knowledge is personalized to the user’s context, the better knowledge is acknowledged and internalized by the user [15].

- **Knowledge Monitoring**
  Knowledge monitoring is used to monitor the process of new knowledge capturing and knowledge sharing among CoP. One way to make user aware of the information available is through notification agent. User will be notified via email, sms or any means that can alert user of new knowledge that available in the system [16].

- **Knowledge Searching**
  Knowledge searching assists the users to browse and searching in the system. The simple and advanced searching gives the flexibility to the user to navigate the desired knowledge. This can relieve user from burden of searching and accessing non-relevant sources.

- **Knowledge Reporting**
  Knowledge reporting is used to report the description of the new contribution that is submitted by the CoP.

![e-FacultyPortal architecture](image)

**Content Management.** The content management component provides all learning materials and knowledge requires by the CoP. Student may access course materials, assignments, projects, and examinations online. Using collaboration tools such as email, discussion board and forum, a collaborative environment allows member of the educational community to collaborate together by sharing knowledge and information. Content tool includes three integrated parts: lecturer tools, administration tools and student tools. Lecturer tools include curriculum design and online assessment with automated grading. Administration tools include file management, authentication and authorization. Student tool functions include:
• Learning Material: lecture notes, modules, reference notes, readings, assignments, projects, and other resources.
• Collaboration: asynchronous and synchronous bulletin boards and discussion forums
• Learning progress scheduling and tracking: assignment reminder and submission, personal calendars, and activity logs.
• Self-assessment and evaluation: tests designed by lecturers to evaluate student performance.

Agent Component. Intelligent agent could make e-learning more powerful and dynamic. We use agent component as the intelligent features in e-FacultyPortal to deal with changing environment due to changes in business processes or IT infrastructure [9]. With the agents, the e-FacultyPortal has characteristics of reactive, personalized and social behaviour. We adopt the Prometheus methodology [13] as our methodology to guide us to design the agent component. We proposed five agents which are working together with the following functionalities:

• Profile agent: agent to keep track and report all information about students, lecturers and administrator. Personalization of knowledge is based on the interest of the user when they register in the system profile.
• Mobile agent: agent to identify the mobile devices and make adjustment when displaying information in mobile screen. Mobile agent also can detect the mac address in every mobile device to push new information.
• Notification agent: agent to notify the student if there is any new announcement, assignment or new knowledge deposited into the e-FacultyPortal.
• Reminder agent: agent to remind the student on the due date of the assignment or project.
• Scheduler agent: agent to manage the individual scheduler and also for the faculties activities. The entire CoP can use the scheduler as a day planner and scheduler agent can alert the user based on individual activities.

Search Component. Search component is based on a metasearch framework to support queries and post-retrieval analysis. Metasearch module handles query requests and results for several existing search portal. This search tool accesses community knowledge repository. The search tool helps knowledge travels as information to user/learners. As information is transferred to the member of CoP, it becomes enriched, expanded, and synthesized into new or unique contexts. These processes are viewed as knowledge flow from experts and repositories to individuals and groups.

7. Result and analysis

In this section we present our results and analysis based on the pre e-FacultyPortal implementation survey. The survey has been carried out to obtain qualitative and quantitative data from the CoP members on the requirement of e-FacultyPortal.

Analysis shows students do agree that the current Virtual Class do not provide them with flexible method of learning as it cannot be done at anytime and anywhere. Students need immediate notification and to be kept alert on the new knowledge and material published in the portal.

Students in general support the e-FacultyPortal, 74% of the students agree that e-FacultyPortal is useful for the existing courses, 72% agree that e-FacultyPortal have a good discussion tool and 66% agree that it is easy to understand the portal. Figure 4 shows the overall result of agreement and disagreement analysis.

![Figure 4: Student survey agreement/disagreement analysis](image)

Finally, result also shows that the students having mobile devices (93%) own handphones (80%) and notebooks (60%). With the newer digital phones, there are potential for more students acquiring low cost fixed-rate data access services from 3G and Wi-Fi network services in the near future. 75% of the students are willing to use their mobile devices for m-learning.

8. Conclusion

This paper presents the proposal of agent-based mobile knowledge management system called e-FacultyPortal. The result obtained from pre development e-FacultyPortal survey are encouraging and promising for development more complex system
in future. Our future efforts are implementation of e-FacultyPortal prototype and then empirical study will be carried out to evaluate the effectiveness of the method that we proposed. This, we hope could improve the flexibility of the e-learning.

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10. References


