

Software Engineering e-learning Information Retrieval Courseware

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Abstract— Research studies, practical project activities and real-world implementation experiences were focused on designing and building information retrieval courseware system. The objective of the research was oriented towards creating a courseware system that will be based on assessed, and evaluated e-learning outcomes and previous known concepts to users. It was targeting the computing knowledge level of the users and provides higher level of information for the course content and support for different file formats. The main focus was set on evaluating the e-learning outcomes and based on them designed the information retrieval courseware in compliance with theories of learning and didactical pedagogical approach. The research is proposing a new way of tackling the process of creation of e-learning information retrieval courseware by integrating and undertaking the software engineering approach based on e-learning outcomes and taking into consideration theories of learning pedagogical approach in its development. Also business objective expressed through the cost effectiveness of the entire system was set as priority. We have achieved to have a high cost effectiveness through minimizing maintenance and need for training keeping the learning curve flat. Based on our research survey and user feedbacks it resulted in a courseware system that is cost effective and very usable. We recommend this courseware to departments where the staff computer literacy level is low and there are no financial means for a commercial learning management system.

Keywords – e-learning, information retrieval courseware, education

I. INTRODUCTION

In most of the contemporary universities, the implemented Course Management Systems (CMS) lacks of responsiveness of the well-designed model regarding the specific needs of the institution. Usually these models are complicated and require a lot of additional efforts from the staff and students both for learning and usage. On the other hand they are expensive to maintain and support especially when compared with the level of their usage. A straightforward implementation of an existing commercial tool for Course Management Systems (CMS) in environment of low e-Literacy of teachers and e-Culture of students, slow growth of Internet penetration, inadequate and insufficient IT equipment of the Higher Educational Institutions (e.g., countries of “West Balkans” and other regions in the world with similar economic

environments), can bring only simulations and not a substance for improving the real performances of the learning process.

The proposed model in this project is based on achieving the several parameters: to be in compliance with the learning theories and have a didactical pedagogical approach, e-learning outcomes, simplicity in usage-effecting in low learning curve, minimizing the maintenance and support in order to achieve high cost efficiency.

We also considered as crucial and very important to assess and focus on the computer literacy level, but also of the instructors/teachers' views and ideas with regard to their fields (i.e., their practical knowledge in delivery of course.) Our solution was targeting the academic staff computer literacy current level and adopted to their views and needs as prospective users of the system.

Our main research objective was to create an information retrieval courseware system that we named as Intranet Gateway system that will provide higher accessibility on-campus and off-campus. The aim was to raise the level of accessibility by providing additional e-learning features and options to the end users.

The research study objective was set in finding new and more effective approach in designing and building a course management system that will emulate the approach of the classical “teacher-classroom-content laboratory” and will raise it to the overall level of communication and accessibility to information and e-content.

II. RESEARCH METHOD

Our research methodology was fundamental research of the e-learning outcomes, variables and the findings from our fundamental approach we used in our applied research afterwards based on exploratory and constructive research on several hypermedia development methodologies. A hypermedia application represents a collection of unstructured and multimedia nodes connected through links in an associative way. Since hypermedia systems are highly interactive, the design method has to be user-centered. We have however used a hybrid combination and different interaction mechanisms through active x controls and the hyper document is actually accessed in run time from the user side, while from an administrative perspective it is set as file on a remote server. At all stages of the design and development, prototyping and evaluation were the basic activities in the development process. The data for this research was gathered from research interviews with e-learning specialists and participants, focus group and interviews, as well as web based surveys and printed hard copy surveys with academic staff and students.

Key variables and themes that have been studied are: assessing and measuring e-learning outcomes, students needs

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analyses, environment of usage feasibility analyses incorporating multicultural and multilinguicity specifics, applications specifics and requirements in correlation with the environment and situation of the University and then broadly generalized for all contemporary Universities, accessibility and learning specifics based on usability testing and evaluation of the environment.

Considering the software development methodology approach, we have used the "spiral" software development life cycle, prototyping, usability expressed in matrix and usability testing; and cross-sectional survey using questioners, in order to find and get the feedback from the users of the system in accordance with the guidelines from [6].

III. REQUIREMENTS ANALYSIS AND THE CONCEPTUAL DESIGN

The mission of the application is established by identifying prospective users and defining the nature of the information base. Also identifying and assessing the e-learning outcomes is set as primary goal. In addition to the customary requirement collection and feasibility assessment tasks, web applications designed for universal access require special care in the identification of human-computer interaction requirements. In order to establish the interaction mode most suitable for each expected category of users, and for each type of output device that users are expected to use to connect to the application based on recommendations from [3].

Speaking to a prospective users and research interviews with e-learning specialists and participants, focus groups we have assessed and defined our users computing literacy level. Our results shown that almost all of them had knowledge of basic Operating System commands, opening , creating, changing, and deleting folders and they know the common operations with using files, as well as they all know MS Word, and notepad. They were all aware of other file formats as: Adobe portable document (pdf), and Windows help file (chm) format. These assessed knowledge level was set as our target and our software was built to target this level of knowledge and use only these operations as well as embed them in our software solution for the courseware.

As far as the conceptualization is concerned the application is represented through a set of abstract models that convey the main components of the envisioned solution. In the Web context, conceptualization focus is on capturing objects and relationships as they will appear to users, rather than as they will be represented within the software system. In our approach in building the Intranet Gateway we have created a Public Folder in a remote server where the entire content of the courses content and subject materials can be placed. Conceptually we have organized the folders to contain all the files inside them and an additional folder to be set up for the web page needs. The lecturer of a particular subject and his assistants have administrative privileges and are allowed to have access to the folder of the subject in the remote folder, where they can add, change, delete, write or read information, change and manage the content. The students are not allowed to have access to these folders. They will access the content from a web interface. To provide a formal user-interface design, the frame concept has been employed.

IV. SYSTEM MODELING

In developing the Intranet Gateway system we have approached using the spiral life cycle model and followed the usability principles recommended by [2], and [5].

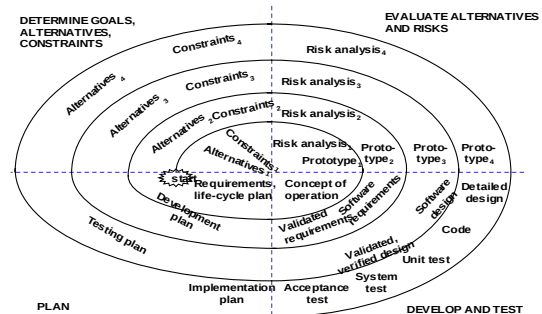


Figure. 1 The Spiral Method, [6]

As a platform we have used Microsoft Active Server Pages-ASP. The spiral methodology reflects the relationship of tasks with rapid prototyping, increased parallelism, and concurrency in design and builds activities. The spiral method should still be planned methodically, with tasks and deliverables identified for each step in the spiral software development life cycle (Figure 1).

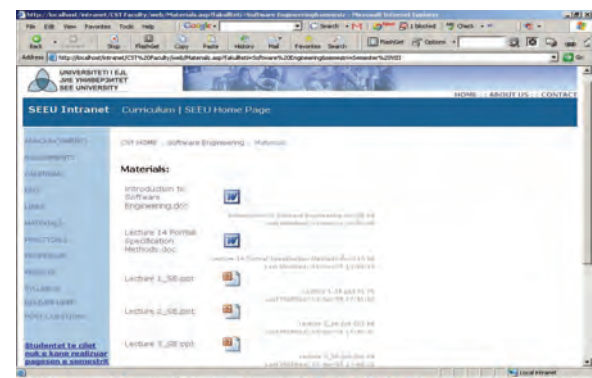


Figure. 2 Intranet Gateway courseware system – Class content materials

An important issue during development was importing the entire content from the remote Public folder and nothing to be hard coded as content.

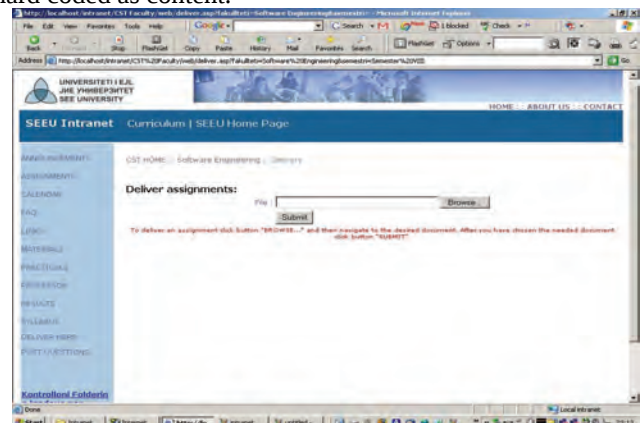


Figure. 3 Intranet Gateway courseware system – Delivery mechanism

This makes it very easy to maintain and manage content. The entire content is loaded in the browser at the moment of accessing the required subject through the web based interface and the course administrator-lecturer and assistants engaged in the subject are not limited and can offer content in different formats like Word documents, Adobe pdf files, MS chm format and all other available standard formats for content presentation. This is realized through using MS Active X controls.

The course administrator simply using copy past functionalities puts the content in the folder from where the students access it. Also the content shows the attributes when it was created and modified as well as its size together with an icon and description of its format. In defining the initial requirements using this model before building our first prototype we first anticipated all the requirements and created a project management time table that would involve all anticipated activities like detailed design, needs analyses, development phase, testing the unit, integration and test, evaluation and implementation.

Activity Number	ACTIVITY Name	DURATION (Weeks)	DEPENDS ON (Dependencies)	PT	OT
10	Feasibility study	2		+2	
15	Requirement analyses	6		+1	-1
20	Modeling-Design using UML	9	15	+1	-1
25	Planning activities	2	20		
30	Write data entry software	3	10		
40	Create Data files	5	30		
50	Create multilingual content	3	40		
60	Write Program Specifications	3	10	+1	-1
70	Construct Program	12	60	+3	-2
80	Test System	5	25,40,70		
90	Familiarize users	2	10		
100	Train Staff	6	90		
110	Deployment	2	50,80,100	+1	-1

Table 1: Work breakdown activities with dependencies, duration, pessimistic (PT) and optimistic time (OT)

The project managing team introduced 13 work breakdown activities for the Gateway project.

Then based on our activities using the Critical Path method-CPM in combination with PERT (program evaluation and review technique) we have defined our critical activities and time of delivery (time when the project can be delivered) that was calculated to be in 25 weeks, and we also have done the risk analyses of the system, analyzing all the possible risks. The project had two critical paths (CP) lying between the activities: CP1: 10-60-70-80-110 and the second critical path between the next activities CP2: 15-20-25-80-110. The system was constantly during its all stages critically evaluated first from the development team during meeting sessions and then from the users. Important issue that was highly considered was the news and announcement options. Based on the interviews with students and lecturers it was concluded that students very rarely access announcement and read news regarding the University, Faculty and subject. In order to solve this issue we have implemented news scrolling text developed using JavaScript that according to our survey was highly appreciated. The entire content of the news and announcement will be uploaded from a simple text file, and it will show in each subject page on the left bottom of the screen. The menu content and links are based on a grounded

theory research that included several comparative analyses of course management systems and web based course systems as well on our experiences and surveys on the users needs analyses. Following the guidelines from [4] the interface is clear and navigational structure is clearly marked using breadcrumbs allowing the user to orient him self at each point about his position in the content structure hierarchy. Also a clear exit or shortcut to the other main content groups is provided so the user can easily navigate depending on his preferences and needs observing the navigational guidelines and not so much the aesthetic perspective of the interface. The aesthetics can be addressed later and has to be sacrificed for the accessibility, content availability and overall functionality since it is not a priority for such a system under development.

V. IMPLEMENTATION ISSUES AND SOLUTIONS

The functionality concerns both training activities and navigational ones, like moving through hypermedia objects and browsing large multimedia structures [1]. The training issues were brought to minimum as it was one of the main goals in the design of the project. The main issue was to develop an interactive system that would support user functionality efficiently and effectively, taking advantage of the new infrastructures currently available. All the users are brought to use a system that is already familiar and based on already used concepts and techniques that they already know how to use the public files. The information provided by the system is presented in a variety of ways, such as interactive simulations demonstrating the use of various Internet tools, hypertext, special sounds, appropriate images and animations, hypermedia object, etc.

VI. CONCLUSION

As a result of the project we have anticipated different outcomes, some positive and some negative aspects. In order to evaluate the outcomes of the Intranet-managed teaching/learning we have based it on the usability testing and evaluation questionnaires that we used as instrument to evaluate the outcomes. The questionnaire was focused on determining the 'level of content' and comparisons between 'old' teaching and 'new-Intranet' approach. Also a grade average analysis (comparison) of students who attended 'classical' classes and those with using 'Intranet Gateway' is done in the following table for the subjects "Computer Application in Communications 1 and 2 – CAC 1 and 2"; Object Oriented Programming in Java(OOPJ), Web Design and Multimedia (WDM 1). It is very difficult to conclude that this improvement in the performances of student success is only due to the impact of Intranet Gateway, because also other factors can influence to it (ex. Methodology of teaching, the evaluative educational aspect of the 'next' generation of students by default for the purpose, etc.), but the notion that the main factor for improvement was this new Course Management System through Intranet after the analysis of the questionnaire is true.

Subject	GPA before Intranet usage	GPA Improvements after usage
CAC 1	6,85	7,40
CAC 2	6,10	6,70
OOPJ	6,72	6,95
WDM	6.05	6.35

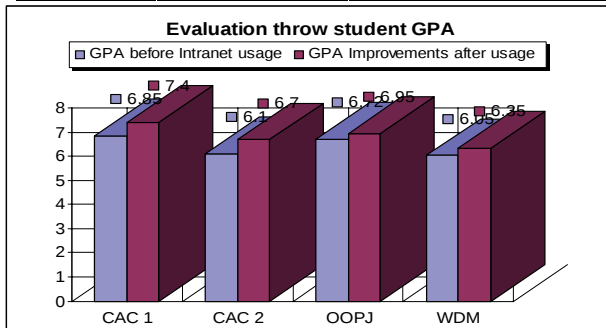


Table.1. Evaluation throw student grade average – GPA

The Intranet gateway was implemented for the courses in the Communication Sciences and Technologies (CST) Faculty - Computers Science Department (CSD) of SEEU. Based on the observations and measuring instruments, the outcomes are as follows:

Positive outcomes:

1. With the use of Intranet, the three classes became more effective. Comparing with the projects from previous years, the quality of the technology tasks were improved, especially the quality of multimedia designs and Web based instruction designs. Some of the projects showed that students accomplished more than they had expected, and even more than the listed course objectives, because they had more opportunities and time to explore the technologies, and to improve learning by team collaboration.

2. Accessibility was substantially increased. The students now had more access to materials and feedback.

3. Student motivation by using the system was also substantially increased. The classes became more interesting for them and they enjoyed learning, requiring new knowledge and technology in the way they felt comfortable, which, to certain extent, motivated their learning. We concluded that learning is substantially more effective when the learners were highly motivated.

4. One of the most important outcomes was that students actively involved through the teaching/learning processes, from which they learned to manage their own studies.

5. Students also learned how to use Intranet to enhance teaching. Their projects reflected not only the technology designs, but also the use of Intranet in teaching. They learned this from the way the classes were organized, and from the way they were taught.

Negative Outcomes:

6. The instructors complained that now their work has been at least doubled and the requirements for a course preparation are more demanding compared to previous years, what effected substantially their motivation in using the system because of the amount of work additionally added to maintain courses.

7. Students were complaining why all of the class materials are not provided electronically-digital format as e-content and why they still have to use only books. They can not take the book everywhere with them while they can access the e-content easily and does not impose any constrain to them.

8. The content provided is of static nature and is simple text and static graphic images which does not effect learning in any other level compared to the previous classes (based on user and instructor survey feedback) and there are no studies that could convey the way of preparing e-content that could substantially increase learning compared to the classical classroom.

9. Based on the user feedbacks, e-learning survey and literature reviews we have concluded that the courseware system at this stage of usage is providing only e-reading and not e-learning since it does not impose any distinct effect on learning, accept on motivation, attention, and accessibility level.

Our observation based on questionnaires, survey and our analyses is that the developed system is very cost effective, with minimized need for a maintenance and staff training since it based on their previously assessed level of knowledge, it proved practical and easy to use, specially having in mind departments were computing knowledge is not a requirement. Future work should involve further research on authentication issues, forum option, links to other University software like library software, SEEU assessment software, central administration, and also should include options for importing and exporting the content into SCORM complement content package that could be easily used in conjunction with the other commercial Course Management Systems.

Because of its cost effectiveness and simplicity of usage and since it is not imposing any previous IT skills and knowledge requirements based on surveys and user feedback it proved practical, useful, and easy to maintain system with highly acceptable cost effectiveness in a broad aspects of usage for different institutions/departments.

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