2011 International Conference on Sociality and Economics Development
IPEDR vol.10 (2011) © (2011) IACSIT Press, Singapore

An Academic Project Management Web System Developed through a Software House Simulation in a Classroom

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Abstract. This work presents an academic project management web system that can be applied to support the educational planning and management demands of the discipline "Graduation Project" of the Computer Science undergraduate programme of the Federal University of Tocantins. Besides, it was simultaneously conceived to support a Master Science or Doctorate programme. The proposed academic project structure allied to a textual structure implement a common framework that shall simplify data acquisition and analysis, and shall provide unified measures to help coordinate the programme. The core of the system was developed during a one semester Computer Science undergraduation class using role-playing to simulate a software house and through a problem-based learning approach. Hence, the main objective is to propose a way to improve the quality of educational programmes strongly based on academic projects; the methodology was to simulate a software house with undergraduate computer science students during the class of "Systems Development" in the second semester of 2010, using as tools JAVA, Javaserver, Primefaces, PostgreSQL, Glassfish and Netbeans; the result is a web system to support academic projects management from the programme's perspective.

Keywords: academic project, software development, web system, role-playing, problem-based learning, project-based learning, project management, education management.

1. Introduction

The quest for quality in education emphasizes the role of planning and management. Hence educational programmes, such as Master Science and Doctorate, may benefit from applying an academic project management system. In order to accomplish that, it is reasonable to establish a common framework that provides a basic structure, which would be useful for acquiring data and generating statistics to support the programme's planning and management. The proposed system intends to be the framework that implements this basic structure.

The system was conceived to satisfy the Computer Science undergraduate programme, at the Federal University of Tocantins (UFT) – it has an obligatory subject at the end of the course called "Graduation Project"; and it should simultaneously attend the Master Science and Doctorate programmes. In this subject each student must develop a project, write a monograph about it and orally defend it to a designated committee that grades the student's work. Actually, this subject is done in one semester, but in the new curriculum it is going to be split in two subjects, that is, "Graduation Project 1" and "Graduation Project 2".

In the beginning of every semester the students enrolled in the subject "Graduation Project" have a deadline to find a supervisor, write a project proposal and elaborate a work plan – an activities schedule. Because of the variety of fields in Computer Science, work plans may differ a lot and a general timetable becomes very difficult to attain. Consequently, the coordinator's task to monitor individually each student may be accomplished, but to manage and to report become very demanding. Hence, to support these last two tasks a software to manage academic projects may be useful.

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In a Project Management approach, it is desirable to use past experiences to improve future results. In accordance to the Project Management Body Of Knowledge (PMBOK) [1], a project has five phases (Initiation, Planning, Execution, Control and Closing), consequently, it may be a suitable approach to educational programmes that are based on academic projects, and to apply a common framework may improve success rates. For the later, the reason is that a basic structure may simplify data acquisition and analysis; it may save time in the initiation and planning phases; and it establishes unified measures – which are essential in the control phase. Additionally, a Web based system that implements that structure may facilitate these previous reasons while supporting execution phase.

Project Management concepts were the inspiration to the framework's conception and its implementation applied some techniques as scheduling, risk analysis and Gantt graphics. The system's main development was through simulating a software house in a problem-based learning (PBL) approach, within the 2010/2 class of "Systems Development" of the Computer Science course – at UFT. The use of role-playing allowed the simulation and the fact that the system is a real project induced the PBL approach.

In the fall of 2010, Ge *et al.* [2] published a similar experience and the authors of this work were not aware of their work at the time of the conception and development of the academic project management system – the beginning of 2010/1. Here, Ge *et al.* [2] abstract is reproduced:

> *A semester-long ethnography study was carried out to investigate project-based learning in a graduate software engineering course through the implementation of an Open-Source Software Development (OSSD) learning environment, which featured authentic projects, learning community, cognitive apprenticeship, and technology affordances. The study revealed that while the OSSD learning environment motivated students to engage in real-world projects, tensions were found between the students' self-processes, such as their perceptions, expectations, beliefs, goals, and values, and the innovative learning environment. Most importantly, this study demonstrated key interplays between project authenticity and learner characteristics, which resulted in different identity representations and different perceptions among students, which in turn affected students' goal orientations, motivation to work on projects, commitment to team collaboration, attitudes toward expert coaching and feedback, and the use of collaborative technologies.*

In Table 1 a comparison of some items of the two works is presented. Other key factors that shall be highlighted are: both experiences happened in a classroom; both happened in a software development context; and in both cases, projects were not completely achieved.

Item	Letouze *et al.*	Ge *et al.*
Disciplines	"Systems Development" and "Graduation Project"	Software Engineering
Level	Computer Science undergraduate	Graduate
Project-based learning	Yes	Yes
Role-playing	Yes	No
Authenticity	Total, it is a real system that is going to be used by the University and it was presented in this way to the students	It had several levels of authenticity (with or without client), which impacted the students performance
Number of projects	1	4
Team work	First 4 teams, then 5 teams – all teams collaborated for a common goal	4 independent teams

Table 1: Comparison of the works of Letouze *et al.* and Ge *et al.*

The authors organized this paper in accordance to the IMRAD structure: introduction, methods, results and discussion; which is adopted as part of the Uniform Requirements for Manuscripts Submitted to Biomedical Journals of the International Committee of Medical Journals Editors, 2008 update. The authors believe that adopting this structure would help search engines in international databases to store and to retrieve information within research papers in order to facilitate meta-analyses and systematic reviews.

2. Methodology

The core of the system was developed through the combination of role-playing and problem-based learning, in a Computer Science undergraduation classroom during the subject "Systems Development" in 2010, second semester.

Basically, according to Savery [3], "PBL is an instructional (and curricular) learner-centered approach that empowers learners to conduct research, integrate theory and practice, and apply knowledge and skills to develop a viable solution to a defined problem." The problem to be solved was how to support educational planning and management of academic projects-based programmes, specifically for the subject "Graduation Project". Besides, it should be applicable to a Master Science or Doctorate programme. Hence, the solution was to develop a Web system, that is, a software project. Actually, the presented approach is also a project-based learning pedagogy, because "the learning activities are organized around achieving a shared goal (project)." [3] Moreover, the size and complexity of the project induced the simulation of a software house through role-playing.

Role-playing in education intends to prepare students for a future performance and to improve abilities within a role. Hence, in that class, a software house was simulated, where the students played the role of the development team; the first author was the client – who was the professor/coordinator of "Graduation Project"; the second author was the team manager – who was a student enrolled in "Graduation Project" and had already done "Systems Development"; and the third author was the software house director – who was the professor of "Systems Development".

The class started with 20 students (all male), one student quit the class due to professional reasons and another student failed due to excess of absence, the other 18 students were approved. Initially, the class was grouped into 3 teams according to individual aptitudes following the MVC 2 model (Model, View and Controller) [4]. There were 6 students in the database team (Model), 4 in the interface team (View) and 8 in the development team (Controller).

The software implementation methodology was the Unified Process (UP). That motivated a second division of the class, because of UP phases [5]: conception, elaboration, construction and transition. In the conception and elaboration phases all students participated focusing in their MVC team's responsibilities. Then in the construction and transition phases the students were grouped into 5 teams, 4 teams for the system's construction and 1 team for tests and integration. In the system's construction teams, there were at least 1 member of the interface team, 1 member of database team and 2 members of development team. In the test and integration team there was at least one member of each MVC team. The groups divisions are presented in Table 2.

Groups	**1**	**2**	**3**	**4**	**Integration**	
Interface	Renato	Renan P.	Tayllon	Marivaldo	Renan P.	
Database	Tito	Renan A.	Alan	Rodrigo	Matheus	Frederico
Development	Kayto	Ronielson	João Andre	Thiago	Lesliê	
	Ennio	Paulo Ricardo	Lesliê	Pedro		

Table 2: Groups divisions

The chosen programming language was JAVA [6] and the framework was Javaserver Faces 2.0 [7], with some external components of Primefaces 2.2 [8]. The database management system was PostgreSQL 8.4 [9], with a relational database and the application server was Glassfish 3.0 [10]. For documentation and modelling it was used the Unified Modelling language (UML) [11]: case use diagrams, class diagrams and sequence diagrams. Finally, the IDE was Netbeans [12].

3. Results

The main result is an Academic Project Management System that is Web-based. The internet site of the project and the system is http://comp.uft.edu.br/nds/sigd. The system implements an academic project structure – represented in Fig. 1, a textual structure – represented in Table 3, and some other functionalities.

Hence, the student must have a supervisor acceptance and with his or her approval elaborate a project proposal and a work plan. These three elements are represented in figure 1 as "A". Then these elements are evaluated by a committee of professors, who decide if it has failed – "X", or approved – with or without modifications. If the project proposal is approved then the student will begin its development. At the conclusion of the project the student shall produce a monograph and defend it orally to the designated committee. The student may fail – "X", or succeed – "C", with or without corrections. Every student must have a supervisor who should approve the proposal and the monograph before submitting it to the committee, and who must supervise the project development. Finally, the subject must have a coordinator, who should monitor all students enrolled in the subject, confirm the committee and homologate the grade. Clearly, many Master Science and Doctorate programmes share this structure.

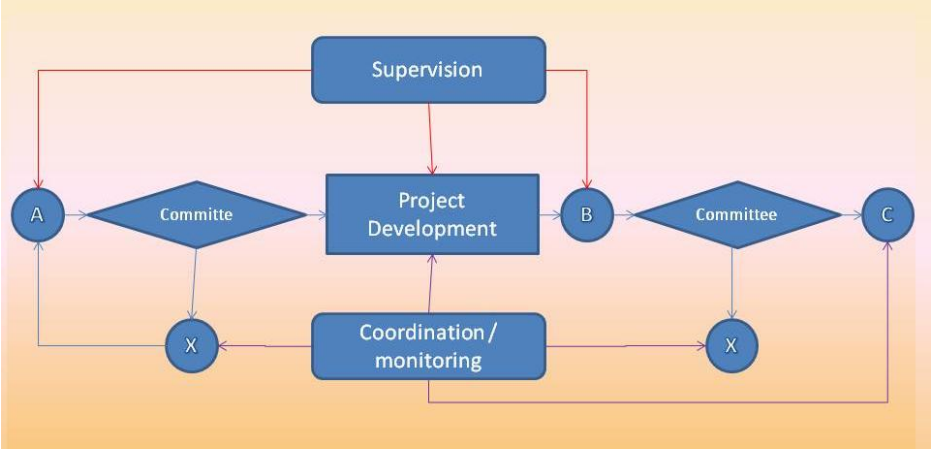

Fig. 1: Academic project structure.

In order to unify and facilitate the work plan process, a textual structure was proposed, which is also a step-by-step guidance to the students – Table 3. Therefore, in the academic project management system each chapter represents a phase that must have a deadline, as a consequence a Gantt chart may be generated. The unified textual approach also represents milestones in a Project Management context and in the system.

Chapter	Text 1	Text 2
1	Introduction: problem overview, justification/ motivation, objectives, methodology (methods, processes and tools)	Introduction: chapter 1 of text 1, corrected and updated
2	Theoretical Foundation: knowledge base for the development of the project	Theoretical Foundation: chapter 2 of text 1, corrected and updated
3	Related work and state of the art	Related work and state of the art: chapter 3 of text 1, corrected and updated
4	Development/ Implementation/ Experimentation: preliminary activities for feasibility evaluation	Development/ Implementation/ Experimentation: final development, implementation or experimentation
5	Results: preliminary analysis	Results: final analysis
6	Conclusion: preliminary discussion to guide the expected results of text 2	Conclusion: discussion of the results and future works
	References	References (updated)

Table 3: Textual structure of the academic project – monograph, dissertation, thesis, etc.

One example of the system's interface is presented in Fig. 2.

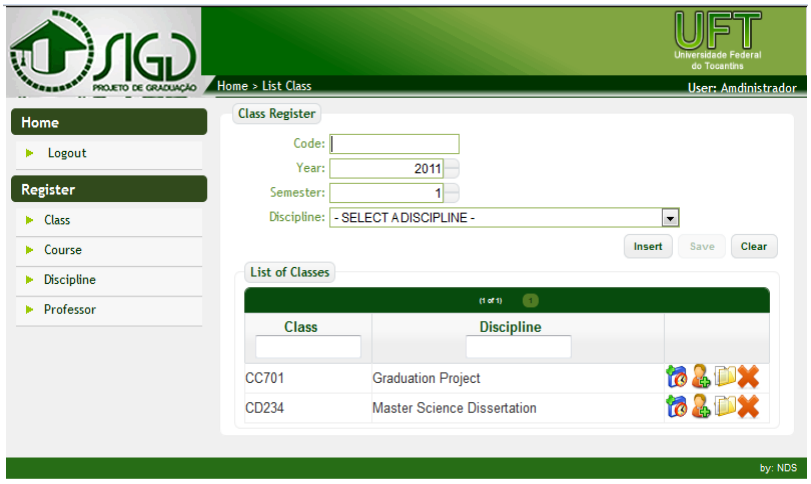

Fig. 2: System's interface example.

4. Discussion

Two important efficiency measures of an educational programme based on academic projects are the rate of success, that is, the relation between how many students enter the programme and how many successfully get out; and the average time to accomplish the programme requirements, that is, the average time a student takes to finish the programme. To improve these measures a programme should employ planning and management, and to do that an academic project management system might be helpful. The proposed system attempts to provide the necessary data to support planning and management of those programmes.

The system intends to represent a common framework that implements a generally accepted basic structure of academic projects. The proposed textual structure serves simultaneously as milestones and orientations to academic projects. An implicit planning order and work sequencing appears in the textual structure that together with the academic structure should promote students understanding of the steps to follow to achieve the required results for graduation. However, special cases may be treated as exemptions, the content of each chapter may be altered and a justification should be added in the appropriate field in the system. Therefore, the apparent rigidity of the system may be overcome.

The development of this Web system may be seen as a research in Computer Science, therefore a new system development through a PBL approach shall comply with the findings of Pierrakos *et. al* [13], such as:

> *Research problems are ill-structured and complex because they require students to use many cognitive operations, integrate multiple areas of domain knowledge, and work in a team environment where technical skills from many disciplines need to be integrated, and where interpersonal skills are essential and required for successful completion of the project.*

And the software house simulation through role-playing shall provide the students with a near professional experience. The quality of the experience may be directly affected by the real life experience of the professors, and it may also be a result of how the professors impose the professional behaviour in class.

In relation to projects conclusion, Ge *et al.* [2] stated:

> *As indicated by the professor and some students, the semester structure made it difficult to have sufficient time to complete a project at a satisfactory level. The students had to narrow their project scope or give up some efforts that could have led to better solutions and functionalities had they been given more time.*

And in this work during the class of one semester, only the core of the system was developed. However, the first usable version was attained after the semester with the collaboration of one of the students and the system should continue to evolve because it is a real system. At the present the system is being tested by some educational programmes at UFT. Moreover, it shall be used at least by the "Graduation Project" subject in the 2011/2 semester. Both works suggest that one semester is not enough to achieve a completely satisfactory system, consequently a two semesters project may be a solution, as in "Graduation Project 1"

and “Graduation Project 2”, of the new Computer Science undergraduate curriculum at UFT, that is, from a project perspective, the second discipline should be a continuation of the first.

Although the development of the system applied a software house simulation through role-playing in a Computer Science classroom and a problem-based learning approach, the focus of this paper is the system itself and the technological tools used to implement it. Hence, the educational experience in the system’s development shall be reported in a future paper. Additionally, the software may have future developments to support educational management and planning, for instance, it may incorporate data mining, knowledge discovery and statistical analysis techniques.

5. Acknowledgements

We would like to thanks all students of the “Systems Development” class of 2010, second semester, especially Lesliê C. da Silva for continuing the system’s development after the end of the semester. Also, our gratitude to Deborah B. Dias for filming the classes and doing the interviews, to Alberto R. Palmieri for creating the system’s logo, and to professor Eduardo Ribeiro for some insights on the system’s interface.

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