

## Online Method and Environment for Elaborate the Project-Based Learning Specifications in Higher Education

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### Abstract

In this paper, we present a method and a computer environment called Smart-Project that can support online student-centered project-based learning (PBL) activities. This environment can also facilitate communication and collaboration between distant actors. We have used a multi-agent system in order to provide a support and an assistance for technical-teaching team. We have proposed a method called OFTP that can help technical-teaching team to elaborate PBL specifications, a matrix called LRP where a project must be obligatorily located in it and finally, we have also proposed a simple model called RDI which describes the realization process of an elementary task of project.

### 1. Introduction

With the current Moroccan higher education reform, the project-based learning (PBL) has become a necessity. It is an approach that transforms teaching from "teachers telling" to "students doing". PBL helps students to develop real world skills like the ability to collaborate well with others, make decisions, take initiative, and face complex situations [1]. They are several challenge faced by teachers during PBL implementation. In particular teachers have difficulties to: (1) Design a PBL specifications; design projects that support learning of specific concepts, skills and production in the real context, (2) Follow-up several projects and give feedback where and when is needed, (3) Use technology that can play an important role in

structuring and supporting effective project-based learning. We can identify three main phases: Pre-project phase (preparation), Project phase (realization), and After-project phase (concluding). Our goal is to provide all actors of project an environment and method that they can help them.

Smart-project apply computer networks to PBL[2]. This idea is not new [3] [4] [5] [6] [7], but there is the need of having available good tools to support student-centered PBL activities. The first version of smart-project and OFTP method have been started on 2006 and have been testing with a Group of Moroccan and French teachers for elaborate together a project specifications.

Firstly, we begin this paper with a presentation of the Smart-project environment. Secondly, we describe the OFTP methodology. Finally, comes the description of the implementation phase.

### 2. The Smart-Project environment

Smart-Project is an a multi-agent system to support online student group projects. For establishing the specifications and the modeling of such environment we have followed the following step. After having defined and analyzed our needs, we drew upon the similar research works [8], in order to identify our contribution with the line of research in question. We have also inspired by works done in domains of:

- Project-based learning (PBL).
- Project management,
- Computer-Supported Collaborative Learning (CSCL),

- Computer-Supported Collaborative Working (CSCW),
- Agents Supported Cooperative Work
- Artificial Intelligence in Education.

From these studies, we have elaborated the model figure 1, where we can identify the following actors Smart-Project:

- Technical-teaching team,
- Student group,
- Tutor.

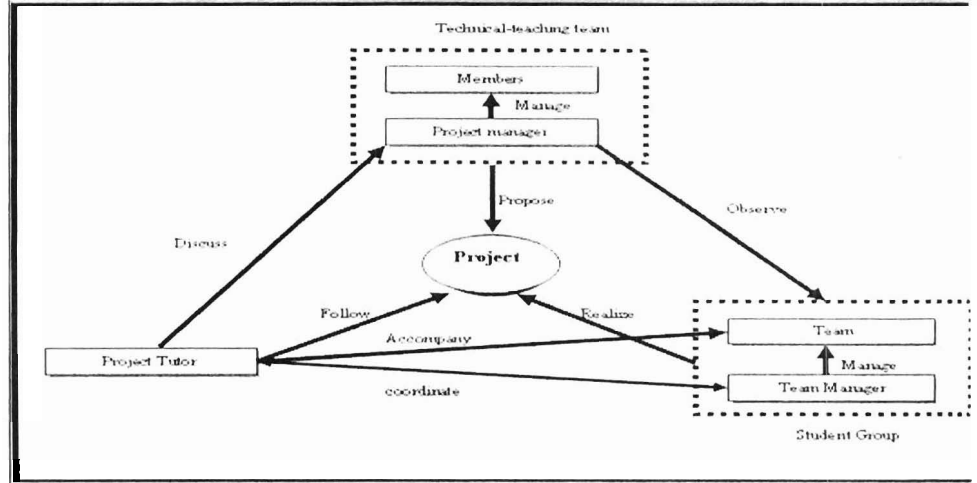


Figure 1. Structure of the Smart-Project Environment

### 2.1. Technical-teaching team

It is called thus, because it can be constituted of heterogeneous actors from the educational and technological domains (teachers, administrators, company engineers, economic operators, etc.) managed by a project manager. Its mission is to propose projects which may be realized during the academic year, to observe the progress of these projects by the student group and finally to discuss with the tutors. Project must be obligatorily located in the matrix LRP (Learning, Respect of constraints time-cost, Production) which we propose (next section).

### 2.2. Student group

Student group is constituted of a group manager and a team. The manager who is only a simple student motivated, implied having a spirit of leadership must accompany his team to realize the project according to the project management methodology (preliminary analysis, development of a list of tasks, planning, etc.). this learning strategy has double roles:

- To make work students on the organization the planning and the realization of a project according to the project management methodology, very used in the real domain which awaits them.
- To relieve the teacher so that it can follow several project at the same time.

Each project comprises specificities and requires an adapted approach and tools, but the majority of the projects can be modeled like a succession of phases in time. Each phase consists of a whole of tasks  $T_i$ . The realization of a task  $T_i$  can be ensured by one or more students, deposited in the Smart-Project environment and validated by the manager and/or the tutor of the project, by alternating individual and collective stages in synchronous and asynchronous phases. This process is described by model RDV (Realize, Deposit and Validate) which we propose.

### 2.3. Project tutor

The Project tutor is a teacher who can follow one or more projects at the same time, accompany one or more teams and coordinate with one or more

rs. Where necessary, he can discuss with the manager.

### FP Methodology

goal of our research is to help students to learn by conducting a project and at the same time to develop skills and understanding of how they can conduct a project. Then, it is necessary for the technical-teaching team to write correctly the project specifications. So, we propose the OFTP methodology of a succession of four studies:

**Opportunity study** that aims to define the perimeter of the project (or context of project), to identify the general needs for the project and to formulate the objectives of the project.

**Feasibility study** that aims to analyze the technical and economic feasibility of the project, to make a coarse estimate of the time considered and cost of project (in term of the human and material means).

**Technical Study** that aims to express the sets of technical specifications characterizing the project, and on which one will be based thereafter to evaluate his success.

**Pedagogical study** that aims to define the teaching objectives to reach and competences to be acquired, after having made an analytical study on knowledge/skills which will require the project in its realization, new knowledge/skills to be acquired and knowledge/skills to be deepened.

ART-Project can help the technical-teaching team to automatically build the PBL specifications via the LS agent, supervised by the OoP agent (Learning of Project agent). This agent which is in the OFTP ontology will allow the automatic generation of the PBL specifications by the compilation of answers to the precise questions in OFTP

Project must be obligatorily located in the LRP matrix (Learning, Respect of constraints time-cost, Production) which we propose (figure 2). So, the main objective of the project must be clear and precise for all the actors (technical-teaching team, students, group and tutors). It must indicate if it is in the learning (case located in the CSCL field), in the production (case located in the CSCW field), or if it respects or not of the constraints (time, cost). The questions which arise now are:

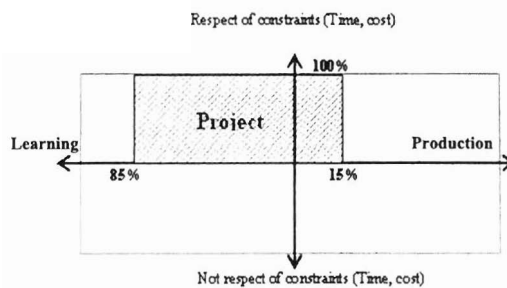


Figure 2. Case of a project located in LRP matrix (CSCL)

- Who will locate the PBL specifications in LRP matrix?
- On which criteria it will do it?

It is the LRP agent which will locate the PBL specifications in the matrix, while being based on the information seized by the technical-teaching team during stages of OFTP methodology. In fact:

To determine the rate Respect of Time noted **RoT**, the technical-teaching team must answer the following questions:

- Indicate the total duration of the project (**DoP**) in days?
- Do you authorize a delay for the realization of the project? if yes indicate the maximum day number (**Delay**).

the Respect rate of time is defined by the following formula:  $RoT(\%) = 100(1 - Delay / DoP)$

For example, if you say to the students you have one month or two months to do it. This sentence is quantified in LRP matrix by a RoT rate equal to 0%. But, if you say that you have one month to do it without any delay moreover. This sentence is quantified in LRP matrix by a RoT rate equal to 100%.

To determine the rate Respect of Cost noted **RoC**, the technical-teaching team must answer the following questions:

- Indicate the total cost of the project (cost)?
- Do you authorize a cost overrun? if yes indicate the value(value).

The rate Respect of cost is defined by the following formula:  $RoC(\%) = 100(1 - value/cost)$

To determine the rate of learning noted **RoL**, the technical-teaching team must quantify the knowledge and/or the skills implemented in the project, while

answering the following questions during the pedagogical study:

- List all knowledge and/or skills which will require the project in order to be carried out. Indicate the total number of this knowledge (and/or skills): **total\_k**?
- Indicate the total number of knowledge (and/or skills) missing: **total\_k\_m**?
- Indicate the total number of knowledge (and/or skills) to deepen: **total\_k\_d**

The rate of learning is defined by the following formula:

$$RoL (\%) = 100(total\_k\_m + 0.5total\_k\_d) / total\_k$$

A 100% RoL rate means that the student does not have any knowledge and/or skills to achieve the project, a 0% RoL rate means that the student has all knowledge and/or skills to achieve the project.

Finally, the rate of production noted RoP will be deduced from the rate of learning by the following formula:

$$RoP (\%) = 100 - RoL$$

In fact, according to our approach the learning and the production are complementary. Their sum constitutes the 100% of objectives aimed of a project.

#### 4. Implementation

Smart-project is an online environment based on the client server concept and Internet technologies. In the client side, we use a simple navigator, in the server side, we use 3 thirds architecture Web: Web server, application server and database server.

After logging into smart-project environment (<http://smartproject.ucd.ac.ma>), actors can access to main page (figure 3) that includes:

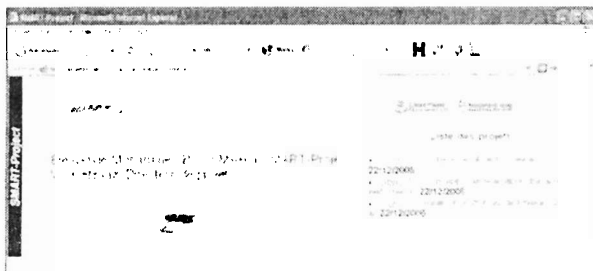


Figure 3. Main page of Smart-Project

- Shared form space team for collaborati defining PBL specifications.
- Collaborative and distributed authori project.
- Chat tool to support peer to pe communication and/or virtual collaborati meeting.
- Shared document tool to upload/downlo files for project.

Figure 4 represents the OFTP methodology page that includes:

- Forms that can be completed by technical teaching team and used by agents after the project specifications are finished.
- Each project has available one open discussion space and shared documents.

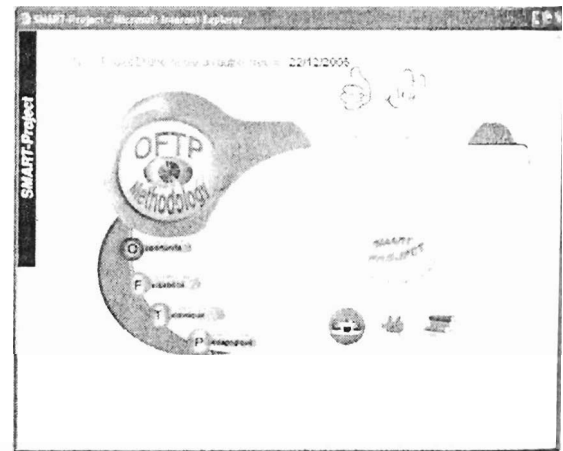


Figure 4. The OFTP methodology page

Technically, we find extremely interesting the use of a multi-agent system in order to provide a support and an assistance for actors working online [9] [10]. Research shows that we can use it if we have an opened, dynamic and complex environment, because it is possible to add or modify agents without touching to the general structure of the system [11]. We have chosen the MaSE methodology (Multiagent System Engineering) for the development of our software agents. This choice is justified by: (1) The simple, modest and pragmatic vision which MaSE gives to the definition of an agent (2) The automation process for creating software agents. (3) The availability of documentation. The systems based on agents specified starting from this methodology are often difficult to implement directly starting from the standard programming languages like Java or others. Several tools are developed recently for multiagent systems

programming: JADE [12], Zeus [13], MadKit [14], AgentBuilder [15]. For our part, after an evaluation of the most popular platforms of multiagent systems development, we have chosen JADE (Java Agent Development Framework) which is a middleware that facilitates the development of multi-agent systems.

## 5. Conclusion and future work

We have presented during this article, a computer environment called SMART-Project that can facilitate communication and collaboration between distant actors. We have used a multi-agent system in order to provide a support and an assistance for the technical-teaching team.

We have described a method of PBL called OFTP that we believe as optimal and has as a goal to help technical-teaching team to implement better PBL, but which will be left flexible to change according to feedback from the evolution of this method.

We have proposed a matrix called LRP (Learning, Respect of constraints time-cost, Production) where a project must be obligatorily located in it by an agent. This matrix indicates if the project supports the learning or the production with a respect or not of the constraints (time, cost).

We have also proposed a simple model called RDV (Realize, Deposit and Validate) which describes the realization process of an elementary task  $T_i$ , its deposit in the SMART-Project environment and validated by the manager and/or the tutor of the project, by alternating individual and collective stages in synchronous and asynchronous phases.

We are currently in validation phase by experimentations. The future work consists of realizing and implementing a multi-agent system in order to provide a support and an assistance for all actors (student group, tutors and technical-teaching team) working online.

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