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PMK: An Intelligent Environment for Project Management Education

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ABSTRACT

The Project Management Knowledge Learning Environment (PMK) was designed to cater for its students' particular needs. The PMK's domain is based on PMI®'s PMBOK®. In order to enable PMK to cater for its students in a personal way, a Learning Companion (LC), VICTOR (Virtual Intelligent Companion for TutOring and Reflection), was integrated to it. VICTOR provides immediate feedback for the student's actions, gives tips and tries to keep the student motivated. This paper presents the contribution of the PMK for Project Management (PM) education.

1. INTRODUCTION

To take full advantage of the benefits of project management (PM), organizations should adopt PM as a methodology in which managers should be trained (Torreão, 2005). Distance learning (DL) is an alternative for the increasing demand for the education of professionals and organizations. However, several DL educational systems do not deliver because they do not adequately treat their users' motivation and use very impersonal presentations, which hinder the student performance (Jonhson, Rickel and Lester, 2000). This problem is even worse when students find themselves in trouble to overcome, very often, quite simple learning barriers and have no one to aid them.

In this light, the use of a virtual Learning Companion (LC), can help to minimize the afore mentioned problems, influencing positively the student's performance (Chou, Chan and Linc, 2003). The use of LC in DL systems characterizes i-learning (intelligent learning) whose objective is to solve the found problems in e-learning, by providing a more individualized care of the learner.

This paper presents the Project Management Knowledge Learning Environment (PMK) (Torreão, 2005), an intelligent learning environment (ILE), that teaches PM methods and techniques. This environment uses a LC as a support technology, VICTOR (Virtual Intelligent Companion for TutOring and Reflection) (Torreão et al. 2004). VICTOR collaborates with the student learning providing immediate feedback to the student's actions, besides tricks and incentives to study.

2. FEATURES

The PMK study content is based in the PMBOK® Guide (Project Management Institute, 2000), which provides basic knowledge and practices on project management, and other bibliographical references on PM (Kerzner, 2001).

The PMK has pedagogical resources (functionalities) which enrich the learning of PM, namely: multiple-alternative exercises (to test knowledge), exercises to assemble processes diagrams (to memorize process items), fill in the gaps exercises (to review and learn concepts), PMP® mocks, student performance reports (finished exercises, difficulties, accessed contents), FAQ, PM library (including files on PM), tricks, e-mail questions and concepts, internet links, glossary, list of figures, among others. The main objective of the PMK tool is to offer to the student a more practical and interactive view on PM, besides a good preparation tool for the PMP® certification exam.

The PMK tool has a LC, called VICTOR, an intelligent pedagogical agent that collaborates with the student to enhance his/her learning process. VICTOR observes the learner, stimulating, and guiding the learning process by providing suggestions to the student (Johnson, Rickel and Lester, 2000).

VICTOR has an animated character (Correia, 2004). The use of an animated character can improve the communication with the student, increase his/her motivation and encourage him/her to reflect about his/her progress (Jonhson, Rickel and Lester, 2000). The LC provides immediate, non obtrusive feedback, mainly when the student is executing an improper action (Qu, Wang and Johnson, 2004). VICTOR also behaves as a chatterbot (Leitão 2004) answering some questions about PM.

3. RESEARCH METHODOLOGY

When developing an environment that teaches a given domain, the first step is to get to know the domain as well as possible. Thus, we have performed a thorough study of the PMBOK® as well as of other relevant references in the area (e.g Kerzner, 2001). As a result, the PMK's knowledge domain is based on the contents of PMBOK®.

In the sequel, we built an ontology that formalizes the PMBOK® content. The ontology model for PMBOK®, shown in Exhibit 1, allows us to visualize the relationship between domain terms. This enables VICTOR to identify, for example, which processes use the term WBS as well as the learning difficulties associated with this term. The ontology is also used by the chatterbot for answering questions about the domain (e.g. "what are the entries for the Schedule Control process?").

Once we had gathered and formalized the domain knowledge, the next step was to identify the main learning difficulties in PM. A member of the research team enrolled in a face-to-face course that prepares students that wish to take the PMI® certificate exam. This course allowed the researcher to observe the main learning difficulties as well as used the teaching strategies and hints by the instructors.

In order to deepen our understanding of the learning difficulties related to the domain we have put a questionnaire up on the web, asking both PMP®s and PMP® candidates details about their studying strategies. This research counted with 153 respondents (cf. Torreão, 2004),

We have also carried out the comparative analysis of strengths and weaknesses of the functionalities of web sites and software tools similar to the PMK tool. Once these analyses were finished, the PMK's scope was defined, and its implementation begun. Once that step was concluded, the Learning Companion was added to PMK. VICTOR's construction was based on the methodology proposed in (Torreão et al., 2004), which presents 6 stages.

The two first stages of the methodology for the construction of the LC (namely, Identifying the Problem and Eliciting Relevant Domain Concepts), were briefly described above. In the third stage, Conceptualizing the Pedagogical Task, the objective of VICTOR and the peda-

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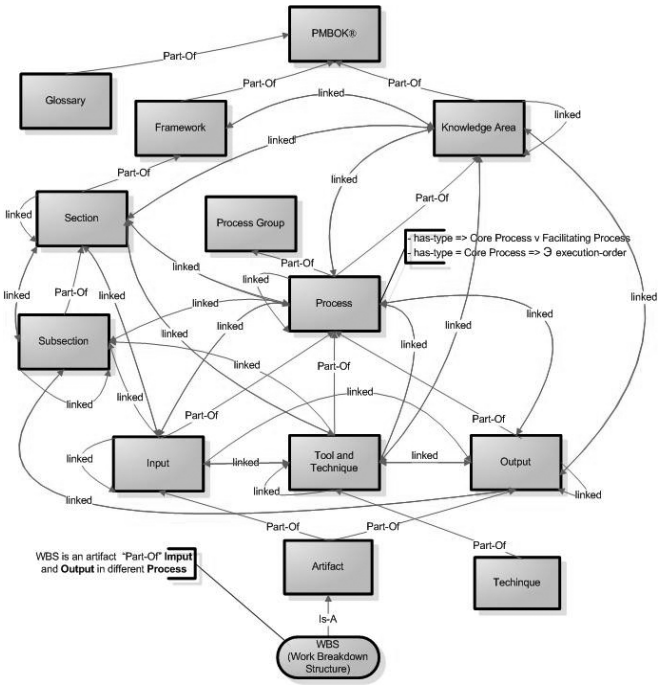
Exhibit 1. Domain Ontology of PMBOK®



gogical strategy and tactics used by him were defined. VICTOR's objective is to collaborate with the student, promoting learning. VICTOR uses different pedagogical strategies with different tactics to fulfill his objective.

In the fourth stage, Building the LC's Architecture, VICTOR's behavior was modeled according to the defined tactics, strategies, and goals. VICTOR's behavior determines how, when and what he perceives from his interaction with the student and environment, as well as what his answers to the student are.

For each of the student's actions, VICTOR applies different tactics. For example, he may supply immediate feedback, praise the student for his/her effort and the correctness of tasks, point errors made, and motivate the student to persevere. Depending on the situation, VICTOR may also point learning difficulties out, give tips to the student, encourage the student to reflect on his/her progress, and answer to some of the student's questions.

The Learning Style versus Personality Type approach is dealt with by the PMK during the application of pedagogical tactics (Felder and Brent, 2005). When registering with the system, the student can answer a personality test based on the Myers Briggs Type Indicator (MBTIâ test) (Myers & Briggs Foundation 2002) and VICTOR to modify the pedagogical tactics.

Still in this stage of the methodology, the Domain Knowledge Base was constructed. The architecture of the implemented LC had four main components: Student's Model; Pedagogical Module; Domain Knowledge Module and a Communication Module.

At the end of this stage, the character's animations, used to represent VICTOR's emotional states (e.g. joy (Exhibit 2)) were defined. A chatterbot that answers some questions on the domain was integrated to VICTOR.

In the fifth stage, Implementing the LC, the architecture components and animations were implemented. A prototype of VICTOR was integrated to the PMK. After concluding the integration, the last stage of the methodology, Assessing and Refining the LC, was carried out.

Exhibit 2. Frame showing VICTOR's gestures when the student does an exercise correctly

4. EVALUATION

Torreão (2005) describes the experiment carried out in order to verify how the PMK helps users to learn PM, and the impact of VICTOR in the student's learning process. The experiment had 19 participants divided into two control goups: one, with 9 participants, that tested the PMK without VICTOR (the SV group) and other (with 10 participants) that tested the PMK with VICTOR (CV group). In this latter case, besides evaluating the PMK itself, the students evaluated the motivation and help provided by VICTOR.

Most users in the SV group said that the PMK is user-friendly, gives useful tips and the contents are good. In the CV group, most users agreed that the PMK is a good tool for PM education, is user friendly, and that VICTOR was motivating and provided interesting tips. Users also remarked that they wanted as much help as possible when studying PM. Also, the CV group scored better in the posttest provided (80% of correcting answers as opposed to 70%from the SV group).

The experiments carried out with PMK have yielded promising results, indicating that it fulfils its Project goals, namely providing PM education in an attractive and intelligent way. Most participants in our experiments considered PMK easy to use, and a good tool for PM education. Moreover, they also believe that VICTOR's presence motivates and helps the student during his/her learning process.

5. CONCLUSIONS AND FURTHER WORK

Project managers must be trained in order to perform well their role, satisfying organizational needs and expectations In order to tackle this situation, we have developed the PMK, an integrated learning environment that can be used to educate professionals, students and people interested in managing projects in a more effective and low-cost way.

PMK's unique feature is a personal and attractive learning experience, provided by VICTOR. The preliminary experiments carried out with PMK have yielded promising results related to the evidence of the greater efficiency of an intelligent learning environment. This type of system, especially those which count on LCs, help to overcome the main difficulties of the DL systems: discouragement and dropouts. The LC here proposed aims at meeting the student's needs in a motivational, dynamic and intelligent way.

In the future, VICTOR will also be able to use the Case-based Teaching Strategy as a pedagogical strategy, presenting PM real-world project scenarios. Adaptive tests which stimulate the student self-confidence could be incorporated to the multiple-choice exercises. Another researcher in our group is working on improving VICTOR's interaction through the use of natural language.

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