

# **Computer Supported Problem Based Learning: The case of project failure**

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## **ABSTRACT**

*In this short paper we present an ongoing research project on computer supported problem based learning (PBL). We believe that the advancement of multimedia technology provides an opportunity to extend this alternative model of learning. We have surveyed experienced PBL students and teachers to find ideas on how current problem based learning activities can be enriched or transformed by interactive multimedia.*

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## **1. INTRODUCTION**

Problem based learning (PBL) as an alternative pedagogical model is gaining popularity in higher education. Computing education such as software engineering, management information systems and informatics are no exceptions. In PBL the starting point of learning is a real world phenomenon or problem the learner wishes to learn more about. The role of the educator is to present or introduce the phenomena or problem in a stimulating way. This is done through a 'vignette' which frequently is a document and it can be anything between a single paragraph and a twenty page case study. Graphics such as pictures and cartoons are used to enrich the vignettes, and recently, video clips are also used. In the same document, the learning objectives of working with the vignette are stated by the educator. In this research project we explore how information technology (IT) can be used to support the design of vignettes, but also how the vignettes can be presented to the students by using IT.

The context for this ongoing research is computing education in a broader sense and we will use *project failure* as an example of phenomena that occurs frequently in different types of projects to exemplify our ideas. IT project failures are well known to researchers and practitioners in both industry and academia. There is a large body of literature of case histories (Brooks 1975; Sauer 1993; Oz 1994), empirical work (Lucas 1975; Ewusi-Mensah and Przasnyski 1991; Ewusi-Mensah and Przasnyski 1994), and efforts to systematize the empirical work (Lyytinen and Hirschheim 1987; Flowers 1997). Recently a new journal

has been fully devoted to this topic, namely “Failure & Lessons Learned in Information Technology Management.”

Project management is a practical task, which we often find difficult to teach realistically with traditional and conventional methods. Courses covering project management often simulate real world project like situations. Early project management simulations were built on very rational ideals, while current simulations include more complex dimensions. Today, educators design situations where students are requested to perform under business pressures. Popular ways to enhance the realism is communication and interaction with simulated project staff, users and consultants. Other ways are, pin pointing typical project problems such as absenteeism, staff diverted to higher priorities, design problems, technical problems, changed requirements, personality conflicts, overstaffing and resignations. Whereas project failure is used to exemplify our ideas the general question addressed in the on-going research is: *How can computing technology enhance problem based learning? And more specifically addressed in this paper: How can multimedia enrich the vignette?*

The remainder of the paper is organized in the following sections which all are to be further developed. First we outline our understanding of learning as a concept. Similarly, the apprehension of teaching is discussed. In the section Practice, we very briefly discuss the relation between teaching and learning from the perspective of problem based learning. In Ideas, we elaborate our ideas about computer enhancement of problem based learning. In the last section we discuss results so far, implications, limitations and outline future work.

## **2. LEARNING**

Our perspective on learning is collaborativism (Slavin 1990) which serves as a theoretical foundation for the project. This perspective asserts that learners construct knowledge by making sense in terms of what they already know and in interaction with other individuals. We are moving from a transfer of information from teachers to students towards a social and individual constructing of knowledge. According to constructivism, people can only understand what they have constructed themselves. A crucial issue here is engagement. To engage in deep learning (Ramsden 1992) the individual must be engaged (Norman and Spohrer 1996). We find that these fundamentals of learning is realized in problem based learning (PBL). For a more thorough introduction to PBL see for instance <http://www.imsa.edu/team/cpbl/cpbl.html>, Boud and Feletti 1991 or Engel 1991. A central idea in PBL is that learning is enhanced if the educational activity center around an authentic task or problem that is relevant and presented in a context. This way the objective is to enable the students to experience the kind of situations they will be dealing with in professional life. The importance of experience is emphasized in Kolb's model of learning which begins with a *concrete experience* (Kolb 1976).

Problem based learning is NOT another way of teaching as it is a fundamentally different approach to learning than traditional teaching. Problem based learning represents a significant challenge to orthodox beliefs about education and learning (Margretson 1991). Central in PBL is the students' development of independent life-long learning. Their own questions, experience, formulations and conceptions of problems serve as the basis for learning.

Participating in change and self-directed learning are composite competencies today. PBL is claimed to be a method that will assist students in developing a set of competencies: adapting to and participating in change; dealing with problems, making reasoned decisions in unfamiliar situations; reasoning critically and creatively; adopting a more universal or holistic approach; practicing empathy, appreciating the other person's point of view. PBL is also an approach of choice in higher education, because it is suitable for adult learning. In PBL learning becomes progressively less straightforward but more complex, as well as more challenging to both students and educators.

### 3. TEACHING

As PBL encourages open-minded, reflective, critical and active learning it is a threat to teachers who prefer total control over the content to be learned and passive students. Educators who conceive education as a one-way process of information transmission and restrict the notion of problem to small, atomic, single difficulties with a single optimal solution are uncomfortable with PBL. With PBL, the role of the teacher is changing from a provider of facts to the one that facilitates a learning environment and creates a sense of community. This way, we argue, PBL is both morally and ethically correct as it pays respect to both students and teachers as individuals with knowledge, understanding, feelings and interests who come together in a shared learning process.

With this in mind, we are currently investigating the field of experiential learning to find theories and ideas to support our work. Experiential learning has been around since the early 1950's. The underlying principle is that the best learning is *by doing* (Graf and Kellogg 1990, p. 231). Examples of experiential learning are internships, computer assisted instruction, live case, case studies, role play, games and simulations. Simulation is probably the most common and has long been a feasible way for educators to present complex matters such as visualization of mathematical, production and logistic processes.

For a better understanding, Graf proposes a number of general characteristics of experiential learning activities (Graf and Kellogg 1990, p.237 – 248), and we find the following characteristics to be valuable in this project. First, *chained decisions*, where the result of one set of decision influence the rest of the decision making process. Second, *debriefing*, which refers to the type of debriefing that is given after the activity has been finished. Third, *skill focus*, refers to the type and range of skills being taught. Fourth, *computerized*, refers to the distinction of the use of computers in the delivery of the activity.

Innovations in technology, such as multimedia, hypertext, video, Internet and virtual reality, is now impacting experiential learning. Examples of these advances in technology are the use of hypertext and the effect it has on the 'real' life experience as described in (Kendall, Kendall et al. 1996), the use of multimedia in systems analysis case studies (Farrimond 1997), or the Cardiac Tutor (Park Wolf 1996) where the student is in middle of the emergency room. From a PBL perspective the difficult task for the educators is to identify what type of learning experience the learner should have. The awareness of the purpose and methodology of the experiential activity is underlined by Jones (1997) where the damaging effect a simulation/game can have is identified. The

reason for the damaging effects is that the instructor does not recognize the methodological conflict in using gaming and simulation.

While it is very easy for educators to become enthusiastic about PBL as an alternative activity, there are of course potential drawbacks. Some PBL becomes mechanical in practice, applied to train students in problem solving and acquire the knowledge for only this. In these cases, the potential for deeper, holistic, creative reflection and learning is lost through the predefined problem solving process.

#### **4. PRACTICE**

PBL in practice can take many forms. In this research the core of PBL is the 'base-group' session where the students work in groups of seven to eight for one to two weeks. The sessions are part of a module which spans over eight weeks. An educator facilitates the group process and assure that the group work according to the model (outlined below), but at the same time keeps a low profile not to interfere with the group dynamics. The work of the base-group is guided through the eight step model briefly outlined below.

- *Step 1:* The base-group is introduced to the vignette (as described in the introduction).
- *Step 2:* The group discusses and identifies the problem or phenomenon covered in the vignette.
- *Step 3:* The next step involves brainstorming around the result from step 2.
- *Step 4:* Systematize the brainstorming in the previous step. Find relations, categorize and eliminate irrelevant sections of the brainstorming.
- *Step 5:* The group formulates concrete learning objectives and states clear questions to work with.
- *Step 6:* Search and gather information and facts.
- *Step 7:* Systematize the new knowledge and validate the knowledge in relation to step 5.
- *Step 8:* Document and present the acquired knowledge in an appropriate way.

The model is divided in two distinct phases. The first phase (steps 1 through 5) consists of three hours of concentrated discussion and work in the base-group facilitated by the educator. In the second phase (steps 6 through 8) students work on their own for, as in our case, one to two weeks.

#### **5. IDEAS**

In this section we outline our ideas on how to enrich the first step of the PBL process, that is, the vignette. As stated before, advancements of multimedia technology provides us with an opportunity to enhance the design and presentation of vignettes. As one source of information, we surveyed 20 students with six months experience of PBL and three facilitators with two open ended questions: *In your opinion, what makes a good vignette good, and what makes*

one poor? How would you describe the relation between the basic group, their work, and the vignette?

The survey revealed several interesting aspects about vignettes. First, several students pin-pointed *the soul* of the vignette, “I think that it is important that the vignette shows that the author has put his heart in it, not just made ‘another vignette’“. Second, real cases, i.e., material from what is happening in the world at the moment: “The vignette should include topics currently discussed in media.” Third, variation and layout, especially in a longer module with a number of vignettes they have to be designed in various formats, and: “enhanced with something that exceeded the language.” Some students also stated that: “we miss the unexpected in the vignettes,” and “we have not experienced any really touching vignettes.” In addition to this, we find our own experience of facilitating PBL sessions to be consistent with these conceptions. Our major observation is that a great number of vignettes seem to have very low quality when it comes to stimulating students.

Supported by the literature, the result of the survey we and our own experience we have started to elaborate our ideas about multimedia vignettes. Basically, our idea is to design and develop a vignette about IT project failure. The purpose of such a vignette is to direct the attention of the base-group to the complexity of IT project management. The vignette is currently being implemented in a world wide web (WWW) hypertext based scenario. The base-group is asked to act as project members. They navigate through a project over time and make decisions about the project. Figure 1 below is an outline of the whole vignette.

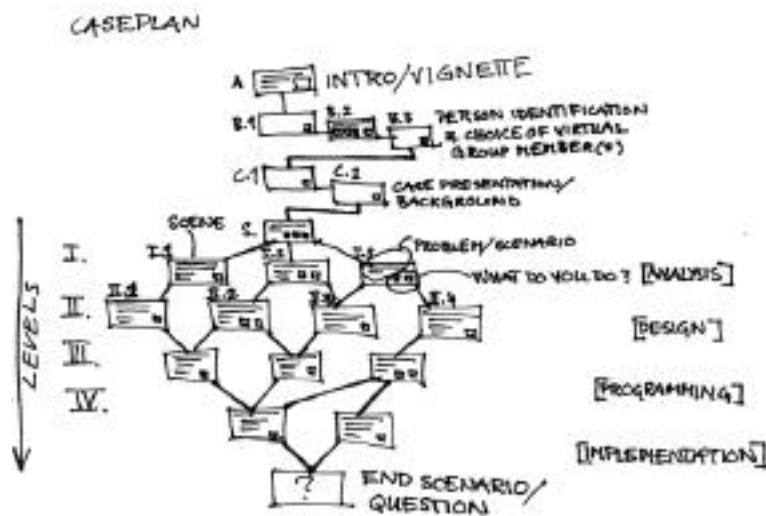
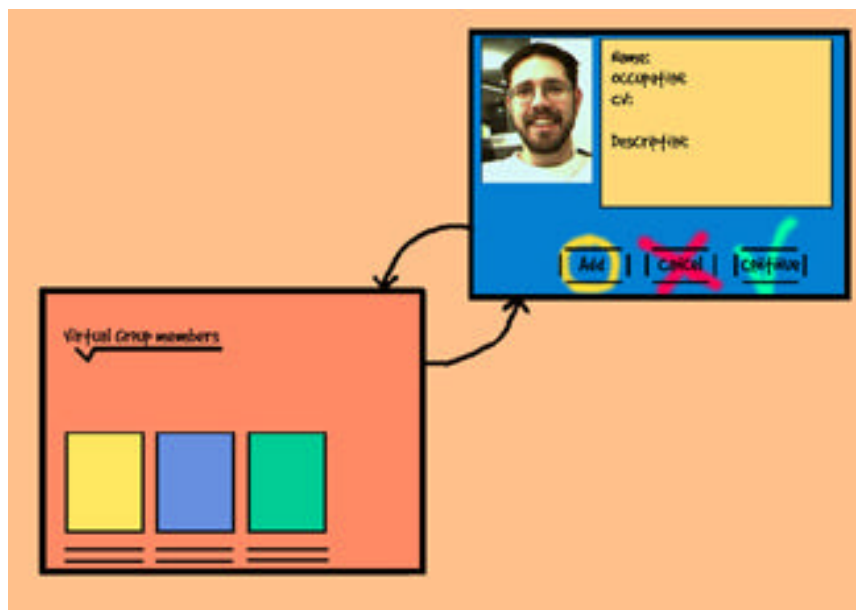


Figure 1. Outline of the whole vignette.

The *scene* serve as building blocks for the vignette. New information about the project is presented in each scene and the group is required to make decisions about things such as technology, personnel and dates. Each scene in the vignette consists of a series of WWW pages with one or a number of objects embedded. This can be graphics, sound, movies or database interfaces. The purpose of the scene is to present information to the base-group and in some of the scenes the group are then required to make a decision. Figure 2 below is an example of a scene where the base-group has to make a decision about choosing an additional project member.

The students get some background information to make the decision. In this case, a simulated e-mail with the news that the most experienced programmer has suddenly left the organization and the project manager i.e., the base-group, has to hire a new programmer. They have three potential candidates, as shown in figure two. Information about each of the prospects is presented, such as CV, personal home page etc. Each person has both good and less desired characteristics which makes the choice a trade-off for the group. No matter which person is hired, there will be consequences later in the scenario. Our intention is to make the students, not only read about the problem, but actively be part in the creation of it. That is, they experience the sense of time and how they have been part of the project during this time. Decisions made are actually made by the base-group and they have thereby invested themselves in the decisions.



**Figure 2. New virtual project member scene.**

Time passes in the project and the group faces additional information, and has to make other decisions. Finally, as figure 1 shows, the group will end up in the single last scene of the vignette. This is how the educator responsible for the

vignette makes sure the students meet the learning objectives of the PBL session. Let us give an example. After the group has worked with the vignette for 30 minutes, been confronted with various project problems, and has been making a number of decisions about database managers, upgrading of software, hiring and firing of people etc., and more and more becoming aware of that the project is probably about to fail. The last scene is from the board room where the president of the company and the CIO questions your (the base-group's) ability to manage the project. The group is of course debriefed and the functionality behind the vignette is explained.

## 6. DISCUSSION

In this paper we have outlined an on-going research project about problem based learning (PBL). We have argued that certain phases of PBL, namely 'the vignette' can be enhanced with the use of computing technology, and especially multimedia. We have conducted a literature review and surveyed students and educators about vignettes and with that as well as our own experience we have started the design of computer based vignettes.

Our results so far are very tentative. However, we argue that the survey showed us some important things about the design of vignettes, both traditional and multimedia. For the continued work, we will involve practitioners to ensure reliability of the content in the next phase which is to fully implement the *failing project vignette*, followed by an evaluation of the usefulness of it. Our intention is to explore the possibility to develop a generic framework or software tool for the design of multimedia vignettes. We also intend to look at the other phases of the eight step PBL model to find other uses of computing technology to enhance the learning process.

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