PIE - Problem Based Learning, Interactive Multimedia and Experiential Learning

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ABSTRACT

This paper discusses design of web-based interactive multimedia for collaborative learning. Experiential learning combined with interactive multimedia has received a great deal of attention in both educational practice and research. We suggest that the advancement of multimedia technology also provide an opportunity to extend problem based learning and combine it with experiential learning. We have designed a prototype application that was evaluated in two different settings: university and industry. Our conclusion is that the prototype works as a tool to integrate experiential learning and problem based learning.

Keywords: *Problem based learning, experiential learning, interactive multimedia*

1. Introduction and Background

A great deal of attention has been focused on interactive multimedia, especially within the educational domain. Many educational institutions have produced different types of educational interactive multimedia courseware to replace or enhance educational activities. In this paper we discuss how interactive multimedia can be used to combine experiential learning (EL) and problem based learning (PBL).

EL and PBL are alternative pedagogical models that are gaining popularity in all levels of the education system. Computing education such as software engineering, management information systems, computer information systems and informatics are no exceptions. The context for this research is computing education and training in a broader sense. In this paper we use *project failure* as an example of a phenomenon 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. See for instance Nulden and Scheepers (1998) for a discussion. Project failure is of course strongly related to project management, a practical task educators often find difficult to teach realistically with traditional and conventional methods. Courses covering project management often simulate real world project like situations. The early project management simulations were built on very rational ideals, while current simulations include more complex dimensions. Today, educators design cases and simulations where students are requested to perform in realistic situations and under business pressure. Common ways to enhance the realism is communication and interaction with simulated project staff, users and consultants. Another way is pin pointing typical project problems such as absenteeism, staff diverted to higher priorities, design problems, technical problems, changed

requirements, personality conflicts, overstaffing and resignations. Educators try to make sure the students experience the situations as real as possible.

With problem based learning, interactive multimedia, experiential learning and computing education, more specifically project management and project failure, as a theoretical and contextual background we formulate the following three research questions to be further elaborated in this paper:

- *How can interactive multimedia enhance problem based learning?*
- *How can experiential learning and problem based learning be integrated in a methodology?*
- *Can interactive multimedia vignettes be used outside a formal education system to train and educate in project management related issues in corporate training programs?*

2. Learning and Facilitating Learning

In this section we briefly discuss problem based learning and experiential learning. It is assumed that the reader have some bascic knowledge about these two pedagogical approaches. PBL is a way of designing and conducting educational activities using problems as stimulus and focus for learner activity. In experiential learning the educator is providing some stimulus to help students have an concrete experience as a starting point for learning.

Problem Based Learning

Problem based learning is: "… a way of constructing and teaching courses using problems as the stimulus and focus for student activity. It is not simply the addition of problem-solving activities to otherwise discipline centered curricula, but a way of conceiving of the curriculum which is centered around key problems in professional practice" (Boud and Feletti, 1991, p.14).

Hence, the starting point of learning in PBL is a real world phenomenon or problem the learner wishes to learn more about. That is, a problem that is relevant from the perspective of the learner's future profession. The problem, or rather the problematic situation, is identified, designed and presented to the students, who then themselves define what the actual problem is. In this research, we focus on one issue we find to be problematic but also very central in PBL—namely introducing the problem to the students.

The responsibility of the teacher is to present or introduce the phenomenon or problem in a stimulating way. In PBL terminology, this starting point is called a 'vignette.' In PBL the vignette is mainly understood as a starting point for self-directed learning. In many ways, PBL is an implementation of the constructivistic model of learning. That is, people can only understand what they have constructed themselves (Leidner and Jarvenpaa, 1995). And as the group is an important resource for the learning process in PBL we have a cooperative model of learning or collaborativism (Slavin, 1990).

The practical implementation of PBL does of course vary. This paper discuss only one possible model. See for instance Boud and Feletti (1991) for a more lengthy discussion about PBL in practice. However, the experience of actually working with the vignette is not explicitly emphasized in discussions about PBL in practice. We therefore look into the notion of experiential learning.

Experiential Learning

In this paper experiential learning refers to small group work, were what is learned is directly related to what happens in the group and how it happens. Various terms have been used to label the process of learning from

experience. Dewey used learning by doing, and others have discussed this process in terms of *learning-in-doing* (Kolb, 1976).

Experiential learning is participative, interactive, and applied. It involves the whole person; learning takes place on the cognitive, affective and behavioral dimension (Gentry, 1990). Already 1916, Dewey noted that schools continued to tell students what to learn despite research clearly showing that teaching by telling does not work, and that learning by doing does work.

Experiential learning has been practiced since the early 1950's. Examples of experiential learning are internships, live case, case studies, role-play, games and simulations. Different types of simulations are 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.

3. Interactive Multimedia

Innovations in technology, such as multimedia, hypertext, video, the Internet and virtual reality, are now having an impact on teaching and learning. The design of interactive multimedia (IMM) has undergone a revolution in the last ten years. Trivial HyperCard stacks and behaviorally oriented drill and practice applications common in the 80's have given way to richer interactive applications where the learner is relatively free to explore at her own pace. However, much of the multimedia training is no better than the old—it just looks sexier. We can also see a shift from CD-rom towards the 'web', as a dominating technology, but also a shift from multimedia for individual learners towards multimedia application for teams or groups of learners.

The use of hypertext and hypermedia permits links among pieces of information such as text, sound and graphics, that permit the user to "explore ideas and pursue thought in a free and 'non-linear' fashion" (Bieber and Kimbrough, 1992). Kendall et. al. compare a hypertext based (IMM) systems analysis case with a conventional case and role playing (Kendall, Kendall et al., 1996). They found that use of hypertext allows students to navigate through the organization, interviewing and examining documents in the order they prefer rather than in the pre-described linear fashion. Their conclusion is that hypertext was an important departure from the traditional activities conducted. The interactivity and non-linearity of hypertext means that the students learn systems analysis and design by exploring an organization, rather than reading a case study of one.

In a systems development education context, Farrimond et. al. are applying current multimedia techniques to transform current paper based case studies into interactive multimedia simulations (Farrimond, 1997). They have developed a mouse driven virtual world. The goal of the interactive case study is not to lead or guide the students towards a specific goal but to provide a context in which to explore the 'real' world. The world in the simulation is a set of interconnected rooms that are populated by people, documents and other objects. The students construct own meaning by interacting with the material rather than being taught something explicitly.

These are just two examples, but they and other simulations we have studied are quite similar to what we suggest in this paper. However, none of the simulations we have studied is explicitly building on the model of problem based learning. In the following section we elaborate these ideas further.

4. Design

We surveyed twenty one master level students, ten men and eleven women, average age of 28 and all with at least six months experience of PBL, about their experience with PBL and the vignette. The survey was analyzed by coding of keywords in their responses. The keywords were then categorized in the following three groups.

First, working with PBL quickly became routine and the groups developed a standard behavior to work with the problem. Second, the vignettes were perceived as lacking relevance and not dealing with timely issues. And third, the lack of variation of the format of the vignettes.

Our major conclusion from the survey is that a great number of vignettes seem to have very low quality when it comes to stimulating and challenging the students. Supported by the literature, the result of the survey, and our own experience as facilitators we started to elaborate our ideas about multimedia vignettes. Figure 1 below summarizes the conceptual ideas of integrating problem based learning and experiential learning.

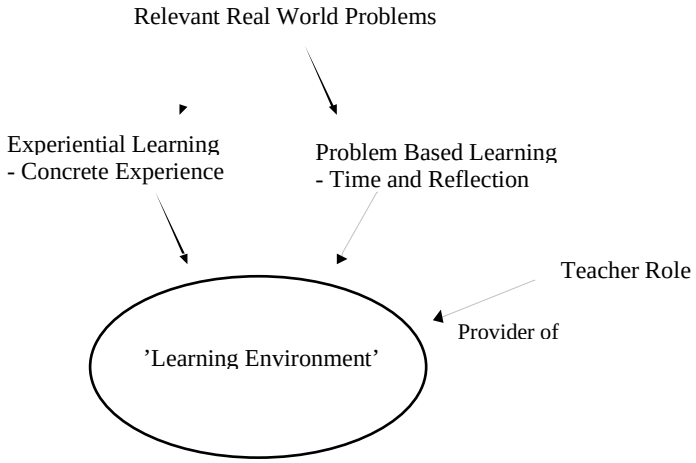

Figure 1. Design Framework

From here we started the design of a vignette about IT project management and failure as discussed in the introduction. The objective with this vignette was to direct the attention of the students to the complexity of IT project management. The students should act as project members and navigate through a project over time and make decisions about the project. Figure 2 below is an outline of a whole vignette.

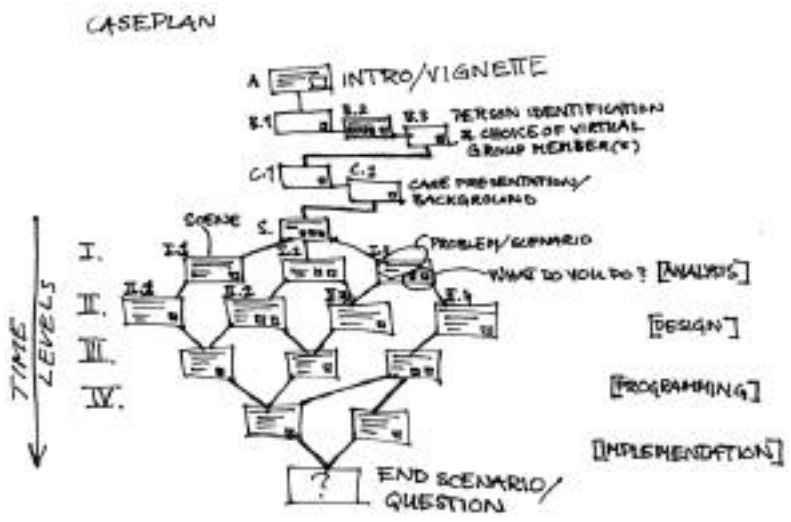

Figure 2. Outline of the whole vignette

The students get some background information to make decisions. The intention is to make the students, not only read about the problem, but actively be part in the creation of it. They experience the sense of time and how they have been part of the project during this time. Decisions are actually made by the students and they have thereby invested themselves in the decisions.

In the vignette, time passes in the project and the group faces additional information, and has to make other decisions. Finally, as figure 2 about the whole case 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 of a possibl end scene. After the group has worked with the vignette for one hour and been confronted with various project problems, they have been making a number of decisions about database managers, upgrading of software, hiring and firing of people etc. They are becoming more and more aware that the project is probably about to fail. The last scene is from the board-room were the president of the company and the CIO question your (the group's) ability to manage the project.

To generalize the ideas, an important aspect of this research is to develop and establish a terminology for designing cases as described in this paper. The *scene* serves as building blocks for the vignette. New information about the scenario is presented in each scene and the group is required to make decisions about matters such as technology, personnel and dates. Each scene in the vignette consists of a series of web-pages with one or a number of objects embedded. Examples are graphics, sounds, movies or database interfaces. The purpose of a scene is to present information to the base-group and in some of the scenes the group is then required to make a decision.

To evaluate the ideas, as described above, a simple prototype of a sequence of scenes was implemented in Microsoft Power Point (PP). The scenario contained a number of scenes setting the stage and providing the group with the background information about the problematic situation. This information was presented in smaller blocks of text on several PP slides. The purpose of this was, as discussed above, to allow the group to reflect and discuss issues raised in the scenario while it was presented. After the group had received this information, scenes, where the students were required to make decisions before continuing, were presented.

5. Evaluation

In the evaluation phase we decided to include people from the industry. Therefore, two groups, one at the Business School of a Swedish university, and one at a large manufacturing industry in Sweden, were selected to participate in the evaluation. We decided to evaluate the vignette with the student group first as approaching the students first would minimize the possible errors we otherwise would bother the professionals with.

Observing the Student Group

The student group participating in the evaluation consisted of a subset of the group surveyed about their opinions about PBL. The setting for the evaluation was a conference room with a table, a portable computer, a projector and a large screen to project on. The students were given a short description of our analysis of the survey, our ideas in general and the purpose of the vignette they were about to work with.

The group worked quietly with the first eight scenes containing the background information. They nodded their heads when they were ready and waited for the next scene. No discussion or comments were made. However, when the first interactive scene appeared the discussion started. The discussion followed a pattern we had expected, but they also raised issues concerning the actual ideas about the prototype. The group constantly made connections to their own experience of PBL.

Short comments were made during the information scenes and more extensive discussions took place in the interactive or decision scenes. The group worked and discussed in an efficient and goal oriented way. It was obvious that their experience of PBL helped them in structuring the group work in this phase of the PBL model.

All members of the group found the prototype and the scenario to be of value. According to them it was easy to understand, although some found it to be too much text in some of the scenes. None of the students found the design to be too simple. A richer multimedia form with more embedded objects would not automatically raise the quality of the vignette, probably the opposite. However, the interaction was found limited due to the interactive case implementation with sequential scenes. Observing the students, it was very interesting to see how they altered their discussion from the actual problematic situation presented in the scenario, to a discussion about their own relation to PBL.

That the scenario ended with a fairly concrete task for the group to work on was not a problem, this despite the fact that this is a conflict with the PBL methodology. Summing up the students' comments during the evaluation session we find that this type of scenario should work as a good way to introduce and engage students to work with different problematic situations. They emphasized that this was certainly a promising alternative to the traditional paper based vignettes they had worked with so far.

Observing the Industry Group

The setting for the second evaluation was a team room at an industrial plant. The team room had a large conference table, some smaller tables and a table with a computer equipped with a large screen. Only four people from different teams were able to participate. The facilitator for the group belonged to a different department of the company. She received some instructions in advance about the role and purpose of the team leading she was about to enter.

The team received a more extensive introduction to the task than the student group. The basics of PBL were explained as a background. They started out quietly, much like the first group. They hummed after they had

read through the text in the information scenes and the person with the mouse clicked on to the next. The work was methodological and gave the impression of being very efficient. When they reached the first interactive scene about whether work practice really had changed the group started a quiet discussion. The discussion escalated after a little while and they penetrated the alternatives, and agreed on one alternative. The facilitator was successful in trying to get everyone's opinions. The group felt a bit more at ease and started to use the supplied drawing and writing material to articulate and explain their standpoints. When the group reached the actual task about suggesting an introduction program for new project members an extensive discussion was taking place. They finished their work and presented a draft of an introduction program for new project team members.

The team had no problem in moving through the interactive case. They recognized the issues raised in the scenario. Smiles and laughter were frequent as they moved through the scenario. The group agreed that the format was good in that they were introduced to a problematic situation in a stimulating way, and the team was presented with a task to complete. They found that the embedding of the instruction in the scenario was helpful. Similarly to the student group, they were not sure that additional multimedia content would automatically add to this type of scenario.

6. Discussion

Observing the students work with the scenario it is obvious that this type of alternative vignette add to the process of PBL. The student group focused on the intended issues before they reached the end of the scenario. The group stopped at the interaction scenes and discussed the situation, they reflected and analyzed the situation to understand and problematize. We did not get the feeling that they were rushing to move on in the scenario. A very important observation is that they clearly spent more high quality time with this vignette than when working with a traditional paper based one.

The industry team found a lack of structure in the scenario. This is a very delicate problem to approach. On the one hand, the scenario must not be too superficial and put words in the participants mouths. The scenario should guide the group, but not control them. On the other hand, and from the company's perspective, the aim or the expected outcome must be very clear. PBL was seen as a somewhat 'unstructured' approach, as the group, according to PBL, defines their own problem.

7. Conclusion

We have designed and developed a simple interactive prototype about project management. The prototype was evaluated in two different settings. The three research questions below guided the research and serve to summarize the findings.

• *How can interactive multimedia enhance problem based learning?*

Our limited evaluation suggests that interactive multimedia have large potential in enhancing the first phase, the vignette, of PBL.

• *How can experiential learning and problem based learning be integrated in a methodology?*

We propose a tentative methodology, PIE (Problem based learning, Interactive multimedia and Experiential learning), which is outlined in table 1 below. PIE is a three phase methodology for structuring educational activities in modules, using interactive multimedia as an important part.

Phase 1.	Experience. The group experience the interactive case facilitated by an instructor. The instructor ensures that the group reaches the end of the scenario and leave the session with the problem on their mind. Duration two hours.
Phase 2.	Reflection. Duration one week
Phase 3.	Feedback and discussion. The group meets together with the instructor and discusses the problem presented in the interactive case. Duration two hours.

Table 1. PIE Framework and Methodology

• *Can interactive multimedia vignettes be used outside a formal education system to train and educate in project management related issues in corporate training programs?*
We claim that PIE is an approach that is useful in organized corporate training about for instance project and project management related issues.

Whereas the findings so far are tentative, we argue that the evaluation showed us some important things about the design of vignettes, both traditional and multimedia. The main limitations of this research, as we see it, are two. First, the very simple prototype designed to implement our idea about interactive multimedia vignettes. The vignette used as example in this research is currently being transferred to a web-based interactive multimedia application. Second, the limited evaluation conducted. However, as our aim with this paper is to discuss the problem of challenging learners in a PBL setting, and suggest how these problems can be handled, we do not find these limitations to be problematic for our purposes in this paper.

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