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Perspectives on using multimedia scenarios in a PBL medical curriculum

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Abstract

In 1999, the Faculty of Health Sciences at Linköping University, Sweden, started up a process of replacing text-based problem-based learning (PBL) scenarios with web-based multimedia-enhanced scenarios. This article brings together three studies of the results of this process and the experience gained from 10 years of implementation work. Results and conclusions: Adding multimedia to PBL scenarios makes them more realistic and thereby more motivating and stimulating for the student to process. The group process is not disrupted by the introduction of the computer in the group room. It is important to challenge the students by varying the scenarios' perspective and design in order to get away from cue-seeking behaviors that might jeopardize a deep approach to learning. Scrutinizing all scenarios in a PBL curriculum can be used as a tool for improvement and renewal of the entire curriculum.

Introduction

Students' effort to understand realistic problems are considered to be the driving force for studies in a problem-based learning (PBL) context. Starting from a problem or a realistic situation, students activate and inquire into their prior knowledge and perceptions, thereby generating their own questions and learning goals. This way of starting a learning process is considered to lead to better motivation and retention (Barrows 1986; Dolmans & Schmidt 1996). The quality of the problems or scenarios is one of the important factors in creating a functional PBL environment (Dolmans et al. 1997; Margetson 1998; Azer 2007). Dolmans et al. have listed a number of factors that influence the quality of the PBL problem. The problem should challenge students' previous perceptions and ideas and give rise to questions that lead them to search for new knowledge within the scope of the learning goals set up by the faculty. Factors such as perceived realism, variation, emotions, perplexity, and contradiction are also important in a good scenario (Russel 1999; Dahlgren & Öberg 2001).

The rapid development of information technology (IT) and multimedia in the recent years has made it possible to create a new type of scenario by adding films, soundtracks, and images. Several studies show that the use of multimedia increases students' involvement and motivation. Students generally consider video clips and other multimedia content to be stimulating due to their perceived authenticity (Parkin & Dogra 2000; Kamin et al. 2003; Balslev et al. 2005; Balslev et al. 2008). Video cases give a holistic and realistic picture of a situation or a patient, which makes it necessary for students to interpret what they see. A video clip can convey emotions and nonverbal communication and a video also makes it possible to expose students to patients and conditions that they would otherwise not be able to see for ethical or practical reasons (De Leng et al. 2007).

Practice points

- Medical students consider multimedia content in PBL scenarios motivating and stimulating.
- Pictures and films that need to be interpreted by the students stimulate inquiry.
- Scenarios, which are structured the same way every time, can lead to ritualized problem processing and cue-seeking behavior in the groups.
- Scrutinizing the PBL scenarios is a useful tool for change and overview of the entire curriculum.

In 1999, the Faculty of Health Sciences (FHS) decided to systematically introduce web-based multimedia scenarios in all undergraduate study programs. The aim was to improve PBL by creating multimedia-enriched scenarios that would stimulate the students' curiosity and internal motivation for learning, and to encourage the use of IT in their studies. The project was called EDIT, an eponym for Educational Development using IT. Today, more than 300 such scenarios have been produced for five undergraduate programs. The medical program uses multimedia-enhanced scenarios in all semesters, a total of 173 scenarios.

Designing and implementing multimedia-enhanced scenarios, not just in a single course but as the central learning tool for the complete medical program, has generated a number of challenging problems, technical as well as pedagogical.

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Aim

The aim of this article is to describe how web-based scenarios are used, what students and teachers think about them, and the structural changes the implementation has brought about.

Background

The medical program at Linköping University

The 5.5-year medical program started as a complete PBL curriculum in 1986 (Areskog 1992). The tutorial group and the scenario play central roles in the curriculum. In the first five semesters, the students process approximately 30 scenarios per semester. During the clinical phase, six to nine scenarios are processed each semester. Learning modalities complementing tutorials are lectures, resource sessions with faculty experts, seminars, skills training, patient-related laboratory methods, and patient communication.

Subjects are studied in an integrated manner and the aim is to achieve vertical as well as horizontal integration of subjects (Brynhildsen et al. 2002; Dahle et al. 2002). The content of a whole semester is assessed at the end of the semester. The program has twice (1997 and 2007) been evaluated as the number one medical program in Sweden. In 2007, the program was awarded the prize "Excellent Study Environment in Higher Education."

Description of the EDIT system

The students process the EDIT scenarios in group rooms equipped with a computer and a projector. Students and teachers access the scenarios through a password-protected intranet. The scenario is projected on a screen or on a whiteboard, which allows the group members to see the projected images or texts at the same time. Thirty group rooms have been equipped to EDIT standards. The EDIT system comprises a database, an interface and software for presentation and handling of text documents, and different types of multimedia material. Apart from the EDIT system, a web browser and the Microsoft Office Package are available in the group room computers.

Scenario design

A typical scenario starts with a short and open review of a patient's complaints and background. The scenario is designed to unfold gradually thereby withholding solutions and "answers" as long as possible in order to make the group discussion free- and open-minded. The introduction is usually followed by more detailed information about results of diagnostic examinations performed, treatment given, and the continued course of events to stimulate discussions on a more detailed level or into new directions. The web format enables the scenario designer to use multimedia such as pictures and films to a greater extent, which together with the hypertext format, creates a more dynamic way of delivering triggers compared to the previously used paper-based cases. Triggers are made available in the form of text documents, pictures, graphs, films, and sound files. One or two teachers are responsible for designing and maintaining each scenario. All scenarios are scrutinized from a medical, legal, and pedagogical point of view, and are often revised several times before publication. Publication on the intranet makes the scenarios public within the faculty, which has stimulated quality assurance work. The students' on-line scenario evaluations are sent directly to the responsible scenario designer who can easily make corrections and changes. Almost all the scenarios have been revised one or several times. A small multimedia production team supports the teachers in creating material. Health care staff, amateur actors and, in some cases, real patients have been engaged in the production of video clips. A network of teachers and health personnel has been formed to find, develop, and digitalize medical diagnostic material. The process of creating scenarios has been centrally coordinated, but teachers and subject experts have had full responsibility for the content.

Use of multimedia

The film format is particularly well suited to illustrating communication between patients and health care staff. Interesting and problematic situations can be illustrated in a realistic way. Films are used to show experiences of the health care system from the patients' point of view, sometimes literally using the camera perspective from the bed or sound sequences mimicking the experience of a hearing disabled person. The video camera can move outside the hospital walls showing patients in their homes and relatives' reactions and feelings. Pictures, photos, and films are used to provide information on diagnostics or treatments. Microscope or radiology images can be visualized with high quality. The film format enables dynamic processes such as cardiac function from echocardiography and film sequences from physical examinations to be shown. Laboratory results are presented in the form of microscope images or as tables or graphs.

Environmental or public health problems and graphic material is presented or linked into the system. Images and films showing workplace environments or environments from developing countries are also included. Pictures, drawings, also in the form of cartoons, and animations illustrating biological mechanisms are used to trigger studies on cellular or subcellular levels. These types of pictures are sometimes deliberately blurred or important information omitted in order to stimulate students' inquiring process.

How the students process the scenario

The group opens the scenario and analyses the problems as the web pages unfold by brainstorming and discussing in order to find out their prior knowledge and understanding of the area. At the end of the session, the group defines common questions and learning goals for individual studies. The learning goals and questions are formulated and mailed to all group participants. When the group meets again 2–3 days later, the scenario is opened up once more and the knowledge acquired is discussed and applied. After finishing this process,

a short summary of the scenario is given. This is read out by one of the students and commented on by the group. The aim of the summary is to motivate decisions made in the actual case and highlight biological and other mechanisms without offering complete answers. Each scenario has a tutor page, which is only accessible to teachers. It contains keywords related to semester objectives and suggestions for areas to be studied. The aim of the tutor page is to support nonexpert tutors. The page is not meant to be a checklist for the students as that might disrupt the creativity of the PBL process.

Methods

A number of evaluations and research studies were carried out during the implementation phase. Besides the initial evaluations, two qualitative studies have been carried out (Kiviloog 2002; Rodriguez Eva Lena 2004). These studies explore how the students interact with the EDIT system and with pictures in the scenarios. Apart from these studies, the on-line evaluation system has provided information from the students as they have the end-of-semester evaluations together with a number of group observations and formal and informal interviews with scenario designers, tutors, and students during the entire implementation phase.

The first evaluation was carried out in 2001 and the results from that study guided the ongoing development process. It comprised the first semester that used EDIT scenarios. Data were obtained by means of observation of tutorial group work, in all 15 observations of five groups, two focus group interviews of representatives from all five tutorial groups and two interviews with the entire class. A questionnaire including both Likert scale items and open-ended questions was distributed to the students (29 out of 31 responded). The tutors were interviewed on four different occasions. Content analysis was applied in the processing of data. The questionnaire enquiry was also carried out with the second group to use EDIT. The data from that group confirmed the results of the first study. Access data were collected *via* the web-based system to see how the system was being used.

Results

The scenarios' ability to stimulate and motivate

Overall, the results from the evaluations showed that the students liked the web-based scenarios and their multimedia content. The new scenarios lead to more dynamic and creative discussions. Stimulating, motivating, realistic, and fun were the words used by the students. Although the multimedia content was what the students found most exciting, observations showed that the time used to analyze pictures, films, and graphs varied extensively, from 30 s to 30 min. Puzzling structures and uncertainties were more appreciated than an overload of images.

New ways of working both for students and tutors

Students found new ways of working as a result of the new scenarios. The projection of the scenario on the whiteboard led to a better group focus and a new practice of reading all texts out loud was developed by the groups. The brainstorming process was adapted to the gradual unfolding of new content. This, in turn, resulted in more words and concepts on the whiteboard and thereby, one might argue, a more thorough elaboration of the problem at hand. This gradual unfolding of the scenario meant that the tutors had to be well prepared so that they could guide the students through the scenario, stopping the group from "just clicking" and helping them to brainstorm several times. All the tutors, therefore, had to go through the scenarios in advance and meetings with the scenario designers were organized for this purpose.

Soon, the groups also started to use the computer for documentation purposes. Many groups started writing down brainstorming words, learning issues, and questions in a document, which was later sent home to the group and the tutor by e-mail. This process in turn had implications for the actual formulation of learning issues and questions. The questions were discussed more carefully and formulated more accurately now when the group actually had to do this together. In between tutorials, however, the students did not open up the scenarios; this came later when the EDIT system was used as a way to revise before examinations.

Alignment between learning activities

Both students and tutors reported that there was a lack of coordination between the scenarios and other learning activities, which negatively affected the processing of the scenario. Students reported that a lecture that came too early could "kill" the scenario by covering everything that the students had decided to study in their individual study time. In the same way, a lecture after processing the scenario could become obsolete if it did not fit the students' new level of knowledge. As a result of the evaluation, a new type of lecture was tried out. Inspired by an article on PBL lectures (Fyrenius et al. 2005), an addition was made to the feedback functionality in the EDIT system. Groups that had further questions or intricate questions remaining after the second tutorial were given an opportunity to send these to the semester coordinator who would then, at the end of that theme, organize a lecture on demand based on the students' questions. These lectures worked very well and the idea was soon adopted by several of the semester coordinators.

Practical considerations

Technical problems sometimes interfered with the group activities. This was something that worried both students and teachers alike. We quickly learned that a system like this has to be so robust that it practically never fails. This was not the case during the first semester. Back-up systems, both web-based and on paper, were developed in order to make sure that the tutorial groups could work even if the system did not function.

Students' interaction with EDIT—Processing aspects

Kiviloog (2002) made observations of the tutorial groups work with a focus on how the actual processing of the scenario took place and how students interacted with the program and the room's equipment. Six tutorial groups were observed, two of which consisted of medical students (the others came from other health care programs using EDIT). The observation was made on two occasions following one group's work with a scenario. During the observation, notes were taken which were later qualitatively analyzed. The observations were followed up by in-depth interviews. Observations focusing on the actual handling of the equipment uncovered some negative effects on the group process where the student who held the mouse or did the writing "the navigator" tended to either take on a teacher role in the group or become excluded from the group process. Some students also expressed irritation over the fact that typing brainstorming words in a document took away some of the creativity and fun in this part of the PBL process. This study also found that the group process was positively affected by the fact that everybody focused on one thing at a time. However, differences in reading speed were mentioned as a problem by some (particularly those with a bit of a language barrier). The Kiviloog study had a major impact on how student groups were trained to use the system since it showed that students needed to be well prepared to make full use of the possibilities. It also pointed to the importance of making sure that the group process was not disrupted by the technical equipment.

Students' interaction with pictures in EDIT

EDIT contains thousands of pictures and films, put there by the scenario designer with the purpose of starting a discussion of a particular problem or phenomenon. Observation reports showed that the time students spent on the different multimedia triggers varied considerably. This required further studies. What did the students actually do with the picture triggers and how could they be used to promote the PBL process?

In 2004, a study of the PBL groups' use of pictures was made. Rodriguez applied a sociocultural perspective to analyze how students used and created meaning out of pictures in the scenarios. From the video recordings of five tutorial group sessions, detailed analyses were made of how the students approached the pictures and the communicative processes around the pictures. Two communicative patterns were found: When opening up a picture, students would explain and interpret words and graphs from the pictures to each other. By verbalizing what they saw, the group would try to understand the meaning of the picture in the scenario context. The other pattern found was when the group used the picture as a starting point for associations and discussion: Here, the process was taken one step further. The pictures were not only merely explained but also used as triggers to discuss related phenomena and experiences.

Rodriguez also found two different perspectives used by students while relating to the pictures: The "us and them" perspective—the students (us) try to figure out what the scenario designers (them) had intended when placing the picture in the scenario. This perspective indicates a "cue-seeking" intention: "What do they want us to do with the picture?" Rodriguez called it "the presence of the scenario-designer." The other perspective found was the physicians' perspective: The students try to imagine what the information in the picture would mean to them as future physicians. They become involved in the scenario and, as Rodriguez calls it, "play the game." A general finding in the Rodriguiez study was that ambiguous pictures, where interpretation was needed, and pictures that evoked emotions lead to qualitatively better processing by the groups.

Discussion

Implementing 173 web-based multimedia-enhanced PBL scenarios in a complete medical curriculum has been a strenuous but instructive process. In this section, we will reflect on this journey from two perspectives. We will discuss the effects that the new scenarios have had on the tutorial process in PBL and we will reflect on the structural changes that have taken place as a result of the implementation process.

Scenarios' effect on the group process

The PBL group constitutes the arena where different perspectives are encountered and knowledge and ideas shared (Dolmans & Schmidt 2006). A well-functioning group is therefore essential for the success of PBL. Kiviloog's study showed that the introduction of a new "group member" in the form of a computer needs to be handled with care. Her findings had some practical consequences: cordless keyboards and mouse were installed in all rooms, which improved the situation for the navigator, who could then sit closer to the other students, and the problem with exclusion from the group became less significant. As students got more used to the equipment, the problem of the so-called cinematic effect turned out to be something good as it made the group work more focused. Thus, in our experience, the group process has not been seriously affected by the introduction of the new technique.

The scenarios' ability to start up the learning process and motivate students

Previous studies have shown that pictures and films stimulate and motivate students (Parkin & Dogra 2000; Balslev et al. 2005; Balslev et al. 2008). What we also noted was that the gradually unfolding quality of a web-based scenario could be used to trigger curiosity. The gradual unfolding of new triggers keeps students in a state of suspense. The storytelling and the use of dramaturgic tools also proved to be important for the scenarios' ability to initiate and maintain motivation during the tutorial. The more the students had to interpret and discuss, the better they liked the scenario. Pictures and films inherently have this quality, which could explain why students appreciate the multimedia content so much.

According to Jonassen (1997) "ill-structured and messy problems" are effective as learning tools. Our findings seem to

be in line with this. To create such problems, however, a great degree of awareness of the students' level of understanding is needed. Creating an adequate degree of "messiness" paradoxically seems to be a challenging and time-consuming task for the scenario designer.

The scenarios' ability to support students' self-directed learning

It seemed to us that the new way students processed the scenarios, by writing more words and discussing each new trigger more carefully, would lead to more intense discussions and better formulation of learning issues and questions. Van den Hurk et al. point out the value of well-formulated specific questions for the quality of the individual studies (Van den Hurk et al. 1999, 2001). The use of a MS Word document positively affected the brainstorming process for some groups while other groups felt that handling the different windows and documents disrupted their creativity. Most groups and tutors, however, found that writing down questions and formulating learning issues together in a common document increased the quality of the questions.

Some tutors feared that the summary might tempt the students to take shortcuts by opening up the page in advance to get the "correct answer" right away, which would have had severely negative consequences for the students' development of self-directed learning skills. Our experience has been that the students do not use the summary that way but, rather use it as a means for reflection on the learning that the group has achieved. Used this way, the summary offers the group "an opportunity to organize and integrate their knowledge into a more systematic conceptual framework" (Hung 2009) and thereby becomes a vital part of the PBL process. The role of the end-of-session summary is, however, complex from a learning perspective and the discussion is still ongoing among faculty members.

The findings in the Rodriguez study were somewhat worrying. By "playing the game," students take the inquiry into the situation seriously and try to relate to the problem the way they would do if it had been for real. Through this approach, students generate questions that are truly their own. On the other hand, some students applied the "us and them" perspective, which theoretically might lead to a superficial processing of the problem. Such instrumental and ritualized inquiry into a problem has been described by both Dolmans et al. (2001) and Silén and Uhlin (2008) as potentially undermining the quality of a PBL curriculum. We are not convinced that this is an effect of the scenario *per se*, but the scenario is one factor (out of several) in the learning context that could possibly affect the students' learning approaches.

Realism and authenticity are keywords when it comes to getting students involved in a problem. "Authentic triggers were capable of immersing students in the problem, and of creating a mindset that allowed students to approach the problems as if it were a real life clinical situation" (Elliott 2000). Theoretically using cases as starting points for learning is based on the idea that learning from the real world as it presents itself, is the ultimate condition for contextualized or situated learning. Authentic patient cases, however, often have to be changed to fit the curricular goals and the level of the students, and the patient's integrity has to be taken into account. Such adaptation must be made with care so that inconsistencies are avoided. Kepell et al. found that students quickly discovered mismatches between, for example, images and textual information. Our solution to this problem has been a compromise: keep to reality as much as possible, using real patient cases, and the real diagnostic material found for this specific patient (X-ray, laboratory lists, etc.) as the starting point of the process of creating the scenario. Apparently, we were, at least to some extent, successful in this since the perceived realism was indeed one of the main advantages of the EDIT scenarios mentioned by the students.

When scrutinizing the scenarios in EDIT, we have noted that many stories are still told from the clinicians' point of view. In reality, the problem will almost always be presented from the patient's point of view and structured according to the patient's understanding. Margetson argues that when the clinician's story is told, the students are motivated to use the problem as a "peg" on which to hang their basic science knowledge. When the patient's voice is heard, the students are stimulated to relate the problem to their previous knowledge and to integrate new knowledge into a "growing web" of understanding (Margetson 1998). To increase the number of students "playing the game," we need to vary the storytellers in EDIT by even more frequently including other voices than the clinicians.

When analyzing the effects of the new scenarios, one needs to be aware of the complex interplay between all the different factors that are important for high-quality learning. We believe that there is no such thing as the "perfect scenario." The scenario always has to be scrutinized in its context. It is well known that alignment with other learning tools, such as learning outcomes and goals, lectures and assessment, are important factors for learning (Biggs 2007). The quality of scenario processing and the students' approaches to learning in the tutorial group is also highly dependent on factors such as group dynamics, tutor skills, and student motivation. Different approaches to learning (Marton & Säljö 1976a, b) occur in various educational contexts and also in medical programs (Lonka & Lindblom-Ylänne 1996; Fyrenius & Wirell & Silén 2007). Recognizing the different approaches in the tutorial group is an important task for the PBL tutor.

Structural perspective

The EDIT project has had educational implications in many ways. The planning of scenarios and of semesters, in general, has gained an overview and the sequence of different learning activities has been paid more attention. Carlile et al. (1998) reported similar experiences when web-based scenarios were introduced in Sydney: Better overview of the curriculum affected curriculum design and management, and created productive faculty discussions. We have observed more pedagogical awareness and discussions among teachers and tutors, and more contacts between the undergraduate programs at FHS as a result of the implementation process. Altogether, the process started by the EDIT project strongly contributed to a review of the entire medical program, which

resulted in a revised curriculum that was implemented in 2004. Criteria for selection and sequencing of scenarios and a plan for all scenarios in the medical program to ensure increasing complexity and avoid recurrence, were an important outcome of this work.

Conclusions

The introduction of multimedia-enhanced web-based PBL scenarios had positive effects in that it made the group more focused and did not have any long-term negative effects on the group dynamics. Students were motivated by the new scenarios, particularly by the multimedia content. The self-directed learning process might have been affected negatively in those groups that adopted ritualized scenario processing: "What do they want us to learn." Whether this is an effect of the scenario *per se* or a more complex phenomenon needs to be analyzed further.

Designing for learning is a task that requires both overview and care in every detail. Lectures, scenarios, skills training, time for individual studies, and practice all need to be aligned so that everything fits together. Making this construction both solid and transparent is essential for the success of this venture. The scenarios can be used as starting points not only for the students but also for the planners. Scrutinizing and renewing scenarios has turned out to be an excellent tool for curriculum development.

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