

PROBLEM-BASED LEARNING

Problem-Based Learning in Public Health Instruction: A Pilot Study of an Online Simulation as a Problem-Based Learning Approach

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ABSTRACT *Although increasingly used as a modality in medical education, Problem-Based Learning (PBL) remains somewhat overlooked in the training of public health students (Pham & Blumberg, 2000). This project involved a pilot test of a web-based community simulation as a PBL platform in an undergraduate health behavior course.*

Purpose: *To develop and pilot test a web-based computer simulation as an implementation of problem-based learning in an undergraduate public health behavior course.*

Method: *Using a web-based simulation platform, a virtual community was designed in which the effects of a mock infectious disease outbreak could be studied and various interventions could be tested. Upon completion of the semester course, 14 undergraduate public health education students completed a survey and participated in a focus group to determine issues related to the simulation. Research focused on whether the simulation was perceived as motivating and which aspects were found to be confusing, ineffective or unrealistic.*

Findings: *Results of the study suggested that a PBL experience based on a community simulation may be effective in providing a motivating and interesting PBL tool for instructing undergraduate public health students. A majority of students agreed that the experience was more motivating and interesting than a more traditional assignment. Design recommendations include an emphasis on incorporating a rich multimedia background, realistic communication and project management tools and the capability for students to submit formatted documents. Further study of attitudinal differences and attainment of learning objectives is recommended between students participating in the simulation experience and those engaging in a traditional assignment.*

KEYWORDS *PBL, problem-based learning, simulation, community health, health education, public health, health behavior.*

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Introduction

Although increasingly used as a modality in medical education, Problem-Based Learning (PBL) remains somewhat overlooked in the training of undergraduate public health students (Pham & Blumberg, 2000). As an instructional approach, PBL recognizes the need to develop problem-solving skills as well as the acquisition of knowledge. In a PBL curriculum, “students are given ill-structured problems through which they develop high order thinking and problem-solving skills” (Yip, 2002, p. 303). PBL differs from traditional lecture-based curriculums in that it relies on the use of real or simulated problems to develop critical thinking skills. PBL provides a stimulus and a framework for applying problem-solving skills, as well as the opportunity to acquire the information needed to understand the mechanisms responsible for and the means to resolve the problem (Brandon & Majumdar, 1997, p.18).

Limitations to PBL

Traditional case studies have employed problem scenarios that suffer from limitations that can be mitigated with multimedia-enhanced computer-based simulations. One limitation is that case studies lack flexibility (Hoffman & Ritchie, 1997). Students using traditional case studies can only rely on the information presented with no ability to interact with individuals involved in the scenario or to request clarification to better understand the context of the problem. Spiro, Coulson, Feltovich, & Anderson (1988) argued that when presenting an ill-defined problem, an individual’s ability to process the information is often exceeded by the amount of the information that is available. Cognitive Flexibility Theory suggests that an iterative approach to viewing and processing information from varying perspectives can enhance the acquisition of complex knowledge (Spiro *et al.*, 1988). A computer-based PBL platform using multimedia and hypertext navigation can allow a problem to be presented from a number of different perspectives, while modeling the problem environment allows the student to solve the problem in an iterative fashion.

A second limitation of a text-based scenario is that it may not adequately depict the problem so that a student can ultimately relate it to a real-world situation. A medical student, for example, who has learned diagnostic skills through a text-based scenario may be at a loss when confronted with a real-world patient (Bridges, 1992). Similarly, a public health student may not readily appreciate the significance of real-world data when trained using a text-based scenario. It has been suggested that computer-based PBL environments incorporating multimedia can offset a number of the traditional limitations associated with PBL (Hoffman & Ritchie, 1997). Multimedia offers a multi-dimensional experience for students by associating scenarios with sensory information that is not available in a text-based environment.

A third limitation involves time and space constraints (Hoffman & Ritchie, 1997). In the real world, social, economic and environmental conditions are in a state of constant change while an intervention is being researched, designed and implemented. All the while, the progression of a disease across a population is proceeding. Intervention planning requires space and time management skills, such as taking into account the lead-time needed when requesting information, or determining when and where outcomes can be observed and evaluated. Although static case studies cannot adequately represent those spatial and temporal constraints, a computer-based simulation can model both factors. Additionally, time can be compressed or expanded in a simulation so that the PBL experience can fit into an academic time frame.

Simulations as a PBL Method in Medical Education and in Public Health Instruction

In medical education, PBL and computer simulations have been used increasingly to model the physiological effects of disease and medical interventions attempted by students. By modeling the body's physiological response to disease, injury and intervention, simulations allow students to practice clinical reasoning skills without putting an actual patient at risk. In the public health field, much of the literature focuses on simulations as *applied* decision support tools in areas such as screening strategies (Davies *et al.*, 2002), smoking cessation (Levy *et al.*, 2000; Kaplan *et al.*, 2001), and immunization programs (Harris *et al.*, 2001). Simulations have also been used successfully to model behavior change and the prevalence of chronic disease (Roberts, 2001).

Although the literature contains a number of studies concentrating on the use of PBL, much of the higher education focus is on medical education. Likewise, research related to the use of computer-based simulations as a means of delivering a PBL curriculum has been somewhat overlooked in the field of public health (Pham & Blumberg, 2000). Despite the apparent lack of research related to the use of PBL and computer simulations in public health instruction, studies of PBL in medical education and other disciplines suggest that PBL may be effective in producing positive student attitudinal changes as well as achievement of learner objectives (Zimmerman *et al.*, 1997; Trevena & Clarke, 2002).

Purpose

The purpose of this study was to develop and pilot test an online community simulation as a PBL curriculum for an undergraduate health

behavior course in order to assess the feasibility of an online simulation as a PBL modality. The results of the study will be used to make future design and technology modifications to the simulation as part of an ongoing development process.

Developing a Simulated Public Health Environment

The ability of a computer-based simulation, as a PBL modality, to model a problem scenario using multimedia may overcome many of the text-based PBL limitations. Additionally, the use of the Internet may provide an effective and convenient mode to deliver a simulation. This pilot study involved a semester-long web-based simulation of Lincoln County, a hypothetical US community. The public health challenge concerned an elevated and growing number of tuberculosis cases. Through the creation of an online environment, students working in small groups accessed information resources that had been prepared for them in advance. Those resources included an annotated bibliography, notes from simulated meetings with a former professor and simulated responses to requests for information via an email discussion list. Additionally, students could ask questions, administer surveys, review simulated survey results and recommend intervention strategies.

The course began with a short orientation during which students asked questions, practiced submitting recommendations and asynchronously met online with one another using an electronic conference room.

Throughout the simulation, the instructor could change the environment by introducing timely documents into the students' virtual *inbox*. The inbox consisted of a weblog that was integrated into the simulation website. It was described to students as analogous to the inbox on their desks, where they might find newspaper clippings, memos, phone messages, etc. The instructor prepared each item placed in the inbox in response to a student's recommendation or as a mechanism to continue the progress of the simulation's timeline through various news events.

Another communication tool was an online threaded newsgroup presented using the metaphor of a *conference room*, where students could asynchronously exchange messages with group members. Students could use the conference room to communicate with one another when not in class. Additionally, the instructor could monitor the discussions within the various groups and interject suggestions and comments, posing as a simulation character.

Each simulation included a form so students could submit emails, phone calls and written recommendations to the simulation characters. Student communications were delivered via email to the instructor who would then generate responses from characters. Responses appeared as messages, emails or memos in the students' inboxes.

Methodology

Twenty-eight undergraduate students at California State University, Northridge participated in the pilot study. Students formed four groups, each consisting of six to eight students. Two groups were randomly assigned to the simulation exercise, while two groups were assigned the traditional course project in which students selected a community, researched a health problem, then developed and tested a health education intervention on a small sample target group. At the conclusion of the term, groups documented their interventions and results in written reports. Outcomes for simulation groups consisted of modeled morbidity and mortality data. Finally, a survey was administered to all students to determine their attitudes about the two learning modalities. Face validity was determined through internal consistency of responses and comparisons with focus group responses. Twenty-two of 28 students completed and returned the surveys which included four open-ended questions and 15 Lickert scale questions designed to assess students' interest in the topic. Students were asked to assess their interest in the simulation, anxiety in completing the exercise, group interaction and the perceived usefulness of the simulation, all in comparison to assignments in other courses they had taken.

Two focus groups were also held with students. The emphasis of the focus group discussions was placed on the following items:

- What problems did students encounter while working on the project?
- What changes could be made to improve the project as a learning experience?

Results

Findings suggested that students participating in the simulation found the dynamically changing environment motivating and interesting. The fact that new information and communications from the characters were likely to show up at any time produced interest and curiosity as to how the scenario would unfold. Students also reported that the dynamic nature of the simulation meant that they could not put the assignment on the "back burner". Consequently, students reported that the simulation produced somewhat more stress than a traditional assignment in which work could be postponed to a more convenient time.

When asked what they disliked most about the simulation, students tended to focus on technical aspects of the environment. Some concerns included:

- Occasional long delays between the time that students submitted recommendations or information requests and the time that the scenario changed in response to student-input.

- The lack of formatting for communications from students to the simulation characters. This was frustrating for students attempting to submit complex documents such as proposed survey instruments and health education materials.
- A lack of understanding as to what was possible within the environment. For example, some students failed to submit interview questions for a simulated TB patient because they did not realize that it was possible for them to do so.
- The environment included a hyperlink that was used for students to submit recommendations. Many students reported some confusion as to when it was appropriate to submit input in this manner and what format the submission should take.

When asked what changes should be made to the simulation, students also tended to focus on technical aspects of the simulation including items such as:

- Making available examples of the types of communications that could be initiated by the students.
- Providing the ability to communicate in a synchronous environment with simulation characters.
- Providing more biographical information about the simulation characters.
- Providing a planning calendar to which group members could contribute in order to help organize scheduling.

Students most frequently reported the following positive aspects of the simulation:

- A realistic portrayal of a community and what the students believed would be the issues faced in resolving a real-world health problem.
- Ability to see public health outcomes associated with an intervention.
- Flexibility to work on the problem at convenient times and places without need for students to plan frequent face-to-face meetings.
- The experience of applying newly acquired skills to a realistic problem.

Participants were asked to agree or disagree with a statement that the experience was more motivating than a typical project. One hundred percent of the respondents rated the experience a one, two, or three on a ten-point scale (one equated to “strongly agree”). This compared to 82% who rated the non-simulation exercise similarly. Likewise, 100% strongly agreed (with a rating of “one” or “two”) that the simulation was more interesting, and 100% strongly agreed that they preferred the experience to writing a traditional academic paper, as compared to 82% and 91%, respectively, for the non-simulation students.

An ANOVA conducted on final scores showed no significant difference in the average overall score ($p=0.64$) for the non-simulation students in comparison to those participating in the simulation.

Students participating in the simulation reported the experience produced less anxiety than the traditional group ($p = 0.12$) and that the ability to view outcomes resulting from their interventions was a valuable part of the exercise ($p=0.13$). Although not statistically significant, simulation students also reported the experience was more interesting ($p=0.37$) and more motivating ($p=0.19$) in comparison to non-simulation students.

Conclusions

The use of a community simulation appears to be a potentially feasible problem-based learning modality for an undergraduate health education course. Students participating in the simulation perceived the experience as helpful in providing a clear context for the application of health behavior theory and as a motivating experience overall. Additionally, web-based simulations provide a unique opportunity for students worldwide to experience health education challenges that originate in a variety of distinctly different cultures. Without the constraint of distance, students can collaborate in a common work setting as they pursue solutions to health problems.

Feedback provided by students will be used to produce an enhanced simulation that will be evaluated further to determine its educational potential as compared to the traditionally assigned reality-based project.

Recommendations

Although the use of a simulation as a PBL modality in public health may offer a number of key benefits, the following design recommendations are based on student feedback and instructor observation:

- An underlying epidemiological model should be used to model changes to the community's health status. The instructor should have the ability to modify underlying assumptions related to student recommendations, thus changing the epidemiological outcomes.
- The method used for students to transmit their communications to simulation characters should include the ability to format text or attach documents such as student-developed pamphlets, and survey instruments.
- A comprehensive orientation should be conducted in which students are introduced to the virtual environment and given the opportunity to practice using the various tools. A typical challenge encountered in the

simulation should be included, so that students have the opportunity to experience the function and application of tools.

- The inclusion of project management tools, such as a group calendar allowing students to meet dates and deadlines, can help support students' efforts when working in small groups.
- The interface should emulate the work setting of a health educator. For example, rather than providing a tool for expressly submitting recommendations, the use of communication tools enabling students to leave phone messages or send emails to simulation characters may be more intuitive.

Further comparative study of students participating in the simulation assignment compared to an alternative is needed to understand affects on attitudinal and academic outcomes.

Lessons Learned

Findings suggest that a simulation-based PBL in a public health curriculum may be a feasible and effective way to improve student interest and motivation. Care must be taken to ensure the simulation includes realistic representations of tools used by practicing professionals, as misrepresentations can produce confusion that ultimately interferes with learning.

The inclusion of collaborative tools is an important component that leverages use of the Internet, allowing students to work together with reduced need to meet face-to-face.

Given the unfamiliarity of the virtual environment, a comprehensive orientation is critical to insure that students fully understand instructors' expectations and the simulation's technological capabilities.

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