Web-based technology in a constructivist community of learners

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Undergraduate and postgraduate students in chemistry, pre-medical sciences, and science education enroll in coursework which focuses on contextual learning experiences in science through supervised research. A theoretical framework of constructivism guides the learning activities in this research community, linking to students’ prior experiences and understandings within a real-life context. Three aspects that make this study different from traditional scientific research in a non-medical school setting include:

• using contextual learning, grounded in constructivism,
• developing a learning community of postgraduate students and undergraduate students in both the sciences and education, and
• sharing medical knowledge learned through a world wide website.

These studies also differ from the typical university instructional environments because students must autonomously search and make sense of information using many different sources. Science education majors work side by side with the science students, seeking ways to improve the teaching and learning of science in both the kindergarten–12th grade and post-secondary education sectors.

The contextual learning course has three goals:

• to help students develop a deeper understanding of the biochemistry of disease,
• to provide relevant opportunities for students to learn about the dynamic nature of scientific research, and share their learning on cancer and autoimmune diseases, and
• to develop a collaborative learning community.

Theoretical underpinnings
From a constructivist perspective (Glasersfeld, 1989; Tobin and Tippins, 1993), students make sense of their understandings of science based on prior experiences. Students construct knowledge as they engage in new experiences within a research context, immersing themselves in the culture of science within a collaborative learning community (Senge, 1990).

This notion is consistent with the development of a common discourse community in which all stakeholders are given opportunities to learn from each other through the
use of language (Lemke, 1995). Using the language of science and negotiating the meaning of words, participants construct meaning and learn science. In a sense, the instructor and students view themselves as equal participants who “co-participate” in the learning of science. Tobin (1997) has addressed the issue of co-participation as “the presence with one another such that meaningful learning occurs” (p.369).

**Course design and methods**
The professor interviews each student at the beginning of the study to provide an overview of her expectations, to learn of the prior experiences of the student-researchers, to discuss the types of biochemical research being undertaken in the group, to ascertain the academic interests of each student, and to establish a customized plan for individual research. Instead of totally immersing ourselves immediately in the research, we take the time to develop a learning community, forming collaborative groups, learning each other’s individual goals, and setting group goals. Working generally in pairs, students select a specific autoimmune disease or form of cancer to study. Table 1 shows the range of activities (and the percentage of time) in which students engage in contextual learning.

The first contextual study conducted focused on an autoimmune disease called lupus (Gilmer et al., 1996). The success of this first study led to exploration of other autoimmune diseases and cancer. An important outcome of this course relates to the collaboration between student researchers and the mutual respect they gain as they share information via class presentation or over electronic mail.

<table>
<thead>
<tr>
<th>Activities in which students engaged</th>
<th>% of effort</th>
</tr>
</thead>
<tbody>
<tr>
<td>reading scientific/medical literature</td>
<td>20</td>
</tr>
<tr>
<td>developing common goals within our contextual learning research group</td>
<td>5</td>
</tr>
<tr>
<td>developing action-research plan in contextual learning focus groups</td>
<td>10</td>
</tr>
<tr>
<td>sharing what we are learning within our larger research group</td>
<td>10</td>
</tr>
<tr>
<td>developing the webpages</td>
<td>10</td>
</tr>
<tr>
<td>expanding learning community to those on the world wide web</td>
<td>5</td>
</tr>
<tr>
<td>writing questionnaires and submitting forms for use of “human subjects in research”</td>
<td>5</td>
</tr>
<tr>
<td>interviewing physicians and nurses who treat patients with diseases of interest</td>
<td>5</td>
</tr>
<tr>
<td>reading patient files</td>
<td>5</td>
</tr>
<tr>
<td>interviewing patients</td>
<td>5</td>
</tr>
<tr>
<td>visiting clinical laboratories</td>
<td>5</td>
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<tr>
<td>attending meetings of patient groups</td>
<td>5</td>
</tr>
<tr>
<td>writing up work for presentation at international meetings</td>
<td>5</td>
</tr>
<tr>
<td>preparing work for publication</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 1: Different activities and percentage of effort in which students engaged during contextual learning

Development of a Webpage
The World Wide Web has contributed greatly to what we have learned as a contextual learning community. It provides a “hands-on” approach to learning information and knowledge. Like sleuths, we incorporate many different techniques to gather information. Using journals, books, and with the help of doctors, cancer survivors, and the American Cancer Society (1997), we gain valuable information about the diseases of interest. The Internet offers the perfect venue for our students to share their research findings with the public (for the main page of our Lymphosite webpage, see Figure 1). We share what we learn through the Internet, and help people become more educated about disease (Gilmer, 1997).

Reflections of a Student Researcher
Mohammad Nazarian, a senior undergraduate, reflects on his contextual learning experience:

“In my research, I learned how to make sense out of a wealth of information and bring it to a conclusion. Initially, I worked with a freshman undergraduate, focusing on non-Hodgkin’s lymphoma, a cancer of the immune system. We utilized resources from the library, on the world wide web, and through interactions with other peers in the same research group. We developed

a website which includes information on the immune system, non-Hodgkin’s lymphoma, ankylosing spondylitis, leukemia, and Hodgkin’s disease, giving patients, physicians and other researchers access to our findings. I learned how to create, modify and update a website on my own. At the same time, I learned more biochemistry from the other students’ research. Through this project, I can now better define myself both academically and professionally.”

Conclusions
The Internet addresses the important issue of access whereby students can work on course assignments at times that are convenient to them and have time to reflect on their learning before posting responses or assignments. Moreover, providing students the opportunity to make connections to what they are learning and what they plan to do for a career can make a difference in their self confidence, interest and motivation to learn. As students make contact with faculty, off-campus experts, and peers through Email and disseminate their findings on World Wide Web sites, they learn practical applications in their chosen fields, important social issues, and ethical and legal aspects associated with research. Beyond this conceptual learning base, students also begin to understand the critical importance of collaboration related to understanding difficult scientific issues, learning about potential careers, and participating in a discourse community of learners.

References