Historical London through the Lens of Technology
A Facilitative Learning Approach as Authentic Alternative for Teaching the History of Technology

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Abstract

This paper describes a unique course developed by a multidisciplinary team of faculty from the College of Applied Science at the University of Cincinnati. The course provides an opportunity for Honors Program students to develop an appreciation for the strong inter-relationship between technology and society by exploring the history and developing technology of four structures in London: the Tower of London, St. Paul's Cathedral, the Tube, and Shakespeare's Globe Theatre. The course is grounded in the Problem Based Learning (PBL) pedagogy where students are divided into groups and become independent learners with faculty acting principally as guides or resources. The course culminated in the group visiting London for eight days.

Introduction

Historical London through the Lens of Technology is a Special Topics Honors course that satisfies a Humanities Elective requirement for baccalaureate degrees. In the class, students explore the strong inter-relationship between technological developments and societal needs, culture, and perceptions of progress by studying the history and developing technology of four structures in London. A multidisciplinary team of faculty consisting of an architect, a humanities professor, and four engineers with expertise in construction, electrical, and mechanical engineering technologies developed the course. The faculty team's initial question was "what is an effective learning strategy to encourage a deeper level understanding and a holistic integration of historical and technological concepts?" Problem Based Learning (PBL), with its emphasis on synthetic understanding and developing meaning over mere fact collection and recall, was a natural choice during course design.[1] This paper is written as a case study that records how learners, using the action-oriented learning attitude implicit in PBL, engaged in the process of making sense of *open-ended* problems, reports on their successes and complications in seeking *useful solutions*, and evaluates how effectively the assessment strategies supported and potentially drove the learning.[2] The six faculty members strongly agree with the assertion that the active research strategy of PBL methodology positively impacts the quality of student learning.

Faculty administered a survey instrument on the first day of class and on the last day of class. The two survey instruments were identical and probed cognitive, behavioral and affective attitudes. The "Assessment" section included here provides graphs that aggregate the results.

Question ten from the survey probes learner attitudes regarding the two main orientations to teaching: knowledge transmission and learning facilitation; whereas, the course design here assumes that deeper learning results from active experience in a reflective group-supported process with an intention of making sense of a complicated problem, and in an environment where colleagues learn from each other.[3] Support for this assumption comes from the proposition that, "[l]earning is a process of making sense of the world and of seeking useful understanding – an understanding that aids in resolving uncertainty . . . in the goal-oriented use of those resources in a specific context and for a specific purpose." [2] It seems particularly apropos here to explore the etymology of the word history which leads back to the Greek *historein*, to inquire.

Twenty-three people of diverse backgrounds, inclusive of the six faculty course designers, met each Monday and Wednesday during the ten weeks of autumn quarter 2004 to inquire; *does a diverse work group environment strengthen the process of learning*? Another question from the assessment survey, number two, proposes that society and technology are interdependent. Again, if one seeks a hermeneutical approach, the word society derives from the Latin *socius*, for companion and fellowship; and, technology derives from the Greek *techne*, for skill. The parallels between the subject of inquiry, society seeking meaning through technologies, and the process of inquiry, the social construct of a PBL group seeking a systematic understanding about technologies, demonstrates an interesting pedagogical symmetry. The following sections examine a set of outcomes and solutions for one of the problems, St. Paul's Cathedral, where this symmetrical process is evident.

Table 1: Analysis of Group Descriptive Attributes

Group	Members	Males	Females	Majors
1	5	4	1	Construction Management Architectural Engineering Technology Electrical Engineering Technology Electronic Broadcast Media Information Engineering Technology
2	4	2	2	Construction Management Architectural Engineering Technology Electrical Engineering Technology English
3	4	3	1	Mechanical Engineering Technology Construction Management Architectural Engineering Technology Information Engineering Technology
4	4	2	2	Industrial Design Construction Management Computer Engineering Technology

St. Paul's Cathedral

This problem was the student's second project, and focused on a simulation technique that directors' use in the making of movies, storyboarding.[4] Students were assured that, ". . . while it helps to draw well, it's the story concept that counts, and even rudimentary drawing techniques can convey the narrative flow of a given production." [5] The premise of the problem was that a group of students had won a reality show contest to accompany a contemporary rock band, The Wrens, to London. The Wrens were planning to shoot a music video highlighting the history and

technology of St. Paul's Cathedral within the cathedral itself. The students' problem was to create a set of storyboards in order to pitch their ideas for the music video to the band. The complete text of the problem is included in the appendix.

Expectations and Results

Considering the presentation and exercises on storyboarding and the explicit requirement in Part Two for a music video in storyboard form, the faculty were expecting a storyboard on St. Paul's. All four groups did develop storyboards but then moved beyond the storyboard to a collection of unique and very creative presentations.

Group 1 developed a set of thirty-two beautifully hand drawn sketches that depicted the history and technology of St. Paul's Cathedral from the Great Fire in 1666 to modern times. A particularly creative visual effect was the use of a Priest character that appeared in most of the sketches and aged as time progressed. Each sketch included director's instructions for the music video, for example, "End pan on smoldering ruins of old church. In accelerated speed new supports, then walls form, and St. Paul's takes shape. Camera tracks back from window." The sketches depicted changes in dress ("Priest watches street as time passes at accelerated speed. People in early 1700s period dress change to larger and more upscale crowd in 1800s dress"); changes in technology ("Interior light changes from dim candles to brighter electric lights"); and social issues ("Over the shoulder shot as Priest watches wealthy business man snub and step over beggar on steps of church"). The sketches were presented in a power point slide presentation accompanied by an original song (music and lyrics) composed by a member of this group.

Group 2 began with a presentation that included a historical overview of St. Paul's cathedral and a discussion of the cathedral's design. Their presentation was followed by a video that showed St. Paul's cathedral using a backward progression of time – an approach unique to this group. The images used were from books and Internet resources rather than hand drawn. The music selected by the group complemented the visual images. One particularly sophisticated visual effect was the video morphing used to illustrate the destruction and rebuilding of the cathedral throughout its history.

Group 3 had a unique approach in comparing modern technology with the technology in the past and exploring these differences through the history of St. Paul's. Their main areas of focus were in construction, acoustics, and art. The images used were from books and Internet sources with FLASH animation added by one of the group members. The video included images of scaffolding used in the construction of St. Paul's compared to modern construction equipment. A particularly effective contrast was the amount of time required to clear the rubble of St. Paul's after the Great Fire of 1666 compared to clearing the rubble from the World Trade Center in New York in 2001. This group also had an original song (music and lyrics) written by one of their members that accompanied their video.

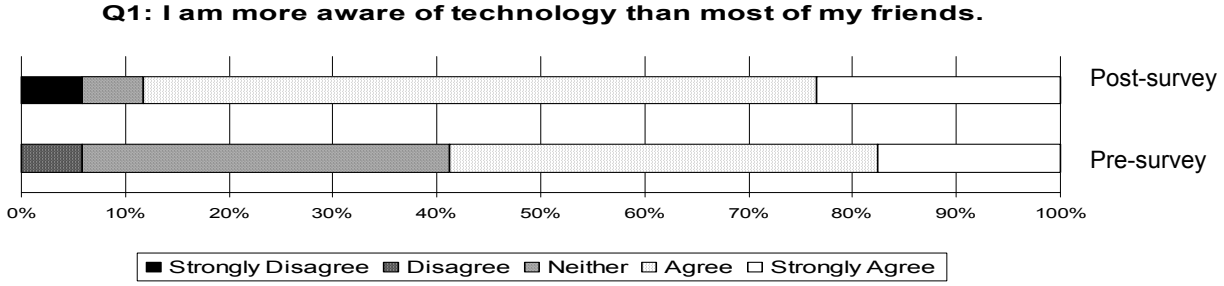
Group 4 had an animated storyboard that was performed by the group members using "Shadow acting". It began with a member of the group walking into the room with a candle asking for directions to St. Paul's cathedral. He stepped behind a curtain that was then lit from behind. The music began and group members (hidden for the most part unless they were characters) held up

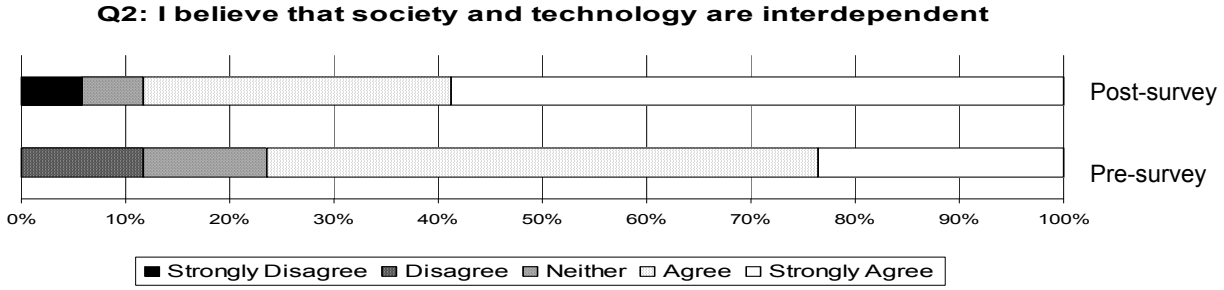
symbols made from cardboard that depicted the history of St. Paul's as a shadow play production. The choice of background music was very effective. One outstanding symbolic scene was a silhouette of St. Paul's with a warplane flying over-head as the WWII sirens blared in the background. At the end of the presentation, all group members left the room in silence carrying flashlights – a stark contrast to the candle at the beginning.

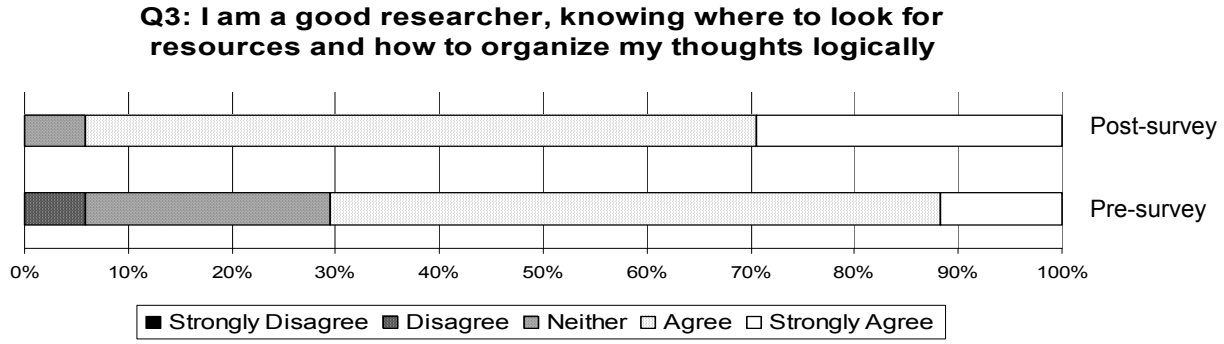
Assessment

Several different forms of assessment were used to study the effectiveness of the PBL approach in this course: a student survey, peer evaluations, a workshop in London, instructor evaluations, and a reflection paper after returning from London. This section describes some of these assessment methods and results.

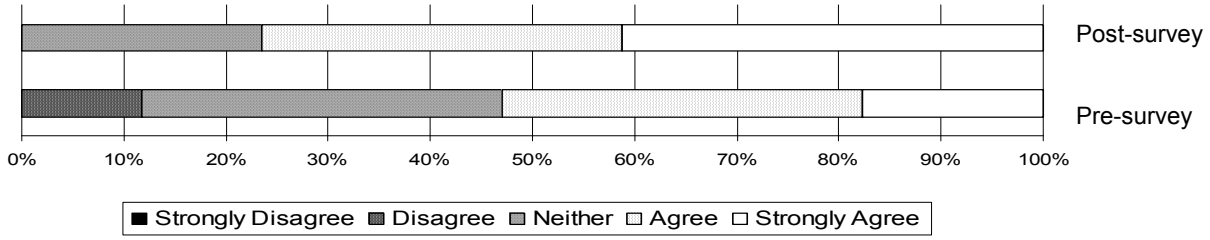
On the first day of class and on the last day of class, students were given a survey consisting of eleven questions designed to reflect the cognitive, behavioral, and affective objectives for this course. The pre and post results for each question are illustrated in the graphs that follow.



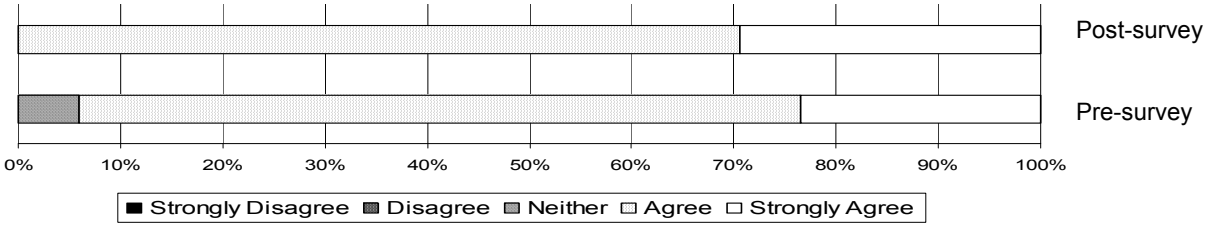




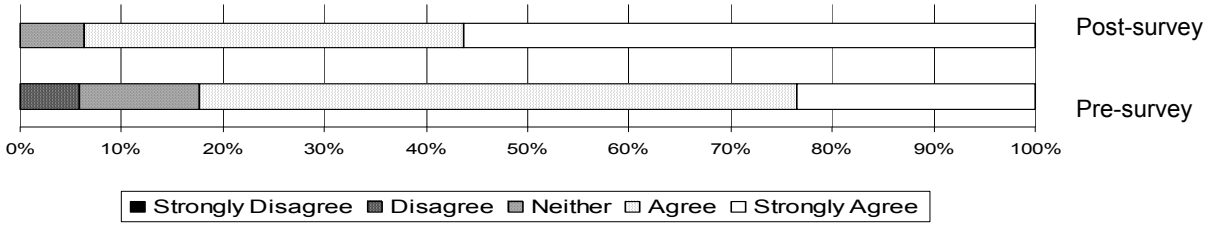
Q4: I feel confident presenting my work in front of a room full of people



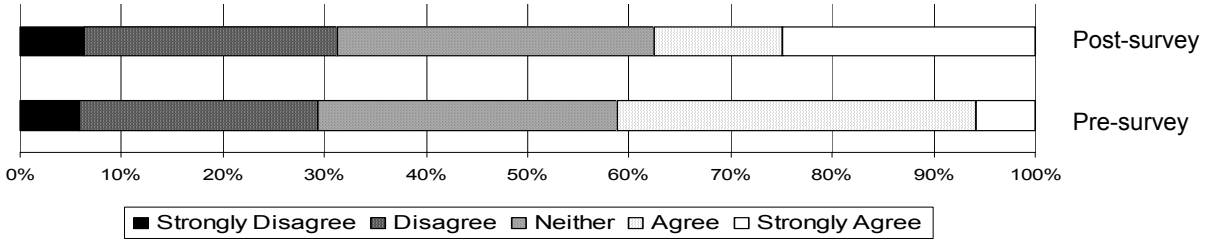
Q5: When presented with a difficult problem, I know how to find information that helps me work on solutions.



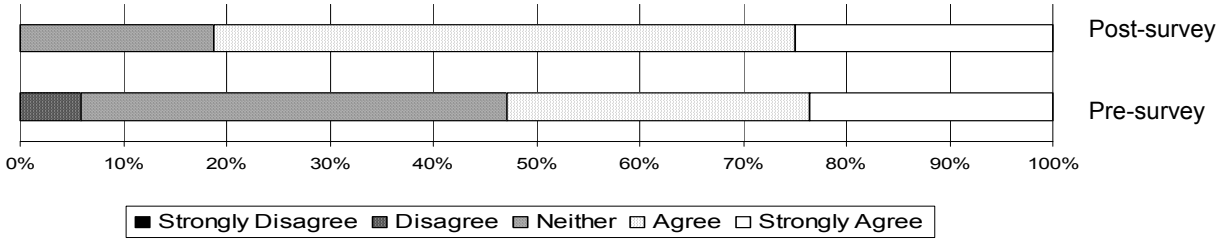
Q6: I have good "people-skills" that help me when I work in teams.

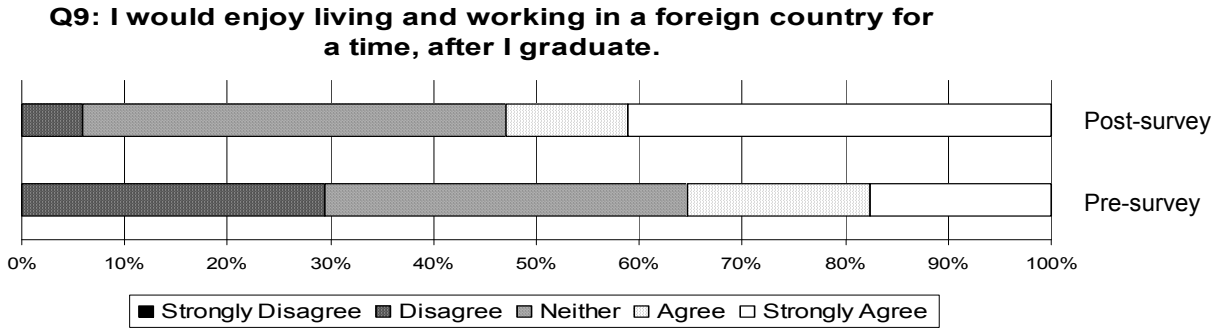


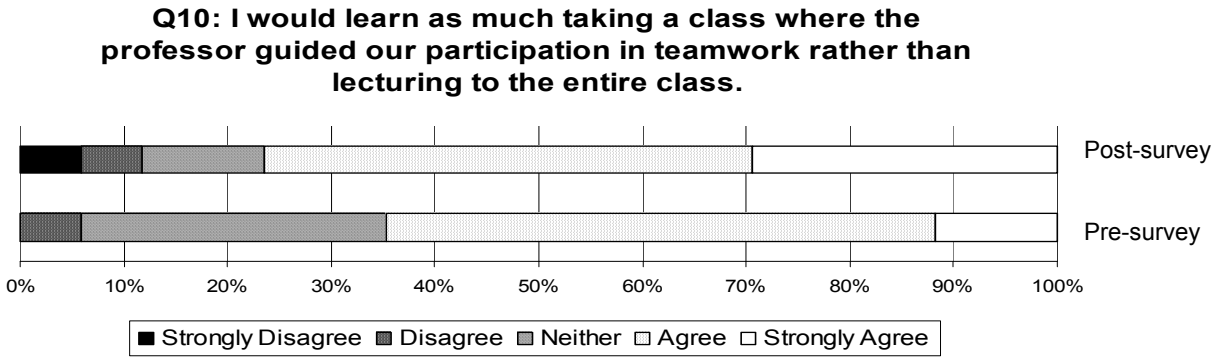
Q7: I often enjoy reading books in addition to my class assigned reading.

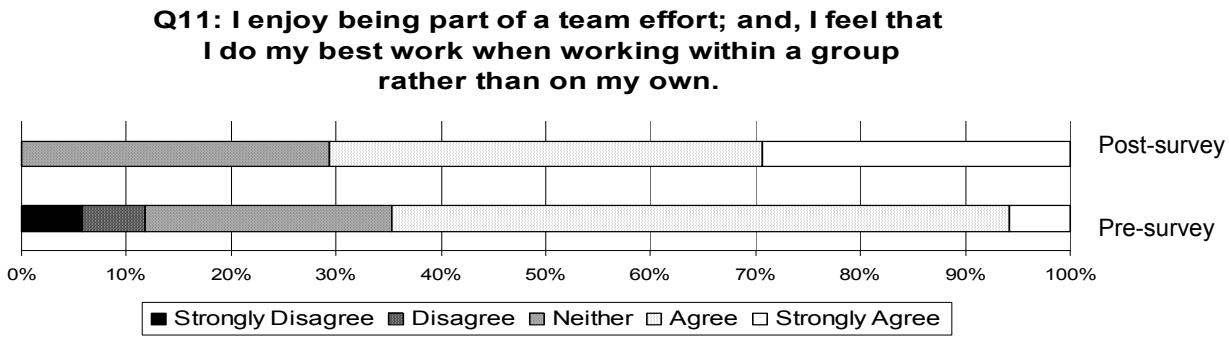


Q8: I believe that learning history helps me make better decisions.









The graphs indicate that student confidence improved on most items by the end of the course. A T-test was also utilized to test the hypothesis that the mean increased on each question between the pre and post tests. The results, summarized in Table 2, indicate that by the end of the course (at a 0.05 level of significance), students were more aware of the link between society and technology and the value in learning history to improve decision making. They were also more confident in their abilities to do effective research, work well within a team, and present their work to others. Students recognized the value of team work in producing a better product or problem solution as opposed to working as individuals. Since most of the students in the course were majoring in a technical field, it is perhaps not surprising that their awareness of technology and confidence in their own problem-solving abilities did not increase (at the 0.05 significance level) as a result of this course. The results of question 10 indicate that the students did not significantly prefer the problem based learning approach over the traditional lecture style. For most of the students in the class, this was their first exposure to problem based learning. Perhaps more courses using the PBL approach would affect this opinion.

Table 2: T-Test Analysis of Assessment Survey Data

Question	Pre-Test Mean	Post-Test Mean	Post-Test Standard Deviation	T-Value	Mean Increased?*
1	3.71	4.00	0.94	1.296407	
2	3.88	4.35	1.06	1.835326	YES
3	3.76	4.24	0.56	3.450649	YES
4	3.59	4.18	0.81	2.998127	YES
5	4.18	4.29	0.47	1.032796	
6	4.00	4.50	0.63	3.162278	YES
7	3.12	3.25	1.29	0.410081	
8	3.71	4.06	0.68	2.097524	YES
9	3.24	3.88	1.05	2.531915	YES
10	3.71	3.88	1.11	0.654654	
11	3.50	4.00	0.79	2.607681	YES

*Hypothesis Testing at a Significance Level of 0.05

Students were given the opportunity to anonymously evaluate the members of their group and also provide a self-evaluation. Not surprisingly, the majority of the evaluations were outstanding since the class consisted of highly motivated and talented honors students. However, comments included in the evaluations clearly illustrated some of the challenges encountered in the group work. The biggest challenge mentioned was working with a group of highly motivated individuals with lots of creative ideas all of whom were used to being leaders and organizers. The other challenge was in dealing with a few members of the class who, although very talented, were accustomed to working alone and putting material together at the last minute, which was not conducive to the group effort.

During the London trip, students and faculty participated in a one-day workshop with three faculty members from the University of Manchester with expertise in PBL. The students were given the opportunity to present their solutions to the problems posed in the course then participated in a group discussion about their experiences in the course. In terms of group work, students commented on the advantages of a team-oriented environment, utilizing the specific talents of individual group members to solve the problems, and from a social aspect, how enriching it was to get to know group members rather than just sitting next to someone in class all quarter. One interesting challenge in the group work was that all the students were honors students and therefore tended to be leaders who wanted to dominate the discussion. In terms of the PBL approach, students commented positively on the open-problems which allowed for freedom and creativity, not having professors thinking for the students, being able to personalize the learning, and having, as one student commented, "no ceiling – go as far as you want with the solution". Faculty from the University of Manchester commented positively on the quality of the presentations and the creativity and enthusiasm of the students.

The six professors teaching the course were very enthusiastic about the problem based learning outcomes. Faculty discussed at great length just how to evaluate the prodigious and creative student efforts. Admittedly with some angst, faculty debated the merits of rigorous assessment and the potential outside perceptions about an undergraduate class where all participants received

an exceptional "A" grade. Yet, professors agreed that the student work very much exceeded both past teaching experiences and prior expectations. The course definitely challenged notions of pedagogy and assessment and has, in the opinion of the authors, the great potential to "raise the bar" for student learning outcomes.

After returning from London, students were asked to submit a final reflection paper describing their experience in the course. A selection of the many insightful comments made by the students is included here.

"This class was also my first experience with problem based learning and working with such opened ended questions in a diverse group really helped me to see how a problem could be approached from several different angles, many of which would work equally well."

"The next learning point was how to incorporate different individuals' ideas into the group's solution. Being honors students, many think that their idea is the best and that it is the only way to solve a case. It takes a true leader to be able to shuffle everyone's ideas into a solution so that all the team members feel as if their idea is being utilized."

"I have found that working with honors students can be very rewarding in the sense that you do not have to worry about the quality of work that they produce but it can also be difficult to work together. We are all used to being leaders but sometimes we need to learn how to step back and become a follower."

"In regards to the behavioral objectives of the class, I feel that presenting to the class as well as watching the other presentations of the projects helped me to better understand what goes into making an effective presentation that is both engaging to the audience as well as informative and educational."

"Problem based learning has encouraged a new way of learning. It allowed us to open our minds and use our imagination to find new ways of finding the information needed as well as presenting it. By doing this we were required to know and understand all of the information, so that way we could attack the problem from all angles. This allowed the most in depth learning and it also made it fun at the same time. We are guided in the direction we need to go to cover the material but within that we can explore our own possibilities and simply roll with the ideas that interest us."

"Looking back at the course, I find that my skills evolved as the class progressed. Initially, I resisted the PBL approach to learning. It didn't feel natural not having a strict set of guidelines to follow. But what I found is that lecture based learning has limitations because it pursues only one path to a solution which may only effectively "teach" certain students. PBL taught me to stop, look at the problem as a whole, and see the many paths. I found that, in my case, learning comes from choosing the path that most interests me. The power of this learning was not truly understood until our visit to London. What shocked me is that as we visited the sites we researched I found that I had retained almost all the knowledge I had obtained."

Conclusion

As stated, the faculty for Historical London through the Lens of Technology are committed to the active learning propositions inherent with Problem Based Learning and strongly assert that the PBL methodology produced exciting, high quality and deep level learning. Some of the best "evidence" in support of the original research question can be found in the anecdotal student comments listed above as well as those not printed here due to space limitations. The learning outcomes for this course, particularly the group presentations of the problem solutions, exceed the expectations of all twenty-three participants and provide explicit qualitative support that PBL is an effective strategy for encouraging deeper level cognitive, behavioral and affective learning outcomes. While students can be initially skeptical about pedagogies that vary from the more common didactic lecture format, facilitators to the process (faculty) need to pay special attention to achieving learner "buy-in" to the process. The very favorable facilitator to learner ratio for this class (1:3) provided considerable support for this trust building process.

The graphs that present the survey results illustrate positive shifts in the student attitudes about the goals that course designers had for the learning outcomes. The sample size for each survey is 17, and therefore limits generalization to a larger student population. Intuitively, one can visually observe from the graphs very good "quantitative" gains and shifts in attitudes at least in this sample. Other synergistic factors are prevalent that likewise limit statistical inference to a larger population of students. The very favorable facilitator to learner ratio, previously mentioned, is a luxury unlikely to be repeated except for these kinds of experimental course design projects that have supplemental funding. Faculty training in PBL and travel stipends were funded collectively by the university's Center for the Enhancement of Teaching and Learning, the Honors Program and the Institute for Global Studies and Affairs. Additionally, honors students seemed very willing to readily adopt PBL processes and especially welcomed group work. Can the same thing be said of a more conservatively disposed population of college students that seem to favor traditional lecture formats and individual work?

The greater and more rewarding inquiry here is the significance of diversely defined work groups that feature heterogeneous student presage factors.[3] Intuitively, it seems to matter how the PBL groups are defined. Faculty paid significant attention to forming the groups such that each was interdisciplinary and also gender-distributed. Anecdotally, the students and faculty continue to share a common theme, "*. . . a diverse group really helped me to see how a problem could be approached from several different angles . . .*" From such a diverse group of twenty-three independent travelers on this exciting expedition to London's many technological and cultural achievements there is consensus on the proposition that a diverse work group strengthens the processes of learning; and, that Problem Based Learning is a uniquely appropriate pedagogy that enables deeper level experiential learning.

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Appendix

The Wren's: Making the Video
A Problem on the History of Technology in St. Paul's Cathedral
Four UC Students Win Reality Show Contest

By Sir Christopher Wren, Staff Reporter
August 23rd, 2004

Cincinnati – Huddled together around a small television in a dorm room four UC Students celebrated Sunday. Nicole Mansart, Chris Sheldon, Jenny Serlio and Rajiv Vitruvi watched the final episode together over popcorn, and made last minute additions to very full suitcases. The local team of four has won the reality show contest *Making the Video: Season One* and now has the chance to make their dreams come true. They will assist in the production of a music video in London at St. Paul's Cathedral.

The team will shadow, and be advised by, video production professionals for a period of four weeks. The four creative students will be working to produce a music video for the alternative rock band, The Wren's. Respected for their cerebral lyrics and jazz-induced musical reveries, The Wren's are perhaps best known for their ground-breaking videos, described as ironic commentaries on technology and society – often featuring thought-provoking juxtapositions of historical backdrops and technological innovations. . ..

Rajiv shakes his head in disbelief as he puts down the newspaper in the seat next to him at Delta terminal B19. Still very much unaccustomed to reading his name in the paper, he is awaiting Nicole, Chris and Jenny's return with a much needed café latte. Rajiv still cannot believe the news. The four friends have found themselves to be the unlikely passengers on an early morning chartered flight to London with their favorite band, The Wren's, and a video production crew.

Imagine that you are the team of four on this plane. During the eight hour flight you should have great access to your captive audience – the band and the video professionals on board. Now is your best opportunity to begin *storyboarding* the conceptual framework and sequence. The captain has just reached the cruising altitude and turned off the fasten seat belts sign. It is time to get up and meet some people . . ..

In addition to the technical questions, here are some thematic questions you will want to consider. You will likely generate many more in your group discussion.

Architecture & Construction: How has the design of church architecture developed in England and where does St. Paul's fit into this historical continuum? What is a Latin Cross plan? What is the significance of the two Baroque towers? What is a peristyle? Why do you think Wren would have objected to the addition of the balustrade around the first drum of the dome? What is the construction of the dome? What is the nature of innovation in spanning large distances – i.e. domes, iron, etc?

Mechanical & Electrical: What are the main sources of lighting? How has this changed from the past? How was the building retrofitted to accommodate modern wiring? What systems support modern requirements for safety, security and theater? How has the environmental conditioning of the interior space changed from 1710 to the present? What is the history of plumbing in London and how does St. Paul's reflect that history?

Social & Humanities: Why would St. Paul's be considered London's most famous landmark? Who is Sir Christopher Wren, and what was his role in rebuilding London? What was the

significance of the great fire to London in 1666? What was the significance of St. Paul's to Londoners during the aerial assaults of World War II? How have the images of St. Paul's – paintings, literature, songs and photographs – changed through its history?

Part Two

Your team shall present your version of a music video in storyboard form. The storyboards should be sequenced, resulting in the "director's sketch" of the video. Your video should be sympathetic to the artistic vision of the band.

The Wren's envision their art in a *Postmodern* context, hence, they rely heavily on ironic expression in telling their story. As historical experts on St. Paul's technology, your contributions to this project should center on how best to reach out to the Wren's intelligent audience by engaging them in the *experience* of society's encounter with technology through the ages.

This is a journey of emotional and intellectual importance, and your team's music video should underline The Wren's thesis that societal and technological change does not occur in a smooth, linear or logical pattern, but rather in sometimes uncomfortable jolts.

Bibliography

[1] Vallino, James. 2003. Design patterns: Evolving from passive to active learning. Paper presented at 33rd ASEE/IEEE Frontiers in Education Conference, Boulder, CO, http://fie.engrng.pitt.edu/fie2003/papers/1268.pdf.

[2] Duffy, Thomas M., and Jamie R. Kirkley. 2004. *Learner-centered theory and practice in distance education : Cases from higher education*. Mahwah, N.J: Lawrence Erlbaum Associates.

[3] Kember, David. 2000. *Action learning and action research : Improving the quality of teaching and learning*. London: Kogan Page.

[4] Inglert, Eric. 2003. Engaging freshman minds: Redesigning the introductory construction course for student retention. Paper presented at 2003 Associated Schools of Construction Regional Conference, Downer's Grove, IL, http://homepages.uc.edu/~inglere/Articles/Engaging%20Freshman%20Minds.htm.

[5] Hart, John. 1999. *The art of the storyboard : Storyboarding for film, TV, and animation*. Boston: Focal Press.

Biography

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