
Evolving instruction in biology: using the web to improve in-class instruction

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Abstract

Much debate in the library literature has focused on the effectiveness of web-based or online instruction versus traditional face-to-face library instruction. While both forms of library instruction have their strengths and weaknesses, the authors contend that a hybrid approach to information literacy instruction, by bringing the web into the classroom, offers students and instructors the greatest benefit. The authors' experience with the evolution of instruction sessions for 1,100 first-year biology students from PowerPoint presentations to web-based courseware (WebCT) to its current web-based format illustrates the improvements to instruction that have accrued as the program has developed. These include the ability to address diverse learning styles, encourage active participation, provide 24/7 access, and foster increased student contact with librarians.

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Introduction

Current literature tends to present web-based and face-to-face modes of instruction in opposition to each other. The evolution of a tutorial for first-year Biology students at the University of Calgary shows that this view neglects the value of combining the strengths of both approaches to build a valuable learning experience for students that is also sustainable for librarians, even those faced with large classes. By using the web, the librarian gains the greater interactivity, flexibility, accessibility, usability, and the higher engagement of learners that are associated with using this technology for instruction. By using the web as a platform within a face-to-face teaching environment, the librarian gains the personal contact, immediate feedback, and enhanced communication among students so often lamented as losses in virtual learning. Increased student engagement, participation, and focus on tasks, the accommodation of different learning styles, and 24/7 access are just some of the improvements we have seen as the sessions have become increasingly interactive, and open to the students' individual research tasks. The flexibility allowed by the web-based platforms encourages students to follow the lecture more closely and to search the resources with terms drawn from their own assignments. As the tutorial for biology evolved, we learned many lessons that enhance our current offering and inform plans for its future development.

Background

Every fall, approximately 1,100 first-year biology students participate in an information literacy workshop delivered in the Library's Information Commons teaching classrooms. These classrooms are fully equipped with computers and internet access for the students as well as a teaching station for the librarian. The sessions are developed in concert with the biology faculty to introduce students to a variety of information resources with a focus on peer-reviewed journals. The sessions typically have 100 students and take two hours, with the majority of that time being spent in hands-on work to complete their lab assignment. This assignment has also evolved over time, from a 16-page booklet students filled in to a briefer form that no longer includes the explanatory material now available on the web.

Throughout the development of the tutorial, librarians have routinely sought feedback from

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both the students and from the teaching assistants who mark the assignments. This has consisted of formal surveys, informal conversations and lately a web-based evaluation incorporated into the tutorial.

Literature review

Librarians have been using information technology to teach information literacy skills since the introduction of personal computers as a teaching tool. Numerous studies have been published to support the view that active learning, which enables students to interact with information tools, improves retention of skills. As an early example, Ridgeway (1989) says, "Research has shown that active learning activities are more effective at achieving higher cognitive objectives than are passive learning situations". The use of technology to support active learning in information literacy instruction is well enough entrenched in our discipline that numerous reviews have been written (including Dewald, 1999; Germain *et al.*, 2000; Cox and Houseright, 2001; Hoffman, 2002; Joint, 2003; Nicholls *et al.*, 2003). It would, in fact, be difficult now to find an academic library carrying out such instruction without the use of technology. The benefits of hands-on practice as part of a tutorial are also supported by the literature (Cox and Houseright, 2001; Gutierrez and Wang, 2001; Germain *et al.*, 2000; Kaplowitz and Yamamoto, 2001; and Wittkopf, 2003).

Most of the recent articles on technology in the service of library instruction have focused on the use of the web and other internet-based technologies, including courseware such as WebCT and Blackboard (Getty *et al.*, 2000 and Bellew Martin and Lee, 2003). Librarians are exploring the web as a means of delivering instruction to distance students (Cox and Houseright, 2001 and Turman *et al.*, 2004), and as a way of dealing with increased demand for instruction with decreased librarians (Bracke and Dickstein, 2002). The technology of the web is now so familiar that a number of studies comparing the effectiveness of face-to-face classes with web-based tutorials have been done with varying results; some favoring face-to-face (Germain *et al.*, 2000; Cudiner and Harmon, 2001; Kaplowitz and Yamamoto, 2001) while others show a student preference for or higher marks achieved after web-based instruction (Bren *et al.*, 1998). Some show no significant difference in student achievement (Germain *et al.*, 2000). In spite of the varying results there are some common themes – students appreciate the interactivity and

availability of instruction on the web, and librarians are concerned about the loss of contact with students and the effects this has sometimes been shown to have on student achievement (Germain *et al.*, 2000; Michel, 2001; Joint, 2003). This concern echoes the foremost of Chickering and Ehrmann's (1996) Seven Principles for Good Practice in Undergraduate Education: "Good practice encourages student-faculty contact" and Hunt and Birks's (2004) "Best practices in information literacy".

We have drawn extensively on the literature on effective pedagogy for information literacy instruction in the development of tutorials at the University of Calgary. Dewald (1999) posits that in addition to the inherent value of active or blended learning: "library instruction is best received when it is course-related, and specifically assignment-related", a sentiment which underpins our instruction in the sciences which is always tied to a particular assignment. The Association of College and Research Libraries, ACRL Best Practices Initiative (2003) has distilled much of the wisdom in our field, and its guidelines for Articulation within the Curriculum, and Collaboration. The Pedagogy Guidelines are especially applicable to the development of the biology tutorial. They are:

- supports diverse approaches to teaching;
- incorporates appropriate information technology and other media resources; includes active and collaborative activities;
- encompasses critical thinking and reflection;
- responds to multiple learning styles;
- supports student-centered learning;
- builds on students' existing knowledge; and
- links information literacy to ongoing coursework and real-life experiences appropriate to program and course level.

Reaching students with multiple learning styles has become a growing concern on information literacy instruction (Cudiner and Harmon, 2001). Using a web-based presentation to accompany a lecture followed immediately by hands-on practice has the potential to serve students with a variety of learning styles – auditory, visual and kinesthetic/experiential.

In reviewing the literature it is interesting to note how little information exists on using the web as a teaching platform in the face-to-face classroom. This dearth of information exists not only in the library literature, but in the wider education literature as well. One of the few sources that mention this (Suarez, 2002) focuses on the mechanics of designing web resources rather than on the benefits they can bring to the classroom. An exception to this is a previous paper by one of the authors on the use of web-based worksheets in

information literacy sessions for Business students (MacMillan, 2004). Other articles discuss using the web to improve the availability of resources after a class (Brown and Krumholz, 2002), and speculate on the advisability of using hyperlinks to provide greater flexibility in the class (Ragains, 2001).

The literature then supports both technologically enhanced active learning and personal contact with students as part of effective pedagogies librarians can deploy. These two key factors, along with course-integrated, contextualized learning, hands-on practice and availability of resources outside of class time support the evolutionary path our tutorial has taken.

Phase 1 – PowerPoint instruction

The majority of library instruction at the University of Calgary Library is delivered through PowerPoint. In 2000 and 2001, this was also true of the biology library information sessions. As a mode of delivery, PowerPoint has some advantages:

- It is visual and allows for screenshots. When doing demonstrations of web-based products, these screen shots can be relied on if the web is slow, or the connection to the product is down.
- Presentations may be mounted on the web for later viewing.
- Handouts can be easily made from the presentation, allowing students to follow along and make notes.
- The software is easy to use, and slides may be adapted to other, similar, presentations quickly.

Thus, in 2000 and 2001, first-year biology students received library instruction through PowerPoint. A multi-page fill-in-the-blanks booklet also accompanied this two-hour session. The booklet was graded by laboratory assistants and formed roughly 2 percent of the students' laboratory mark. Pairs of students were given one of several mock research topics to apply to the booklet. The session also gave students active learning opportunities throughout.

Goals

The goals were to:

- introduce students to library research skills;
- provide students with a take-away guide to library research that could be referred to after the instruction session;

- involve students throughout the instruction session;
- tie the instruction session to an assignment, thereby holding students accountable for the material; and
- deliver library instruction content in a visual and organized manner.

Delivery

Students received library instruction in the form of a PowerPoint presentation within a classroom in the library's Information Commons. This session was the first laboratory session for the course. They also received a 16-page booklet that acted both as their "library lab" assignment and handout. The library-related topics within the booklet were chosen after discussion with a faculty member and included defining a research topic, choosing keywords, choosing an appropriate article index, searching article indexes, deciphering a citation for a journal article, finding a print or electronic copy of the article using the library's online catalogue, finding and citing a web site and identifying document delivery service (ILL) if the journal issue was not available at the library.

During the presentation, students received active learning opportunities: they were asked to follow along on their computers during demonstrations of indexes, and then were given time to use the indexes on topics that were assigned to them for the instruction session. The librarian and several facilitators circulated among the students to answer questions during the work time. The last half-hour of the session was "free time", which allowed students to finish parts of the booklet that they did not finish during the session, and to clarify points of instruction. In many cases, students completed their library assignment within the instruction session; if not, they were allowed one week to do so. In the span of one week, ten of these sessions occurred, covering about 1,100 students.

Evaluation

Aside from intermittent paper surveys asking students about the delivery and content of the instruction sessions, there was no assessment of student learning, or of the effectiveness of PowerPoint as a mode of delivery. However, in 2001, Julien and Boon studied the outcomes of library instruction using pre- and post-tests. The University of Calgary biology session was one of their sample groups. Their results in the 2002 CAIS/ACSI proceedings reported a significant increase in post-test scores, demonstrating

short-term learning from the session (Julien and Boon, 2002.)

Lessons learned

Based on Julien and Boon's (2002) results, one could say that delivering the sessions using PowerPoint had a positive effect on students. However, this mode of delivery used a large amount of human resources. Also, it was possible that the course would take on more students in the foreseeable future, and increase the demand for even more instruction sessions and resources. In the summer of 2002, a pilot project was undertaken to deliver library instruction to the biology class via WebCT.

Phase 2 – implementing WebCT

Over the spring and summer of 2002, the content of the fill-in-the-blanks booklet was made into a WebCT module. This was in line with the University's move to increase the use of course management software and WebCT was the campus-supported application at the time. As a pilot project, eight laboratory sections were chosen to receive this mode of delivery.

Goals

The goals were to:

- provide increased access to course materials, especially after the instruction session;
- provide students with self-paced learning opportunities;
- respond to higher demand and strained library resources; and
- take advantage of available campus courseware.

Delivery

The booklet that was given to students as an assignment and guide in the 2000 and 2001 sessions formed the bulk of the WebCT module. However, the booklet was divided across several web pages in WebCT, rather than placing the content onto one page. Many parts were also re-written to include more explanation of the concepts normally explained during a session, since this was to be a self-paced module. Sections included keywords, selecting a database, searching an article index, and searching the library catalogue. Within these sections, there were subsections about searching Biological Abstracts, using article indexes to find articles, formatting a citation for a bibliography, and document delivery

services. The assignment questions were also placed within these sections, in two major parts. Graphics and screenshots were added to illustrate concepts, an existing glossary was adapted and added, and WebCT's self-test function was employed so that students could monitor their own progress.

Biology students in the laboratory were divided into three groups. The first group of four laboratories went through the WebCT module and submitted the two parts of the assignment one week later. The second group of four laboratories went through the WebCT module, and submitted the two parts of the assignment one week apart. Both groups submitted their assignments electronically. The third group of 32 laboratories completed the paper-based assignment much as in the previous years. The first two groups received instruction on using WebCT from a library staff member, and the last group received the "traditional" library instruction session.

Evaluation

A large amount of staff time and effort was spent learning how to use the software. This included not only WebCT, but also the image editing tools required to ensure that the screen captures and images were of a good quality, yet had small file sizes. WebCT's HTML editor proved to be clunky, so most of the content was created outside WebCT and then transferred into the module. The courseware may have improved considerably since this project occurred in 2002.

All of the students who completed the WebCT module were surveyed on the content and delivery of course material, as were 100 of the students who received the "traditional" library instruction session. The feedback overall was similar to other surveys done in past courses: generally positive, although remarks varied widely. Marks for the laboratory were also obtained from the course coordinator. The average mark for those who used WebCT was 78 percent, with first group's and second group's average being virtually the same (77.98 percent and 78.13 percent, respectively) while the average mark for those who received the "traditional" library instruction session was 85 percent. No calculations were performed to determine if these numbers were statistically significant; other factors not mentioned in this article may have also come into play.

Negative feedback from the WebCT group focused on the time spent introducing the WebCT software. Many students expected to receive instruction on completing their assignment and to "meet a librarian". Instead they discovered they were being taught how to use WebCT, a technology for which they had no context. They

then had to use WebCT to teach themselves those information skills, instead of learning “how to use the library”. In general, the context for using WebCT needed to be better explained and delivered at a slower pace. Comments included:

I found submitting my assignment online very confusing, even with the written instructions.

I never understood what the point was [of being shown WebCT].

Comments received from the group that completed the WebCT version of the assignment also included:

Easy access to information. Provides another resource for research.

Easy to use, and can provide useful information for my other classes.

Students who completed the traditional paper version commented:

Was given an idea [of] where to look for resources. how to use the university computers.

The way you word your search determine[s] the quality of your results.

Didn't teach [me] anything new.

Interestingly, WebCT logs indicated that students were still visiting certain portions of the site up to four months after the course was finished. This was especially true of the citation formatting page. This demonstrates the usefulness of having information online outside of the course. The only drawback here is that the University of Calgary has switched to BlackBoard, another course management software, and so students can no longer access this information.

Lessons learned

The lessons learned were:

- Make use of available technical help: while WebCT was relatively easy to use, there was still a considerable learning curve. More use could have been made of the technical expertise available on campus. This would free up librarians' time to concentrate on other instructional concerns, rather than implementation.
- Students also need to invest time to learn how to use the course management system, and it should not happen during “library time”. This time should be class time instead, and the class itself should be using the course management software: if students will be in the library, the time may be better spent with a librarian on a library instruction session, rather than on the use of WebCT. This problem may diminish as more and more courses on campus turn to course management systems, however. In that

case, it would be best if the course included the library module in with the rest of its modules.

- Web content is accessed after the fact: logs show that students used the course material after the session.
- Course management software such as WebCT has many features, which should be used and advertised. If the course management software features are not used, then it may be better to use alternatives for delivering material, e.g. web page.

Phase 3 – implementing web-based tutorials

In 2003, a librarian with experience in both HTML and web-based presentation joined the department. As the Biology tutorial needed revision anyway, given that the University was no longer supporting WebCT, it was decided to move to a simpler web-based format. In consultation with the Biology faculty, a web page was developed that would serve as the outline for the lecture in the classroom. A separate short paper handout was also developed, based on the presentation, for students to fill in and submit to their laboratory instructors.

Goals

The goals were to:

- Follow up on advantages of Phase 2 – students could use web-based materials after the class and from a distance.
- Regain student contact by having librarians deliver the tutorial in the library classroom.
- Integrate the tutorial better with the course by making it available within the course Blackboard site as well as from the library pages.
- Simplify the process of developing the web page – by using Dreamweaver, a web editing software package to create a frames-based page that would be simple to produce, easy to update and could serve as a model for other classes. As the librarian was already familiar with web development, the learning curve in setting up the page was minimized.
- Reduce the learning curve for the students – as most are familiar with basic web navigation, a simple page would be easier for them to use, as they would not have to learn how to use courseware navigation. By using a simple web page, the barrier of having to enter a separate password to access the site was also removed.

Delivery

The web resource[1] or the class provides conceptual information on searching, followed by links to appropriate resources with tips on how best to use them. It uses frames to provide easy navigation to the different sections of the tutorial, enabling students to work ahead or catch up as needed. Links to databases and other subject resources opened in new windows so students always had easy access to the starting points and tips on the worksheet. The worksheet also has contact information for the librarian, reinforcing the face-to-face classroom interaction with the availability of further personal assistance. Given that the students were able to meet the librarian during the class, it is not surprising that many of them contacted the librarian during the semester for help with other assignments.

The sessions were delivered by a librarian in the Library classroom with the assistance of other library staff. Typical classes had 100 students and lasted for two hours. These sessions were offered during a one-week period in October, 2003, while a smaller, winter intake of students, was offered in February, 2004. Students shared a computer with their laboratory partner. They were led to the tutorial web page and then followed the librarian, using links on the page to access the various resources they needed to use for their assignment. As each resource was demonstrated, students were given some time to practice with it before the next resource was introduced, and there was also considerable time at the end of the session for students to work on the assignment. Students had been given individual topics to research and were able to search their own examples in the databases. As they worked, the librarian and assisting staff walked around and provided feedback or tips as necessary.

Evaluation

Evaluation of this phase has taken many forms. Informally, comments from Biology instructors and teaching assistants indicate a high degree of satisfaction with the tutorial. Library staff assisting in the session commented that students were much more focused on the task at hand than in other sessions, and accomplished much more than during previous phases of this tutorial. The students themselves have been encouraged to use an online feedback form which was linked to the tutorial called Free Assessment Summary Tool (FAST)[2] to comment on the tutorial and their feedback has also been positive. Representative comments include:

- Informative, learned better searching skills.
- Interactive process.
- Very professional.

- The assistance from the TAs.
- The tutorial web site was good.
- Simplified information.

Common themes in the feedback include a preference for hands-on practice with the databases with experts available for help, the availability of the web page from the Biology pages, and the personal contact with a helpful librarian. This last may be of the greatest benefit in defusing library anxiety and encouraging a positive view of the library. The Biology 231 assignment has changed from previous years so year-to-year comparisons cannot be made.

In their own evaluation of Phase 3, the authors have noted several advantages of using the web-based presentation in the classroom:

(1) *Benefits for students:*

- increased flexibility, encouraging practice using keywords from the students' own assignment;
- immediate feedback from a librarian or teaching assistant on searches;
- easy access to the material for review;
- increased interactivity, leading to observed increased engagement and probably increased retention/transfer;
- increased time-on-task with less time in passive absorption of lecture or waiting for slides/large files to load; and
- increased time and encouragement to experiment with electronic resources, scaffolded by both print learning materials and personal contact with library staff.

(2) *Benefits for library staff:*

- ease of use as a teaching platform – scrolling or using the navigation frame allows smoother review than PowerPoint presentation;
- ease of updating – as links change (and they always do!) simple web pages are very easy to update; and
- ease of use at the Reference desk – staff can assist students having difficulty at the reference desk by bringing up the web site and reviewing the material.

In evaluating all phases of the Biology tutorial, a key factor is sustainability. Library instruction programs have to be sustainable, as well as effective, particularly in an era of increasing demand and decreasing budgets. By switching to a web-based presentation, several savings were realized. There were time savings, as Dreamweaver is no more difficult to learn and use than word processing software. The ease of updating material also saved considerable time, as did the

implementation of an online, paperless evaluation. Considerable paper and time savings were also realized in moving the explanatory material for the assignment from the paper booklet to the web. This will have year-to-year savings as well, as the assignment sheet can be copied in bulk, given that changeable information has been moved to the web where it can be easily updated.

There are also savings already being realized through the ability to easily copy parts of the tutorial into materials for other classes. By using simple web pages as opposed to courseware, this process is easy and convenient and materials for other courses can be generated very quickly – often it is simply a matter of changing the search examples. The development of simple web pages costs relatively little in comparison with full online courses or large-scale interactive web tutorials meant to be used independently of the librarians. More of the librarians' time is spent in the classroom than on developing content which is arguably a better use of this scarce resource. Teaching this way may not work for all libraries, as it requires the presence of a librarian to work well, in a way that standalone web modules do not. However, the educational benefits to the students of retaining the personal contact aspect of traditional library classes are significant enough that while this may not be a more cost-efficient way of teaching we think it is more effective in enhancing students' abilities to use information resources.

Lessons learned

Lessons learned were:

- Make sure you know your partners. Determine the objectives of your faculty colleagues and ensure that the channels of communication are open at all times.
- Ensure that the assignment questions are very explicit. For example, in our assignment, students are asked on one question to include the journal title as part of their article citation information. In Biological Abstracts the "Source" field includes the journal name and not all students are aware of this.
- Add a web counter to the tutorial web page to track how many students are accessing the page after the training sessions. This was not done for our initial sessions.
- Check license agreements for simultaneous users with database vendors. Connectivity issues have not posed any serious problems even with 50 students simultaneously accessing the same resource(s). Potential access problems may be mitigated by setting up a special training password for the training

sessions and having links embedded in the web page.

- Although server problems at major institutions are rare, they can happen – at least have a backup on CD so that you can do a demonstration, even if the hands on activities are not possible.
- Students are becoming very reluctant to use print sources and need to be reminded of their usefulness.
- No amount of development will make web-based instruction completely self-explanatory.

Conclusion

As Dewald (1999) notes:

... web pages cannot substitute for a human connection in learning and web-based library instruction should not substitute completely for librarian interaction with students.

We have found that web-based tutorials work best as part of a face-to-face session. This combines the benefits of web-based flexible, learner-centered instruction with personal interaction.

Throughout the evolution of the Biology tutorial, we have tried to incorporate appropriate technology to make the library sessions more effective and more rewarding for the students. As technologies became available, we sought first to make an appealing visual tutorial using PowerPoint, that could take advantage of annotated screen captures to increase student familiarity with electronic resources. The stepped instruction and illustrations became the foundation for a WebCT site with which we harnessed the power of the web to increase interactivity and active learning by providing better links for students into live versions of the databases. We hoped to free the tutorial from the constraints of the library to deal with competing demands for the library classroom, for librarians' time, for resources. In the current phase of web-based presentations, we have tried to combine the strengths of all of these technologies with the acknowledged good of personal contact. With the simple web pages the tutorial is now more closely linked to the course and library websites, more adaptable to students' individual topics, and easier to use. However, the key to the success of the presentations is that there is a librarian presenting, there to respond to student questions, provide feedback on search experiments and reassure or repeat as the students require. It is interesting that students have commented on the

enthusiasm of the instructor, a key factor in student success and a component of most student-evaluation-of-teaching-instruments. Given that instructor enthusiasm is a key factor in student motivation and learning, it can be inferred that student motivation is enhanced in the face-to-face setting.

The evolution of the Biology tutorial has not ceased in its latest form. We continue to look for ways to enhance interactivity and otherwise improve this session and develop others. Both our experience and our literature review suggest many avenues for future research – can we identify those students who require extra help and find some non-invasive way of providing that assistance (Joint, 2003) Are there ways of assessing whether higher learning objectives beyond mechanical skills are being supported by this format? What would be the impact of going entirely paperless, with the students filling out their assignments online – without tangible evidence that a session had occurred would they remember? How often and in what circumstances do students access the web tutorial after the class (Bracke and Dickstein, 2002)? What would be the impact of follow-up exercises to reinforce learning after the in-class assignment? Is the material on the web presentation clear enough to stand on its own for students who may have missed the class? Research along any of these paths would lead to a deeper convergence of our instruction with student needs. The authors would appreciate hearing from colleagues at similar institutions who use similar methods or who are engaged in research that can inform our practice. Using the web as a platform for in-class instruction may not work in all instances, but it is another strategy instruction librarians can use that brings together the personal, pedagogical and technological strengths of our profession.

Notes

- 1 Web-based Biology presentations (Biology 231) available at: www.ucalgary.ca/library/subjects/biol/help.htm
- 2 Link to Free Assessment Summary Tool (FAST) available at: www.getfast.ca

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