E-LEARNING MATERIALS: BENEFITS AND DRAWBACKS

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Abstract *¾ Educators wishing to use e-learning materials must choose between homegrown solutions and off-the-shelf materials. Each choice has distinct benefits and drawbacks. Handcrafted materials are often expensive to develop and maintain, yet their content will likely better meet an educator's requirements than a commercial product, and carries with it the potential to become marketable in the future. While the expense associated with commercial products is borne by their developers and the students who purchase the products, the content of such products is less likely to match educator requirements or expectations.*

This paper reports our experiences redesigning a large-enrollment computer fluency course to use of existing e-learning materials and suggests questions which should be raised before any adoption is made. While many existing products show promise, the content available did not always meet our expectations or our students' needs. Moreover, it was difficult to customize the products for our purposes or even to add or modify content. While locally developed solutions may have solved some of these problems, they would have required a significant investment of faculty time.

We conclude that a good compromise between the custom-made and off-the-shelf approaches can be reached by fostering closer interaction between the (professional) developers of these materials and their users (both educators and students). Such cooperation could result in significantly improved products all around.

Index Terms ¾ K.3.2 Computer science education, K.3.1 Computer-managed instruction

INTRODUCTION

This paper reports on our experiences in selecting and using off-the-shelf e-learning materials in the redesign of a non-majors computer literacy course. The course redesign goals were to maintain or increase learning while decreasing costs associated with running the course. One component of the redesign was the use of off-the-shelf e-learning materials to help save faculty time when teaching and administering the course and accomodate different learning styles amongst students.

We report on the course that we redesigned, the types of e-learning materials we used and discuss the issues that arose in selecting and using these materials. We highlight especially those issues we believe are important in selecting e-learning materials. Rather than focus on the specific materials we used in our course, we discuss here the general types of materials and the issues related to their use.

THE COURSE

The redesign project focused on our computer literacy course, a course serving non-majors students. The course enrols between 600 and 800 students per academic year. Although some of these students have limited experience using computers or specific applications, the majority of students taking this course are not computer literate.

The main goals of the redesign were to increase student learning and decreasing the per-student course delivery costs. A major component of the redesign supporting these goals was the introduction of e-learning materials to help both students and faculty. A particular challenge in teaching this course is to use computers and technology to teach students *about* computers and technology. It was challenging to find e-learning materials which presented material appropriate to beginners in a manner which beginners could comfortably access.

A secondary goal of the redesign was that it be generic enough that it could be applied to other courses, both within and outside computer science. The project was funded by the Pew Learning and Technology Program. Further information about the course redesign can be found at http://pew.cse.buffalo.edu

TYPES OF E-LEARNING MATERIALS

We made use of four kinds of e-learning materials. These are described briefly in this section. In sections which follow we outline issues which we found to be important to consider before making an adoption decision.

On-line textbook content and supplements

On-line content, either in the form of a CD-ROM to accompany a textbook or a publisher web site, is a common supplement to textbooks. This material sometimes includes interactive components, allowing students the chance to test their understanding of the material as they work with it.

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Tutoring software

Tutoring software teaches students about some topic. The tutoring software we considered focused on building skills in the use of specific software applications, such as word processing and spreadsheet programs. There are two types of such tutoring software. A live-in-the-application system interacts with the actual application, which must be installed on the system on which the tutoring software is run. The other is a simulation system, in which the application being tutored is simulated. The actual application does not need to be installed on the system that the tutoring software is running on. This is a significant advantage if students are to compute on their own machines, rather than solely in university or department facilities. Our institution requires that students have access to computers. Students typically have their own computers. For us, it is therefore reasonable to assume that students have and will use their own computers outside of class to complete course-related work.

Testing software

On-line testing software administers and (for most question types) grades assessments. Essay questions, if the software accomodates them, must be graded by a human. Many question types (multiple-choice and true-false questions) are available in question banks. It is often possible to create new question banks with one's own questions, but it can be challenging and time-consuming to set up question banks so that automatically-generated, randomized tests all contain a reasonably mix of questions from a given set of topics, with similar levels of difficulty for the questions.

Course Management Software

Course management software (such as Blackboard and WebCT) provides an intergrated environment with a uniform interface for a variety of tools. Commonly these systems include web site construction tools, e-mail, discussion groups, tools for tracking student usage of on-line materials, an on-line testing component, as well as grade reporting facilities.

HOMEGROWN VERSUS OFF-THE-SHELF

The first obvious question one faces is whether to develop one's own materials or use off-the-shelf commercial software. Unsurprisingly, there is no single answer to this question., as each approach has its own advantages and disadvantages. A significant factor in the choice must be the motivation one has for adopting e-learning materials in the first place.

With homegrown software there is the potential that the resulting software exactly matches the needs of the course. This may not always be the case, depending on how ambitious ones plans are and how good the developers one employs are. Homegrown software is typically not as polished as commercially produced software. Support is another important issue to consider. Commercially produced software offers professional support, while the support of homegrown software typically falls to those who wrote it. If the software was written by faculty members, this time commitment must be factored into the overall equation. If the software was written by student or group of students, the fact that students as a rule graduate and move on must be considered in the long-term viability of the product.

If a homegrown product is successful and has broad appeal, it may be commercialized. Otherwise it is likely to remain a only a locally used piece of software, especially if it is tailored to local needs since the needs of other institutions are likely to differ.

One of our redesign goals was to lower the per-student cost of course delivery. We also did not want to impose a burden on the faculty teaching the course by increasing their workload. This would have jeapordized faculty buy-in to the redesign. Therefore, we chose to use only off-the-shelf e-learning materials. We invested neither time nor money in developing our own software.

HOSTING ISSUES

Some e-learning materials are available only remotely. Textbook web sites are a good example of this. Other materials are distributed in non-networked ways, such as CD-ROMs packaged with a traditional textbook. Such materials can be available in a departmentally supported facility, a university-supported facility, on student machines, or some combination of these.

For materials which are hosted in some centralized manner there are typically four hosting possibilities, two of which are local and two of which are remote. The local possibilities are within the department and within the university but outside the department. This is common if the school has a site license for the software. Remotely hosted software can be hosted with by a publisher (such as the web site associated with a text book) or a third party (such as the company contracted to develop a tutorial to go along with a textbook).

In this section we outline what we encountered as general positives and negatives with various hosting options for software. More specific issues are raised in the next section of the paper.

Local Hosting within Department

Being in a Computer Science and Engineering department our initial inclination was to maintain control over software installations by having software installed in a

departmentally-controlled computer laboratory. Not all departments will have the luxury of this option. Moreover, our experience was that this was not a good choice for us, our students, or our technical staff. The primary reasons for this are that our technical staff at the time were Unix-trained, and the lab they were trying to support was Windows-based. We are currently using a university supported laboratory which is administered by staff trained extensively in a Windows environment. These staff members are part of a larger support organization which runs several Windows-based labs, and were able to provide excellent support for our course. The results were less frustrations on the part of everyone involved (faculty, departmental staff and students).

The positive aspects of having software hosted in a departmental lab are that one has more direct control over such things as how the software is installed. It might also be more convenient for graders to access on-line submissions by students. Finally, there is no dependence on the internet link to a remote site.

The negative aspects are that unless the local environment is set up to support the software and operating system used in the course, significantly more time may be spent trouble-shooting small problems than might otherwise be the case.

Local Hosting within University

If the software is hosted within the university but outside the department, the department gives up some control in return for decreased responsibility. Generally speaking this is a good compromise. If the software is used by others within the university it is advantageous to have a centralized support structure, rather than have individual units within the university attempt to provide the same service. Not only are economies of scale at work, but also problem reporting and resolution are centralized. This means that a what might otherwise be dismissed as an insignificant or intermittent problem might instead be recognized as a more frequent and substantial problem, one which warrants significant attention. Again, there is no dependence on the internet link to a remote site.

A potential downside to this sort of arrangment is that concerns of a single department may be downplayed in favor of more common concerns. Also, if the software in question in not widely adopted for use in other courses there may not be much incentive for the centralized support staff to train specifically for the software. In this situation a departmentally-provided service may be preferred.

Remote Hosting by Publisher

Some materials can be hosted locally or on a publisher website (such as textbook-related materials prepared for a course managment tool). Hosting by the publisher can be a good option if ones department or univeristy does not have the computing infrastructure to support the hosting of the material. The publisher has an interest in keeping its customers happy, so that they remain with the publisher's materials, and perhaps even recommend them to colleagues.

Any time software is hosted remotely one must expect that the software will be intermittently unavailable due to network problems. This can be especially problematic if access to the on-line materials is crucial to the success of the course. For example, if the publisher is hosting a web site built for a course management tool and the tool is being used for communication outside of the classroom, the delivery of assignments, readings or quizzes and exams, any downtime will be detrimental to the delivery of the course. This is, of course, a concern anytime one uses software, but network issues can generally be avoided in local installations.

Remote Hosting by Third Party

Some materials are hosted by a third party rather than a publisher. For example, on-line testing software cab be hosted by the developer of software made available with a textbook and marketed by the textbook publisher. This has its good points: the developer is most likely to have the expertise to support their software. However, you are not their direct customer, and so there may be decreased incentive to support a current product rather than develop a new version or a new product. The same general concern as with any remote hosting, that of network outages, applies.

GENERAL ISSUES

There are many issues which crop up when e-learning materials are used, and some are more acute when hosting is remote. In this section we highlight those issues which we feel are of particular importance and must be addressed before any final decisions are made. Since local requirements and expectations can be significantly different, we do not suggest answers to the questions we raise. Our contribution is instead to raise the issues so that others can make their own reasoned decisions.

Privacy/Security/Reliability Issues

An important consideration when using software which is hosted remotely is the security of the hosting site, and the privacy guarantees that the site offers. For instance, if assessments are done on a remote server and results (grades) are stored remote or transmitted to a local server there must be sufficient safegaurds in place that the privacy of student records is not compromised.

Relvant questions to consider are:

- How is the security of the server maintained? Servers must be both physically and electronically protected. The servers must not be vulnerable to hacker attacks.

- Is there a single-point of failure? For example, is there a single server machine or are there several? Typically there are multiple servers to handle the expected load. Is all the equipment housed in the same physical location? It is better that servers are located in geographically distinct locations.

- Are critical data (including student submissions) backed up on a regular basis and are backups stored off-site?

- Are assessments maintained securely, or it is easy for students to take exams from unauthorized places or at unauthorized times?

- Are transmissions over the internet secure? Are student submissions and grade reports made over a secure connection, or are such things transmitted via e-mail or some other insecure means?

- How is privacy guaranteed? Your institution may have policies which prevent student grades from being stored by a third party, especially if they are stored by student number or social security number.

While it is easy to dismiss these sorts of concerns as being "nothing to worry about" and something that the software producers and hosting service must already have taken into account, these are important issues to consider. In the end it is the academic institution and its faculty that are responsible for the integrity of its student records and the quality of its courses. That said, it is unreasonable to expect 100% uptime. We believe a reasonable goal is to ensure that using software hosted remotely does not differ significantly in availability or security compared to an on-campus installation.

Usability Issues

There are two important aspects to the usability of e-learning materials. The first is usability from the perspective of the faculty member, who may need to supply content to or extract information from such a software tool. The second is the usability for the student, and in some respects this is more important than the former. If students do not find the materials accessible their learning will suffer. It is therefore extremely important to assess student proficiency and comfort with technology before adopting materials.

Usability issues are nonetheless also important from a faculty perspective. If the software tools adopted are too cumbersome to use, or are not flexible enough to accomodate the needs of the course and faculty, faculty are unlikely to continue using the tools. One of the types of software we found most frustrating to use was the on-line testing software.

For instance, we found that the question banks supplied with on-line testing applications were often lacking in quality. Questions were sometimes vaguely worded, and many questions in a bank were repeated in only slightly different forms (sometimes with a negative phrasing). This makes it difficult to generate randomized versions of exams, since many questions may be testing essentially the same material.

One solution is to create custom question banks. This proved to be difficult because of the interface provided and the manner in which randomized exams were created. For example, the course management software we adopted provided an on-line testing facility. We wanted to use this to generate randomized tests for each of our lab sections, since students wrote these exams in the lab. Because of the large enrolment in the course and the limited seating capacity of the lab, the course has between ten and twenty lab sections, depending on the semester. The testing software was able to create randomized exams by pulling a set number of questions from each of a set of designated question banks. In order to balance topic coverage and question difficulty a question bank for each would need to be created. Moreover, the web-based interface for creating the question banks was very cumbersome to use. The format of the question banks was not made available to us, so we could not use more convenient tools to set up question banks or convert existing question banks to the required format, nor could we bypass the cumbersome interface in creating new question banks.

Another issue to confront is how easy it is to load student information into the course management tool or on-line testing product. For small-enrollment courses it is not unreasonable to use the typical web-based interface to enter information about each student by hand. However, this ceases to be realistic for larger classes. In our situation it was not something we as faculty could do on our own. Once the course management tool was set up and supported at the University level it was possible for the maintainers to set up all our student data for us. This was a distinct advantage over a departmental hosting set-up, or a remote hosting set-up.

Many course management tools provide integrated e-mail. This is practical for instructor because e-mail can be sent to all students or selected groups of students easily. For example, it is possible to send a personalized e-mail to each student who did not perform well on an examination quite easily by providing the course management tool with the requisite selection criteria. A significant downside is that both students and faculty need to contend with an additional e-mail system to contend with. Some of our students, for example, already have multiple e-mail systems. Some have e-mail with the university, the engineering school and the department, not to mention off-campus e-mail services students may have signed up for. One more adds to the confusion.

Wherever the materials are hosted, it is important for faculty to know whether course materials will be maintained from one semester to the next.

Faculty should also realize that a course web site within a course management system is typically a private site. This is different from usual web site, which is (generally speaking) public. Although there may be advantages to keeping a course web site private, and restricting access to only those students registered in the course, keeping a course site private does not encourage a free exchange of ideas, nor does it allow students not enrolled in the course to browse the site to see whether this might be a course they would like to take in the future.

CONCLUSION

Our experiences indicates that many e-learning materials are mature enough to make adoption straightforward, but that some require further refinement. Among the former are the on-line tutoring packages. The focus of tutoring programs is typically narrow. The programs are stand-alone (they do not depend on other software to function properly), and both the content and the software delivering the content are typically of high quality. Among the latter are on-line testing programs and course management tools. It should be noted that these software programs are subject to continual development, and so some of our concerns with on-line testing and course management may already have been addressed. During our course redesign project we interacted with publishers and developers and brought several of our concerns to their attention. While most parties were receptive and responsive to our concerns, some issues would have been better addressed at a much earlier stage of software development. We therefore feel that a closer cooperation throughout the development process between the producers of e-learning materials and the users of them (both faculty and students) will produce higher-qualtiy materials, which address the concerns of all involved. It is, however, ultimately the responsibility of the faculty member (or whomever is the decision-marker) to ask the right questions before making any adoption decision.