Transitioning to e-Learning: A Case Study

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Abstract

An early approach to providing distance learning was to take what is taught in the campus classroom, and offer it to students remote from campus, including lifelong learners. However, as technologies became more sophisticated, and students more accustomed to using online tools, their instructional needs were not being met with this approach. Also, students in lifelong learning programs often demand alternative formats and even an altered organization of content to better suit their needs and desire for zero-time learning. Specifically, they demand "student-centered learning" that is "just-in-time, just-for-me, and just-enough." Such learning mandates instruction that is developed more specifically for the e-learning format and requires a development process that is more involved than typical course development. This process produces pedagogically sound e-learning programs that also have potential for use in academic curriculum.

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I. Introduction

Opportunities to distribute education and training, afforded by the Internet, can become challenges when older paradigms are applied to new technology. Students now expect much more than simple online access to course materials, and as such are contributing to the demand for change in instructional delivery.

Instruction is not enhanced by technology when it is merely shuffled from one medium to another, failing to take into account the strengths of different media, or forgetting that learning is an active process. Online delivery becomes powerful when it is created to promote a learner-centered model where students are empowered to acquire, correlate, and reflect on their own and others' thoughts. It is very difficult to take what goes on in a traditional classroom and transport it into an e-learning environment.

We define e-learning as the experience of gaining knowledge and skills through the electronic delivery of education, training or professional development. It encompasses distance learning and asynchronous learning, and may be delivered in an on-demand environment, or even in a format customized for the individual learner by the learner.

A standard model of the instructional process provides three stages for the teacher: the preteaching stage; the teaching stage; and the postteaching stage [1]. In our development of the e-learning described in this paper, we converted a course that used the standard instructional process into an e-learning program which adopted an instructional design model where the "teacher"is not as integral to the development process. However, this raised the question: What are the differences between the process used to develop e-learning and those we use to develop traditional instruction?

There is a wealth of literature and research regarding "teaching" and in this paper, we will instead focus on our experiences developing an e-learning program using a systematic design of instruction, also known as instructional systems design (ISD) and the lessons that we can share from these efforts. We are not suggesting that e-learning needs to be derived from the standard model of instruction, but rather we will share with you our experiences in taking a traditionally delivered course into the e-learning environment. Our intention is to share the lessons we learned so that others can build upon our experience, creating a better awareness of issues that impact e-learning course development.

II. The Challenge of Transitioning a Traditional Program into e-Learning

The University of Texas at Austin sponsored the creation of the Software Quality Institute (SQI) nearly ten years ago to address the needs of the growing software industry in the Central Texas region. SQI draws upon the wealth of research and expertise available at UT-Austin as well as from a large pool of outstanding talent from industry and government. Now located in the College of Engineering and run by the Center for Lifelong Engineering Education, SQI strives to build value-added partnerships between faculty, practitioners, and industry and remains committed to serving the educational needs of the software industry. SQI specializes in practitioner-to-practitioner training,

emphasizing skills that are immediately applicable in the workplace.

An early industry need identified by SQI was the need for project management training, especially for those involved in software development. The result was a 48-session non-credit program in Software Project Management (SWPM) aimed at fully-employed professionals. The program has been highly successful; since its beginnings in 1993 through mid-2002, twelve sequences of SWPM have been taught, graduating several hundred students, and creating a loyal alumni base regularly involved in other SQI activities.

In addition to knowledge of the principles of software engineering, software project managers must incorporate skills for managing people, products, and processes into their daily routine. For this reason, the Software Project Management curriculum is grounded in two interlaced bodies of knowledge developed by internationally recognized organizations: the Project Management Institute (PMI) and the American Society for Quality (ASQ). The curriculum is also designed to prepare students to pursue further certifications, such as the Project Management Professional (PMP) certification, and the Certified Software Quality Engineer (CSQE). Quality, applicability, timeliness, portability, and profitability are all key areas of focus for the Software Project Management curriculum.

SWPM is a competency-based learning experience. Team projects, homework assignments, in-class exercises and exams are an integral part of the program. Participants must complete the entire sequence with a passing grade for all four exams, two presentations, team member evaluations, and team project deliverables.

Location, job responsibilities, travel demands, and family commitments often stand in the way of pursuing further education for prospective students. Additionally, our SWPM graduates, many of whom are employed by multinational companies, urged us to broaden the reach of SWPM by serving their colleagues located outside of Austin. Beginning in late 2000, the SWPM program was made available at a distance via the Internet, allowing students to choose to participate in a synchronous manner with the class, depending upon their individual needs for convenience.

Initially, the new online version of SWPM incorporated online components with traditional classroom delivery, producing a blended model that was simultaneously delivered in the classroom and to a small set of remote students using an online courseware tool dubbed "UTwired." Both sets of students participated as a single class, similar to traditional synchronous distance learning. Each Tuesday evening, students in the Austin area physically attended class on campus where instruction was delivered in a traditional manner. Instruction was simultaneously Webcast and later available for asynchronous review through UTwired by both sets of students. A member of the instructional team acted as mentor, and interacted during class with the online students via a chat room as they viewed the live Webcast.

However, to stay true to the tenets upon which SWPM was originally built, the online environment needed to preserve a high level of interaction among students. As the instructional team began working through these issues, an instructional design team was formed to support the effort, with the instructors playing a key role, and supported by an instructional designer, a system analyst, and an administrative program manager. At this time, we also formed a partnership with a large global oil field services company to provide SWPM to their employees around the world. Adding this industrial partner to the team brought new insights and a valuable source of feedback, as well as resources to enable a more effective transistion to e-learning.

III. e-Learning Development Process

Early attempts at online learning failed to engage learners because the instruction was static and non-interactive. It can be difficult to sit at a computer, watch streaming media with a "talking head" and stay engaged. However, today's online learning tools offer rich, interactive environments where students can actively participate. Students can respond to questions in a chat room, have "digital dialogues" on bulletin boards, and receive instant feedback on quizzes.

A. Pedagogical Strategies

The traditional model of instruction has a teacher creating the curriculum and delivering it, but that model does not necessarily work for online instruction. Good online courses are often developed using ISD, that is based on the tenets of instructional design. With ISD, a development team rather than an individual creates online courses. Traditionally, professors have developed their courses on their own with little regard to the demands of other people's schedules and they have not needed technical support or utilized instructional designers [2].

Additionally, ISD focuses on the student and what they will know and do at the end of instruction. "The fundamental principle of the ISD approach is that all aspects of learning and instruction should be defined behaviorally so that what the student is expected to learn can be measured and teaching can concentrate on the student's observable performance" [3]. Basically, ISD poses three questions: First, what do I expect a student to be able to do? Second, in what way should the student demonstrate learning? Third, what student performance is acceptable as evidence of learning?

Robert Gagne's seminal book, The Conditions of Learning, was first published in 1965 and in it; he identified the mental conditions for learning [4]. With the conditions as a guide, Gagne

Table 1. Web-based Pedagogical Strategies and Gagne's Nine Events of Instruction [5].

Event	Web-based Strategy
1. Gain Attention	Effective use of graphical and multimedia elements. Effective Web design including appropriate use of color, fonts, and text. An announcement section. A discussion of current topics. Referral to appropriate Web sites.
2. Inform Learners of Objectives	Course orientation. Course tutorial. Post-course syllabus.
3. Stimulate Recall of Prior Learning	A getting started self-test to apply what you know. An electronic discussion about prior topics.
4. Present the Content	Web-enhanced lectures, textbook activities, and other content delivery activities through Web-research, simulations, audio/video modules, and others.
5. Provide Learning Guide	Post syllabus, course notes, course assignments, and other course related documents. Facilitate discussions.
6. Elicit Feedback	Electronic student surveys, electronic discussions, electronic quizzes, and electronic office hours. Students submit work electronically.
7. Provide Feedback	Electronic discussions and electronic office hours.Respond to email in a timely fashion.
8. Assess Performance	Electronic testing. Graded work is returned electronically. Student portfolios are reviewed electronically.
9. Enhance Retention and Transfer to Job	Web-research activities to foster critical thinking. Team collaborations. Resolve case studies. Student Web-based portfolios. Utilize technologies common in workplace.

created a nine-step process called the Nine Events of Instruction. Table 1 suggests Web-based pedagogical strategies for the e-learning environment based on Gagne's Nine Events of Instruction.

B. Designing an Online Course

Certain requirements are needed for more traditional course development, but there are requirements considered essential for online course development. Without an understanding of the learner, the technology, and interactions between the two, online courses can be static and do not fully utilize the Web's potential.

Designing an online course requires:

- understanding the role of motivation in learning;
- assessing and using students' prior learning;
- creating an inventory of students' learning styles;
- understanding learning processes and how to best-fit learning styles;
- planning for collaborative/cooperative and problem-based learning;
- assessing course and student outcomes; and
- knowing how to use instructional technology tools.

As shown in Figure 1, there are these basic development steps for course creation that we promote:

- analyze the conditions of the online environment, students, and content;
- plan/develop the objectives, create learning assessments, select teaching methods, and build course content; and
- evaluate with an ongoing review of the development phases and create student evaluations of the course and its instructors.

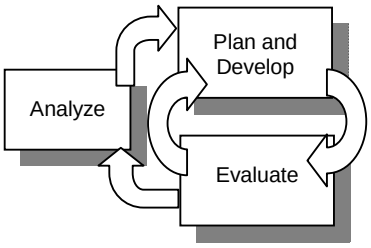

Figure 1. A Generic Development Model

The development process (Figure 2) for the Software Project Management (SWPM) program included: 1) conducting an initial program analysis, 2) defining objectives, 3) performing content validation, 4) developing a prototype, 5) planning content, 6) developing final materials, and 7) pilot testing. Each of these is further described below.

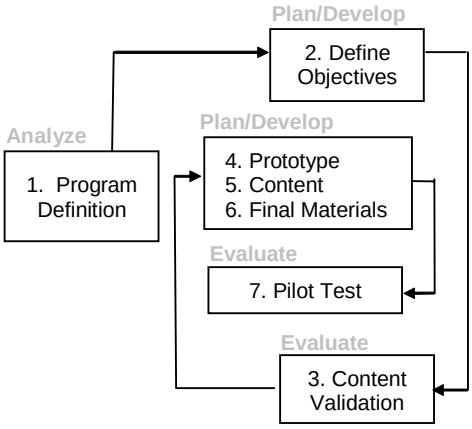

Figure 2. e-Learning Course Development Process

To begin the development process, the SWPM instructional team was asked to:

- plan a logical sequence of sessions and lessons of each module;
- recommend group activities, individual activities, discussion topics, test items, and interactive multimedia activities or assets;
- identify Web-based articles and appropriate textbooks to be used for reading assignments;
- assure that all materials and activities support the objectives; and
- provide case scenarios, examples, models, templates, or other assets required to illustrate concepts or carry out recommended activities.

Table 2 highlights the key experiences as we proceeded through each phase of the e-learning course development process adhered to by the instructional team.

IV. Lessons Learned When Developing for Online Delivery

A. What We Did Right During Development

1) Required that objectives drive content development. SWPM reviewed the objectives of each existing session and mapped them into the online sessions.

2) Included an instructional designer early on. The instructional designer assists in writing course objectives and monitoring their implementation throughout the process. Instructional objectives should drive the entire content development process.

3) Created prototypes and templates. Text-base templates, outlining the contents of each online session provided a standard structure for each lesson to follow.

4) Provide a hands-on training session for the instructors. Prior to taking SWPM into online development, all of the instructors were invited to attend a session that explored issues related to online design and delivery.

5) Held a pilot course for a limited number of students. This allowed us to revise and refine the course in order to improve the content and identify technical problems.

6) Provided pre-course support. Orientation materials and technical requirements were designed to help students become familiar with the online environment and work out any connectivity issues.

Table 2. Mapping SWPM to the e-Learning Course Development Process.

Basic Development Steps	e-Learning Development Steps	
Analyze	1. Initial Program Definition	SWPM stayed true to the scope and content of the certificate program that was developed by its advisory board in 1993 and refined in 1998. In this first step, SWPM had the advantage of existing content, ready to use.
Plan/Develop	2. Define Objectives	With SWPM, objectives for each lesson existed from prior deliveries, but they had been written by the practitioner instructors. SME's had to work hard at defining objectives. One of the greatest challenges with instructors/SMEs, who are responsible for content development, is getting them to understand that objectives, not topics, should drive content. The SWPM instructors worked with the instructional designers and assembled the objectives into an integrated, outlined whole.
Evaluate	3. Content Validation	Because SWPM had been offered and continually improved for almost 10 years based on student evaluations and industry advisory board review, the content was deemed to be sound.
Plan/Develop	4. Prototype Development	Tapes of SWPM lectures were digitized to become video segments in the online topic presentaton. Reading lists and individual exercises were developed, along with instructions for team deliverables based on a case study. Text-based templates were developed to provide structure for the upcoming content development task. The main goal of the templates was to encourage consistency.
Plan/Develop	5. Content Planning	For SWPM, the content had to be tightened, rather than developed. What was originally 48 lessons had to be condensed into 34 lessons, in order to refine the content and to correlate it with the just-published text book for the class [4].
Plan/Develop	6. Final Materials	SWPM lesson plans were prepared in the format of an approved template, then translated into actual online components. Each lesson plan, and each completed lesson was reviewed by a team member; suggestions and corrections were returned to the author.

B. What We Would Do Differently During Development

1) *Spend more time in schedule estimation and tracking.* Underestimating project tasks is not unusual, but we were ill-prepared for some of the technical and communication challenges that resulted from a diverse development team. One hurdle we had to overcome was a number of subject matter experts who were accustomed to live, lecture-driven instruction and who were therefore unfamiliar with interactive teaching methods. Building interactive content is much more complex than placing PowerPoint slides online.

2) *Utilize and strictly adhere to project management processes and principles.* The programs differed in this respect. SWPM benefited from the strong project management skills of its team members.

3) *Publish a life cycle process and stick with it.* The whole life cycle of the project must be apparent (e.g., phases, flowchart, roles and responsibilities, schedule, milestones, deliverables, completion/approval criteria, etc.) to all participants.

4) *Use parallel development judiciously.* If the project requires more than one content expert/developer, it is better to manage the development of the pieces of the course in sequence rather than simultaneously. At least develop one piece completely before starting a parallel development process.

5) *Use a robust courseware tool*, supported by a technical group that reports to the development management. It's important to be fully aware of the limitations of existing

courseware. Given that these programs were testing the limits of online delivery, there were times that technical restrictions were frustrating.

6) *Engage the technical team as development group members.* This would facilitate early design of a formal process for problem reporting, tracking, and resolution of issues with courseware applications.

7) *Enlist someone unfamiliar with the material to read the required readings and to log their time.* We were too optimistic in our estimates of the time required from students.

8) *Gauge the appropriateness of the length of the video clips.* We had a tendency to make the video clips too long. This meant the student had to wait an uncomfortably long time for the videos to buffer and load, creating some frustration. Very short clips are not recommended either, as it hardly seemed worth the wait for loading them. Clips between 12 and 20 minutes in length were the most popular with participants in the prototype deliveries.

9) *Educate the content developers.* We would make sure the content developers understood the differences of how online instruction differs from traditional practice.

10) *Assign individual team member roles and responsibilities* as an initial step, and insure that individuals with the right skills and experience for the required tasks are on the team.

11) *Inspect the work products via a formal peer review process*, paying particular attention to the student assignments.

12) *Plan practice assignments and assessments* before creating information/content presentations.

13) *Hold development team meetings frequently and regularly* to review progress and to assist each other with solving common problems.

IV. Success Factors

Our experience with transitioning SWPM from a traditional classroom delivered program to an e-learning program was deemed successful by the student evaluations collected, and instructor reports. Working through issues related to the transition has forced us to focus more on continuous improvement than we might otherwise have done in the delivery of a traditional program. After each module (a group of sessions, typically 6-8), students are asked for evaluations. This has allowed continous improvement to the program even in advance of student's progress.

A number of factors related to the transition of SWPM into the e-learning mode contributed to success. First, the diverse skillsets of the instructional team was key. There are several domains of expertise that come into play including knowledge of subject matter, online delivery techniques, instructional design, and managing development projects. The core development team has to have all those bases covered, and the expertise needs to match the development role. The benefit of having a multi-talented instructional team is that the developers are intimately familiar with the content and have experience in knowing what the student is expected to learn and how it can be measured. In the SWPM conversion, having the "teacher" or experiential model combined with the systematic design of instruction (ISD model), provided more insight than on a development model that relies on ISD alone.

Team dynamics also played an important role in the development since the instructors had worked together for years and recently collaborated on a text book. The organization of this text formed the new outline for redesigning the content in SWPM. Having content available and not having to create content for the course was also a key success factor. SWPM relies on software project management skills defined by the original SQI advisory board. These skills are based on widely accepted bodies of knowledge in the software and project management industries.

One of the most important lessons learned is that all program development benefits from following basic project management principles. SWPM was fortunate to have instructors who are certified project managers with years of experience in the field.

Finally, the resources for supporting the conversion of SWPM were available. Support was provided from the College of Engineering through the Center for Lifelong Engineering Education and the Faculty Innovation Center, and the financial underwriting by an industry partner supported the effort.

V. Summary

In the College of Engineering, we have been promoting the concept of altering instruction for improved learning and positioning technology as an enabler for change. More importantly, our goal is to alter instruction to be more "learner-centered" [5]. This is a goal of the College of Engineering and we engaged in a college-wide multi-faceted approach to accomplishing this objective.

A growing interest in course modularity and granularity of learning objects supports this course improvement effort. Modules can be reusable and customizable learning events, whether for academic or lifelong learning use.The University of Texas at Austin is part of a National Science Foundation Engineering Research Center investigating the design of effective learning environments, and their work has heavily influenced our strategy [6].

However, it is critical that development of e-learning programs becomes more efficient and development time be reduced. Faculty involved in the academic curriculum will generally not be interested in devoting the time required to create e-learning as we have described it here. Our experiences with this program has helped to develop a standard production template for further e-learning course development.

We learned that developing courses for e-learning takes more time than originally planned. Adhering to project management techniques is key to successful course development, especially to launch a course on schedule. Early establishment of individual team roles and responsibilities is also critical, as is having subject matter experts well engaged in the instructional design process.

Only after these tasks have been completed should the content details be developed, including reading assignments, content presentations, and other resources.

Of particular importance, is the development and implementation of a test plan, even before content is created, is emphasized. Involving students as well as subject matter experts was also considered, and students will be included in the design process for our next iterations of e-learning. A strong technical infrastructure that includes staff with skills in the use of technology as well as the design of instruction is a requirement for success.

There are several unresolved questions from our experience. We have observed that new communication issues arise when students accept that there will be no face-to-face contact with other participants or with instructors. While this simulates the practical work environment of many students today, adult students are still "programmed" to desire live, face-face instruction and learning. Another question we are examining is the continued reluctance of many faculty and practitioner instructors to engage in e-learning and online learning despite the increased demand from traditional as well as professional students to use e-learning tools. Because of our experience with SWPM and other similar projects in the College, we suspect this may be due to a forced change in the instructional model because of e-learning, and the attendant time and resources needed to create e-learning. Finally, continued assessment of the effectiveness of these efforts must be undertaken, not only because of the significant investment in creating e-learning, but also because of the potential for enhanced teaching and learning.

Acknowledgments

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