Instructional Design Strategies for Teaching Technological Courses Online

Jiangping Chen1, Ryan Knudson1,

1 Department of Library and Information Sciences, University North Texas, 1155 Union Circle #311068, Denton, TX 76203, United States
{Jiangping.chen, Ryan.Knudson}@unt.edu

Abstract. This paper describes different instructional design strategies for teaching computer technological courses online. Two of the three courses discussed in the paper have been taught on the Internet for over five years. The course content, assignments, and interaction have been designed and implemented based on the distinct challenges of the courses, their learning objectives, and the computing backgrounds of students. Students’ evaluations of these courses are presented. The authors discuss important factors that may affect teaching and learning effectiveness for distance education.

Keywords: technological courses, distance education, online instructional design

1 Introduction

In September of 1996, Dr. Phillip Turner became dean of the School of Library and Information Sciences (LIS) at the University of North Texas (UNT). At his prior position at the University of Alabama, he gained experience with distance learning, which he implemented into UNT. Turner became the Associate Vice President for Academic Affairs for Distance Education during his deanship. In 1999, UNT offered the nation’s first online Learning Resource Endorsement. This initial move was a huge success, with a 40% increase in enrollment transpiring between spring 2000 and spring 2001. In 2004, a total of 827 master’s students were enrolled in the LIS program, which was a 45% increase from the previous spring’s enrollment. The first Web Institute, a four-day intensive introduction to the master’s of library science (MLS) degree, was launched in June of 2001. After each Web Institute, students complete the remainder of the classes toward the MLS electronically. Also in 1999, the School offered the MLS to students living in Minnesota. This was done through a partnership with St. Cloud State University in Minnesota. Since that time, LIS at UNT has fostered partnerships with many other geographically remote institutions. These include: Houston, Texas; Georgia; Los Angeles, California; the Pacific Islands; and South Dakota; among others. (“A Brief history,” 2010). This growth illustrates the popularity of this type of program which offers either completely online or blended courses making use of Internet Technologies.
The LIS curriculum includes computer technological courses such as database design and computer programming. In 2004, these courses were still taught face-to-face while many other courses were offered online. We started to design online sections for these courses in 2004. Now, all computer technological courses in the department are offered to all students in either online or blended formats.

The purpose of this paper is to present and analyze different instructional design approaches used in three online courses, all of which aim to achieve an equivalent level of learning as is achieved in a face-to-face classroom, and to summarize the challenges and factors that affect teaching and learning effectiveness in distance education for computer courses.

2 Theoretical Foundations to Online Instructional Design

How does one design online computer courses so that the students can learn as effectively as in the face-to-face (F2F) classroom? We have looked at different instructional models and their implications for instructional design. Theories and models in instructional design are divided into three categories: Behaviorism, Cognitivism, and Constructivism, all with distinct basic principles (Dabbagh, 2011). In distance learning and online instructional design, Moore’s Transactional Distance Theory has been greatly explored (McBrien & Jones, 2009; and Tesone, Severt, & Carpenter, 2008). Moore (1993) stated that in every educational transaction, there is transactional distance, which transcends physical distance. The greater this distance, the more separated students feel from the instructor. Interaction between student and teacher (dialogue), student autonomy, and structure are all variables that interact within this theory. Moore suggested a balance of structure, dialogue, and autonomy.

Tesone, Severt, and Carpenter (2008) discussed four modern learning theories, all of which fell under Constructivism, and their implications for distance learning and course development. They discussed Cognitive Flexibility Theory, which proposes that the interconnection of content knowledge areas within what is to be learned should be understood by learners; Dual-Coding Theory, which suggests that verbal and nonverbal systems constitute learned knowledge, and that use of both together maximizes information processing in a learner; Elaboration Theory, which suggests that learning is maximized when content is presented in a simple-to-complex manner; and Transactional Distance Theory, which proposes that increased dialogue and reduced structure will lessen perceived distance between a teacher and student.

Technologies implemented into distance learning curricula change at a rapid pace (Burich, 2004). These changes require the adoption of new and emerging technologies by both students and instructors. Internet-based distance education has taken advantage of rich Internet communication tools and systems. For example, use of synchronous online classes has been shown to reduce transactional distance in online students (McBrien, Jones, and Cheng, 2009). In a synchronous online class, students can communicate orally with their teachers. The platforms for such classes, e.g., Wimba Live Classroom, allow for files such as PowerPoint (PPT) presentations to be uploaded and viewed by those present in the online class.
3 The Distance Learning Environment

Blackboard (http://www.blackboard.com/) is the course management system UNT applies to manage all its online or blended courses. Blackboard provides an interactive learning environment for instructors and students. Figure 1 is the homepage of one of the courses discussed in this paper. Course materials such as syllabi, lessons, tutorials, and assignments can all be created in the form of HTML pages. Additionally, Blackboard provides extended interaction functions such as email, a discussion forum, announcements and a chat room. It also integrates Wimba Live classroom (http://www.wimba.com/products/wimba_classroom) for the instructor to present lectures online.

![Figure 1. A Sample Homepage for One of the Online Courses](image)

4 Three Distance Computer Technological Courses

We have developed three distance computer technological courses using the Blackboard learning environment. Course 1 is on database design; Course 2 is about Web programming using PHP and MySQL; and Course 3 is a seminar type of course on Language Processing Technologies. Students learn specific programming languages or Database Management Systems from Courses 1 and 2, while they are expected to gain knowledge about multilingual information access (MLIA) and the ability to use Internet MLIA tools in Course 3.

The learning objectives played a crucial role in determining instructional design strategies for these courses. A clear understanding and statement of learning objectives is very important to guide the design of online classes. We identified distinct learning objectives for each course. For example, Course 1 has the following
learning objectives: (1) Understand the basic concepts of database and data modeling; (2) Master database conceptual design using the Entity-Relationship modeling approach; (3) Create conceptual design diagrams using graphic software packages; (4) Understand and use Structured Query Language (SQL) to perform database operations; and (5) Develop a prototype database system to solve a real-world data management problem.

Table 1 Instructional Design for Three Computer Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Challenges of the Course</th>
<th>Students’ Background</th>
<th>Online Instructional Design</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course 1</td>
<td>Students will not only learn the concepts, but also design and implement database systems. They need to learn to use multiple systems on their own.</td>
<td>Students have used computer and Internet, but most have only minimum knowledge of database design and haven’t used the specified software systems.</td>
<td>- No F2F meetings; - Detailed lessons with exercises and self-test questions; - Tutorials; - Virtual labs; - Assignments that build on each other - Individual term project</td>
</tr>
<tr>
<td>Course 2</td>
<td>Students should be able to write computer programs using PHP, and should be able to design and build Web database systems. The term project is building a real-world prototype Web system.</td>
<td>Students have knowledge of database design and writing HTML pages, but no knowledge of any sort of computer programming. They also have no knowledge of how the Internet works.</td>
<td>- Three full-day F2F meetings; - Detailed lessons with exercise and self-test questions; - Links to Internet tutorials and resources; - Team term project - Web server for assignments and the term project</td>
</tr>
<tr>
<td>Course 3</td>
<td>Students need to read a lot, analyze computer literature on information retrieval and language technologies, and conduct natural language processing (NLP) tasks using installed NLP tools</td>
<td>Many students are bilingual or multilingual, but have no knowledge of NLP. They have good communication skills and reading capabilities.</td>
<td>- No F2F meetings; - Detailed lessons with weekly readings and related discussion questions; - Links to Internet tutorials and resources; - Team term project - Web server with tools installed for assignments and the term project - Two virtual meetings</td>
</tr>
</tbody>
</table>

Also, because our students live in many states across the US, these courses have to be taught online or in blended format so that these out of Texas can take them.
Furthermore, many LIS students don’t have strong technical backgrounds. They are however highly motivated to learn computer technologies. Taking into account the above, we identified the specific challenges for each class and came up with different strategies for designing the three courses, as illustrated in Table 1. Below we explain the course design and implementation in Blackboard for the three courses.

4.1 The Choices of Face-to-Face Meetings or Completely Online

Courses 1 and 3 are offered only online, while Course 2 is a blended course, including three full days of F2F meetings. The above decision was based on students’ comfort levels with the content. Course 2 focuses on Web programming. The majority of our students do not come from a Computer Science background; they have many years’ experience with personal computers, but no experience in programming. Neither are they familiar with the concept of Web server and Internet architecture related to Web programming. The F2F meetings enable them to learn how to connect to the Web server, upload their HTML and PHP pages to the Web server, and to open their pages in their browsers. It also allows the teams to get together to discuss their term projects. Students present these projects at the third meeting as well.

The mandatory F2F meeting has a negative impact on student enrollment. Course 2 has been a relatively small class with less than 10 students on average for each semester it is offered.

4.2 Syllabi and the Online Course Content

Syllabi for online courses are not significantly different from F2F courses. However, there are issues that have to be specified in the syllabi such as the release dates of each lesson and a suggested study plan for the whole course. The study plan includes the weeks for studying each lesson and the due dates for assignments and/or project. This information helps students to better manage their time and plan their study.

Designing the course content involved the biggest effort. The whole class should be divided into distinct but interconnected lessons or modules. For example, Courses 1 and 2 contain 12 lessons. For each lesson, PPT slides may not be the most appropriate presentation style, while PPT is frequently used in F2F classes. We designed a detailed series of Web pages for each lesson, which contains pages on learning objectives, lectures of main concepts or topics, exercises, self-test questions, a summary, and instructions to prepare for the next lesson.

To help students understand the course content and complete assignments, we designed tutorials for Course 1 and provided links to related Internet resources in all three courses. Related library resources are also accessible through the class Websites.

4.3 The Design of the Assessments

Student assessments normally include class participation, individual assignments, and projects. Assessments were designed with Elaboration Theory in mind (Tesone et al., 2008). Each assessment includes recently learned content, and the assessments grow
more complex as more content is covered, each building upon and adding to the
previously learned content.

Class participation is vital even for online classes. Students are required to post
answers to discussion topics or questions presented in lessons. They are required to
attend the F2F meetings in Course 2. The design of the assignments for online courses
has no difference from that for F2F classes: assignments should test students’
understanding of the contents of respective lessons. They should be built on each
other to enhance learning. A term project is required for all three courses. In Course 2
and Course 3, students are required to work in teams on a selected real-world problem
related to the class. Team projects in these courses enable students to grow more
comfortable with peer collaboration in digital environments. But this also requires
that instructors develop strategies to motivate and to manage the teams.

4.4 The Design of the Interaction

Students are encouraged to communicate with the instructors and with other students
throughout the semester. The available channels for this type of communication are:
discussion forums, emails, announcements, and synchronous live classrooms.
Feedback given to students is prompt, and the instructors make it a point to try and
answer students’ emails and questions posted to the discussion board within a 24-
hour period. The weekly use of synchronous online classes is implemented to reduce
transactional distance among students (McBrien et al., 2009). Some of these meetings
are mandatory and others are not. In every instance of a synchronous online class, a
chat log is stored in the course website. Students who did not attend an online meeting
are encouraged to view the chat logs. Discussion postings and responses are required
to increase interaction in the courses. This reduces transactional distance by raising
students’ dialogue with one another and the instructor.

We use Course 1 to illustrate the above design. Course 1 is taught in both fall and
spring semesters. It was converted from a F2F version to a 100% online class in 2005
and has experienced increasing improvement over the years. In the beginning of each
semester, so as not to overwhelm the students with information, only the first two
lessons are released to the students. The syllabus contains a lesson release schedule
that tells students when each lesson will become available to them. Also included in
the syllabus is a recommended study schedule and due dates for assignments and
projects. The students are initially directed to a Start Here module which outlines the
course and how it will proceed. The students are instructed to introduce themselves
virtually in the discussion board, which is divided into thematic topics, including:
Main Forum, Live Classroom Related, Assignments Related, etc. These categories
facilitate student-teacher communication, allowing students to select an appropriate
channel of communication related to their questions. Files can be attached to a posting
to share information. The homepage includes a folder containing tutorials for using
Microsoft Access. They are in both HTML pages and PPT slides. Some lessons
contain discussion topics to be completed by the students. This often generates rich
interaction between the students and instructor. Also included in each lesson is a self
quiz that enables students to test their knowledge of the lesson content. Four virtual
labs are scheduled in the Live Classroom during the semester to present difficult
topics and demonstrate the use of software systems. Students can listen to the lecture and talk or type to interact with the instructor or other students.

5 Assessment

How effective are these online computer classes? Students have evaluated both F2F and online classes. The evaluations covered the course organization, teaching effectiveness, and teacher-student interactions, among others. Students rated the courses based on a 5-point scale where 5 was excellent and 4 was above average. Table 2 presents the evaluation results for Courses 1 and 2 over 7 years in both F2F and online formats. Note there are some years that we don’t have the evaluation data. Course 3 was not evaluated because it is a newly developed course.

Table 2. Student Course Evaluation Results

<table>
<thead>
<tr>
<th>Course</th>
<th>Deliver Mode</th>
<th>Period that the Course was Offered</th>
<th># of Students Taking the Course</th>
<th># of Students Responded to the Evaluation</th>
<th>Mean Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Course 1</td>
<td>F2F</td>
<td>2004, 2006 - 2007</td>
<td>34</td>
<td>16</td>
<td>3.96</td>
</tr>
<tr>
<td></td>
<td>Online</td>
<td>2005 - 2010</td>
<td>141</td>
<td>61</td>
<td>4.22</td>
</tr>
<tr>
<td>Course 2</td>
<td>F2F</td>
<td>2004 - 2006</td>
<td>29</td>
<td>23</td>
<td>4.33</td>
</tr>
<tr>
<td></td>
<td>Blended</td>
<td>2007, 2009-2010</td>
<td>26</td>
<td>10</td>
<td>4.61</td>
</tr>
</tbody>
</table>

The evaluation results in Table 2 demonstrate that students were even more satisfied with our online classes than the same classes taught F2F. The effectiveness of these classes has been confirmed by comments written by students in their evaluations. Below are some comments from the students on Courses 1 and 2:

- “This course was very well structured. There were no questions about what should be studied each week. Best designed course I’ve had so far!”
- “…has done a beautiful job of organizing complex information that is taught in a logical order. Each lesson builds upon and reinforces the last.”
- “… answered all my questions and was able to understand the question-behind-the-question in a number of questions when I was floundering.”
- “… were amazingly patient and professional throughout”
- “The discussion area for this class is lively and very helpful. Classmates often provide assistance when working through rough patches, ….”
- “The instructor is very knowledgeable in this area, she is very methodical.”
- “This instructor encouraged different ways to solve problems.”

Every semester, we’ve had outstanding students who not only did excellent work on their own assignments and term projects, but also provided assistance to other students through the discussion forums of the class website.
6 Discussion & Summary

This paper described our design of three computer courses offered online. Students’ evaluations indicated that students enjoyed learning in these online courses more than in their F2F sections. We believe the following factors contributed to the success of these courses: well-organized and well-designed course content, the interactive learning environment, multiple channels for interaction, rich resources for assisting learning, and the instructors’ prompt responses to students’ questions. Course modifications based on students’ feedback is also very important. For example, we added online chats to Course 1 as requested in students’ feedback in 2006.

Currently, we are dealing with challenges from managing students’ team projects. Although most students did fine, some students are reluctant to participate in and contribute to the team project. We are exploring factors and strategies for increasing motivation and interaction in collaborative learning in the distance environment.

As for the future of online education, we should keep up with new technologies and implement and accept them as needed. For example, literature has explored the use of mobile phones and related devices in engaging learners in distance education (Makoe, 2010; and Parsons, 2010). However, the application of these technologies needs further implementation and evaluation.

References