Developing a Blended Computer Security Course

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Online Learning

A recent survey by the Babson College Survey Research Group reports that:

- Over 6.1 million students were taking at least one online course during the fall 2010 term.
- This represents a 10% growth rate for online enrollments, which far exceeds the 1% growth of the overall higher education student population.
- Thirty-one percent of all higher education students now take at least one course online.

This suggests that online learning is coming whether or not institutions are ready for it.

What's an Online Course: A Matter of Degree

Allen and Seaman (*Going The Distance: Online Education in the U.S. 2011*) introduce the following taxonomy:

- **Online**: most content (at least 80%) is delivered online.
- **Blended/Hybrid**: combine online and face-to-face delivery, with 30% to 79% delivered online;.
- **Web-facilitated**: web-based technology used to facilitate what is essentially a face-to-face course, with 1% to 29% of content delivered on-line.
- **Traditional**: no online delivery.

Why Go Online?

In general, there are lots of reasons. There were two primary goals driving *this* effort:

- investigate online delivery for security education;
- move toward developing an online offering for non-traditional students.

Three subsidiary constraints/goals:

- maintain the basic content and rigor of the existing lecture-based course;
- follow best practices for online instruction;
- use an existing content delivery system (the Quest Learning and Assessment system).

The Traditional Course

- CS361: Introduction to Computer Security.
- Very popular lecture-based course, offered 16 times since 2003.
- Focuses on foundations of security, rather then cutting edge problems and research
  - Overview of the security problem
  - Confidentiality, integrity, availability policies
  - Basic information theory
  - Crypto and cryptographic protocols
  - Malware
  - System certification

The Blended Course

During summer 2011, the traditional course was redone into a blended format:

- 80 videotaped mini-lectures (5–10 minutes each) grouped into 17 modules;
- online access to slides, worked problems, supplementary materials;
- essay questions associated with each module;
- required discussion sections twice weekly;
- around 6 challenging programming assignments during the semester;
- two major in-class exams: midterm and final.

The First Few Modules

Lect	Mod	Wk	Title
01	1	1	Introduction
02	1	1	Why Security is Hard
03	1	1	Security as Risk Management
04	1	1	Aspects of Security
05	2	2	Policies and Metapolicies
06	2	2	A Policy Example: MLS
07	2	2	MLS Example: Part II
08	2	2	MLS Example: Part III
09	2	2	MLS Example: Part IV
10	2	2	Tranquility and BLP
11	3	3	Access Control Policies
12	3	3	Lattice-Based Security
13	3	3	Covert Channels I
14	3	3	Covert Channels II
15	3	3	Covert Channels III
16	3	3	Detecting Covert Channels

Use of Quest

Quest Learning and Assessment is a web-based content delivery system developed and maintained by the College of Natural Sciences at the University of Texas at Austin.

Though widely used at UT Austin in math and science classes:

- previously, videos used for supplemental material, not as a primary lecture delivery vehicle;
- previously no support for essay questions;
- sometimes maddeningly slow to respond;
- some features required workarounds.

Test Results

The exams were essentially identical to those given in the traditional class, with comparable results:

Semester	Class Size	Midterm Exam	Final Exam	Class Average
Fall 2011	52	75.23	75.28	77.93
Fall 2010	58	82.42	75.17	82.58
Summer 2010	45	72.03	74.59	77.55
Spring 2009	39	76.13	77.89	77.26
Summer 2009	44	79.45	79.11	82.81
Spring 2008	34	78.24	75.42	81.32
Fall 2008	36	78.61	81.87	80.84

Student Responses

- Response was uniformly favorable to the online format. Students rated the blended format as more effective or equally effective compared to a traditional course.
- Many students did not value the required in-class meetings.
- The time commitment was almost uniformly rated as equal to a traditional class.
- Students requested more timely feedback on the online questions.
- Around half of the respondents reacted negatively to the use of Quest. Many found the system cumbersome and difficult to navigate.

Industrial Class

Moving toward an online security offering for an industrial audience requires:

- the content be useful and marketable to the target audience;
- the quality of instruction reflect favorably on the institution;
- the delivery be efficient and cost-effective for the institution;
- the delivery be suitable for and accessible to the target audience.

The particulars of this experiment didn't test these aspects very well.

Instruction Media Don't Matter Much

Russell and others have found what they call "the no significant difference phenomenon": the choice of instructional media do not significantly affect learning.

Only true if the course designer and instructor follow sound pedagogical practice.

Quality seems to be less about the media than about the teaching.

How Does a Non-Expert Cope

Lacking prior expertise in developing online instructional materials, the author fell back on best practices for education in general.

The "Seven Principles for Good Practice in Undergraduate Education," are one benchmark for quality undergraduate teaching:

1. encourage student-faculty contact,
2. encourage cooperation among students,
3. encourage active learning,
4. give prompt feedback,
5. emphasize time on task,
6. communicate high expectations, and
7. respect diverse talents and ways of learning.

Lessons

This exercise had mixed results:

- Learning (as measured by test scores) was comparable to the traditional class.
- Student satisfaction was comparable to the traditional class.
- The move to online format probably was too tentative.
- Use of Quest had both positive and negative aspects.
- Not clear that this was an useful step toward an industrial class.