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Pedagogical Design for an Online Information Literacy Course: College Students' Learning Experience with Multi-modal Objects

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Abstract: This project is an exploratory study on the use of multi-modal objects in an online information literacy course. This paper reports on the second phase of the project, which focused on students' learning experience within five course modules employing different multi-modal media objects for instruction. Seven online surveys were conducted at the beginning of the course, immediately after each of the webcast discussion sessions accompanying each course module, and at the end of the course. The findings show significant relationships among computer skills, online teaching materials, use of communication tools, learning experience, and satisfaction with the course.

Introduction

Use of information and communication technologies (ICTs) by instructors and students, both in and out of classroom, is on the rise (Bruce, Dowd, Eastburn and D'Arcy 2005; Benson, et al. 2002; Dutton and Loader 2002; Hazemi and Hailes 2002; Steeples and Jones 2002; Bills and Stanley 2001; Pippert and Moore 1999). The expanding use of ICTs in instruction provides opportunities for evaluating the effectiveness of particular approaches and for developing an understanding of how student attitudes are affected by networked learning. University investments in campus information infrastructure and technological implementation have contributed to this increased use, but they additionally demonstrate a continuing demand for potential instructional benefits of ICTs in higher education (Agre 2002; Armstong 2002; Boyd-Barrett 2002). High costs accompany this demand, and university administrators must understand whether investment on ICTs has improved the quality of teaching and learning.

Many researchers have pointed out that new methods and evaluation factors are needed to examine the effectiveness of the instructional use of ICTs (Boehner, Gay and Larkin 2005; Gay and Hembrooke 2004; Lievrouw and Livingstone 2006; McMillan 2006). The major difficulties for the implementation of research methods and the selection of evaluation factors are the variety of learning environments and learners. The learning environments may involve synchronous/asynchronous methods, both individual users and groups of users, and a variety of media types. Meanwhile, learners may be accessing the environment from a variety of locations and even speak different languages, factors which can have a tremendous impact on the reliable data collection needed to examine the use of ICTs.

The quality of teaching and learning can be examined by a variety of measures. The investigators are interested identifying evaluation factors of ICTs on networked learning and how participation in an online class affects students' attitudes and expectations toward online courses and the associated technologies. The investigators focused on an online information literacy course for undergraduates. This course provides an overview of the history of Internet and its social impacts alongside hands-on training in various technologies. Data collection took place in this course during the Fall 2005 semester.

The goal of this project is to determine what factors are meaningful in the evaluation of web-based classes and to equip instructors and designers with better teaching and design strategies. The investigators are interested in learning what impact students feel media variety and interaction type have on how they work within the web-based environment and how their learning experiences in such an environment evolve as they progress throughout the course.

Background and Related Work

New Research Methods and Evaluation

ICTs enable instructors and designers to create new configurations of media for instruction and also provide new channels for interaction in learning environments. However, ICTs have complicated the development of evaluation procedures on networked learning. To understand such a dynamic space, Gay and her colleagues applied activity-centered design (ACD) to study computer-supported learning (Boehner, Gay and Larkin 2005; Gay and Hembrooke 2004). The ACD model, developed by Gifford and Enyedy, is based on activity theory (1999). In the findings from their Renwick Gallery project, Gay and her colleagues state that "…a systematic evaluation of the type and

presentation of information has not, to our knowledge, been completed. Furthermore, this effort underscores the importance of bringing evaluation requirements into design requirements and specifications," (Boehner, Gay and Larkin 2005, 229). Lievrouw and Livingstone (2006) also advocate the importance and necessity of new methods for studying new media and ICTs.

Models of Interactivity and Multi-modal Learning Objects

Students' ITC use in a course can influence presentation and organization of course content. It also has great impact on in-class communication and interaction among students and between instructors and students in both synchronous and asynchronous forms. Bouhnik and Marcus (2006) present a model promoting student interaction with course content, instructors, and systems (Figure 1). McMillan (2006) emphasizes three important components of interactivity: users, documents, and systems. She suggests that a multifaceted approach to the three components is needed to facilitate understanding interactive communication. Multi-modal learning objects in this study are broadly identified as both visual and auditory modes such as text, graphic, audio, and video.

(Insert FIG. 1.here)

Instructional technologists have promoted the use of multimedia in classrooms, believing that multimedia enriches the learning process and students can perform better with pictures and words than just words alone (Mayer 2001; Rouet, Levonen and Biardeau 2001). However, some learning scientists doubt the effectiveness of graphical presentation on learning opportunities (Reimann 1999; Rogers 1999). Mixed results in students' feedback suggest that multi-modal learning objects may have no influence on magnitude of students' learning judgment (Chen and Fu 2003); and some

students still prefer face-to-face lectures, which can be more animated than those presented in a Web format (Bruce, Dowd, Eastburn and D'Arcy 2005).

The use of appropriate multi-modal learning objects in a variety of units in one class is an important topic for course content development and student-centered learning. Understanding how students' attitudes and habits change once engaged in instruction with such technologies can help to elucidate how these learning objects may be employed effectively at all levels.

Students' Perceptions on Effectiveness

Evaluation of networked learning often focuses on attracting new students, generating new revenues, providing students flexible and convenient educational opportunities. Some researchers have identified key disadvantages for students in networked learning as low self-motivation and discipline, minimal interaction with instructors and peers, and lack of a learning framework (Dutton and Perry 2002; Swam 2001). Hara and Kling (2002) point out that most studies fail to address students' difficulties, and the quality and effectiveness of online distance education courses.

Many public universities are required by state legislators or the U.S. Congress to justify their budgets and accountability (Trible 2005). Effectiveness is one aspect of accountability measurement in education, as universities invest considerable resources in technologies for instruction (Kiernan 2005; Armstong 2002; Boyd-Barrett 2002). As the pedagogical focus switches from teacher-centered to student-centered, instructional effectiveness should include students' feedback on the use of technology (Koeber 2005; Bork 2002; Hara and Kling 2002).

Whether students perceive the same value of the use of technology as their instructors is an area that needs more study (Hara and Kling 2002).

Student Motivation and Belief

Student attitudes toward instructional media are related to their motivation and learning outcomes (Joo, Bong and Choi 2000). Sims (2003) advocates the importance of aligning students' perceptions and expectations regarding interactive multimedia in the networked learning environment. According to his study, sixty-eight Australian undergraduate students considered effective interactivity to consist of engagement, control, communication, design, the individual and learning. Bruce, Dowd, Eastburn, and D'Arcy (2005) find similar responses from college students in an online agricultural Web site over a six-year period.

Multi-modal learning objects are often employed in environments that provide flexible learning opportunities and cater to non-traditional students who may not share the same demographic characteristics as the traditional college-age student body. Instructional technologists cannot assume that everyone enrolled in an online or blended course brings the same skillset and competency to the coursework (Williams and Chen 2008). Eastin and LaRose's 2000 discussion of Internet self-efficacy and the digital divide highlights the wide range of comfort levels and expectations students display in networked learning environments. Regarding student resistance, Thompson and Lynch (2003) discovered that people with weak Internet self-efficacy beliefs would be inclined to resist Web-based instruction. Spitzberg (2006) discusses the development a model of computer-mediated communication (CMC) competence based on motivation, knowledge, and skill. Assumptions made about the technology literacy and comfort of students should be avoided, as they allow barriers to be

built into instruction and inhibit community. Student attitudes, expectations, and competency are essential factors to the success of networked learning environment.

The Online Course Examined: INF 312 Information in Cyberspace

The course examined in this study, Information In Cyberspace, is the largest online course taught at the University of Texas. It has been evolving since 1998; it began as a face-to-face classroom course, but due to space constraints and student demand, it has evolved into a course that is taught completely online. The course content covers the basics of technology and information literacy, and the course is taught by graduate students and staff of the UT School of Information. In this course, students learn new skills for research and communication online, consider the history and future of the networked society, and regularly engage with new technologies. There are five core course modules: An Introduction to Unix and Linux, Computer and Internet Security, Internet History and Governance, Information Searching and Evaluation, and An Introduction to Copyright. The course utilizes a variety of methods to deliver content. The instructors present materials through a course website containing instructional modules created by the instructors, outside readings on various topics, streaming multimedia lectures, synchronous multi-user and one-on-one chat, discussion boards, and online tutorials for hands-on exercises (Figure 2 and 3).

To communicate with students, instructors use email, Instant Messaging (IM), discussion boards, online surveys, up-to-date lists of frequently asked questions (FAQs), weblogs, social bookmarks, and face-to-face meetings in the school's IT lab. Emphasis is placed on multiple modes of contact and awareness of class milestones, as well as the functional roles of underlying technologies (hence the integrated assignment & class deadline countdown and browser/computer information).

(Insert FIG 2 here)

(Insert FIG 3 here)

Each week, instructors and TAs are available via chat for more than 60 hours. Students are made aware of who is online when through a contact page on the course website that contains real-time online status indicators (Figure 4).

(Insert FIG 4 here)

Additionally, in order to create community and combat the illusion of isolation in such a large class, the instructors hold one live webcast discussion session per two-week module. These webcasts incorporate streaming audio and video with text-based chat, voice over IP, and other collaborative tools. Students are typically provided with streaming audio and video of their instructors and guests related to the current module's topic, and are directed to a text-based chat room in which they may interact with each other, the instructors and TAs, and the guest speakers (Figure 5).

(Insert FIG 5 here)

In order to expose students to the variety of synchronous collaborative technologies available, the instructors alternate between the tools they use to present the group chat session. These tools include Blackboard's "Office Hours" (a text-only group chatroom), the more robust Blackboard "Virtual Classroom" (which includes a virtual whiteboard and other tools), and the group chat feature of Skype, a popular voice-over-IP client (Table 1).

(Insert TABLE 1 here)

The instructors of the course have found that communicating with and maintaining students' awareness of others can be a challenge for such a course. In order to address as the widely varying levels of experience with technology present among students, the instructors chose to offer students a variety of communication options to ensure that students remain informed and feel that their voices will be heard (Williams, et al. 2005).

The instructors have also incorporated enhancements to course materials based on student feedback, and seek to include a wide spectrum of technologies for content delivery. Based on the instructors' informal interaction with students, such enhancements have contributed to student excitement about the course, and also have helped to point out some areas in which student attitudes indicate limitations of some instructional technologies.

Research Questions

The development of a systematic student-oriented instructional evaluation of the class would enhance the quality of the class. In creating the course content and delivery strategies, the class needs to rely on student-perceived effectiveness of different approaches (collected through discussion and surveys) and to create an instructional environment in which students have multiple paths and multi-modal arrangements for engaging with the instructional modules, as well as among themselves and with their instructors. Therefore, the investigators propose the following three research questions:

1. What are the relationships between participants' characteristics and their learning outcomes?

2. What are the students' learning experiences within the five course modules?
3. What are the relationships between students' learning experiences and their characteristics and learning outcomes?

Research Methods

Data collection included seven surveys corresponding to course content. Online surveys were conducted at the beginning of the course, immediately after each of the five webcast sessions, and at the end of the course. The investigators' survey items were integrated within regular surveys designed by instructors to elicit student feedback on the design and content of the course. The investigators did not have access to the survey data until after the class concluded and grades were submitted.

As part of the course orientation, students were required to complete the incoming student survey, which was presented on a web page they accessed in completing initial course orientation requirements. The real-time webcast session conducted during the second week of each of the five core instructional modules served as the setting for the five interstitial surveys. Toward the end of each of these webcast sessions, a hyperlink to an online survey form was provided to students in the online chat session. Students were given time as discussion was winding down to complete the each of the surveys. Response submission was closed one hour after the webcast ended. Webcast sessions were not mandatory, but most students did, however, attend more than one webcast session. A hyperlink to the web-based exit survey was shared with students upon their completion of the course's final examination.

Results and Discussion

Students needed to answer both incoming and exit surveys with some optional module surveys to be considered complete cases in this analysis. The investigators collected complete sets of answers from 36 participants from the class (Table 2). Some students failed to answer the incoming survey during the drop-add registration time, the first two weeks of the semester, as well as the exit survey at the end of the semester. The investigators presented a detailed report on the class, 162 students, regarding their attitudes and perceptions of the use of media on networked learning (Chen & Williams in press). The investigators will discuss alternative methods to prevent any incomplete cases in the future.

(Insert TABLE 2 here)

Regarding research questions #1 and #3, the investigators first applied linear regression analyses to evaluate relationships among variables. Normality and equality of error variance assumptions were met in most cases. In a few analyses where these assumptions were marginally satisfied, the investigators used Spearman's rho correlation analyses (two-tailed) to further substantiate the relationship between variables. Spearman's rho was used rather than Pearson's because the use of Spearman's rho is not limited to normally distributed data. The investigators applied Generalized Estimated Equations (GEEs) to the research question #2. GEE is appropriate for examining correlated data which can be modeled in a generalized linear model.

Research question #1: Relationships between participants' characteristics and their learning outcomes

When the investigators analyzed survey results focused on learning outcomes, they found that students who indicated that they found INF312 more convenient than their face-to-face courses were more likely to be male (r=-0.479, p=0.003; Spearman rho=-0.486, p=0.003) and also more likely to be upperclassmen (r=0.369, p=0.027; Spearman rho=0.389, p=0.019). Additionally, students who indicated that INF312 had a higher workload relative to their other classes were more likely to be female (r=0.440, p=0.007; Spearman rho=0.440, p=0.007) and stated a higher tendency to procrastinate (r=0.476, p=0.003; Spearman rho=0.453, p=0.006). Students who reported printing the materials from the course website more frequently were more likely to be freshmen and sophomores (r=-0.505, p=0.002; Spearman rho=-0.500, p=0.002). Students who reported that they encountered frequent technical problems with course technologies were more likely to have stated lower levels of computer skills (r=-0.354, p=0.034; Spearman rho=-0.365, p=0.028) coming into the course, as well as less frequent use computers (r=-0.335, p=0.046; Spearman rho=0.368, p=0.027) in the incoming student survey. Female students (r=-0.340, p=0.042; Spearman rho=0.393, p=0.018) were more likely to state that they would recommend the course to their friends in the outgoing student survey.

Research question#2: Students' learning experiences in the five course module webcast session.

Analyzing student survey responses dealing with learning experiences in the synchronous webcast sessions across the five course modules, the investigators found that students preferred the audio quality of the webcast sessions for Module 1, which involved the rich, graphical chat room better

than the audio quality of Modules 2 ($r=-1.96$, $p=0.0494$); and 4 ($r=-5.08$, $p<0.0001$), both of which involved use of the lightweight, text-only client. The technology used to stream synchronous audio to students was identical in all cases.

Additionally, students preferred the video quality of webcast for Module 1 over that of the webcast for Module 4 ($r=-1.87$, $p=0.0615$), but preferred the video quality of Module 5 ($r=1.96$, $p=0.0499$) over Module 1. Again, Module 1's webcast employed the rich chat room, while Module 4 involved the light-weight text-only chat. Module 5's chat took place in Skype's chat room, which allowed some voice chat.

In terms of the chat technology used in the five webcast sessions, the rich text chat used in Module 1 was rated as better than the text-only chat used in Module 2's webcast ($r=-1.80$, $p=0.0716$), but students preferred the second use of the rich chat room during Module 3's webcast ($r=1.93$, $p=0.0541$) over the initial use of that tool in Module 1.

Despite these differences among reports of video, audio, and chat room quality in the webcast sessions, students reported no significant difference in their feeling of engagement within the webcast sessions or with their impression of webcasts being better or worse than large physical lecture sessions. Students also reported no significant difference in the overall learning experience between the webcast sessions for the five course modules. However, their ability to follow the content of the webcast sessions differed among two of the sessions: students reported that the webcast for Module 3 ($r=-2.07$, $p=0.0382$), which used the rich chat room, was more difficult to

follow than the webcast for Module 1. Overall, students preferred the overall experience of the webcast session for Module 5 (r=1.91, p=0.0560) over that of Module 1.

Research question #3: Relationships between students' learning experiences and their characteristics and learning outcomes

Students who indicated higher overall audio quality in the five post-webcast surveys were more likely to indicate that they had higher computing skills (r=0.420, p=0.021; Spearman's rho= 0.431, p=0.017), used computers more often (r=0.420, p=0.021; Spearman's rho= 0.423, p=0.020), and tended to procrastinate in the incoming student survey (r=0.415, p=0.023; Spearman's rho= 0.397, p=0.030).

Additionally, the students who revealed a tendency to procrastinate in their answers to the incoming student survey tended to report that the INF312 synchronous webcast sessions were a valuable learning experience (r=0.486, p=0.007; Spearman's rho= 0.374, p=0.042). Students who rated the course webcast sessions as better than a face-to-face course were more likely to have reported both a more frequent use of instant messenger (r=0.366, p=0.047; Spearman's rho= 0.404, p=0.027) and a higher level of expectations for the course(r=0.458, p=0.011; Spearman's rho= 0.451, p=0.012) in the incoming student survey.

In terms of overall learning experience in the course webcast sessions, students who reported a positive experience reported higher computer skills (r=0.466, p=0.009; Spearman's rho= 0.457, p=0.011) and more frequent use of computers (r=0.60, p=0.011; Spearman's rho= 0.434, p=0.017) in the incoming student survey. Students who felt this class was more convenient than a face-to-face

course indicated that the webcast sessions were a valuable learning experience (r=0.379, p=0.0391; Spearman's rho= 0.391, p=0.032) and reported that and the webcast sessions were better than the large-scale face-to-face lectures they receive in physically co-present courses (r=0.499, p=0.005; Spearman's rho= 0.547, p=0.002).

Students who noted frequent use of IM in their incoming survey were more likely to report they were satisfied by the level of audio quality (r=0.483, p=0.007; Spearman's rho= 0.534, p=0.002) throughout the post-webcast surveys.

In the end-of-course survey, students who reported encountering technical problems more frequently tended to rate the audio quality (r=-0.484, p=0.007; Spearman's rho= -0.397, p=0.030) and video quality as worse (r=-0.608, p=0.000; Spearman's rho= -0.580, p=0.001). These students also reported a that the webcasts were less valuable as a learning experience (r=-0.627, p=0.000; Spearman's rho= -0.586, p=0.001), indicated a lower score for the overall webcast experience (r=-0.407, p=0.026; Spearman's rho= -0.328, p=0.077), and reported that they were less able to follow the content of the webcast sessions (r=-0.501, p=0.005; Spearman's rho= -0.547, p=0.002)

Additionally, those who said they would recommend the class to their fellow students in the final survey were more likely to have indicated a belief in the potential for webcasting to be better than physical lectures as high (r=0.413, p=0.023; Spearman's rho= 0.495, p=0.005) and had an easier time following the content of the sessions (r=0.329, p=0.076; Spearman's rho= 0.340, p=0.066) in the earlier surveys.

Finally, those who reported they were likely to take more online courses in the final survey reported high levels of engagement (r=0.392, p=0.032; Spearman's rho= 0.384) and were better able to follow the content of the sessions (r=0.342, p=0.065; Spearman's rho= 0.423, p=0.020), as reported in the post-webcast session surveys.

Conclusions

Tracking student responses to the incoming and outgoing surveys along with the five post-webcast survey revealed some expected and unexpected results. Some of the results seem to build on a conclusion the investigators drew in part one of the project: students come into online courses with varying levels of technical competence and familiarity with computers. For example, students who were unfamiliar or unaccustomed to IM, and appeared to have less competence with the course technology were more critical of these technologies when problems occurred. Encountering fewer technical problems proved to be a factor in students feeling engaged, following along, and the enjoying the overall experience of an online course. The less tech-savvy students were not as willing to accept technical difficulties as their classmates who reported more frequent use of the course technologies at the onset of the course.

These findings make it clear that institutions offering synchronous online instruction need to have contingency plans for students who struggle with the technology to keep them engaged. Additionally, a technology competency program is needed to get everyone to a comfortable level with course technologies prior to the first day of class. In the first part of this study (Chen and Williams in press), female students appeared to be more in need of this type of technical training in advance of the course. In this current analysis, the only significant difference between male and

female student responses was in perception of the course workload, as reported in the final survey. Female students were more likely to view the workload as high compared to their other courses.

The findings also point out effects of the differences among the synchronous communications technologies at play in the course. Students were more critical of the audio and video quality when the other technologies (like the chat room) had fewer features. Students seemed to be less critical of technical problems with the audio and video (which were always served through the same method) when the group chat technology used in the webcast session had more features. The webcasts with the text-only chat system corresponded with the lowest ratings of audio and video quality. This leads the investigators to believe that offering a variety of features may provide students with enough options for engagement that problems with other aspects of a synchronous session may be overcome, or at the very least, easier to accept.

Additionally, students' attitudes toward the class technologies definitely were active in whether or not the experience was seen as valuable. Students with high expectations had a better overall experience even with high levels of technical problems. Students who thought the course was more convenient than their face-to-face courses also gave the overall experience of the webcast sessions better scores, despite the similarity between the scheduled, synchronous sessions and their face-to-face counterparts. Students who reported a tendency to procrastinate appeared more open to and likely to value the webcast sessions. The investigators believe this might be due to the fact that procrastinators often find self-paced work a challenge, and the webcast sessions offered several opportunities for receiving course credit in a scheduled, non-self-determined manner.

The networked learning environment offers many options for both educators and students. Instructional technologists need to take into account the differing needs and experiences of students in their designs, and employ the flexibility of these new technologies to create learning objects that allow for student success at any level and enable students at all levels of technology competency, skill, and experience to progressively advance through their continued use of such tools.

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FIG. 1. Bouhnik and Marcus's model (2006, p. 304).

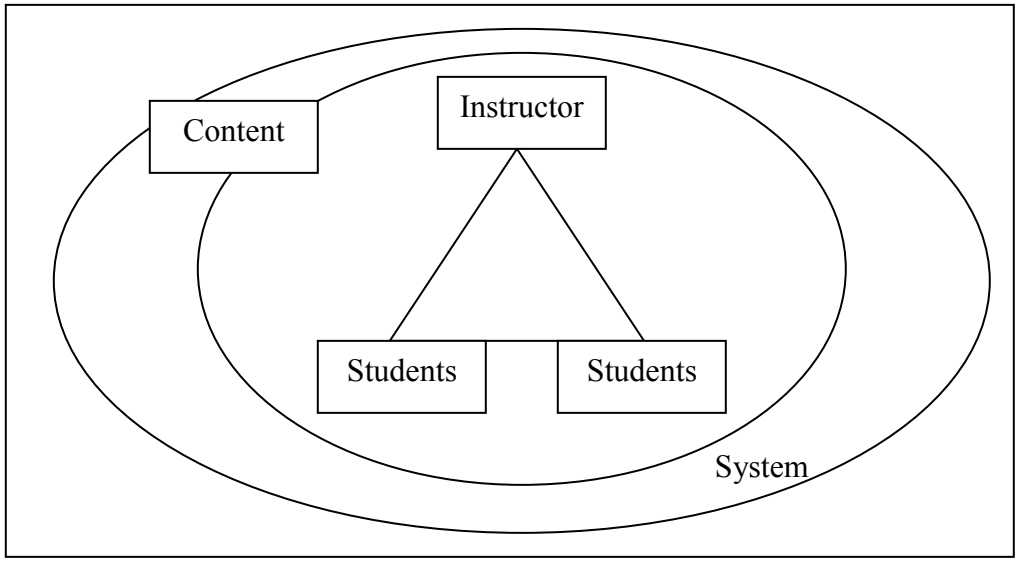

FIG 2. INF 312 Course Homepage.

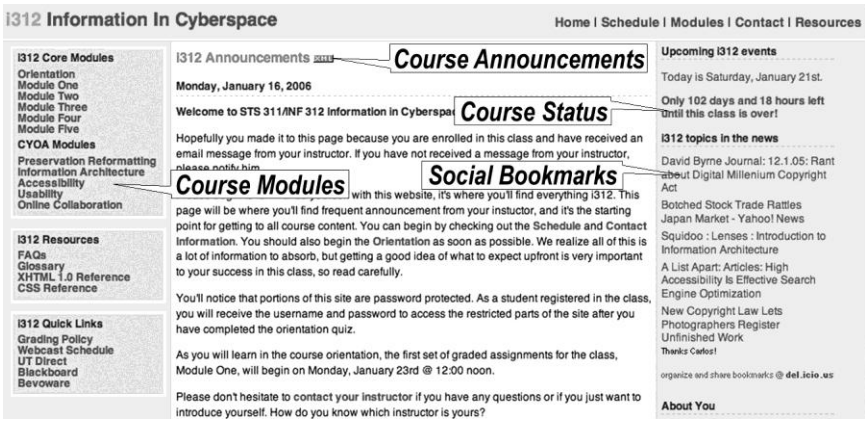

FIG 3. The Initial Page of an INF 312 Instructional Module

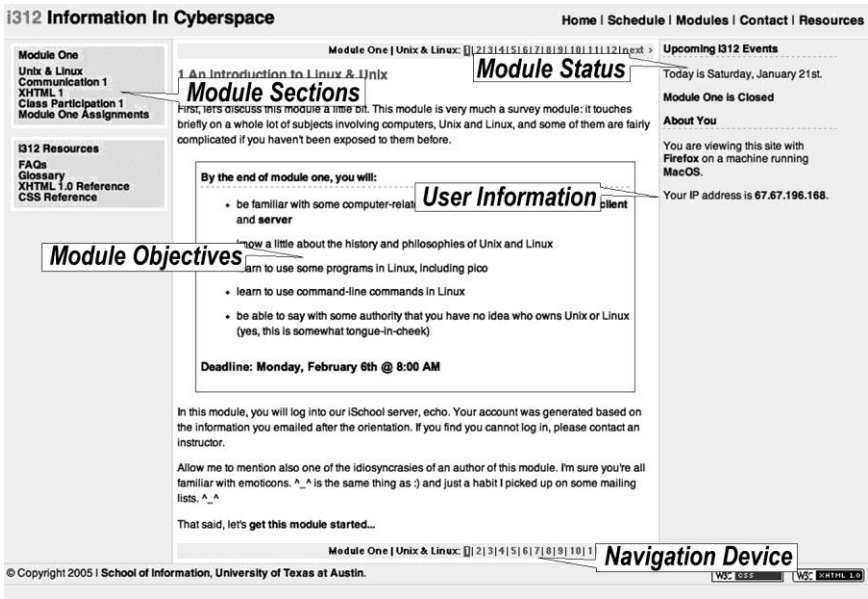

FIG 4. INF 312 Contact Information Page with schedule and online indicators

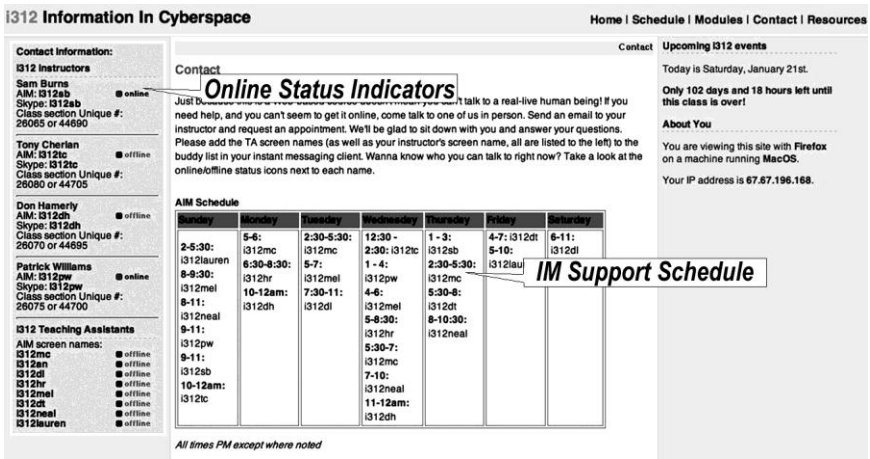

FIG 5. Components of an INF 312 Webcast session

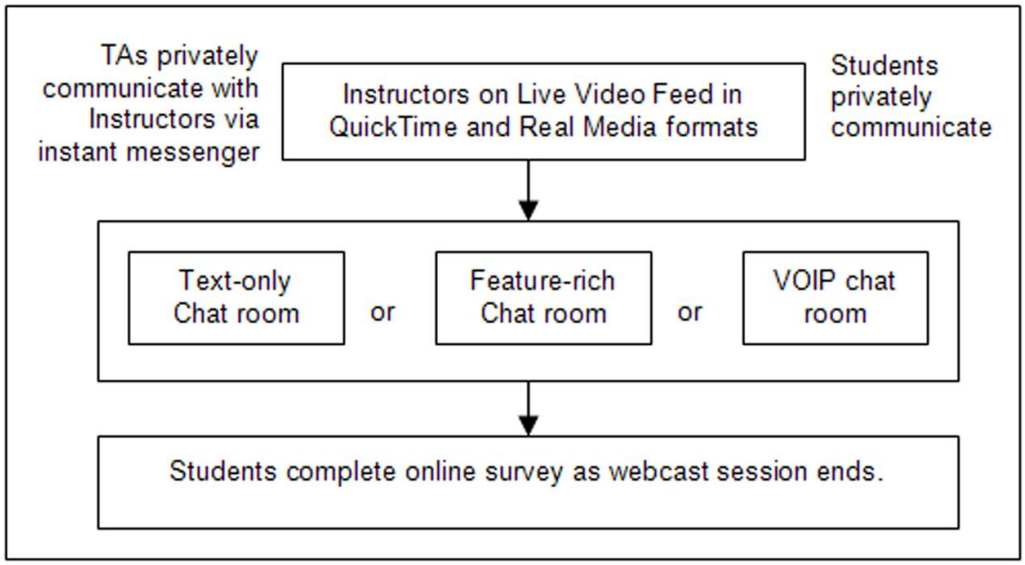

TABLE 1. Media Type by Module

Media Type	**Instructional Module**				
	1	2	3	4	5
Text on Webpages	√	√	√	√	√
Video Tutorials	√	√	√	√	√
Audio "Readings"		√			
Live Chat	√	√	√	√	√
Weblogs		√	√	√	
Social Bookmarks		√	√	√	√
Webcast Chat Setting	√ (rich chat)	√ (text only)	√ (rich chat)	√ (text only)	√ (Skype)

TABLE 2. Participants' characteristics (N=36)

Characteristics	Measurement	Number of participants	%
Academic status	• Freshman	2	5.6
	• Sophomore	16	44.4
	• Junior	7	19.4
	• Senior	11	30.6
Gender	• Male	17	47.2
	• Female	19	52.8