# AC 2007-227: ASSESSMENT OF MULTI-MEDIA & WEB-BASED INSTRUCTION IN A SCIENCE-TECHNOLOGY & SOCIETY COURSE

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# Assessment of Multimedia and Web-Based Instruction in a Science-Technology & Society Course

Abstract

Multimedia can be a powerful tool in exploring the nature of the world around us, including its technological systems. This paper describes the assessment of self-paced multimedia and web-based modules that are used in an advanced General Education (GE) course in the College of Engineering at San José State University. The development of these modules began in 1994 and has undergone many revisions. Currently, four of the seven units in this class are taught using either multimedia CDs or web-based material.

The General Education course, Technology and Civilization (TECH 198), is designed to introduce students to the realm of history and usage of technology in society and to increase their awareness of both the uncertainties as well as the promises of the utilization of technology as a creative human enterprise. Technology and Civilization, a Science, Technology, and Society (STS) course, is an example of courses that are becoming more evident on campuses throughout the USA.

The goal of these multimedia modules is to have the students use technology as they explore its impact on our society over time. Although the web and multimedia materials were developed by one instructor, they are used by all instructors in this class in different ways. The continuous improvement of the multimedia is driven by the evaluation of the multimedia by students and other faculty. Each year, the multimedia and web-based modules are revised to reflect the evaluative input gathered from the various constituents (students and faculty).

As part of the General Education program, this course undergoes regular assessment to determine whether it is meeting the GE Learning Goals. In addition to the GE assessment, SJSU mandates end-of-term assessment for at least two courses for each professor every academic year. This approach does not give a quick turnaround for implementing improvements in the curriculum. This paper will discuss the entire assessment model for this course including the GE assessment, the end-of-term course assessment, and the student assessment.

## Introduction

The general education program at San José State University[1] is different from many in the United States. Instead of specifying a specific series of courses as part of the General Education (GE) of each student, SJSU has five Core GE areas (Skills, Science, Humanities & Arts, Social Sciences, and Human Understanding and Development). In addition, every SJSU student must take SJSU Studies (formerly called Advanced GE) courses in four areas: Earth & Environment; Self, Society & Equality in the U.S.; Culture, Civilization & Global Understanding; and Written Communication. Any department may propose a course for any area of GE. The course involved in this multimedia development process, Tech 198—*Technology and Civilization*, was approved as an Advanced GE course in the Earth & Environment area until Spring 2000. In Fall 2000,

after a revision of the university General Education program, the course was approved in another Advanced GE Area (Area V--Culture, Civilization & Global Understanding) where it remains an approved course today.

Many universities offer courses for general education under the general theme of science, technology, and society. Frostburg State University[2] offers an interdisciplinary course titled *Science Technology and Society* as a freshmen-level in general education for non-science and non-engineering majors. At the University of Denver[3], an interdisciplinary team including faculty from the Department of Engineering has offered a three-quarter long course called *Technology 21* for fourteen years to approximately 100 students each year. At the University of Denver, this course is used by the non-engineering and non-science students to meet their university's science general education requirement. A general education course titled *Technology and the Engineering Method* at the University of Dayton[4] also fulfills a science education requirement and is taken by a diverse group of non-engineering students. Other universities that have engineering courses as part of the General Education programs at their institutions include Miami University[5], Penn State University[6], Old Dominion University[7]. North Carolina State University[8], and the University of Texas at Austin.[9]

Course Mechanics

Tech 198 is a required course for all BS Industrial Technology, BS Aviation, and BS Computer Engineering (effective Spring 2007) majors; in addition, it is part of SJSU's SJSU Studies (Advanced General Education) curriculum and attracts students from all over campus. This course is delivered in a novel way. It has a hybrid structure and is composed of three units that are delivered through self-paced multimedia CD, one unit that is delivered through WWW instruction, and three units that are delivered through a traditional classroom model[10]. This course is evaluated each semester under SJSU's general education program and this continuous assessment and improvement is also unique. The medium and content for each unit is displayed in Table 1.

**Table 1**. Content, Title, and Media Format for Each Unit in Tech 198

| **Unit** | **Title of Unit** | **Media Format** |
|---|---|---|
| 1 | Nature of Science and Technology | Multimedia CDs |
| 2 | History of Technology | Web-based |
| 3 | Technology and Work | Multimedia CDs |
| 4 | Technology and Gender Issues | Multimedia CDs |
| 5 | Technology Transfer and Cultural Issues | Lecture/Activity |
| 6 | Quality of Life | Lecture/Activity |
| 7 | Ethics | Lecture/Activity |

All the instructors teaching this course use the CD and web-based learning materials in their classes. There are five tenured faculty and two lecturers who regularly teach this class and the department offers several sections of this class each semester. The department has a policy that no faculty may teach this class without first observing another instructor for an entire session.

After this, two other Tech 198 instructors observe the "new" faculty in his/her Tech 198. If the "new" faculty passes the probationary period, he/she is considered certified to teach Tech 198.

This course is structured to measure assessment by student achievement of the learning objectives for Area V of SJSU's GE program (see Figure 1). At the end of each semester, each instructor submits an assessment report to the course coordinator that describes how the student learning objectives were measured and how many students met each learning goal. To determine student achievement of each GE Learning Objective, each instructor generally uses various, and usually multiple, measures of student performance. Since this class has been approved since Fall 2000, these measures have varied. However, the Tech 198 faculty as a whole continually monitors this class to ensure that it adheres to the Area V Goals and Objectives.

**SJSU Studies: CULTURE, CIVILIZATION, & GLOBAL UNDERSTANDING (V)**

**A. Goals**

Courses in Culture, Civilization, and Global Understanding should give students an appreciation for human expression in cultures outside the U.S. and an understanding of how that expression has developed over time. These courses should also increase students' understanding of how traditions of cultures outside the U.S. have influenced American culture and society, as well as how cultures in general both develop distinctive features and interact with other cultures.

**B. Student Learning**

Students shall be able to:

1. compare systematically the ideas, values, images, cultural artifacts, economic structures, technological developments, and/or attitudes of people from more than one culture outside the U.S.;
2. identify the historical context of ideas and cultural traditions outside the U.S. and how they have influenced American culture; and
3. explain how a culture outside the U.S. has changed in response to internal and external pressures.

**Figure 1.** Goals and Objectives for Area V (*Culture, Civilization & Global Understanding*) at SJSU[1]

As shown in Table 1, three units are taught using multimedia CDs (Unit 1 [The nature of science and technology], Unit 3 [Technology and Work], and Unit 4 [Technology and Gender]). Also, there is a web-based unit on History of Technology (Unit 2). All professors except one lecturer use all the multimedia units. That specific lecturer uses the multimedia for Units 3 and 4 and the web-based Unit 2. Some professors have students complete the multimedia and web-based activities instead of attending lectures while others use the multimedia activities as supplemental homework activities. The remaining units (Unit 5—Technology Transfer & Cultural Issues; Unit 6—Quality of Life; and Unit 7—Ethics) are taught in the classroom.

Course Content

The following section outlines the content and objectives for each unit in this course. The certified faculty of this course as a whole determines that content for each Unit. Each individual faculty teaching this course decides on the presentation order for the units and the specific student activities for each lecture/activity unit.

Multimedia and Web-based Units

There are three units that are taught using multimedia CDs. The software used for this multimedia was Macromedia Authorware and there are multimedia CDs available for students on both the Windows and MAC platforms. Two of the multimedia units (*Unit 1: The nature of science and technology* and *Unit 3: Technology and work*) have been used by all instructors since Fall 2000. The last multimedia unit (*Unit 4: Technology and gender issues)* was developed in Fall 2002 and first used in Spring 2003. The multimedia CDs are evaluated each year by the faculty teaching this class and are revised every two years.

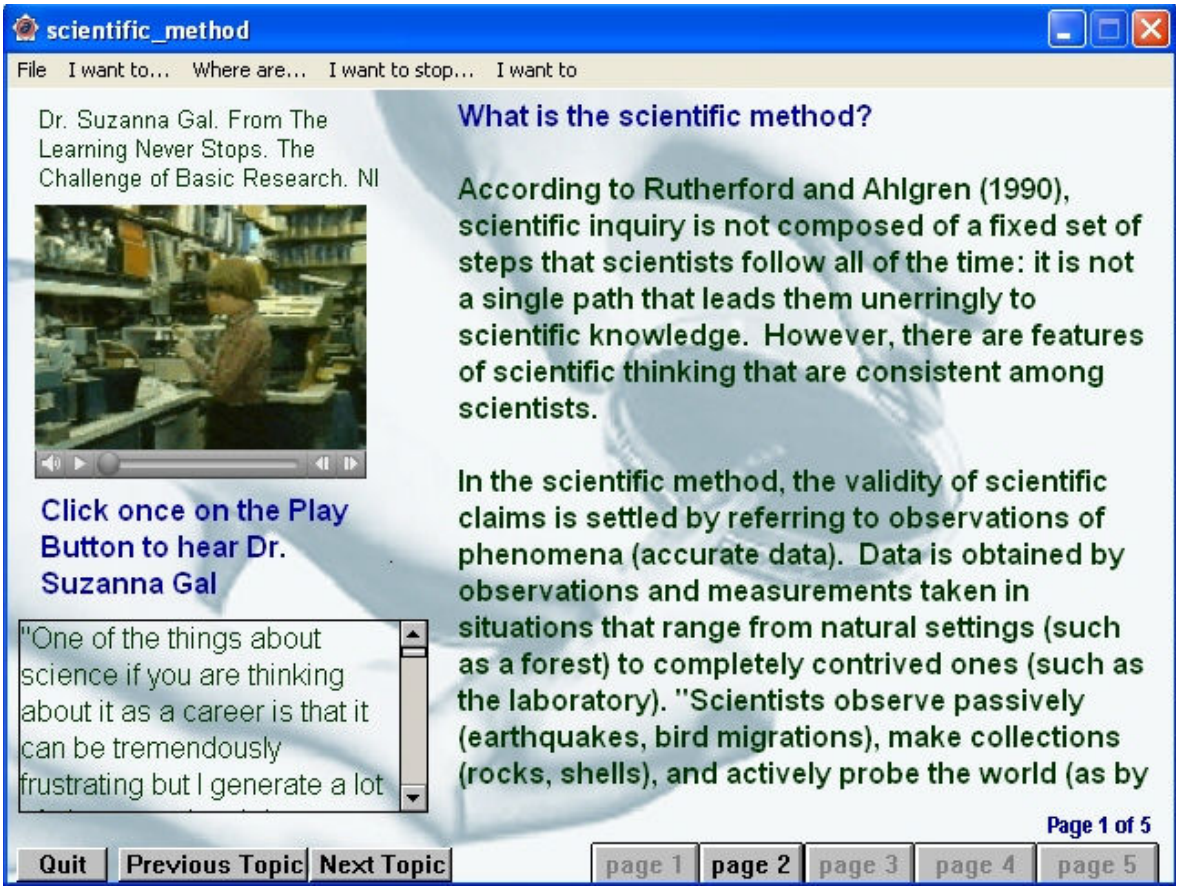


**Figure 2.** Screenshot from Section 4—The scientific method of Unit 1 (*The nature of science and technology)*

The multimedia for each Unit is structured so that the information is presented in manageable chunks. The information was chunked into sections and the navigation is between the sections

of information using *Next Topic* and *Previous Topic* (see Figure 2 for an example). As Laurillard[11] pointed out in her research, "learners working on interactive media with no clear narrative structure display learning behaviour [sic] that is generally unfocused and inconclusive" (p. 231). The chunking of information is interlinked with the narrative structure of multimedia. Because the teacher-storyteller is remote from the student-listener, the design of the multimedia and the chunking of its content needs to be robust.

The content in each section was designed so that the students could reread a section without restarting from the beginning. This reorganization provided a better narrative structure and, at the same time, increased learner control. As Steinberg[12] found, increasing learner control can make the learning experience more motivating as well as increase student learning.

Unit 1. The content of Unit 1 (*The nature of science and technology)* is used as the foundation for this course and provides a broad overview of the nature of science and technology. In addition, we discuss common attitudes and reactions towards technology and technological change. In Unit 1, we contrast different views about science and technology, especially how they relate to different socio-cultural groups in the United States. There are seven sections in this multimedia: What is Science?, What is Technology?, What is Scientific and Technological Literacy?, The Scientific Method, Attitudes Toward Technology, Technology Dependence and Technology Traps, and Impact of Technology on Society. Each of the sections contains text, movies, pictures, and audio clips that relate to the topic. Figure 1 shows a sample screenshot for the introduction page to Section 5 (Attitudes Toward Technology) of Unit 1. The objectives for Unit 1 are listed below.

**Unit 1 Objectives:**

a. Contrast the concepts of science and technology.
b. Describe the evolution of "modern science" as a Western construct.
c. Differentiate among the various definitions of scientific and technological literacy.
d. Analyze cultural differences in technological literacy
e. Describe one feminist and one cultural critique of the scientific method
f. Investigate several prevailing attitudes toward technological changes and innovations.
g. Illustrate examples of technology dependence and technology traps.

Unit 2. Unit 2 is designed as a web-based History of Technology. This unit was designed to particularly address one of the Area Goals—"Students shall be able to identify the historic context of ideas and cultural practices in their dynamic relations to other historical contexts." In this course, technology is the form of human expression (or ideas) studied. This web-based unit on the History of Technology focuses on how technology developed over time in three different cultures and had three distinct sections: *Technology in the Middle Ages*, *Islam Spain and the History of Technology* and *Chinese Contributions to Technology*. The objectives for Unit 2 are listed below.

**Unit 2 Objectives:**

a. Analyze the development of technology over time and in different cultures.
b. Synthesize the contributions of China and Islam to modern science and technology.
c. Compare Western and non-Western contributions in the history of technology.

Each section of this web-based unit is structured in the same way. The first part presents a historical context for the section. This introduction, although not comprehensive, is designed to assist students without a background or appreciation of history. After reading these background history sections, the student should have an understanding of the economic, political, religious and intellectual environment of China, the Islamic world, or the Middle Ages in Europe. The history section links to existing history materials on the WWW including materials at the University of Calgary[13], Western New England College[14], CUNY-Brooklyn[15], and the Internet History Sourcebooks Project[16].

The remainder of each section focuses on selected technologies and the history of their development and use. The section on "Technology in the Middle Ages" explores various technologies that were developed during the Middle Ages in Europe. This section focused on technologies that appear to be natively "European." The study of medieval technology is divided into six sections: Agricultural Tools, The Harnessing of Time, The Use of Iron on the Middle Ages, Weaving and the Textile Industry, and Building Construction. The content of this section was written by the author and included links to other medieval resources on the WWW including The Medieval Technology Pages[17], the Online Resource Book for Medieval Studies[18], and the Internet Medieval Sourcebook[16].

The section "Chinese Contributions to Technology" focuses on the many Western innovations that have their basis in China, particularly those in printing (paper, block printing, and moveable-type printing), agricultural technology (irrigation systems), mechanical engineering (clockwork, iron, and lead manufacturing, efficient harnesses), and martial (gunpowder, the precursors to the barrel gun, and cannons) technology. The web-based tutorial uses Needham's comprehensive work on China[19] as its basis (see Figure 3). Needham[19] sees the bottom two compartments are being able to take achievements from non-Western cultures. In the case of scientific development, Needham notes many Asian accomplishments which preceded Western developments; however, many times without directly building on them.

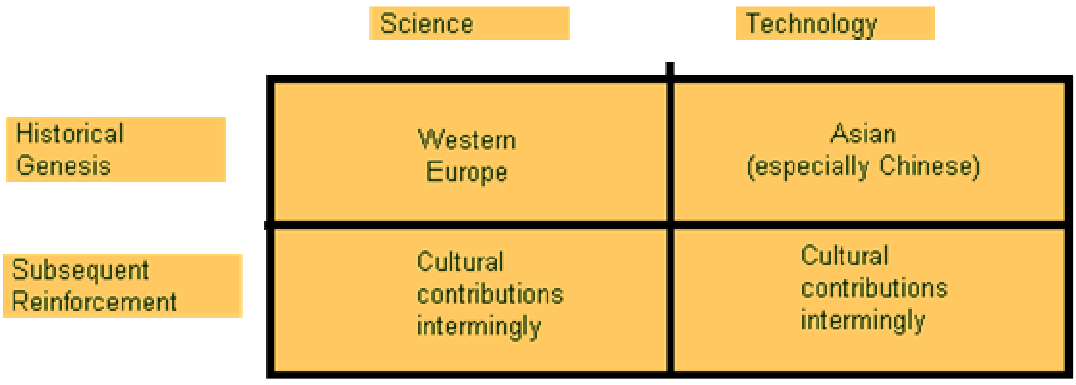


**Figure 3**. Needham's[19] conceptualization of the historical genesis and further developments in Science and Technology, comparing Western Europe to Asian contributions.

The last section, "Islam Spain and the History of Technology," presents the contributions of the Islamic world to modern science and technology, both through the discoveries by Muslim scientists as well other knowledge that was transferred to Europe from other cultures (through Islamic Spain) including the Greeks, Persians, Indian, and Chinese. The Muslims synthesized, elaborated, and transmitted this knowledge to Spain; and eventually, to the entire Western world. In Western Europe at this time, most of the knowledge of the Greeks was lost. It was only through the transfer of Greek knowledge (including Aristotle's philosophy, Ptolemy's geography, Hippocrates' medicine) by Islam Spain that this information ever got to Western Europe.

The section on Islam Spain is structured in a slightly different way than the other two sections. After the introductory section on the History of Islamic Spain, the author included a section that described Muslim contributions to science and technology in a historical context. This section was added after a review by focus groups concluded that there needed to be a more explicit link between the development of scientific and technological knowledge and the history of both Western Europe and Islamic Spain. Students in this course tend to think of modern science and technology beginning with the Renaissance in Western Europe—they often do not have the historical knowledge as to how most of this knowledge was transmitted to Western Europe. The remainder of this section considers specific scientific innovations and technologies that were transferred to Western Europe through Islamic Spain and is divided this into three sections: mathematics, astronomy, and chemistry and medicine.

Each section of this web-based unit is designed to maximize the use of digitized primary source materials. These primary materials included art images such as Picture Arabic Book of Simple Drugs from Dioscorides' Materia Medica (Creation Date: c. 1334), a photo of the Astronomical Clock from Lyon Cathedral in France (Creation Date: 1383), and the earliest printed book found in China (Creation Date: 868). This web-based unit also contains links to text-based sources on the Web. One example, included in the historical introduction to the role of Islamic Spain in science and technology, has a link to three different accounts of the Battle of Tours in 732 (http://www.fordham.edu/halsall/source/732tours.html). Several text primary sources were obtained from the Medieval Sourcebook[16] including a 12th century agreement on profit-sharing in a silver mine and a 13th century account of the effect of war on the woolen trade between Florentine and Flemish merchants and England. Other primary texts were obtained from the Chinese Culture web site at CUNY[15]; one example used in the web-based unit is The Art of Printing (late 16th Century CE) by the Western priest, Matteo Ricci, in which he describes the process of block printing in China.

At the end of the web-based unit, students are required to answer one class activity. The online history of technology web tutorial is available at http://www.engr.sjsu.edu/pabacker/history/.

Unit 3. The content of the Unit 3 multimedia focuses on the history of technology with respect to work beginning at the Industrial Revolution. We show how work has changed during the past 150 years, how technology has directed/affected this change, and how workers and their attitudes have adapted to technology. Some of the questions addressed in this unit are: How has technology affected work in the West? Has it changed the way we work? Has technology caused deskilling and a loss of jobs? There are eight sections in this multimedia: The Industrial

Revolution, Industrialization of Society in the 19th Century, Workplace of 1900, Scientific Management, The Development of the Assembly Line, Consumerism in the West, Nature of Work Today, and How Does Technology Affect the Workplace? The objectives for Unit 3 are listed below.

**Unit 3 Objectives:**

a. Investigate how work has evolved since the Industrial Revolution and how technology has influenced this evolution in the US and in other countries.
b. Describe the changes in technology and work since the Industrial Revolution and the interplay of this history with other significant historical events.
c. Analyze the effect of the work environment on different groups in society throughout the history of "modern work."
d. Discuss the nature of industrial work in the Twentieth Century? How do "smart technologies" affect white collar workers? What does machine-pacing and de-skilling do to blue-collar workers?
e. Illustrate the effect of technology and robotics on the workplace and workers.

Unit 4. The last multimedia unit is Unit 4 (*Technology and gender issues*). This unit explores the interaction of gender with technology. Are men and women different kinds of technology users? What does history tell us about the role of women at work relating to technology? The ideas presented in Unit 4 generally challenge some commonly-held myths and misconceptions about technology in our society. Also, we discuss stereotypically "female-based" technologies and how they differ from "male-based" technologies in our society. The effect of cultural biases and perspectives on the working and educational environments also are addressed. Unit 4 has five sections: Technology and Gender; Women at work before 1900; Women at work, 1900 to today; Attitudes of, and About, Women in Technology; and Gender-based Technologies. The objectives for Unit 4 are listed below.

**Unit 4 Objectives:**

a. Characterize the gender-related contexts of technology development.
b. Synthesize the stereotypes of "men's work" and "women's work" as they relate to technology.
c. Contrast how work in the home has evolved as compared to work in the marketplace.
d. Describe the evolving role of women in society since the beginning of the 20th century and how technology has affected this development.
e. Analyze the effects of technology on women from different cultures and societies.

At the end of each section in a multimedia unit, the students must complete a class activity that is, depending on their individual instructor, either emailed to their instructor or brought into class as homework. The questions for each class activity are directly linked to the Learning Objectives for SJSU's GE Area V.

Lecture/Activity Units

Three of the units in this course are taught in a lecture/activity mode. Although some of the class periods are in the lecture format, the structure of this course is primarily based on the model of

collaborative learning[27]. That is, most of the periods are spent in class discussions, group activities, individual activities, video presentations, and other interactive learning modalities**.** Tech 198 is scheduled to meet in a multimedia teaching classroom that is equipped with wireless internet connections, one teacher's workstation with LCD projector (including video/DVD capabilities), twenty student computers, and hexagon tables for student activities.

Unit 5. The topic of Unit 5 is *Technology Transfer and Cultural Issues*. This unit looks at the multi-faceted issues related to technology transfer and the interactions of technology with culture. Baark and Jamison (1986) approached the study of technology transfer and appropriate technology by looking at the relationship between culture and technology. They defined technological imperative as the universal, modernizing trend in technology development. To balance this technological imperative, Baark and Jamison defined the term "cultural critique of technology" to include the images of technology as well as the values challenged by technological change. We use the perspective of Baark and Jamison[26] (see Figure 4) as the context for this unit.

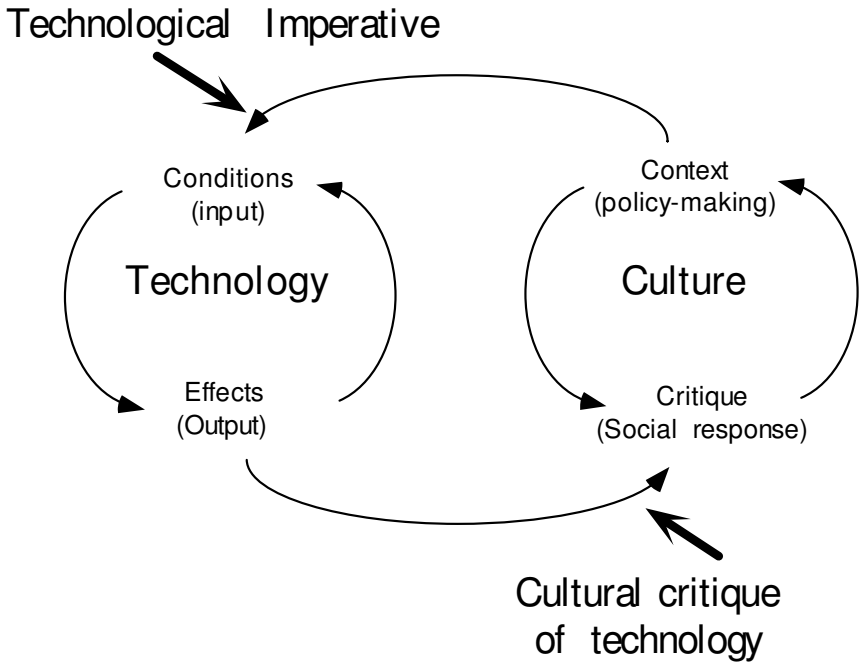


**Figure 4.** The interrelationships between technology and culture (Baark & Jamison)[26]

The course objectives for Unit 5 are listed below.

**Unit 5 Objectives:**

a. Discuss the culture-related contexts of technology development.
b. Describe the mechanisms of technology transfer.
c. Analyze possible uses of technology transfer among countries.
d. Analyze environmental racism with respect to technology use and development.
e. Discuss how technology impacts the division between the "haves" and the "have-nots" in the world

Unit 6. The topic for Unit 6 is Quality of Life. In this unit, we discuss the impact of technology on the quality of life both in the United States as well as in other countries around the world. Most instructors use a combination of articles about specific technologies and videos to lead discussion sessions with their students. Some of the topics discussed include global climate change, global pollution, and waste. Each instructor chooses different technologies as the context for the class activities for Unit 6. The learning objectives for Unit 6 are listed below.

**Unit 6 Objectives:**

a. Describe those elements that are essential to the QOL in societies around the world.
b. Contrast opposing points of view to determine the effects of technology on the environment.
c. Compare technological problem solving using "technology fixes" versus social engineering.
d. Describe the impact of technology on the quality of life of people from different countries

Unit 7. The topic for Unit 7 is ethics. We begin our discussion of ethics by reviewing several classical ethical theories including *consequentialism, deontology,* and *virtue theory.* As in Unit 6, we follow up our discussion of ethical theories with class discussions and activities related to specific technologies. Recently, most instructors have used bioterrorism, global information technology, reproductive technology, and/or biotechnology as the context for our discussion of ethics and technology. The objectives for Unit 7 are listed below.

**Unit 7 Objectives:**

a. Clarify values with regard to the impact of unplanned rapid change on the persons who live in newly industrialized countries.
b. Review several contemporary technology innovations and developments and the ethics associated with responsible technology decision-making.
c. Discuss procreation medical technologies and their impact on men and women in contemporary societies.
d. Trace the effects of our reliance on high tech medicine on ethical standards in society--both in the United States and in other countries.
e. Analyze the effect of information technology on individual and workplace privacy.

Most instructors use a combination of articles about specific technology and videos to lead discussion sessions with their students. A sample lesson plan that uses bioethics as the context for this unit is shown below. This lesson plan (for a three-hour class period) uses a combination of video clips, individual class activity, group activity, and computer activity to engage students in the topic of technology and ethics.

- The nature of ethics
  - Powerpoint presentation about ethical theories
  - Present a potential ethical technology (for example, nuclear weapons, guns, in-vitro) and ask individual students to give their ethical response. That is, students should say if they think the technology is "good" or "bad." Based upon their response, the teacher should discuss whether their perspective is deontological, consequentialist, or virtue theory.

- Mesthene and McDermott articles
    - Have students individually answer questions about Mesthene and McDermott articles
    - Lead class discussion on answers
- Bioethics
    - Show portion of presentation on bioethics (from http://www.hhmi.org/research/bioethics/general/)
    - Show video clip (Overview) from Ethics in Biomedical Research
    - Have students divide into groups and work on the Bioethics case study
    - Show video clip (Genetic Alteration) from Ethics in Biomedical Research
    - Bioethics computer activity

Assessment of this Course

SJSU's GE program is developed as an outcomes-based program. SJSU uses course-embedded assessment to determine the university's achievement of its GE learning goals. Each course, which is approved for general education, must submit an assessment report to document how students meet the specific learning objectives for the GE area. The assessment data for all the courses in a GE area is aggregated by the university to assess the overall results for each GE learning objective. Course-embedded assessment "uses instructor grading to answer questions about student learning outcomes in a non-intrusive, systematic manner. The process requires instructors to define learning objectives for each course, devise a rubric that measures these objectives, use the rubric to grade student work, record the data, and note needed changes for future course offerings."[20]

Normally, courses submit assessment reports every four years. Since Tech 198 had been recertified in AY 2002-2003 it was required to submit a complete assessment report to SJSU's Board of General Education in Fall 2006 in order for the course to remain in the General Education program. The assessment summary included information on how many students met each GE learning objective and how this was assessed by the instructor.

Overall, there are seven multimedia class activities in Unit 1 [The nature of science and technology], eight multimedia activities in Unit 3 [Technology and work], and six multimedia class activities in Unit 4 [Technology and gender]. Students write ½ to 1 page essay responses to each of the multimedia activities. Also, the students complete a longer class activity related to the web-based unit on History of Technology and they write 1-2 pages on this assignment. Since the department required that this class be predominately non-lecture, there are dozens of individual and group in-class writing assignments that are used each semester by the different instructors. Each week, students submit one to two writing assignments. The students receive feedback for both content and writing on their assignments. Most of these writing assignments are directly linked to the student learning objectives for Area V of GE.

For example, Learning Objective 2 for SJSU's GE Area V is *Students shall be able to identify the historic context of ideas and cultural practices in their dynamic relations to other historical contexts.*[1] To assess whether students meet this student learning objective, all instructors in Tech 198 use the web-based history of History of Technology tutorial and all students in all sections

complete the class activity at the end of this tutorial. Also, all instructors use the multimedia for Unit 3 [Technology and Work]. Several sections of the Unit 3 multimedia relate to this learning objective: Assembly Line (section 5–Technology and work), and The Nature of Work Today (Section 7– Technology and work). The specific class activities that meet this student learn ing objective are listed below.

*Web-based Class Activity Related to this Learning Objective*

**Web-based unit on History of Technology**
(http://www.engr.sjsu.edu/pabacker/history/)

1. Discuss the history of timekeeping and the clock from its early beginnings to the Renaissance.
2. Describe at least two forces (e.g., historical, cultural, social, economic, political) that affected the development of timekeeping and the clock?
3. How did the development and use of the mechanical clock change its country of origin (China)?
4. How did the development and use of the mechanical clock affect Europe in the Middle Ages?
5. How has the use of the clock influenced American culture?

*Multimedia Class Activities Related to this Learning Objective*

**Class Activity Five (Unit 3 multimedia [Technology and Work])**:

1. Briefly describe the history of the assembly line outside the US (prior to Henry Ford).
2. How did Henry Ford perfect the assembly line?
3. What were some of the effects of the assembly line on workers in the US?
4. On a broader scale, how did the assembly line influence American culture?

**Class Activity Seven (Unit 3 multimedia [Technology and Work])**:

1. Discuss the development of Just-in-Time in Japan.
2. How has the Just-in-Time philosophy affected the work environment in the US?

In addition to these multimedia and web-based class activities, each instructor supplements this assessment with other measures. One faculty member supplements this with midterm examinations that contain essay questions that require students to address historical changes in social and individual attitudes to technology and science outside the US and how they have influenced American culture. Another professor's students complete an individual assignment that focuses on 20th century societal change due to the development of technologies and the interplay of those technologies with culture. A third professor has his students complete a group activity that focuses on his article "Bridging the Gap between cultures." All professors have embedded questions on the final and/or midterm exam that directly relate to this learning objective. For each student learning objective for Area V, there are some standard assessment measures used by all professors. These standard measures are supplemented by individual assessment measures created by the faculty.

The department offered five sections of Tech 198 in Fall 2005, one section in Winter 2006, four sections in Spring 2006, and one section in Summer 2006. All of these sections were included in

the assessment report submitted to the university. After review by the university, the course was approved for continuing certification in General Education with no concerns. The Board of General Education at SJSU wrote, in their approval memo, that Tech 198 was considered to be a "model." The assessment report for Tech 198 is posted on the GE web site.[28]

Table 2 shows the assessment results for this course for each GE area over the AY 05-06 year. The lowest SLO, as far as student achievement, is SLO #2. SLO#2 states "*Students shall be able to identify the historical context of ideas and cultural traditions outside the U.S. and how they have influenced American culture.*" Based upon the analysis of the results by the faculty, it appears that students have a difficult time describing the historical contexts of ideas outside the US and then linking this discussion with American culture.

**Table 2.** Embedded assessment results for Tech 198 for AY 2005-2006

| Area V SLO | | B+ or greater | C or greater | Less than C- | Total number of students |
|---|---|---|---|---|---|
| 1 | compare systematically the ideas, values, images, cultural artifacts, economic structures, technological developments, and/or attitudes of people from more than one culture outside the U.S. | 74 (31%) | 191 (80%) | 48 (20%) | 239 |
| 2 | identify the historical context of ideas and cultural traditions outside the U.S. and how they have influenced American culture | 67 (28%) | 180 (75%) | 59 (25%) | 239 |
| 3 | explain how a culture outside the U.S. has changed in response to internal and external pressures. | 79 (30%) | 192 (80%) | 47 (20%) | 239 |

The content of this course is continually being modified to more closely address the student learning objectives and goals for this GE area. Every two years, the multimedia is revised and new class activities are written. Each professor continually tries new activities in this class which are shared as best practices among the faculty teaching this class. Specifically, in Summer 2006, we modified several multimedia and web-based class activities to more closely align with the GE Learning goals. Overall, the following class activities were revised to more closely meet the GE learning objectives: What are the cultural aspects to scientific and technological literacy? (Unit 1, Section 3); The Industrial Revolution (Unit 3, Section 2); The Industrialization of Society in the 19th century (Unit 3, Section 2); Scientific Management (Unit 3, Section 4); The Assembly Line (Unit 3, Section 5); Work Today (Unit 3, Section 7); Women at work before 1900 (Unit 4, Section 2); Women working around the work (Unit 4, Section 4); and Attitudes towards and about women in technology (Unit 4, Section 5). In addition, we revised the two research exercises in this class to more closely align with the Area V student learning objectives (see Appendix). We hope that these new student activities will help the students in their achievement of the student learning objectives for Area V.

The faculty also reviewed student assessment data gathered from SJSU's teacher evaluations for this course. Each tenured faculty at SJSU is required to have two classes each year evaluated by the students in the class. In our department, we require that all classes taught by instructors be

evaluated each semester. During AY 2005-2006, four Tech 198 classes were evaluated by students through the Student Opinion of Teaching Effectiveness (SOTE) instrument.[21] Two of the items on the SOTE instrument are related to the mechanics of this course; therefore we examined the student data for these items. Item 1, with a weighted mean of 3.88 over all four sections, is entitled *demonstrated relevance of the course content.* Item 2 (*used assignments that enhanced learning)*, with a weighted mean of 3.7, is also related to this assessment. Both of these items indicate that the class was "somewhat effective" to "effective" in meeting this objective. The faculty decided to follow up this SOTE evaluation with an in-depth student evaluation of this course in Spring 2007 using the Student Assessment of Learning Gains (SALG) instrument[22]. The SALG was originally designed for assessing chemistry teaching and learning in over 100 two- and four-year institutions. The National Science Foundation funded this project for five years (1995-2000) as part of two, linked consortium, "ChemLinks" and "ModularChem." The SALG instrument was modified to meet the needs of this course. The SALG can be found at http://www.wcer.wisc.edu/salgains/instructor.

Based upon the embedded assessment results, the extensive use in all class sections of short essay class activities in these multimedia modules show the students' abilities to integrate their learning into their lives. There have been long-standing claims in the research literature that students learn faster and retain more information the more they are involved in the learning process (Liu & Hsiao[23], Royer & Royer[24]). Therefore, the more students interact, the more they will learn. From a theoretical perspective, Hamilton[25] saw the curriculum as a process that should not separate what is learned from how it is learned. This duality is the fundamental identity of multimedia.

Since this class has continuous assignments for students, each week they must write about the course topics each week. Our surveys show that students enjoy the self-paced multimedia modules for Units 1 through 4 and their answers to the class activities in these units (21 in total) show an understanding of the SJSU GE Learning Objectives.

Each Spring, this class undergoes an intensive assessment effort and each faculty who is certified to teach this course participates in this effort. The entire course is reviewed including the multimedia modules, the web-based module, the books, the readings, and the syllabi. The faculty construct the new syllabi for the following academic year. In the Spring semester, we generally have two to four meetings to finalize this work. In the Fall, we meet only twice to review any issues and concerns.

Summary

The use of the multimedia and web-based units ensures consistency in this course. In essence, the multimedia developer (who also serves as the course coordinator) provides the "lecture instruction" to all sections of the class each semester through the medium of the multimedia. Also, since most of the class activities in the multimedia require essay writing, this helps the department meets its GE writing goal for this course. For the other faculty teaching this class, the use of the multimedia reduces their workload. If they wish, they do not have to meet their classes for approximately 65% of the semester. These instructors are only required to grade the class activities that the students submit. Since SJSU is a teaching institution where faculty members

normally teach 12 WTUs, this reduction in workload is significant for the individual instructor. The instructor can then use the "free time" to undertake their scholarly and professional activities. For the instructor, the use of multimedia allows them to provide one-on-one instruction to their students while decreasing their workload. Considering the increased expectations of faculty, this reason alone might be sufficient for using multimedia in instruction. As more universities consider adding STS courses to their curriculum, the delivery of these courses through multimedia can add depth to the story they are telling about the relation of technology to society. By using the Web and multimedia, student experiences can be enhanced and students can get a richer, more complex view of technology and its effects on our world.

The assessment model used for this course is complex but it allows the faculty to teach this course rather than teach to a standardized test. Individual faculty are free to change this course to better meet their interests. We look at this course as a fluid learning experience for students and instructors. All the faculty who teach this course work together to continually improve it and assist each other in our teaching and learning.

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