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From the Editor

Form, Function, Faucets, and Design

Humankind has used vessels to transfer liquids for several thousand years. Despite all this cumulative experience by artisans and engineers in designing pouring vessels, I cannot pour coffee from the carafe of our current coffee maker to a cup without spilling it. The only successful pours I have made occur when the carafe is about half full. If it is on the full side or the empty side, a spill is sure to occur. I have ruled out my waning psychomotor skills and steadiness that come with aging as possible causes. Even replacing the carafe with a new one did not improve its pouring performance. If the carafe had been manufactured by an upstart company, then perhaps an excuse could be conjured up, but the coffee maker was designed by one of the largest coffee maker manufacturers in the world, with over 40 years of experience.

Another personal design frustration is related to my increasing interest in learning to play the piano. It has always been a challenge to me as a novice musician to turn the pages of the music while trying to maintain a constant tempo. The only solution I have come up with is to memorize the notes that need to be played during the page turning activity. I do not have a solution, though, to the annoyance of trying to keep the pages from turning by themselves as I play, since most music books are "perfect bound" and the pages do not stay put. Thus, when I purchase a new music book, I go through a routine of opening the book and then pressing the pages down in an attempt to get them to lay flat. This is an inadequate solution at best. What's more, it causes premature failure of the binding. I am not sure how long spiral book binding has existed, but it surely seems that it should be the *de facto* standard for music books.

A third frustration is related to the trend, at least in the US, toward "super-sizing" consumer products. The fast food industry is perhaps the most well-known example of this phenomenon, whereby consumers can request that their meal be super-sized, adding to the amount of food and the number of calories. Super-sizing has even occurred in paper products, with most brands of paper towels and toilet paper offering super-sized rolls of their products. I am confident that many consumers think that they are getting more for their money in the super sizing, but in fact the cost per sheet is typically the same, regardless of the size of the roll. The problem here is that neither the toilet paper nor the paper towels can be easily removed from the rolls using the typical paper holders that are available until the roll is reduced to a "regular" size through use. Until that point, the act of pulling a towel from the roll and tearing it off requires two hands. I decided that the paper manufacturers and the paper holder manufacturers had collaborated in a conspiracy to force consumers to upgrade their holders to the new sized rolls. However, in taking some preliminary measurements in my admittedly unscientific “study” in the marketplace, I discovered that nearly all the paper holders properly accommodate a standard-sized roll of the paper product. The exceptions that I found to this were rare and many of those were non-functional for other reasons.

Considering how well-developed our designing and engineering practices and accomplishments are, it is truly amazing that these design and engineering foibles continue to exist. There are many lessons for our students that can come from an analysis of the functionality of even the simplest of the products that we use each day. The opportunities include design, engineering, history, and economics. Moreover, learning opportunities along these lines are either directly or implicitly included in the *Standards for Technological Literacy* (International Technology Education Association, 2000).

As students of design, we are no doubt familiar with the relationship between function and form and the classical axiom that “form follows function.” In other words, if a product does not serve its utilitarian purpose, the fact that it looks good is of no significance – *sine qua non*. I recently had the occasion to learn quite a lot about an artifact most of us use everyday and usually take for granted: the humble and mundane water faucet. At the lowest level of functionality, the water faucet must control the flow of hot and cold water. At the next level, the technology allows the user to control the water with either two separate valves or just a single valve. In the average home, faucets are used in three primary applications: the kitchen, the lavatory, and the bath. Thus, there are really six fundamental choices: single versus double handles and three sites in the home where faucets are used. Yet, I counted 158 different faucets on display at our local home center store. Designs ranged from ultramodern to classical and finishes ranged from traditional chrome to copper with a patina reminiscent of an ancient bronze statue. Even more possibilities are available by special order. Beneath their outward appearance, though, the faucets of a particular manufacturer are functionally identical and use the same set of repair parts.

There is little difference in the functional performance of faucets these days. By and large, they all perform excellently and will provide carefree service for a number of years. What sells faucets is how pleasing their appearance is in the eyes of the consumer. In effect, good performance is expected and the products are distinguished from one another by how good they look. Aesthetics have become the principal venue of competition among manufacturers of a wide range of products. Manufacturing products that are aesthetically pleasing to the consumers and are competitive in price and performance at the same time is a significant challenge to engineers and designers. Yet, meeting this challenge is essential for an enterprise to remain viable.

I once learned that the difference between humans and other living entities was that humans could use tools to make things – *homo faber.* This notion has been dispelled if only through observing the behavior of primates on television documentaries such as those sponsored by *National Geographic*. For example, monkeys can remove the branches from a small tree and fashion it into a device to fetch food floating on a pond, thus making a tool.

One of the characteristics that separate humans from lower life forms is our ability to design objects that are beautiful. Some of these objects are simply pleasant to look at while others are both pleasing to look at and also serve some utilitarian purpose. Humans' ability to create beauty and to seek environments in which beauty exists are arguably definitive elements in determining the condition of being "civilized."

When the industrial revolution occurred in the US there was increasing concern about the sameness of the products produced by the evolving system of mass production. This similarity of product was a logical outcome of the revolution since it took a huge investment in the production system required to mass produce a given product. But once in place, the system could produce products very cheaply and competitors who were custom-producing the same products were driven out of the market place. In addition, the challenge of mass producing products was formidable in itself and aesthetics were clearly compromised.

The absence of beauty in these early products, in fact, was a springboard to increased concern for teaching students about aesthetics in the educational programs, some of which had an historical lineage to the technology education programs of today. In fact there is evidence that can be found that concern over the lack of aesthetics in the early industrial system influenced a change in name from manual training to manual arts.

At roughly the peak of the industrial revolution, the 1876 Centennial Exposition was held. Most of the exhibits that were set up for this event are now on display at the Smithsonian Museum in Washington, DC. In the exhibit are examples of the "prime movers" of technology of that day such as steam engines, mechanical conversion systems, and milling machines. One is taken aback at how much effort went into making these exclusively functional artifacts of technology into objects that were also very beautiful. Pin stripping, brass adornments, and polished mechanical fasteners are examples of the accoutrements. Today, the engine compartment of the automobile has a parallel emphasis on aesthetics, with obvious attention to form along with efficiency.

The *Standards for Technological Literacy* (International Technology Education Association, 2000) distinguishes between technological design and artistic design, emphasizing that the former is driven by efficiency and the latter by aesthetics (p. 90). The Standards nearly exclusively focus upon technological or engineering design. There are practical reasons for bifurcating the two in order to make the scope of the Standards manageable, especially considering that they represent a pioneering, prototypical effort.

Ignoring aesthetic considerations certainly makes the engineering design process simpler. On the other hand, it disregards a very significant aspect of design, especially considering the free market economy toward which the world continues to move. Moreover, the synergism that occurs from collaboration, cooperation, and communication among the members of an organization clearly leads to increased results and creativity. Modern management theory clearly dispels the notion that accomplishment comes from individuals and disciplines working in isolation from one another. Fortunately, the Standards are considered to be a working document and there is considerable flexibility to at least include aesthetics as a constraint in the design process.

As is so often the case in my conclusions to these editorials over the years, I must once again point out that we have little research to inform us about how the consideration of aesthetics might attract the interest of more students and enhance the overall learning process. For sure, we are unique in our ability to provide a learning environment in which students can not only design solutions to technological problems that function efficiently, but look good as well. Arguably, this is just as important as the application of science and mathematic principles. Moreover, this is one way that we can make the educational experience of our students much richer than might be the case in a traditional classroom. Separating aesthetics from function, separating the industrial designer from the engineer, does not seem either plausible or logical in either the real world or in technology education. The two are inseparable partners in the design process and joining them in our educational programs is consistent with our general education intentions. This desire for beauty in our human-made environment has driven us to seek aesthetic qualities in the automobiles we drive, the homes in which we live, the shelter by which we are protected, and the fabrics that clothe us.

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Articles

WebCT as an E-Learning Tool: A Study of Technology Students' Perceptions

Lesta A. Burgess

Introduction

Educators today are using distance education and Internet-based[1] learning as methods for delivering courses. There are many software packages specifically designed for electronic learning (e-learning), such as WebCT, Blackboard, and Prometheus. Before Internet access became widely available, instructors delivered asynchronous instruction via telephone, cable TV, videotape, or printed materials to distance learning students (Hazari, 1998). In recent years, universities have moved to Internet-based courses to attract students not able to attend traditional classes for various reasons. In the majority of cases, students enroll in Internet-based classes because of convenience while working toward a diploma or enhancing professional skills that may result in a promotion or career change (Hazari, 1998).

Teaching styles have to be adapted to this new environment because the Internet is a different medium. Faculty and students have to adjust to the pedagogy that uses instructional technology as an integral component in teaching. Many faculty who have not used instructional technology to accomplish course objectives in the past now have to be trained to do so, and they very often include a component in the course that provides information to students about the technology itself (Hazari, 1998). Students must be trained to work with instructional technology in order to be successful with online learning classes. This study sought to determine students' interest in using WebCT as a tool for completing courses online. It also sought to determine students' familiarity with WebCT. WebCT was selected because of its use by the university being studied. Two industrial technology courses were selected. Students were surveyed at the end of the course after they used WebCT for a variety of assignments and electronic interaction. The goal of this article is to inform those considering online education about students' perceptions of using WebCT. While some statistics are available for online programs as a whole, little research has been done in the area that focuses on a specific software package such as WebCT.

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Since the study focused on students in a technology curriculum, it should have particular relevance to technology education professionals. There is reason to suspect that technology education majors may respond differently to online course experiences, since there is some evidence that their learning styles differ from those in other teaching majors (see Reed, 2001).

Distance Education

Distance education, the transmission of instruction from one location to multiple locations via telecommunications technology, has expanded at an exponential rate in post-secondary education settings (Smallwood & Zargari, 2000). This exchange of information between instructor and student can be in the form of compressed video/interactive television (ITV), video conferencing, satellite transmission, Internet, or Internet-based delivery used separately and/or in combination with traditional modes of instruction. Access to distance education may require students to be at a specific location at a specific time, such as with ITV, or the course can be made available via electronic files and accessed at the student's convenience. This is the case with Internet-based courses (Smallwood & Zargari, 2000). Thus, the more traditional method of teaching via lecture or face-to-face interaction could potentially be supplanted by students learning at their own pace, on their own time, and at any location with an Internet portal (Whitehead, 2001).

Internet-Based Learning

The use of the Internet as a tool for Internet-based learning (also called e-learning) has educators rethinking the way instruction is administered to students. Internet-based communication creates a variety of ways to deliver instruction and provide electronic resources for student learning. Some methods, such as using Web pages to deliver text in much the same way as hard bound texts, are very familiar to faculty. However, a big advantage is that the Internet also supports the delivery and use of multimedia elements, such as sound, video, and interactive hypermedia (McNeil, Robin & Miller, 2000). Curriculum, administration, and assessment are all affected as members of the educational community experience changes in communication and commerce that are a result of the explosive expansion of the Internet (Austin & Mahlman, 2001). Thus, many educators are looking at the way Internet-based learning can provide flexibility and convenience. Internet-based learning can overcome some traditional barriers such as time and place. A student can study independently online or take an instructor-led online class, which combines the benefits of self-study with those of more traditional classroom-based learning (Ryan, 2001). For working adults occupying an increasingly large percentage of our college population, and with greater numbers of students having computer and Internet experience prior to entering college, opportunities are being made to better meet their needs, interests, and work schedules through online classes

(Cooper, 2001). As university-level technology education programs begin to offer more online classes and degree programs, technology education professors may be in the position of developing online offerings (Flowers, 2001).

Internet-based learning does not require extensive computer skills, although familiarity with computers and software (especially Web browsers) does help to reduce the intimidation factor (Ryan, 2001). Internet-based learning generally fits into one of three major categories:

> *Self-paced independent study.* Students determine the schedule and study at their own pace. They can review the material for as long as necessary. Feedback from online quizzes takes the form of preprogrammed responses. Unfortunately, there is no one to whom the student can direct questions. This form of study requires the most self-motivation.
> *Asynchronous interactive.* The students participate with an instructor and other students, although not at the same time. They attend classes whenever they need or until the course material is completed. This approach offers support and feedback from the instructor and classmates. It is usually not as self-paced as independent study.
> *Synchronous learning.* Students attend live lectures via computer and ask questions by e-mail or in real-time live chat. This format is the most interactive of the three and feels the most like a traditional classroom. Flexibility is restricted by the previously determined lecture schedule. There are limited course offerings in this format due to high delivery costs (Ryan, 2001).

Positive and Negative Aspects of Internet-Based Learning

Proponents argue that Internet-based courses actually succeed more than traditional instruction at discouraging student passivity and encouraging lifelong learning (Rosenbaum, 2001). Since Internet-based instruction is such a new medium, evidence of effectiveness of online courses compared to traditional instruction is lacking (Hazari, 1998). It is true that in an interactive, multimedia environment, students often find greater opportunities to learn by actively working through new concepts. This, of course, is dependent on the structure and kind of Internet-based learning tools made available to the student. For example, relatively low-tech presentations delivered online allow students to proceed slowly or click past material they already know. Ideally, Internet-based learning also promotes group learning and inquiry via serial e-mails known as "discussion threads" (Rosenbaum, 2001). Instructor tools that can improve or enhance classroom management include e-mail, digital drop box, discussion board, and the chat room. These tools can enable students and the instructor to have broader access to one another as needed (McEwen, 2001).

The advantages of Internet-based courses include: determination of time and place of learning "class time" by the student, access to global resources and experts, completion of coursework at home or at work, scheduling flexibility, and the ability to track progress (Gallagher, 2001; Smallwood & Zargari, 2000).

While Internet-based courses have advantages, it is equally important to note that there are disadvantages. These might include little or no "in-person" contact with the faculty member, feelings of isolation, a difficult learning curve in how to navigate within the system, problems with the technology, the need for the student to be actively involved in learning, and increased lead-time required for feedback regarding assignments (Smallwood & Zargari, 2000). Another disadvantage is the lack of availability of the hardware and software necessary for Internet-based learning.

WebCT

WebCT (Web Course Tools) was developed in 1995 by Murray Goldberg, a faculty member at the University of British Columbia. Universal Learning Technologies purchased WebCT in 1999. According to WebCT, "[It] is the most popular web course platform in higher education today. More than 39,000 instructors at over 1,350 colleges and universities use WebCT to deliver over 147,000 courses to more than 6 million student accounts in 55 countries" (www.webct.com).

WebCT integrates communication tools, including a bulletin board, chat room, private e-mail, and calendar on the WebCT site. In addition, graphics, video, and audio files can be incorporated into a WebCT site. Such features can facilitate interaction between faculty and students (Morss, 1999). These tools are available only to the students and instructor of the course, thus protecting the intellectual property of the instructor, the privacy of the student, and the course content from external parties.

WebCT also provides instructional tools to support course content such as a glossary, references, self-test, and quiz module. Students, too, can place assignments and other materials in WebCT for courses in which they are enrolled. WebCT also gives faculty course management tools for grading, tracking student interaction, and monitoring class progress. Students access their WebCT course materials using a Web browser from any computer connected to the campus Intranet or Internet (Morss, 1999).

A hardware problem with WebCT is that the program only runs on servers using the UNIX operating system. If the institution does not have a UNIX server or is unwilling to devote space on its server for WebCT, it will be impossible to offer WebCT at that institution. A second problem with WebCT is that it is heavily frame-dependent. Frames have a tendency to load slowly, can be cumbersome to navigate, and require more memory than Web pages without frames. Institutions considering WebCT as their e-learning tool will need to determine if students and faculty have the necessary computing power (Fredrickson, 1999).

The Study

The purpose of this study was to examine students' interest in and familiarity with WebCT in order to determine its feasibility as a tool for delivering classes in an Internet-based environment. In this study, WebCT was used as a supplement to traditional teaching methods in two sequential sections of an industrial technology course. The method of instruction in the course could be described as a combination of traditional face-to-face teaching complemented by synchronous interactive elements. Traditional methods included lecture, hands-on activities, and discussions. Students were required, at a minimum, to use the bulletin board feature of the system to view assignments and discussion questions posted by the instructor, and were required to send electronic versions of written assignments to the instructor's mailbox. There were a variety of other functions such as live chat sessions, a personal calendar for each student, and an electronic version of the syllabus available for optional use.

During the course of the semester, the students were gradually introduced to new features in the courseware package as it related to the corresponding course materials. For example, in the first two weeks of the course, the syllabus tool and calendar function were reviewed during class. Elements of the courseware that were required to be used were re-reviewed to assure that students would be successful when on their own after the scheduled meeting time.

The students (n = 57) were surveyed using pen and paper instruments at the end of the semester after using the courseware tool for a variety of assignments and electronic interaction opportunities. The survey instrument incorporated dichotomous and open-ended questions regarding their experiences with WebCT. The questions sought to determine whether the students perceived that they had used the e-learning tool effectively, what elements of WebCT they elected to use, what difficulties they might have encountered, and their overall opinions regarding this e-learning tool.

The first section of the instrument collected data about student use of and familiarity with WebCT. Questions asked how they learned to use WebCT, whether it was useful for the coursework and assignments in the class, and what, if any, technical problems they encountered. The second section of the survey inquired about their interest in using e-learning tools in the future. The last section collected demographic information.

Instrument Validation and Pilot Testing

The validity and reliability of the instrument was ensured by experts in related fields, as well as through a pilot test. The questionnaire was sent to five university faculty for validation. They were asked to evaluate the content of the instrument and to comment on the clarity and appropriateness of the items. Before implementing the survey, a pilot test was administered to fifteen students. A random sampling was used to select the participants. The purpose of the pilot test was to check the time required to finish the questionnaire, to determine if there were ambiguity and format problems, and to clarify items. According to the results of the pilot test group, the researcher made the necessary corrections.

The data were analyzed and descriptive statistics were calculated for the dichotomous items, and the qualitative data were analyzed for emerging themes and consistency with the quantitative data. The data were then sorted by undergraduate major and contrasted on single questions and related-groups of questions. The results of that analysis follow.

Participants

The course selected for integrating e-learning tools was a core course on graphic communication applications, which had no prerequisites. Any student interested in the topic could register for the course, thus there was a wide variety of majors who took the class either as an elective in their program of study or as an open elective course for university credits. This particular course was selected due to the lack of prerequisites, the expected variation in students' skills and interest areas, and the suitability for integration of e-learning tools.

The undergraduate majors in the course were studying Graphic Communications (35.1%), Technology Education (29.8%), Technology Management (10.5%), General Industry (5.3%), Manufacturing Technology (3.5%) and Marketing (3.5%). There was also one student each from Art, Interpersonal Communications, Art Studio, English, General Studies, as well as an Undecided major. The demographic information collected did not include gender or age. Also, the amount of computer experience each participant had prior to enrolling in the class was not measured. The majority of participants (83.9%) were undergraduate and graduate majors in technical or industry-related fields. Upper class (juniors and seniors) or graduate students comprised 80.7% of the sample.

Results

For the majority (94.7%) of students, this was the first time they had used WebCT or any courseware tool. The students appeared to learn the basic concepts of using WebCT easily and required little additional instruction or help from the instructor during the face-to-face class meetings. Comments on the need for additional instruction after introduction to the software included, "It was very easy to figure out," "Clear instructions," "WebCT is self-explanatory," "Didn't really need help."

The calendar function, i.e., important dates relevant to the course generated by the instructor, was reported as the most frequently used tool in the WebCT courseware package. This tool simply required the student to navigate to the calendar page, as updating with personal information was an option. Use of this tool would be similar to referring to a course calendar in a standard, paper-copy course syllabus, albeit the calendar function is a dynamic version of a syllabus. In addition to the calendar, the bulletin board function was regularly used by the instructor to post questions relevant to the course and solicit responses and discussion from the students. This function and the assignment posting feature were the second most commonly used WebCT elements reported by the students.

When asked whether WebCT was useful in electronic communications with regard to the class, more students indicated that contacting the instructor was more useful than connecting with fellow students in the course. Some of the reasons for this included: ". . . She could respond to all of us," "I knew I could get a hold [sic] of you anytime," "Always got prompt answers," "Never used it [communicate with students]; I just talked to them," "Had no reason to communicate with them [classmates]," "Never used it." On the whole, the students found WebCT useful for their course (78.6%). The frequencies and percentages for survey questions regarding use of WebCT are displayed in Table 1.

Table 1
Survey Items Regarding Use of WebCT

Question	Response	*f*	%
Is this the first time using WebCT?	Yes	54	94.7
	No	3	5.3
Did you need additional instruction in using WebCT?	Yes	21	36.8
	No	36	63.2
What WebCT element did you use most frequently?	-Calendar	36	63.2
	-Bulletin board	10	17.5
	-Chat room	2	3.5
	-Assignment	9	15.8
Was WebCT useful for communicating with the instructor?	Yes	44	77.2
	No	13	22.8
Was WebCT useful for communicating with your classmates?	Yes	28*	49.0*
	No	28	49.0
Did you find WebCT useful for your coursework?	Yes	44*	78.6*
	No	12	21.4

*Missing data not included in frequency and percentage calculations.

A majority of students (52.6%) reported no technical problems with the software, and for those who did encounter problems, submitting assignments was the most burdensome task. Some specific examples of problems given by the students were: "Sometimes hard to download and post things," "Seemed difficult at times to post assignments," "Having to write assignments somewhere else and then load them up," "Posting/replying was kind of confusing," "Not knowing when I had to check it for something new," "Hard to understand the procedure." It should be noted that there were also a large number of comments stating no difficulties were encountered.

Further analysis showed that Technology Education undergraduate majors had a strong positive response to the question of the usefulness of WebCT as a course tool. When considering reported technical problems with the software, Technology Education as a group had fewer problems than many other undergraduate majors. Additionally, Technology Education majors responded that they would enroll in a distance education course using only WebCT as their only contact with the instructor. Those students who reported they would not enroll in a distance education course using only WebCT as their only contact with the instructor (42.1%) cited reasons such as: "I like the face-to-face contact with the instructor," "I don't have that good of a computer at home," "Too difficult for me to use."

Other groups of undergraduate majors liked the idea of online education. The frequencies and percentages for survey questions about difficulties with WebCT, desired future use of the technology, and using WebCT as a singular mode of learning are displayed below in Table 2.

Table 2
Survey Items Regarding Technical Problems and Future Use of WebCT

Question	Response	*f*	%
Did you have any technical problems with WebCT (select all that apply)?	Logging on to WebCT	4	7.0
	Submitting assignments	19	33.3
	Accessing the calendar	0	0.0
	Posting/replying on bulletin board	4	7.0
	Sending/receiving private e-mail	0	0.0
	Other	0	0.0
	Did not have any problems	30	52.6
Which one item would you like to see WebCT used for?	Assignments online vs. hard copy	22	38.6
	Quizzes / tests	13	22.8
	Class discussions using chat room	4	7.0
	Bulletin board communication	11	19.3
	Other	7	12.3
Would you enroll in a distance education course with WebCT as your only contact with the instructor?	Yes	33	57.9
	No	24	42.1

Conclusion and Recommendations

In conclusion, it seems that WebCT is a useful tool for students who are comfortable with the technology and do not encounter serious technical problems. Technology Education majors indicated their acceptance of this mode of information access in greater degrees than their classmates in other majors. It could be inferred that Technology Education majors are more willing than other student majors to embrace new or emerging electronic formatted text-based or graphics-enhanced media. Further research on this issue would be warranted.

Overall, the results of the study indicate that student interest in the WebCT is tempered by initial experiences with the technology. For students who struggled with uploading assignments, using the calendar or bulletin board features, or checking for new postings on a regular basis, e-learning was perceived to be time consuming and/or challenging. However, the majority of students adjusted to the technology quickly and with enthusiasm.

Further research needs to be conducted to determine whether e-learning is being accepted by students and/or whether e-learning is better than traditional instructional methods. It is also recommended that studies be undertaken concerning the pedagogical methods that are employed in using e-learning tools. Finally, it is recommended that the study be repeated with a larger sample size and with in-depth interviews with the participants possibly conducted.

Endnotes

[1] For the sake of clarity, the Internet is defined as "a massive network of networks" that includes the World Wide Web (Web), e-mail, Usenet groups, instant messaging, and file transfer protocol (FTP). [http://www.webopedia.com/DidYouKnow/Internet/2002/Web_vs_Internet.asp]

[2] As a result of an internal panel review of courseware packages currently on the market, the author's institution selected WebCT as the e-learning tool to be offered to the faculty for their Internet-based courses

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Gender Issues in Technology Education: A Quasi-Ethnographic Interview Approach

W. J. Haynie, III

In 1999, my study of "Cross-Gender Interactions in Technology Education" was published in the *Journal of Technology Education* (Haynie, 1999). It reported survey findings on "how professionals in technology education feel about certain issues concerning cross-gender interaction in technology education and whether or not men and women differ on those issues" (p. 28). The study purported itself as an attempt to open a new line of inquiry and admitted that, taken alone, it was merely a beginning. My hope was that other researchers would follow that survey with studies of different designs to provide the triangulation required to draw supportable conclusions from qualitative research. I hoped that those researchers would be well versed in the techniques of qualitative research. This has not occurred. Not satisfied to assume that this lack of action meant there are no problems to study, and feeling that failure to proceed was not good for the health of our profession, I decided to take the next step. Since I had previously conducted only quantitative (and mostly experimental) research, I began some independent study about appropriate methods for follow-up studies to the 1999 work. This paper reports the findings of a quasi-ethnographic interview approach conducted in 2002. It is tempered with my own purposeful observations since 1966. Since reference and comparisons are made to findings from the 1999 survey, the triangulation provided here is from three perspectives: survey, interview, and personal observation.

Background

Since the early 1980s, a curriculum known as technology education has evolved from the earlier industrial arts. Industrial arts had failed to attract many female students or teachers but there were some early indicators that the more contemporary technology curriculum would be more attractive to females (Cummings, 1998; Hill, 1998; Sanders, 2001; and Zuga, 1998). Simultaneously, changes in society have made women feel more accepted in traditionally male dominated professions and have redefined acceptable behavior for both males and females in social interactions (Foster, 1996; Haynie, 1999; Stevens, 1996;

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and Wolters & Fridgen, 1996). A small body of research has begun to develop concerning issues such as the lack of women in technology education, the need for more women to enter the profession, the historical reasons why there are so few women, and potential factors which may cause the problem to persist (ITEA, 1994; Liedtke, 1995; Markert, 1996; Silverman & Pritchard, 1996; Trautman, Hayden, & Smink, 1995; and Volk & Holsey, 1997). Most of the efforts, however, have either been opinion papers or library research. The 1999 survey by Haynie was helpful and based upon recently collected hard data, but not sufficient. Its findings included: "(1) all technology education professionals should regard the school environment as a setting that requires a more conservative demeanor than society at large, (2) they should realize that their colleagues are likely a little more conservative than the values implied by contemporary society, (3) they should be sensitive to constantly monitor the appropriateness of their own actions and adjust them according to the reactions of others, and (4) they should treat all persons with respect and fairness—judging them on their performance and ignoring all other potentially divisive factors" (p. 39).

How should research efforts on women's issues in technology education be directed in the future? Markert (1996) clearly indicated that "Educators at all levels (both male and female) must be mindful of a wide assortment of behaviors they may unknowingly display that create a chilly classroom or null academic environment for their female students" (p. 28). These unknown behaviors must be identified and eradicated because "Speeches and reports that extol the benefits of gender equality are nothing more than empty rhetoric if they are not followed up with commensurate action" (Akubue, 2001, p. 71). The library research conducted thus far, though helpful in demonstrating that study is needed and identifying a few issues, does little to solve the problem—more quantitative and qualitative study (involving people who are living today) is needed to ascertain what "is" and what "should be" concerning the comfort of women in technology education. Once these sorts of investigations reveal the factors that need to be addressed, the profession can make the changes needed to attract and retain more female students and teachers.

Methodology and Instrumentation

In the ethnographic interview technique, the researcher actually becomes part of the instrumentation—thus it is important for the reader to know what preconceptions and notions brought the researcher to study the issues at hand. The reader should be informed of the background of the researcher, preparation for conducting the research, motives, and why the researcher "feels" qualified to conduct the study. It is possible, perhaps likely, that a different researcher would obtain different findings, but that does not invalidate these findings—it would yield additional information from a different perspective.

My interest in studying gender issues in technology education first developed in 1966. At that time, I was an undergraduate student preparing to become an industrial arts teacher. In our program of about 100 students there was one female. I came to be a close friend of this student, but not a romantic companion. I saw her face many challenges as she attempted to fit into a male dominated and sometimes hostile environment. She was highly skilled both academically and technically—she scored at the top of most classes. This may have led to resentment from a few of her male colleagues. Despite the fact that some of the professors proclaimed how important it was to make females feel comfortable and valued in our field, some of their own actions had the opposite effect. I am not saying the situation was horrible: she was not physically abused or hated by all the males, nor was she made the target of sexual aggression. Nonetheless, she was not fully accepted and made to feel "normal." She experienced isolation, innuendo, some resentment, and there was a lot of "talk behind her back" (some of which she heard). I could identify with how she felt more accurately than most of my male colleagues because I was a long-haired, bearded "hippie" in a program of very conservative, clean shaven fellows who ridiculed me more openly than they did her. So, I believe I had more than average sensitivity to such issues among males of my age in our profession, and I paid close attention to what I saw and heard—drawing ridicule when I defended her.

I also have a wife who is a mathematics and statistics teacher (also fields that are somewhat dominated by males) and a daughter who we have tried to raise to seek opportunities without reservations based on perceived societal gender-role expectations. It pleases me to see her grab a hammer or check the oil level dipstick in her car, but I have not succeeded in convincing her to become a technology teacher. A lack of interest is not the reason she gives for avoiding our field.

Though I am a male, white, Anglo-Saxon, Protestant (WASP), I have been very observant of the issues studied here for the past 36 years. I have always attempted to encourage women and girls to enroll in courses I have taught at all levels and I have been frustrated by how unsuccessful these attempts have been. I cannot, however, claim to wear the suit of purity with no prejudices. I am a male, I think like a male, and I am sometimes at a loss as to why a particular woman might react in a certain way. I probably do not understand my wife any better than my male friends say they can understand theirs. And, I take great delight in humorous stories/jokes that poke light-hearted fun at differences between men and women. However, there is a line of decency which, in my view, should not be crossed that demarks the point at which such jokes become insulting and hurtful. If finding some of these jokes humorous disqualifies me from conducting this study, then someone else should do the work. I try to be careful not to tell or transmit hurtful and judgmental jokes in any forum that would, in my opinion, offend women or perpetuate harmful stereotypes. So, the portion of the instrumentation that reflects me personally is imperfect, but it appears to be the only one in our profession to date, and I have made every effort to be fair and accurately observant.

The basic methodology used was personal interviews. I attempted to follow guidelines in a classic work by Spradley (1979) for the conduct of fruitful ethnographic interviews. I also consulted Borg and Gall (1989), Burgess (1985), and Goetz and LeCompte (1984) for help with design of the study and instrument. A paper instrument, which I developed, was used to record data and the interviews were tape recorded.

The written instrument was comprised of eight half-size sheets (5-1/2" X 8-1/2") stapled together. This format was used so that the instrument would be small enough to be used in a restaurant and still provide ample space for recording the responses. The first page had a scripted introduction in which the clients were thanked for their participation, informed of the purpose, assured of their anonymity, and asked if they would permit tape recording. Then demographic information was gathered and included gender, marital status, age (categoric intervals of 5 years), number of children and their ages and genders, ethnicity, number of years in technology education, number of siblings and their genders, ages of the students they manage, title of their position in technology education, and subjects that they teach.

The first substantive items on the instrument were three broadly stated, opening questions which allowed the interviewee to speak freely and without limit. These concerned (1) the cultural climate in technology education, (2) barriers to women and whether treatment by men could be a problem, and (3) how to attract more women to enter the profession. They were intended to function as "grand tour" questions in accordance with Spradley (1979). Though some very good information was gathered by these opening items, the fact that clients could see that there were six more pages of follow-up questions may have limited the breadth of their responses—perhaps they felt the interview would last several hours if they talked too long at this early point. This may have limited the responses, but the follow-up questions were more detailed, and there were also repeated forms of these opening items at the very end of the instrument that should have compensated for this weakness.

The follow-up items consisted of 27 items from the 1999 survey by Haynie and seven new open-ended items designed specifically for this study. The 27 previously used items were chosen because they were ones that resulted in significant findings in the earlier study (which included both men and women).

According to Spradley (1979), the manner in which an ethnographic interview is conducted has great effect upon the depth and accuracy of findings. People who feel comfortable, safe, and valued are more forthcoming than those who are treated merely as sources of information. Spradley compares the ethnographic interview to other "speech events," such as the friendly conversation, and points out how it is similar in form but more directed in purpose. An effective ethnographic interview should begin as a friendly conversation and then transition to its purposeful elements—establishing rapport along the way. This was done by conducting interviews in restaurants. Through e-mail contact several weeks before an anticipated interview, I established an appointment at a time when I could take the client to a restaurant for a meal or dessert. The ride or walk to the restaurant provided several minutes for "small talk." While we waited to have our orders taken, the conversations continued.

Topics generally included our families, backgrounds, personal interests and hobbies, and current events. I shared as much of my own self as I requested from them.

Once the food order was placed, we began the interview with my reading the scripted opening statement and turning on the recorder. When the food arrived, I turned off the recorder and we again resumed small talk. This is in keeping with the recommendations of Spradley (1979) to intersperse some informal conversation within the interview to avoid the nature of an interrogation and maintain good rapport. If the respondent seemed to be tiring or losing attention, I suggested a break or interjected some comment which led to a brief diversion into small talk before proceeding.

Spradley asserted that the ethnographic interview is much akin to a personal conversation except that it includes the following three important elements: explicit purpose, ethnographic explanations, and ethnographic questions. The explicit purpose and the initial ethnographic explanations were transmitted during my scripted opening statement. Additional explanations were interspersed where needed to clarify questions or to keep the informant on track. Most of the interview instrument was comprised of the ethnographic questions. Several techniques and follow-up questions or statements advocated by Spradley were employed during the interviews. These included: project explanations, interview explanations, descriptive questions, structural questions, contrast questions, asymmetrical turn-taking, expressing interest, expressing cultural ignorance, repeating, restating in informant's terms, incorporating, creating hypothetical situations, asking friendly questions, and taking leave.

Spradley pointed out that "practice also reduces the anxiety which all ethnographers experience when they begin interviewing a new informant" (p. 57). I must admit that, though it did not seem intimidating when I first conceptualized this study, I was very nervous at the beginning of the first few interviews. Since I was not a popular person in my youth and had very few dates, I have little poise in isolated social situations with women. I worried about how it looked for me to be taking a woman other than my wife out for dinner—especially since some of the interviews took place in my community. Did other people think it was a date? In fact, my wife and I joked about it and called the interviews my "dates" when we discussed scheduled events. If the interviewee was much younger than I, I worried that other folks might think ill of her or me. Once the actual interview phase began and the tape recorder and written instrument were visible, those questions dissipated—still, they added to my initial feelings of anxiety. Generally, the small talk phase helped me as much as it was intended to relax the informants, and I believe we both felt more at ease after sharing a little about ourselves and our families.

The Informants

An attempt was made to include a broad cross-section of women among the informants. I knew some participants from settings prior to the study, but several were strangers to me. Care must be taken in describing group demographics because there are few women in our field, especially at certain levels, and it might be possible for readers to logically ascertain who was interviewed despite my promises to conceal their identity. Thus, I will not state any numbers except to say that two or more women represented most of the demographic groups and very few of the categories listed had lone representatives. No women who were asked to participate refused. A total of 12 women were interviewed. Most of the interviews took place during national, regional, or state conferences.

Most of the women were married, but they ranged across the demographic gamut and included those who were single, divorced, divorced and remarried, and widowed. The ages ranged from the 25-30 category to the over 50 category. They had from 0 to 4 children with a mixture of genders. Some had only boys or girls but three had both genders and the children ranged in age from infant to 20 years. Regrettably, the only ethnic groups represented were white and Afro-American. The informants had worked in technology education from fewer than 5 to more than 25 years. When asked about siblings, the informants reported a range from 0 to 5 with some having both male and female siblings and others having only brothers or sisters. If the respondents were among those who managed students, the ages of those students ranged from 12 to 22+ years. The following technology education positions were represented: middle school teacher, high school teacher, university professor, supervisor, and graduate student. Seven of the women currently work and live in the southeast United States. However, even several of these had worked and lived in other areas of the country, which helps reduce the influence of localized geographic factors.

Findings

The first substantive question read to the informants was broad: "Acknowledging that technology education is still somewhat a male-dominated field, and has a long history as such, how do you feel about the current cultural climate in technology education?" All informants expressed a basic comfort level in technology education and several mentioned positive change since the curriculum change toward computer-intensive work and away from the heavy industry topics of the preceding industrial arts era. Several women mentioned a perceived difference between older men and younger men in the profession. More of the older men were perceived to hold conservative views than the younger men. This was mentioned by both younger and older women. The more experienced informants remembered a field historically dominated and governed by a "good old boys club" with conservative values—they felt they had been pioneers to break into this field. The younger women expressed this perception only concerning older men within the profession. Both older and younger women felt they were better accepted by younger men who had joined the profession since the shift toward technology and away from industry. Some said that breakdown of sex-role stereotypes within society at large is helping in technology education also, but previously developed viewpoints persist among some senior male members of the profession. Specific events described by informants most often occurred in university courses or at conferences—only one event in a public school was described in which a woman was made to feel that she was out of her place by a male technology education professional. Despite a few negative comments and examples, overall, the informants reported that they feel very comfortable most of the time in technology education, students respect them, they wish more girls would take courses and consider a technology education profession, and most men make appropriate efforts to insure their comfort.

The second grand tour question asked, "What are the biggest barriers to women in our field? Do any of these have to do with the way women are treated by men?" Most of the informants had little substantive to say in answer to this question, although two who had not mentioned anything negative in answer to the first item offered the observation previously made by others that a few older men made them feel out of place. Several informants noted a lack of women to serve as role models and this makes it more difficult to attract and retain female students and teachers. One respondent lamented the lack of a well established network for females as there is for men.

The third grand tour question asked, "Do you foresee changes in the near future that will attract more women to technology education? What could we do to attract more women?" The shift in curriculum away from the industrial "shops" of the past and toward computers, communication, bio-medical technology, design, graphics, research and development, and similar topics was mentioned as a positive change in making the field more attractive to women. Other factors included an increase in girls involved in Technology Student Association conferences, more female role model teachers, and some shift in general society which shows women in more assertive and non-stereotypical roles on television. Things that the profession could do to increase enrollment of females and attract more female teachers include: equity camps, online teacher education courses that result in licensure that can be taken while working fulltime or raising a family, technology camps, lateral entry opportunities that will attract more women to a second career in technology education, high visibility events such as TSA and standards research efforts, and affirmative action efforts designed to attract more women. This last suggestion was mentioned by an informant who called for more women in leadership roles within the profession. She pointed out that there are no females on the current ITEA Board and that the few who have served before were "alone"—she used the "old boy's club" analogy to describe our leadership, both historically and currently.

Items From the 1999 Survey

Following these broad questions, a series of items from the previous 1999 survey by Haynie were used as "member checks" (Merriam, 1995) to confirm some of the findings from the previous study. This was possible because half of the women had participated in the earlier study. One of these items asked the informants how they felt about the prevailing social trends of our times which permit “more apparent general acceptance of crude and sexually oriented language.” Though two women indicated this is “OK,” the others said it is a problem and seven used words such as “disgraceful,” “rude,” or “inappropriate.” Two items from the 1999 survey asked about gender specific jokes of two types: those that are “not derogatory or only mildly so with plays on ‘male macho’ or ‘female sensitivity,’” and those that are “intentionally derogatory, but not pornographic (male immaturity/impatience, impulsiveness, PMS, driving, ‘dumb blond,’ etc.).” All informants except one indicated that the first type of jokes were OK if tasteful, but a few pointed out that there would be variations in what individuals consider tasteful or that few of the jokes actually are tasteful. Most of the women said the second type of jokes are offensive or absolutely forbidden, though three of them view these as OK and indicated that they personally share them freely with others. Nearly everyone indicated that the forum in which the joke was told and who was telling the joke made a difference—a joke they might share with their best friend would be inappropriate and poorly perceived if it came from a colleague or their boss.

I had in mind certain types of jokes and attempted to indicate them through the descriptors included with the items. The findings here very closely paralleled those of the earlier survey. Still, I was not certain that we all shared a common understanding of what the two categories meant. Fortunately, after the final interview, and as I began writing this report, I received a humorous e-mail which I felt was near the border between these two types of jokes. I often relay similar jokes to colleagues if I feel they would not be offended, but I stopped short on sending this one. Yes, I did find it to be very funny. I saved it on my computer and when a few close friends came into the office, I pulled it up on the screen for their amusement, but I did not feel comfortable broadcasting it for fear that it might offend some individuals. The e-mail had an image with the heading “the difference between men and women.” The image showed two faux electronic devices with nice brushed aluminum faces and neatly arranged controls that would have made any electronics teacher of the 1960s proud. One of the devices was labeled “Men” and it had only one switch marked “on” and “off” with a pilot light above it. The other device, labeled “Women” had the same switch and pilot light, but additionally had 43 more knobs for various analog controls and adjustments. I decided this joke was close enough to the imaginary line I had drawn in my own mind between offensive and non-offensive to use as a test case. So, I sent it to the women who had participated in the interviews with requests for them to categorize it as derogatory or non-derogatory, offensive or not, and humorous or not. At the end of the message I apologized to any of the informants who might find it offensive. All of the respondents replied to my request. One woman found it “mildly derogatory,” and all of the others said it was not derogatory toward women—but two said they thought that it somewhat “slammed” men. None found it offensive and all found it humorous, though one said it was only slightly humorous. A few of them sent it to other friends or colleagues. One woman, however, pointed out that it would depend somewhat on who the joke came from and in what setting. She also indicated that there was an implicit sexual overtone to the image. Follow-up conversations with three other informants showed that it could be understood on several levels and might indicate various gender stereotypes commonly used in jokes. I had not initially perceived the possible sexual interpretation and only one of the women that I asked said she had caught that meaning initially, but they all recognized it when it was pointed out. Still, they felt that it was not a harmful joke in general.

Another question asked about crude and sexually-oriented jokes in mixed company. These were considered taboo for professional settings, though they were considered acceptable and enjoyable by several of the women in certain situations. Again, it depends more on the setting, who is telling the joke, who is present to hear it, the magnitude of the salacious nature of the joke, and other factors. These findings replicated those of the earlier survey.

One of my hunches (perhaps biases) prior to the first survey was that inappropriate, crude, and sexually oriented language among males might be one of the hidden factors driving women from the field. My observations in the late 1960s were that some of the shops had almost a "locker room" atmosphere, and the lone woman who took the classes was an invader. There were occasions when males said very crude or suggestive things in her presence that seemed intended to offend her or (at least) to make her feel out of place. Do my fellow male colleagues (in significant numbers) still hold the prejudices and exhibit the behaviors that I witnessed nearly 40 years ago, or has our profession matured? Another possibility is that the general view among both women and men has changed so much in society at large that the comments I found so offensive in the past are now within the range of what is commonly acceptable behavior. If that is the case, then my hunch about making women feel uncomfortable and uninvited through abusive language would be moot. That was the reason for this particular series of questions on the 1999 survey and for following them up in these interviews.

The next question in this series asked: "In most regards, do you feel that professionals in technology education correctly recognize the expected language and behavior patterns in cross gender relationships, and that they act/speak accordingly?" Universally, all of the interviewees answered yes and only one reminded me that "sometimes some of the older men will go too far." This finding supports the one in the 1999 survey in which both women and men shared the same perception. In fact, one of the women in the interviews indicated that my follow-up probing question on this issue was unnecessary because there were few "skeletons in the closet" to find.

All but one of the women indicated they would feel comfortable telling a male colleague who asked permission to tell a salacious joke that they did not want to hear it. However, only half of the women reported that they would deny the request if they knew the person well. Three questions asked how informants would react in embarrassing or offensive situations. All of the women reported that they would either use a facial expression, back away, or verbally confront a man who said something they found offensive, touched them in a way that made them uncomfortable, or offended them in any other way. These signals of disapproval were generally understood and effective in eradicating offending behavior. These findings also replicated those of the previous survey.

When asked how they manage situations in which students crossed the line of decency, most informants agreed they would reprimand students who used terms such as “fag” in description of homosexuals, or commented on another student’s body type or sex appeal. Most of the women would make these reprimands privately, but a few would do it openly in class. Several indicated additional punishments appropriate to the level of the students and the specific comments involved. However, one informant said she would just let these comments pass unchallenged.

Another question asked what the informants would do if a male student “takes over” a difficult task from a female student who was struggling to do it, but who had not requested his help. The most common response was for the teacher to indicate that the female student needed the opportunity to learn from the experience, some responded they would remove him from the situation, and one reported she had the opposite problem in a computer graphics class in which a girl had pushed a boy aside so she could complete his assigned task.

Offensive Events Experienced

Next, the informants were asked to describe events in which they were offended, embarrassed, or threatened by the actions or speech of a technology education colleague and how it made them feel. Not everyone had a response and some were very similar. The following were representative:

- At the ITEA conference, a former classmate hugged me too closely/clinging in the presence of my spouse.
- At a conference an older man made a comment about the “good looking woman” and it made me feel like a token instead of a valued professional.
- One professor frequently made me feel like I stood out, it was isolated to only one person but it was obvious to everyone. I do not think he even knew he was offending me.
- One former faculty colleague used offensive language frequently. Another actually made a sexual advance.
- A man I seldom see except at conferences is a close hugger and sometimes makes “fresh” comments. I believe he thinks he is being cute or funny—I try to avoid him.
- At the national conference I was talking to a salesman at one of the exhibitors’ booths and a male colleague barged in, grabbed the salesman’s hand and drew him away as if I were not even there. It made me feel that I was not taken seriously.

When asked if they had ever worked in another male-dominated field and how relationships in technology education compared to that field, five informants reported they had. Two had worked in engineering and one each in military service, landscaping, and retail sales. Two reported their experiences in both fields were very similar, but three encountered more offensive and rough language and felt less respected in their previous experience than in technology education. One former engineering employee said there was better opportunity for women in technology education and the woman who had served in the military said the "thick skin" she had developed there gave her courage to confront anyone who offended her.

Free Response Items

When given an open-ended opportunity to speak about things that make them feel uncomfortable in our profession, some of the women had no answer, and the ones who did respond noted the following:

- Inability of the profession to define itself to others.
- Technical challenges (i.e., fix the sander).
- Isolation—I'm the only technology education teacher at the school.
- Rift between traditional industrial arts and modern technology education teachers.
- There is a glass ceiling preventing advancement, but that may not be gender specific.
- Lack of long and broad technical experience.
- Age—I'm the youngest teacher at my school.

The next question asked, "What is the best thing about working in technology education?" Several highlights of the responses included:

- Feeling needed and that the subject is important (2).
- Fun (5), Variety (3), Exciting (2), Creativity (2).
- The people and the curriculum.
- Family atmosphere.

The last series of substantive questions asked if there was ever a time when technology education did not seem attractive as a profession and how they would react if their own daughter or son wished to become a technology education teacher. Five women admitted that they did not see technology education as a likely career in high school or college. Two of them were influenced to enter the profession by other female technology education teachers who became role models. All of the women interviewed responded that more female role models would attract more women and that they would encourage their own children (of either gender) who expressed interest in technology education to consider the profession.

The final repeat form of the initial open-ended questions elicited the same general responses as the first set, with addition of only the following points:

- We should emphasize quality programs and high standards more to eliminate the "dumping ground" mentality of school administrators and guidance counselors.
- There is some gap between what is taught in teacher education programs and the real world of the public school technology education laboratory.
- Personally, I have not had lots of bad experiences, but there are other females who have been coddled or minimized, and we could encourage and mentor females better.

The last finding that must be reported was an event that I observed at a conference of technology education professionals from several states (during which some of the interviews actually occurred). A female administrator from the university hosting the conference made a brief introductory speech welcoming the participants. The organization president (a male who has been prominent and active in the profession since the days of industrial arts) forgot her name as he thanked her for her remarks, and instead substituted "Marilyn." When his error was noted, he quipped to the group, "I got her confused with Marilyn Monroe." Though this guest is blonde and presents an attractive image, both her dress and demeanor made it clear that she wished to make a professional rather than "beauty queen" impression. The audience response was a mixture of some who laughed and many who felt most embarrassed. I looked to see the reactions of several of the interviewees from this study and each gave a look of utter despair, rolled their eyes, or otherwise made it clear that this was exactly the sort of comments which minimize women in our profession and isolate them. I also noted that few women in the group were laughing, most looked annoyed to some degree, and the most robust laughers would (in general) fit the profile stereotype of the old boys club mentioned by women in response to early questions in the study. It was obvious that the president thought there was nothing wrong with his comment and he probably meant no harm, but an impression was made among all present that do care about such matters, including the visitor. I sent an apology to her and explained the basic concept of this study and my earlier work. Her response was: "Thanks for your remarks. I think you are right on the money about these sorts of episodes having the effect of holding back progress toward [technology education] becoming a truly inclusive, civil, and progressive professional field." Perhaps her response, as an outside observer of only one event, best summarizes a key finding of this work. How many other women are left with a similar impression the first time they meet a technology education professional? In one of the major gatherings of the 2003 ITEA Conference in Nashville, a man at the podium to give an award made reference to the recipient spending time at "Hooters" (a restaurant chain which proudly flaunts its exclusive employment of provocatively clad young women as waitpersons). Again, the chortles from the audience showed that many people were embarrassed by this comment.

Conclusions

Since so much of this paper has concerned reporting of actual comments by women in our profession and observations of the researcher, only a few conclusions will be elaborated here. The reader is encouraged to review the "findings" section and draw personal conclusions. It must be noted, however, that none of the findings in this study were in contradiction with those of the previous survey (Haynie, 1999) or with my observations of the past 36 years. From these three sources, I conclude that:

- Women are generally well accepted and comfortable in the technology education profession, but there are some problems which make them feel isolated, patronized, minimized, conspicuous, or otherwise uncomfortable.
- Many of the problems leading to these feelings of isolation are due to the attitudes and actions of a minority of men within our profession who hold outdated views.
- These problems will best be eliminated if more women are encouraged to enter the profession and are advanced to positions of leadership in which they may serve as role models.
- The general manner in which men and women interact in the profession is healthy and normal within the context of our current social mores and standards of behavior.
- Men within the profession should be careful to avoid saying things which call attention to the gender of female students or colleagues and to only emphasize the abilities and attributes which make all people valuable within the profession.
- The evolving nature of the curriculum, coupled with retirement of some key older men who hold the most biased viewpoints, will slowly work to reduce the frequency of negative events and make the profession more attractive to women.

Recommendations

Three recommendations seem appropriate from the findings of this study. First, a similar study should be conducted at a later time to see if the changes projected here actually occur and to find what new pressures arise in coming years. Second, perhaps more study is needed by different researchers using various techniques. The triangulation provided here (survey data, interviews, and long term personal observation) is heavily influenced by one researcher and his viewpoints—though he has tried to be fair, there could be important information that was not revealed because women feel hesitant to share it with any man, or with him in particular. Likewise, perhaps none of the methods used thus far can fully answer the research questions posed. These problems can only be overcome if other researchers become involved and additional techniques are employed. Lastly, some of the interviewees mentioned events and perceptions that actually had more to do with other marginalized populations than they did with women in technology education. Are there factors which need to be discovered that make this profession or field of study uncomfortable for African-Americans, Latinos, other cultural groups, gays, disabled persons, or any other identifiable group that is sometimes marginalized in our society? If so, studies to investigate such factors should be conducted. Sanders (2001) noted that despite some gains in diversity, "technology education is still taught mostly by middle-aged white men"—the troubling question remains: Why?

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An Analysis of the Technology Education Curriculum of Six Countries

Aki Rasinen

Introduction

The government of Finland has begun planning a new national curriculum framework for the comprehensive and upper secondary schools. The aim of this study was to find information that could be used in establishing a theoretical basis for planning the technology education curriculum. In order to define the scope and focus of each curriculum element (e.g., rationale, theory, objectives, methods, content, and means of evaluation), the technology education curricula of six different countries were studied: Australia, England, France, The Netherlands, Sweden, and the United States. The rationale for choosing these six countries was that their technology education programs have developed rapidly over the past ten years and profound research, experimental programs, and the development of learning materials have been undertaken, especially in Australia, England, The Netherlands, and the United States. The aim was not to conduct a comparative study of the curricula of other countries. Rather, it was to synthesize theory and practice. A secondary aim was to search for more detailed and concrete curriculum materials for provincial, district, municipal, and school purposes. Although this research was conducted to support Finnish curriculum development, the results may be pertinent to other countries as well.

Different countries use different terms to describe technology education, such as technics, design and technology, technology education, and technological education. In this study these titles were considered to be synonymous. Regardless of the term used, the universal goal is to help students to become technologically literate.

A model was developed so that the technology education curricula of the selected countries could be systematically analyzed and the important curricular elements could be identified. Assessment practices were not included in the study, although Kimbell's (1997) work in this area must be recognized since he included most of the countries reported herein.

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The analysis is presented in two phases. First, the curricula of the six countries are summarized. The goal at the outset was to cross tabulate the elements from the curricula; however, it was found that the countries differ to such degree that it was impossible to reach this goal. Curriculum guidelines of the six countries are, however, presented so that the reader can obtain a general understanding of the different curricula. Following this, all six countries are examined more closely using a method of systematic analysis in order to identify both common and unique features of their curricula.

Curricula Overview

According to Madaus and Kelleghan (1992, p. 128), a curriculum consists of six components: 1) content 2) general objectives 3) specific objectives 4) curriculum materials 5) transaction 6) results. These components served as one dimension of comparison for the study. A second dimension used three elements: rationale and content, implementation goals, and other observations.

The primary sources for curriculum information in this study were:

Australia	*A statement on technology for Australian schools, A joint project of the States, Territories and the Commonwealth of Australia* (Australian Education Council, 1994).
England	*Design and technology in the National Curriculum 2000* (Qualifications and Curriculum Authority, 2000)
France	*Noveaux programmes de 6e* (Ministére de l'Education,1995) *Noveaux programmes du cycle central* (Ministére de l'Education, 1997)
The Netherlands	*The new core objectives for the subject technology in the Netherlands* (Huijs, 1997) *Development of technology education* (deVries, 1999)
Sweden	*Kursplaner för grundskolan* (Utbildningsdepartement, 1994)
United States	*Technology for all Americans: A rationale and structure for the study of technology* (International Technology Education Association, 1996) *Standards for technological literacy: Content for the study of technology* (International Technology Education Association, 2000).

All of these documents were regarded as nationally accepted guidelines for technology education within the countries concerned at the time the study was conducted.

The Technology Education Curriculum of Australia

In Australia, technology is one of eight subject areas studied in schools. Technology is divided into four content areas, called strands: designing, making, and appraising; information; materials; systems. The strands are considered to be interrelated and are the basis for curriculum monitoring, revision, and reform.

Rationale and Content

The curriculum is based upon the rationale that people face technology everyday and therefore they must learn about it.

National Goals

The overall goal is to respond to the current and emerging economic and social needs of the nation and to provide those skills which will allow students maximum flexibility and adaptability in their future employment and other aspects of life. This includes the development in the student of:

- Skills of analyzing and problem solving
- Skills of information-processing and computing
- An understanding of the role of science and technology in society, together with development of scientific and technological skills
- An understanding of and concern for a balanced development of the global environment
- A capacity to exercise judgment in matters of morality, ethics, and social justice

The Importance of Technology

Through the study of technology, people will become more innovative, knowledgeable, skillful, adaptable and enterprising. This will enable people to:

- respond critically and resourcefully to challenges
- devise creative ways of generating and applying ideas
- translate ideas into worthwhile outcomes
- find innovative solutions to community needs
- focus on the design of techniques and products
- deal with uncertainty in an informed way
- cooperate in flexible teams
- appreciate cultural differences
- learn throughout their lives
- use local, national, regional, and international networks

Implementation Goals

Technology is to be included as one of eight broad areas of study:

1. the arts
2. English
3. health and physical education
4. languages other than English
5. mathematics
6. science

7. society and environment
8. technology

The theory and practice of technology are integrated. Study is to be interdisciplinary. Technology involves the development and application of ideas and principles from other areas of learning such as the applied sciences, engineering, and business and commerce.

Technology should be studied by both girls and boys during the compulsory years of schooling (years 1-10). Secondary school programs are more specialized, often leading to discrete programs as students progress toward year twelve. In upper secondary years, many technology programs focus on further education and life and work outside school.

Other Observations

Technology programs can be structured and delivered either as discrete programs or combined with other areas of learning. Technology programs in primary schools give students a broad foundation for further learning. They are taught by classroom teachers, sometimes in association with specialists or resource people, with varying allocations of time to allow different activities. In the secondary school, technology education includes a number of different areas of study.

- agriculture
- computing/information technology
- home economics
- media
- industrial arts, manual arts, design and technology

The Technology Education Curriculum of England

The National Curriculum in England was revised in 2000 and will gradually become statutory over a three-year period. Compulsory schooling is divided into four Key Stages. Key Stage One (grades 1-2, ages 5-7) and Key Stage Two (grades 3-6, ages 8-11) concentrate on English, mathematics, science, design and technology, information and communication technology (ICT), history, geography, art and design, music, and physical education. In Key Stage Three (grades7-9, ages 11-14) and Key Stage Four (grades 10-11, ages 14-16), citizenship and modern languages are added, with one language required.

Rationale and Content

The overall rationale for design and technology education is the need to prepare pupils to participate in tomorrow's rapidly changing technologies. Through technology education they learn to think and intervene creatively to improve the quality of life. They become autonomous and creative problem solvers, as individuals and as members of a team. Through needs, desires, and opportunities they develop a range of ideas in order to design and make products and systems. They combine practical skills, aesthetics, social and environmental issues, and reflect on and evaluate present and past design and technology, its uses and effects. Through design and technology they become innovators and discriminating and informed users of products. Specifically, pupils should be taught to:

- develop, plan, and communicate ideas
- work with tools, equipment, materials, and components to make quality products
- evaluate processes and products
- know and understand materials and components

The specific objectives become more demanding with each higher Key Stage. At Key Stage Four one more objective is added: to know and understand systems and control.

Implementation Goals

Technology is one of the core subjects in the schools and is to be studied by both girls and boys. A national examination is required, resulting in a General Certificate of Education upon completion of compulsory education. Technology education is to be integrated where convenient, for instance with the arts, mathematics, and science.

Other Observations

There are nine attainment levels that become hierarchically more difficult. Very specific information on the quality of pupils' performance is included. The specifications for the ninth level are very rigorous.

The Technology Education Curriculum of France

Technology education is a compulsory subject for the four years of the junior secondary level (ages 11-15). At the time of the study, there is a detailed curriculum only for class levels six (11-12 years, adaptation level), five (12-13 years, first central level), four (13-14 years, second central level) and three (14-15 years, orientation level). A specific plan was not in place at the primary level.

Rationale and Content

Technology education aims to clarify the interconnections among work, products, and human needs, and the effects of technology on society and culture. When studying technology, pupils must face concrete situations requiring application of know-how and implementation of skills. These skills are enriched during the study process. Specifically, technology education gives pupils an opportunity to:

- become acquainted with technical systems, their implementation and use
- learn to use the correct language of the discipline

- become acquainted with the special methods of technology, where a variety of solutions can be found for a specific problem
- learn how to use developed expertise in different situations to solve a problem
- use equipment and control systems in a rational way, by following safety precautions and the laws of ergonomics
- observe development, different means of production, and different technical solutions to a similar technical problem
- observe and build connections between the schools and enterprise
- take a critical stand and participate in the technological world without emotional obstacles

In primary schools, simple mechanisms, electric plans, energy production, and production in general are studied. Students engage in small projects, particularly those using computers. In secondary schools, production, marketing, needs analysis, and professions in production and service are covered. Experience with applications of CAD/CAM is also included.

Implementation Goals

Integration with the French language is considered particularly important. This includes terminology, word processing, critique of commercials, and wise consumerism. Relationships among the French language, science, and social studies, with considerable emphasis on computing, are stressed. The time devoted to the study of technology range from 90 to 120 minutes per week. Technology education is to be studied by both girls and boys.

Other Observations

Technology education is taught by class teachers at primary level and subject teachers at secondary school level. The aim is to use three-fifths of the total study time for hands-on activities or learning by doing. Technology studies must continue from primary school to secondary school without any gaps in the coverage of topics.

The Technology Education Curriculum of the Netherlands

The Technology Action Plan for The Netherlands was implemented during the years 1993 to 1997 for primary schools (pupils aged 4 to 12). Financed jointly by the Ministries of Education, Culture and Science, and Economic Affairs, the purpose was to stimulate attention to technology within and outside primary schools. Importance is given to combining thinking with doing (Lemmen 1997, p. 118).

In the Netherlands, all pupils go to the comprehensive school, "Basisvorming," until the age of 15 or 16. After national debates of what the content of basic education should be, the present curriculum was published in 1998. There are at least 15 subject areas to be studied, with one of them being technology. There are five general objectives to be achieved within all the subject areas:

- working on interdisciplinary themes
- learning to carry out a plan and task
- learning to learn
- learning to communicate
- learning to reflect on the learning process and the future

Technology is studied from three different perspectives:

- technology and society
- technical products and systems
- designing and making products

Rationale and Content

The overall purpose of the technology education curriculum is to enable the students to:

- become familiar with those aspects of technology that are significant to an understanding of culture, to the way in which pupils function in society, and to the development of pupils' technical abilities
- acquire knowledge and understanding of the function of technology and its close relationship with natural sciences and society
- become actively involved in applications of technology
- learn to design and develop solutions for human needs
- learn how to use a number of technological products in a safe manner
- be given the opportunity to explore their abilities and interests in technology

The specific objectives are organized under the headings of technology and society, technical products and systems, and the design and making of products.

Implementation Goals

Technology education curriculum should offer equal opportunities and appeal to both boys and girls (Huijs 1997, p. 107). At the primary level it is not a separate subject area, but is integrated with crafts, arts, and natural sciences. At the secondary level it is a subject area of its own, but it is also integrated with mathematics, science, and social studies. In the first and second years of secondary technology, it is studied for two teaching hours per week. At the secondary level, 180 teaching hours are allocated to technology education.

Other Observations

National tests are given upon completion of the secondary school program.

The Technology Education Curriculum of Sweden

In Sweden, the equivalent to technology education is called "teknik" (technics). According to the national curriculum of 1994, technology education aims to develop in pupils an understanding of the essence of technics, particularly, an understanding of the impact of technology on production, society, physical environment, and living conditions. Technical expertise becomes an important prerequisite for the control and use of technology.

Pupils are expected to achieve basic technical competence (grundläggande teknisk kompetens). This competence results from gaining knowledge of the role of technical development, historical perspective, and reflection on the solution of technical problems. In addition, there is need to develop an ability to analyze and value the relationships among human beings teamwork in the context of society, technics, and nature. Students are to understand the way technics is used and its effects on the environment. A number of ethical questions dealing with basic values are also addressed.

Rationale and Content

The primary objectives of the study of technology education in Sweden are to:

- study the history and development of technical culture, and the effects of technics on people, society, and nature
- develop an awareness of the technics in the world around the student
- reflect upon and evaluate the effects of choices of different technics on human beings, society, and nature
- update technical knowledge of the structure and use of technics for practical situations
- have a positive interest in technics and confidence in their own abilities to solve technical problems

The objectives to be achieved are stated in such a way that they describe what pupils should have learned by the end of grades five and nine. Meeting these objectives provides a basis for making choices about careers and further education.

The primary teaching methods emphasize practical work and exploration. Students are to be engaged in doing tests and observing results, planning, constructing, and evaluation.

Implementation Goals

Technics is to be studied at both the primary and junior secondary levels. It should be integrated with history, science, and social studies, and offered equally to girls and boys. The study of technics:

- should promote development of perspective regarding the effects of technics on individuals, society, and nature from a historical and international point of view

- should illustrate interaction among humans, technics, and nature
- should convey that the purpose of technics is to alter, store, and control
- should present a component – system point of view
- should include construction experiences in a workshop environment for the identification and solution of problems

Other Observations

The curriculum documents indicate a belief that the technical culture is mainly based on the tradition of know-how that has been achieved through practical work. Current technological development is based more on scientific research and systematic development than has been true in the past and this should be reflected in the school curriculum.

The Technology Education Curriculum of the United States

In the United States, there are national standards for various core subjects. At the time of the study, standards existed for English, language arts, geography, music, art, social studies, foreign languages, mathematics (curriculum and evaluation standards were approved as early as 1989), and science (national standards were approved in 1996). The most recent subject for which standards were developed is technology education. They were approved at the beginning of the year 2000. The Technology for All Americans Project has been engaged for the past several years in research and development for technology education. In 1996, an initial statement and policy document called *Technology for All Americans: A Rationale and Structure for the Study of Technology* was published. This publication provided the basis for technology education in the United States and became the philosophical foundation for the *Standards for Technological Literacy: Content for the Study of Technology* (ITEA. 2000). These two documents are intended for state and local curriculum planning.

Rationale and Content

The principal rationale for technology education in the United States is that every citizen should be technologically literate and, thereby, is able to use, manage, and understand technology. Technology is defined as human innovation in action. The framework for technology education is based on the universals of technology. These universals are considered to be significant and timeless, even in an era dominated by uncertainty and accelerated change. At the time this study was started, the universals were comprised of knowledge, processes, and contexts. Though these universals changed with the release of the final version of the Standards (ITEA, 2000), they nonetheless represent the initial philosophy.

Implementation Goals

- technology should be integrated as one of the core subjects from kindergarten to junior and senior high schools, and even beyond
- technology education can be integrated with other school subjects, especially with science and mathematics
- technology should be compulsory at every study level, for girls as well as boys
- local conditions, aspirations of individuals, career goals, and abilities should influence the development of the curriculum for technological literacy
- the ultimate goal is to realize technological literacy for all

Other Observations

The *Standards for Technological Literacy* underwent an extensive review and consensus-building process that extended over a lengthy period of time. The National Academy of Engineers and the National Research Council, very influential and important organizations, were closely involved in the development of the Standards.

Summary of the Curricula of the Selected Countries

The curriculum documents of the six countries vary significantly. On the one hand are *lehrplan-type* documents (from the German word for curriculum) that provide very specific details of what should be taught and how it should be taught (used in Australia and England). On the other hand are curriculum *standards-type* documents that specify the goals that should be met, but do not specify the actual curriculum (used in Sweden and the United States). Standards-type documents are more general and allow a great deal of flexibility (see Malinen, 1985, pp. 17-19 and 39-45). France and the Netherlands use guidelines that are combinations of the two types, having a standards-type emphasis but with many lehrplan-type components (see e.g. Malinen 1992, p. 15). All of the documents described above were published relatively recently. The curriculum documents of Australia and Sweden are the oldest, dating back to 1994. The curriculum for lower-level classes in France is from 1995 and the curriculum for upper-level classes from 1997. The attainment targets of the Netherlands were revised in 1998 and 1999 (see also deVries 1999, p. 143). In England, the curriculum was revised in the year 2000. The curriculum standards for technology education in the United States were published most recently (2000).

According to the technology education curricula of the six countries studied, technology should be studied by both girls and boys. In all of the curricula the importance of studying the effects of technology on society are emphasized, and Sweden particularly emphasizes the importance of the history of technology. France is the only country that does not directly refer to studies of the relationship between technology and the environment. In all the countries, learning how to plan, produce, and evaluate is emphasized. The ability to tolerate uncertainty is included in the curricula of Australia and the United States. In the Australian curriculum the importance of life-long learning and learning of innovative skills is clearly a focus.

Systematic Analysis

To analyze the curricula of the six countries in more depth, a special method called *systematic analysis* was chosen. In this method, factors connected to a particular theory or idea are clarified. In other words, a single method is not used alone, but rather a "method-family" is usually identified and applied (Scriven 1988, pp. 131 - 149; Jussila, Montonen & Nurmi 1992, p. 157). This method includes a qualitative analysis of the content of selected excerpts of text. In this study, the objects of the analysis were the technology education curricula of the six countries.

Systematic analysis differs from content analysis in that the goal is to penetrate the world of ideas as they are expressed linguistically. The aim is not to search for and present statistically representative samples, but to bring forward the essential ideas from thinking-structures in order to make possible the clarification of the original thought entities and their further development if needed (Jussila et al. 1992, p. 160, see also Alasuutari 1993; Pyörälä 1995).

In systematic analysis, logical and conceptual entities are highlighted through theoretically oriented exploration. The task of the researcher is to look for fundamental questions from within the content of the text and to outline and examine the text in order to discover core ideas, even those that are not obvious. A mere description of the expressions presented is not sufficient in this type of analysis (Jussila et al. 1992, p. 174).

One of the objectives of this research was to look for suitable components for the Finnish curriculum framework so that they could be applied by municipalities and individual schools. A two-dimensional model was thus developed to meet this objective. One dimension was the influencers of curriculum and consisted of three elements, the society, the school, and the individual.

- Society (global, state, municipality)
  Elements include technology as part of society, technology and the environment, the relationship between industry and school, the needs of society and people, and technological professions.
- School (teacher)
  Elements include the interaction between the school and the environment, technological know-how, the learning environment, and integration among different subject areas.
- Individual (student)
  Elements include technological literacy, the interaction between technology and the individual, environmental balance, ethics of technology, technological skills and knowledge, and interest.

The second dimension was the internal elements of the curriculum: objectives, methods, and content. Figure 1 below describes the analysis framework.

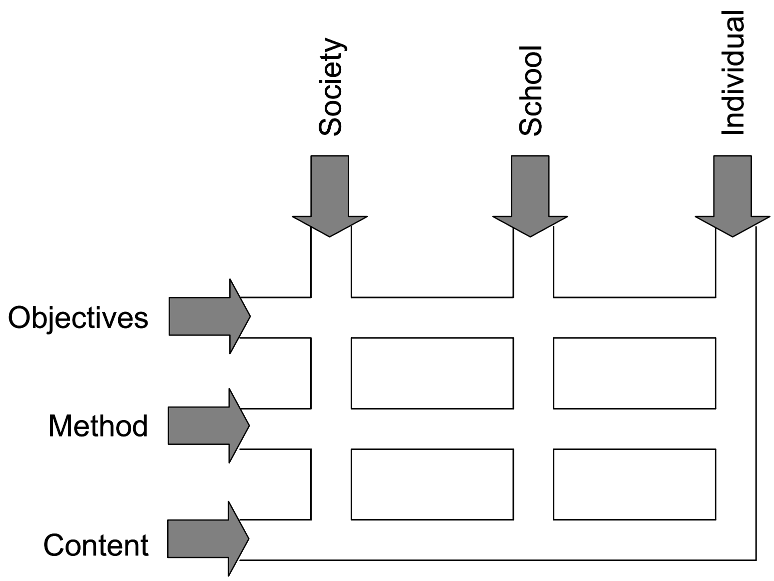

Figure 1. The dimensions of analysis.

Results of the Analysis

The elements of the results of the systematic analysis are presented in abbreviated form in Table 1. The information presented in the table is not in any particular order of importance. For the complete results of the study, the reader is referred to Rasinen (2000).

Although the format and approach in the six curricula studied differ from one another in many ways, common features were found. There were no particular contradictions among any elements of the six curricula, nor are there significant differences in the emphasis placed on the various sub-areas of technological studies. The French curriculum appears to give more attention to computing as a principal focus, whereas computers are seen more as one of the tools of technology in the other countries.

As Table 1 illustrates, there are many overlapping elements, regardless of whether the table is studied horizontally or vertically. Technology is universally seen as a significant part of human life; it affects the routines of individuals, schools, and the whole society, from local municipalities to the entire world. It is considered important to realize the history and development of technology and its effects on human beings and the environment. Technology is not seen as something good that has to be accepted as it is, nor is it seen as something bad, which therefore has to be denied or ignored. Technology is around us, whether we want it or not. Thus, students should be educated to cope and deal with

Table 1.
Comparison of objectives, methods and contents by the perspectives of society, school and the student.

	OBJECTIVES	**METHODS**	**CONTENT**
SOCIETY	Technology is an integral part of society Human needs and technology are intimately connected There is a need to establish a balance between technology and nature There are careers in technology and the schools should provide practical, exploratory experiences related to them	Increase cooperation between the schools and the community outside the schools Provide experiences that prepare the student for life after school Experiences should include teamwork, analysis, invention, planning, producing, and evaluating Experiences should be provided that promote positive attitudes toward careers in technology Experiences should be provided for all students to increase tolerance for uncertainty For boys and girls	Systems and structures of technology (mechanisms, structures, products and their applications, transfer, storage, control, regulation, processing, communication, information, energy, power, quality) Careers in technology (production process, working conditions, control of quality, sharing of work, technical appliances used by different professions, changes in different professions) Safety and ergonomics
SCHOOL	Role of technology in society Skill development (planning, making, knowing and understanding, evaluation, social interaction, moral and ethical) Integration with other subjects	Integration into/with other subjects Experiences in planning Learning by doing Teacher education and in-service development are critical National examinations in technology are needed	Planning, making, evaluating Information Materials Systems Control of systems Structures Processing Communication Energy and power Safety

Table 1.(continued)
Comparison of objectives, methods and contents by the perspectives of society, school and the student.

	OBJECTIVES	METHODS	CONTENT
STUDENT	Technological literacy (ability to use, control, and understand technology) Problem solving skills Understanding the role of science and technology in society Developing technology in balance with the environment Moral, ethic, and social justice Know-how, skills, values Adopting critical attitude Applications of technology Planning and solutions from human viewpoint Students should become more innovative, conscious, skillful, flexible, and enterprising	Planning, co-operation and networking. Practical work: experiments, observations and building; planning and evaluating. Learning by doing Safety	Role of technological development History of technology Solving technological problems Evaluation and valuation of the relationship between humans, society, and nature Effects of technology on nature Functions of technology (alter, store, control, and regulate) Process work (identifying, constructing, and evaluating) Information Energy and power Materials Safety Marketing

technology, to develop it in balance with the environment, and to approach its study with a realistic, yet critical, manner. None of the technology education curricula included in the study defined directly any philosophical points of departure. They do, however, offer brief statements on the importance of the study of technology. The rationale the countries share in common is the need to prepare students to live in a rapidly changing technological world. There seems to be a universal emphasis on learning to plan and produce solutions to technological problems, to become discriminating and informed users of technology, and to become innovative thinkers. Understanding underlying social, aesthetic, and environmental issues is also considered essential within all six curricula. The importance of learning by doing and problem solving is universally evident.

The educational approach to the curricula is clearly hermeneutic. The objective is to learn about natural world and how humans have changed it through technological development. Humans are regarded as goal-oriented, intentional, and active beings who form social systems. Students must learn how to make rational and justified choices while they are in school so that they become contributing members of society once initial schooling is complete.

Technological phenomena are studied as phenomena in themselves. That is, their essence and nature are considered but little attention seems to be placed on what influences them. For example, it is universally believed that students should learn planning, making, and evaluating. However, the way in which the brain controls the planning process or what factors affect eye-hand coordination are not included.

Discussion

The six countries chosen to be studied in this research are at different stages of developing their technology education programs. Departure points for curriculum planning, the planning process, and the structure of the curriculum differ from one country to another. For these reasons, a single model cannot be applied to each country. The curricula have, however, been observed from so many different perspectives that the essentials have undoubtedly been discovered. Although the countries under study are separated geographically at quite a distance from one another and their cultures also differ, there are several similar features in their curricular objectives, methods, and content.

Technological literacy is a universal goal. Principal objectives include understanding the role of science and technology in society, the balance between technology and the environment, the development of technological literacy, and the development of skills such as planning, making, evaluating, social/moral/ethical thinking, innovativeness, awareness, flexibility, and entrepreneurship. The prominent methods focus on experiences for students that engage them in planning, analyzing, inventing, innovating, making, and evaluating. The most significant content includes the systems and structures of technology, professions in technology and industry, safety practices, ergonomics, design, construction techniques, assessment practices, the role and history of technological development, problem-solving strategies, and evaluating and valuing the relationship between society and nature. The list of content included in the curricula of the six countries was quite broad and extensive, making it very difficult to condense it. The long standing argument of breadth versus depth was clearly evident across all of the curricula, with the former being more prevalent than the latter.

The way in which technology studies have been organized also differs from country to country. For the most part, technology education at the primary level is integrated with other subjects, such as handicrafts and science. Since technology education at that level is mainly taught by class teachers, it is more natural and easy to integrate it with other subjects than would be the case if the subject were taught by subject specialists. However, in England, where the practice is already several years old, technology education at the primary level is taught as a separate subject. A systematic in-service program assists the teachers in updating their knowledge and skills.

Technology education in the junior and senior secondary schools in the countries studied is usually taught by specialized subject teachers. However, integration among different subjects and the surrounding society seems to be emphasized universally, at least in theory.

Since technology education does not have a long tradition, the standards of teaching vary widely. The extent to which technology education has evolved varies from one country to another, ranging from the highly developed programs in England to those less developed in other countries. Though technology education in the US has existed for a number of years, there are still few programs at the elementary level. Among the countries studied, technology education is developed to the greatest extent at the middle school/junior high (lower secondary) levels. Even at this level, though, there are still many obstacles that must be overcome before the intended curriculum can fully realize its intended goals and ideals.

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Hong Kong Pupils' Attitudes Toward Technology: The Impact of Design and Technology Programs

Ken Volk, Wai Ming Yip, and Ting Kau Lo

As a subject in Hong Kong secondary schools, Design & Technology (D&T) is influenced by four factors. First, for many years, the subject of Design & Technology was offered almost exclusively to boys, with girls only being allowed to take Home Economics. Recently however, girls are now having the opportunity to take D&T as a required subject in schools. Second, although some schools have allowed girls to take D&T for several years, some have only just started this practice. As a result, some girls have studied D&T from secondary one to three, while others may only be having their initial experience as a secondary three student. Third, the content and teaching of D&T varies from school to school, and depends on the type of syllabus followed and facilities available. Fourth, not all secondary schools in Hong Kong offer D&T, meaning a large number of both boys and girls have never experienced the subject.

To examine Hong Kong pupils' attitudes toward technology, a Pupils' Attitudes Toward Technology (PATT2-HK) study was conducted with over 2,800 students in 22 secondary schools. This study duplicated the first PATT-HK research conducted earlier (Volk & Yip, 1999), and the findings were compared. More specifically, given the immense changes that occurred in just a few short years relating to D&T program availability, facilities, and subject content, this study was undertaken to determine whether or not the proactive measures to ensure that all students have the opportunity to participate in D&T were in fact having a positive impact on pupils' attitudes toward technology. From this PATT2-HK study and examination made of current factors, recommendations as to the impact and future direction of D&T in Hong Kong are made.

Attitudes, Education, and Technology

Attitudes can be considered both the determinants and consequences of learning experiences (Davies and Brember, 2001). Learning experience may be influenced by factors such as self-concept, parents, teachers, environment, socio-economic status, objects, and situations (Coon, 1995; Weiner, 1994).

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Although these experiences may be satisfying or frustrating, attitudes are nevertheless developed, and once established, they enable or inhibit further learning opportunities. As an example, Taplin and Jegede's (2001) study of gender differences in Hong Kong students noted that students' attitudes could be used to predict achievement. They used students' level of confidence in a subject as one important attitudinal variable. Educators have identified strategies found to enhance female students' confidence and success in a subject. These include changing learning materials, encouraging group activities, and reducing uncomfortable situations (Brinkworth, 1999; Nemeth, 1999; Taplin and Jegede, 2001).

Technology impacts students' daily lives and certainly plays an important part in developing students' positive and negative attitudes toward it. As a direct means, technology may help develop attitudes through students' experience with cars, computers, or even when they attempted to ride a bicycle for the first time. Vicariously, technology may form attitudes through less obvious means such as mass media and advertising campaigns.

Translated into their adult lives, students' attitudes and associated learning experiences impact future careers. Relating to the Hong Kong context, Mak and Chung's (1997) examination of education and employment of women pointed out the differences between men and women's careers and salaries, despite perceived gains in educational opportunities. They noted that attitudes formed by women themselves and through outside society tend to reinforce factors which limit a woman's participation in non-traditional (technical) careers. Choi (1995) raised concerns that the structure and content of Hong Kong's education system worked "to reflect and uphold gender inequality in the wider society" (p. 127). In this regard, the formal and informal curricula, gender barriers to fields of science and technical studies, and gender bias in textbooks were seen as contributing factors to gender role acceptance and the perpetuation of the perceived "natural" differences between genders. Obviously, such critiques about education, attitudes, and employment apply to many other nations and cultures, and are not unique to Hong Kong.

Design & Technology in Hong Kong

Reflecting Hong Kong's colonial past, the subject of Design & Technology was influenced by the British system. Born out of the traditional subjects of woodworking and metalworking in the late 1970s, D&T was an attempt to move beyond the craft-based and skill-oriented programs that permeated most school programs. Unfortunately, the subject continued to suffer from a dated syllabus and approach, outdated facilities, and a poor public perception. It also reflected gender discrimination and stereotyping, with only boys taking the subject (EOC, 1999; Hong Kong Human Rights Monitor, 1999). Recently however, that practice has started to change.

In November 1997, the first Hong Kong Pupils' Attitudes Toward Technology study began. Although at that time only one school out of the 18 that participated in the study allowed girls to take D&T, the data indicated that some of the attitudinal differences between boys and girls disappeared when such opportunity exists. Referring to Hong Kong's Sex Discrimination Ordinance that it is unlawful to discriminate against a student in the way it affords him/her access to any benefits, facilities, or services, the results (Volk & Yip, 1997) were sent to the Equal Opportunities Commission (EOC), with the suggestion that they look into the matter.

In early 1999, the Equal Opportunities Commission published their own findings, looking at D&T and Home Economics subject availability and opportunities (EOC, 1999). Their conclusion and subsequent recommendations supported the earlier charge that D&T should be available to all students, regardless of gender. In consultation with the Education Department, a few secondary schools immediately began to allow girls to take D&T that academic year.

It has now been three years since girls have had the opportunity to take D&T, with some schools having to phase in the opportunity due to continued scheduling and/or staffing difficulties. In the 2001-2002 academic year, all schools offering D&T now allow girls to participate. The result is that one group of girls has had D&T for three years, while others have just been introduced to the subject in their third year of secondary schooling.

While it could be considered a big achievement that girls now have the opportunity to take D&T, not all schools offer the subject. This deprives both boys and girls of the experience. According to the Education Department statistics (ED, 2002), 298 of the 488 secondary schools (61%) offer D&T, with most schools only offering the subject up to secondary three (S3) level. Secondary three students would typically be 14-15 years of age. Certificate of Education Examinations at S5 (ages 16-17) and Advanced Level Examinations at S7 (ages 18-19) were only offered in 37 and 4 schools, respectively. In fact, only 551 students in Hong Kong sat for the D&T Certificate of Education Examination in 2002 compared with 17,890 for the subject of Computer Studies and 21,879 for Accounting.

The teaching of Design & Technology is not consistent among schools that offer the subject. As most schools teach up to secondary three, there is no public examination and teachers have relative freedom to follow either the older 1983 syllabus (Curriculum Development Committee, 1983) or the new syllabus introduced in 2000 (Curriculum Development Council, 2000). Factors that influence the type of D&T program are the experience of the teacher and type of equipment contained in the labs. For instance, the standard equipment list for the older syllabus included such items as metalworking lathes and foundry areas, but in practice, these can most often be found covered in plastic sheets and an accumulation of dust because of disuse. Even if a teacher wanted to switch to the new syllabus, limits in existing equipment and budgets may preclude program change. One avenue used by some teachers to improve their facilities has been the awarding of grants through the government-initiated Quality Education Fund. Most notably in this regard has been the purchase of equipment for CAD, CAM, and robotics.

Recently, the Education and Manpower Bureau proposed that all subjects be re-organized and categorized into Key Learning Areas (KLAs), with Technology Education being one of the KLAs (Curriculum Development Council, 2002). Technology Education, as it is broadly defined as a KLA, includes Computer Applications, Home Economics, Business Studies, and Technological Subjects. Within the category of Technological Subjects, D&T is the most common in lower secondary schools, although some schools may offer Graphical Communications, Technology Fundamentals, Design Fundamentals, and/or Electronics and Electricity. Although appearing to be a positive step in requiring D&T subject matter to be included in all schools, including primary schools, it remains to be seen how much of the content of this KLA will be met given the lack of D&T teachers and facilities in such a large number of schools.

Methodology

Following the methodology and instrument used in the previous PATT-HK study, the attitudes of secondary three students toward technology were again examined. First, a list of all secondary schools offering D&T was obtained from the Education Department. This list indicated whether boys and girls were studying the subject for three years or whether girls were just beginning to experience D&T for the first time in secondary three. Using a proportionate sampling technique (Bordens and Abbott, 2002), schools were placed into one of two categories, based on the students' ability to participate in the D&T program. With a population of approximately 85,000 secondary three students, the sample size required to be within a sampling error of ±.03 with a 95% level of confidence was found to be 1,077 (Mitchell and Jolley, 2000). Estimating an approximate number of students in a typical secondary school and using the list of schools compiled for each of the two categories, every fifth school was systematically selected (Crawshaw and Chambers, 2001) and sent a consent letter and sample instrument. From this canvassing, 14 out of 40 schools (35%) having girls just taking D&T for the first time (or about to take D&T that year), and 8 out of 24 (33%) schools that had girls going through three years of D&T agreed to participate. From the number of instruments then requested from participating schools, the sample size was found to be sufficient.

Cooperating teachers were then sent packages of questionnaires, directions to administer the questionnaire, and a short form asking about their program and students. From this more thorough background information obtained, it was found that some of the schools had girls taking D&T for only two years. These schools were then included in the total, but not when examining students with either one or three years of experience.

Follow-up telephone interviews and site visits were also conducted to classify the D&T program in the school as being either "Traditional" or "Innovative." Traditional programs were those that generally maintained craft-based activities, focused on skill development, and followed the old 1983 D&T syllabus. Innovative programs generally included more problem-solving and group activities, and had acquired equipment necessary to teach topics included in the 2000 D&T syllabus such as robotics, electronics, and control technology.

The PATT2-HK questionnaire was the same as the PATT-HK questionnaire, which was based on the earlier work of Bame, Dugger, de Vries, and McBee (1993). PATT2-HK consisted of three sections. The first section asked students to provide a short description of what technology is. The second section requested information required for demographic data analysis. The third section contained 58 statements to assess respondents' attitudes toward technology. A five-part Likert scale, with "strongly agree" to "strongly disagree" was used for student responses. The attitude statements were broadly organized under the following six categories:

1. Interest in technology (Interest)
2. Technology as an activity for both boys and girls (Role Pattern)
3. Perception of the difficulty of technology (Difficulty)
4. Consequences of technology (Consequence)
5. Technology in the school curriculum (Curriculum)
6. Ideas about pursuing a career related to technology (Career Aspiration)

The data obtained from the PATT2-HK instrument were used to examine the following questions:

1. Are there changes in demographics since the 1997 PATT-HK study?
2. What current differences exist between boys' and girls' attitudes toward technology?
3. Are there differences in girls' attitudes for those who participated in D&T for three years, compared with girls with no experience or just starting?
4. Are there differences in students' attitudes from programs that are generally classified as "Traditional" or "Innovative"?

Data were analyzed following similar procedures as in PATT-HK, and descriptive statistics, t test, and two-way analysis of variance (ANOVA) were used. Descriptive statistics were used to examine data related to demographics and were generally reported as percentages. To compare independent population means for characteristics such as gender and the number of years studying D&T, *t* tests were used. To assess the effects of two different treatments, such as the independent variables of gender and having a personal computer, a two-way ANOVA was performed (Kanji, 1999; Peck, Olsen and Devore, 2001).

Results

Demographics and Technological Climate in the Home

A total of 2,876 usable surveys were returned in the PATT2-HK study, with 52.2% of the respondents being boys and 47.8% girls. This proportion corresponds closely to the 2001 Population Census with 51.5% in the 10-15 age group boys and 48.5% girls (Hong Kong SAR Government, 2001). The gender

Table 1
Cross Comparisons of Gender with Student Characteristics and Home Environment

	1997 (in %)		2002 (in %)	
	Boys	**Girls**	**Boys**	**Girls**
Extent father's job has to do with technology (n)	(1,817)	(1,444)	(1,465)	(1,348)
very little	30.5	33.8	41.0	48.7
Little	37.4	38.8	38.6	36.6
Much	25.0	21.3	15.4	10.8
very much	7.1	6.2	5.0	3.8
Extent mother's job has to do with technology (n)	(1,785)	(1,399)	(1,426)	(1,311)
very little	59.6	62.1	64.4	69.7
Little	25.8	22.7	24.5	20.6
Much	11.4	12.2	8.0	7.6
very much	3.2	3.0	3.1	2.1
Do you have Lego or technical toys at home? (n)	(1,847)	(1,460)	(1,479)	(1,361)
Yes	64.6	60.2	59.2	44.8
No	35.4	39.8	40.8	55.2
Do you have a working space for modelling at home? (n)	(1,857)	(1,464)	(1,473)	(1,352)
Yes	27.0	11.2	24.0	9.0
No	73.0	88.8	76.0	91.0
Is there a personal computer in your home? (n)	(1,863)	(1,471)	(1,473)	(1,361)
Yes	54.5	45.7	89.3	87.1
No	45.5	54.3	10.7	12.9
Do you think you will choose a technological profession? (n)	(1,860)	(1,471)	(1,465)	(1,347)
Yes	65.0	47.2	66.5	54.1
No	35.0	52.8	33.5	45.9
Are you a beginner taking Design & Technology or any technical subject in school? (question relevant for girls only) (n)				(1,127)
Just started or will start (One Year)				33.6
Have studied nearly 3 years (Three Years)				66.4

distribution in 2002 was more precise than in 1997, as girls generally did not take D&T and the cooperation of Home Economics classes was required. Table 1 shows the results of the information gathered on the technological climate in the home. For the majority of students, the father's job had little or very little to do with technology. When students were asked about their mother's occupation, a higher percentage indicated that their mother's job had little or very little to do with technology. In general, there appears to be a reduction in occupations relating to technology, having technical toys, and working space for modeling at home since the earlier PATT-HK study.

The availability of personal computers at home greatly increased, with 50% having a computer in 1997 to nearly 88% in 2002. Also, although the percentage of boys indicating an interest in a technological profession remained nearly the same, girls appeared to have a greater interest than in 1997. The number of girls interested in a technology career increased from 47.2% to 54.1%. This increased interest by girls was encouraging, although the interest was still less than boys.

t Tests on Student Characteristics

t Tests were conducted on the six student characteristics and the six attitude categories of "Interest," "Role Pattern," "Difficulties," "Consequence," "Curriculum," and "Career Aspiration." The results are presented in Table 2. The numbers in each category present the mean response, with a lower number indicating a more-positive attitude.

When the characteristic of "Gender" was examined in the earlier PATT-HK study, there were significant differences in all six attitude categories, with boys having significantly more positive attitudes than girls in the categories of "Interest," "Role Pattern," "Difficulties," "Consequence," "Curriculum," and "Career Aspiration." Girls had more positive attitudes about "Role Pattern." However, in 2002 the significant differences in the "Role Pattern" and "Difficulties" categories were now non-existent.

It was also interesting to observe that overall, there was a decline in students' positive attitudes toward technology from 1997 to 2002. This lack of interest for both boys and girls in all categories may reflect the general economic malaise that Hong Kong has witnessed since 1997. It may also reflect a lack of confidence in their future options. For example, according to the Hong Kong University Public Opinion Programme (2002), confidence in Hong Kong's future fell from 77.5% right after the Handover in 1997 to 52.5% at the time the survey was conducted. The unemployment rate also increased during this time, going from 2.1% to 7.4% (Hong Kong SAR Government, 2002).

The impact of having technical toys, a working space at home and/or a personal computer can be seen in several of the categories. Students' "Interest" attitudes toward the "School Curriculum" and "Career Aspiration" seem most affected. As expected, those who would choose a profession related to technology had more positive attitudes in all categories.

Table 2
t Tests on Student Characteristics

Characteristics	**Interest in Technology**	**Role Pattern**	**Technology is Difficult**	**Consequences of Technology**	**School Curriculum**	**Career Aspiration**
Gender						
Boys (1,502)	2.57	2.72	2.81	2.43	2.51	2.62
Girls (1,374)	2.80	2.69	2.81	2.49	2.61	2.77
Significance	**			**	**	**
Technical toys						
Yes (1,486)	2.60	2.68	2.80	2.42	2.51	2.63
No (1,354)	2.78	2.74	2.82	2.49	2.62	2.77
Significance	**	**		**	**	**
Working space at home						
Yes (476)	2.52	2.68	2.79	2.42	2.47	2.60
No (2,349)	2.71	2.71	2.81	2.46	2.58	2.72
Significance	**				**	**
Personal computer						
Yes (2,502)	2.66	2.70	2.80	2.43	2.54	2.67
No (332)	2.82	2.78	2.85	2.61	2.68	2.83
Significance	**	**	**	**	**	**
Choose tech. profession						
Yes (1,703)	2.54	2.67	2.78	2.38	2.45	2.49
No (1,109)	2.89	2.76	2.84	2.57	2.73	3.00
Significance	**	**	**	**	**	**
Girls who have taken D&T or technical subject in school						
One Year (378)	2.79	2.73	2.83	2.55	2.64	2.71
Three Years (745)	2.82	2.67	2.80	2.46	2.60	2.80
Significance				**		**

** $p <= 0.01$

Given the recent opportunities for girls to now take D&T and the varying degree of their being able to participate depending on school—from three years (Three Years) to their first introduction (One Year), several significant differences were observed. Girls who had D&T for three years had more positive attitudes toward the "Consequences of Technology," while girls with little or no experience in D&T had more positive attitudes in the category of "Career Aspiration."

Table 3
Two-way Analysis of Variance on Gender Differences

Characteristics	**Interest in Technology**	**Role Pattern**	**Technology is Difficult**	**Consequences of Technology**	**School Curriculum**	**Career Aspiration**
Technical toys	**	**		**	**	**
Gender	**	**		**	**	**
2-Way Interactions	+				**	
Working space at home	**				**	**
Gender	**	**		**	**	**
2-Way Interactions	+				+	
Personal computer	**	**	**	**	**	**
Gender	**	**		**	**	**
2-Way Interactions	**			**	**	**
Choose tech. profession	**	**	**	**	**	**
Gender	**	**			**	**
2-Way Interactions	+	+				

** p <= .01
\+ interaction found in the earlier PATT-HK study

Two-way Analysis of Variance Examining Gender Differences

To explore the interaction between boys' and girls' attitudes toward technology and each demographic characteristic, a two-way Analysis of Variance (ANOVA) was performed. Although in 1997 five distinct interactions were found for several of the characteristics, having a personal computer was not one of them. However, in the PATT2-HK results, only having a personal computer produced an interaction. Table 3 provides the results of this analysis.

t Tests on Gender and Type of D&T Program

To examine attitudinal differences due to the type of program students were exposed to, *t* tests were conducted on the student characteristics of "Gender," "Personal Computer," and number of years girls have "Taken D&T." Programs were classified into two broad categories—Traditional (T) or Innovative (I), based on characteristics such as activities conducted, syllabus followed, and facilities. The results are presented in Table 4.

For "Traditional" programs, there was no significant difference between boys' and girls' attitudes in the category of "Consequences," although "Innovative" programs still produced significance. This finding was different when the data were analyzed in aggregate (see Table 2).

Having or not having a personal computer appeared to produce significant differences in several categories among students in "Innovative" programs. This may suggest that "Traditional" programs that included more craft-based projects as opposed to "Innovative" programs with activities such as robotics and CAD were more comfortable for students with little interest or access to computer technology.

When girls having three years of D&T were compared with those having only one year, several differences were noted. For the categories of attitudes toward "Role Pattern," "Difficulty," "Consequences," and the "School Curriculum," girls beginning D&T had significantly less-positive attitudes toward technology in programs classified as being "Innovative." This feature was reversed for "Career Aspiration," with first year girls in "Traditional" programs having significantly more-positive attitudes than those with three years of experience in a similar program.

Summary of Results

The major results of the second study on Hong Kong Pupils' Attitudes Toward Technology can be summarized as follows:

1. Changes in demographics since the 1997 PATT-HK study indicated that fewer parents had occupations involving technology, more students had computers, and girls now had a greater interest than in the past to pursue a career in technology. This last characteristic was still less than boys, but somewhat encouraging to observe.
2. Regarding differences in attitudes toward technology between boys and girls, there were still significant differences in four of the categories, but for the categories of "Role Pattern" and "Difficulty," the differences had disappeared since the original PATT-HK study.
3. There were two significant differences found between girls' attitudes for those that participated in D&T for three years, compared with girls with no experience or just starting. Girls with three years of D&T had more positive attitudes toward the "Consequences of Technology,"

while those with one or fewer years of D&T had more positive attitudes relating to “Careers.”

4. Girls in programs generally classified as “Innovative” had less-positive attitudes in several categories of technology when they were just beginning their studies in D&T. But after three years, their attitudes became significantly more positive. “Traditional” programs only produced significance in the category of “Career Aspiration,” with girls being more positive in their first year of study.

Table 4
t-Test on Demographic Characteristics and Program Type

Characteristics	Interest in Technology		Role Pattern		Technology is Difficult		Consequences of Technology		School Curriculum		Career Aspiration	
	T	**I**	**T**	**I**	**T**	**I**	**T**	**I**	**T**	**I**	**T**	**I**
Gender												
Boys (643)/(781)	2.56	2.58	2.70	2.74	2.82	2.79	2.41	2.43	2.51	2.51	2.64	2.62
Girls (652)/(663)	2.79	2.82	2.67	2.71	2.78	2.73	2.47	2.51	2.59	2.63	2.75	2.79
Significance	**	**						**	**	**	**	**
Personal computer												
Yes (1181)/(1253)	2.66	2.66	2.68	2.71	2.80	2.80	2.43	2.44	2.55	2.53	2.69	2.66
No (113)/(201)	2.76	2.88	2.70	2.83	2.83	2.86	2.55	2.64	2.58	2.75	2.77	2.88
Significance		**		**			**	**		**		**
Girls who have taken D&T or technical subject in school												
One Year (172)/(151)	2.73	2.86	2.65	2.81	2.76	2.90	2.49	2.67	2.54	2.76	2.65	2.77
Three Years (398)/(347)	2.80	2.84	2.67	2.67	2.79	2.81	2.46	2.47	2.62	2.58	2.79	2.80
Significance				**		**		**		**	**	

**$p <= 0.01$
T = Traditional Program, I = Innovative Program

Implications

The results of PATT2-HK suggest that D&T programs are beginning to have a positive impact on students' attitudes. This can be illustrated by the changes in girls' attitudes depending on the length of exposure and type of program. Girls appear to have more positive attitudes toward the "Consequences" of technology the more years they are in D&T. This suggests that girls may be developing an awareness of the relationships and impacts of technology through the topics, activities, and time spent in such programs. However, their having less-positive attitudes toward "Careers" the more they are in D&T may suggest a lack of confidence in their ability to succeed or a lack of enjoyment of the activities contained in the D&T program.

The significant changes in attitudes in several of the categories by girls who participated in three years of an "Innovative" program may suggest that innovative programs are having more of an effect on students' attitudes and thus produce a more powerful learning experience than a more traditional approach. As noted earlier, teaching strategies that include changing learning materials, encouraging group activities, and reducing uncomfortable situations help enhance female students' confidence and success in a subject. Perhaps such strategies and content more representative of innovative programs are proving to have greater success in affecting attitudinal change.

While there is guarded optimism about recent changes, especially now with the inclusion of girls in the programs, there remains some degree of uncertainty and vulnerability about the future of the subject in Hong Kong schools. As noted by Hamilton and Middleton (2002), the implementation of a subject such as D&T is enhanced by features such as appropriate facilities, support from school administrators, adequate budget, and involvement of teachers. Tragically, this may not be as favourable for improving the position of D&T in Hong Kong. For instance, school principals currently have considerable control over the type of subjects offered in schools, and as D&T is not a required subject, most new secondary schools are not providing any sort of facilities. This will no doubt impact the already low percentage of secondary schools offering the subject. Furthermore, anecdotal evidence indicates that some schools with existing D&T programs have seen their facilities reduced, with general-purpose computer labs being installed in one of the typical two-room D&T laboratory configurations.

Scheduling time for students to attend D&T has also been affected by the inclusion of girls. The new arrangement requiring splitting time between D&T and Home Economics has resulted in a net loss of total time available for D&T teachers to cover material or let students work on projects. With time and scheduling constraints, a D&T teacher may only have approximately one hour of contact time per week with the students. Although all students are now being exposed, this superficial coverage of D&T may not be providing either the student or the program any benefit.

Finally, with the introduction of the Technology Education Key Learning Area as a required component in all grades, including primary, D&T will no doubt undergo scrutiny as to how the subject matches the value, content knowledge, and skills identified in the TEKLA. Obviously, the reputation of D&T and perceptions of its ability to contribute to the TEKLA will play a role in this review. From the findings of this study and the evidence that D&T-type programs which promote creativity, problem-solving, and collaborative skills, are having a positive effect on students' attitudes toward technology, it is imperative that the past poor reputation of the subject be replaced with a new awareness of the value, need, and potential of the subject to contribute to the TEKLA. Educators, parents, and the public need to realize that the activities and content available through D&T programs, especially those incorporating more innovative approaches, can play an important role in how the new TEKLA is formulated. For secondary and primary schools, this suggests that all schools and all students would benefit from an exposure to quality D&T-type activities and programs, and that the TEKLA cannot be limited to just a study of computer applications, which principals erroneously may view as meeting the objectives of technology education. Without the availability of D&T as a part of the TEKLA in all schools, questions about equal opportunity arise. This opportunity to have a learning experience in Design & Technology is for all students, and not just based on gender.

Conclusion

The PATT2-HK study was conducted five years after the original PATT-HK study and after changes were made to Design & Technology programs, such as the inclusion of girls, new facilities, and new content. The changes to D&T were neither uniform nor universal, as all secondary schools do not offer the subject, and all existing programs did not provide girls with the opportunity at the same time. D&T facilities and content are also varied among schools.

Despite these limitations, it appears that the inclusion of girls in Hong Kong D&T programs is having a positive impact on students' attitudes toward technology, with the differences between boys' and girls' attitudes disappearing for some categories. The type of program and resulting learning experience also impact students' attitudes, suggesting that programs that are more innovative and less craft- and skill-based are more successful in influencing attitudes. This should provide evidence to educators and the public as to the educational value of the subject.

Major concerns still exist with the lack of instructional time available for all students, insufficient facilities, and the traditional syllabus remaining in some schools. Perhaps the biggest obstacle to address is that Design & Technology is not recognized as a necessary subject for all students in all schools. Without this acknowledgement or commitment, approximately 40% of boys and girls in Hong Kong secondary schools never have the opportunity to benefit from the experience. Given this uncertainty, it remains to be seen if the program can weather a future based on economic constraints, educational changes, and public indifference to the subject.

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Editorial

The Educational Technology is Technology Education Manifesto

Stephen Petrina

Technology education (Tech Ed) is equal to educational technology (Ed Tech). The deception of difference can no longer be sustained. The emperor of technology education and the emperor of educational technology have no clothes. Without the dress of technobabble – stripped naked – technology education and educational technology, for all intents and purposes, are the same. It is time to recognize in theory what is true in practice. It is time to stop the accusations and whining; it is time to put down the swords and shields. This is *not* a call to arms; this is a call to action. This is a manifesto for a new politics, where Ed Tech is Tech Ed.

Can the masses, who believe that educational technology is equal to technology education, be so ignorant and so wrong? Must we continue to concede to what we believe is false? Must the International Technology Education Association (ITEA) and the International Society for Technology in Education (ISTE) continue attempts to fool the masses? Must a falsification be fabricated to destroy our idol? No! Can we not believe that technology education and educational technology are equal? Can we not hold this belief in our idol and at the same time know it is the truth? Yes! The end of deception will bring the end of concession for the masses; and the end of concession will bring the end of distinction between the ITEA and ISTE (the associations).

And so it shall be demonstrated, for once and for all: Ed Tech (ET) is Tech Ed (TE). Upon this demonstration, the masses will be vindicated, the agnostics converted, and the associations impugned. I come to speak truth to power – as a witness. I have witnessed the resemblance. I have practiced the uniformity. And I come to tell you it is good for the masses and it is good for the associations. I am not here to preach to the converted. I am here to tell you that you are free to believe what you hold to be self-evident: TE and ET as one.

Some of the ITEA among us have come to see ET as an evil replicant, rising out of the ashes of the failed audiovisual revolution, like a charred, virtual

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phoenix. Some among us have come to see ET as a bad, threatening imposter, and regard the harmless, little face of the monster with contempt. Some of the ISTE among us have come to see TE as a lumbering old golem, suspicious for its new suit assembled from pieces during the failed post-industrial revolution.

Some among us have come to see this TE golem as foolish and mindless, and regard the weary face of the monster with scorn. Some among us accept these monstrous configurations and hold ET to be the head and TE to be the hands. They await the arts or humanities to deliver the heart, the moderator between the head and hands. But I tell you, these arts, these humanities – this prophet – of the heart are as false as the associations' construction of the monsters! There are not two monsters: there is but one. ET is TE.

In the beginning…

In the beginning, we can all confess, there was industrial education (IE) and audiovisual education (AV). They were different. IE, a legitimate school subject by the 1920s, was formed out of a concern for the working classes and the new industrial technologies. The intent was to provide working class children, mostly boys in those days, with knowledge, skills, and values necessary to surviving the effects of industrialization. The intent was industriousness, as Karen Zuga (1994) noted, or "industrial intelligence," the precursor to technological literacy. AV, a legitimate teacher education subject by the 1920s, was formed out of the new mass communication technologies in education, namely cinema and radio. The intent was to provide teachers, mostly women in those days, with knowledge, skills, and values necessary to adopting the new audiovisual technologies in the classroom. Note that IE was a subject with school workshops dedicated to instruction and AV was a subject with university laboratories dedicated to instruction.

Fast forward to the 1950s and 1960s. A series of polemical indictments of schooling published in the mid to late 1950s championed disciplinary knowledge, such as Bestor's *Educational Wastelands* and *The Restoration of Learning* and Vice Admiral Hyman Rickover's *Education and Freedom*. The disciplines of technology education and educational technology were born at this time and matured throughout the 1960s. TE, still called IE (Canada and the US) or craft, design, and technology (Britain) expanded to include systematic instruction in technology, including the new analog and digital electronic technologies. Many a teacher in IE instructed her or his high school students in digital logic and built stereos and personal computers during the 1970s. ET, still called AV, expanded to include systematic instruction in technology including programmed instruction, teaching machines and the new analog electronic technologies. AV expanded to acquire space in the schools for instruction in the late 1960s, mainly in the form of television studios. Many a teacher in AV, come ET by the late 1970s, instructed her or his university students how to use the new AV equipment and program personal computers. Note that in the late 1960s and 1970s, IE was a subject with school electronics laboratories and workshops dedicated to instruction and ET was a university subject with a number of television studios in the schools for programming and production (Petrina, 1998, 2002).

The microcomputer innovations of the late 1970s and 1980s changed all of this. By the early 1990s, it was evident that the cultural changes underway were not merely about microcomputers. Instead, the changes were expansive, suggesting to analysts nothing less that a revolution – a digital technology revolution. The operative word was no longer computer; the operative word was *technology*. The digital technology revolution, marked by convergences, altered the identities of IE and AV for good. It blurred the distinctions.

Apple II computers were introduced into the schools during the late 1970s and early 1980s in Canada and the US. The early adopters were lone adopters, teachers in electronics, mathematics, and science. By the early to mid 1980s, computer laboratories were assembled in the high schools, and courses were offered in computer science. In many schools, typewriter labs were transformed into computer labs. During this time, educational technologists became technology educators as they shifted their interests from AV to computer literacy in the schools. The courses in computer science were generally taught by business, electronics and math teachers who privileged the use and programming of computers over its cultural aspects – they privileged applications over implications. For many who taught the course, computer educator Annette Wright (1980) noted, the stress was "on the technical and mechanistic aspects of computers, to the detriment of their sociological aspects – privacy, security, convenience, learning modes and problem solving" (p. 8). As historian Doug Noble (1984a, 1984b) pointed out, computer literacy, like others such as technological literacy, was linked tightly to the economic needs of the computer vendors and the state (Petrina, 2001).

Industrial educators responded to the microcomputer revolution with a change in bath water, although some would dispense with baby, bath water, and all. Course innovations were made with the new digital technologies of interest. For example, I bought two Apple computers for my high school drafting course in 1984, effecting a small transformation of the curriculum from board drafting to computer aided design (Petrina, 2003). During this time, industrial educators became technology educators as they shifted their interests from industry to technological literacy in the schools. Most associations for IE changed their monikers to TE during the mid 1980s in Canada and the US. Like computer literacy, technological literacy was constructed in the early 1980s as industrialists, the media, and politicians in the US lamented the loss of competitive advantages in labor-intensive industries. The IE come TE teachers, like their AV come ET come TE teachers, privileged the use of technology over its cultural aspects – they privileged applications over implications. But for many IE come TE teachers, the ET come TE teachers usurped their enrollments and jurisdiction. Many IE come TE teachers lamented the increasing conflation of technology with computers and argued, *ad nauseum*, that technology was not just computers.

At the same time, Seymour Papert, LEGO, and LOGO happened. We could actually say that Papert single-handedly brought TE and ET together during the mid 1980s. But we won't. Instead, we will recognize that Papert and his MIT Media Lab colleagues, such as Sherry Turkle, were not interested in the divisions between TE and ET – it was all E in and about T. Papert and his MIT team developed an interface between Apple IIs and a bunch of LEGO compatible motors, creating robots that could be programmed to manipulate LEGO building block sets. In their philosophy of "constructionism," the Media Lab integrated motor skill manipulation with cognitive manipulation, design and building with computers. Of course, what they did was effectively merge TE with ET. They did their work in the elementary schools, the place where there is no time to differentiate between TE and ET – TE and ET are the same (Brand, 1987, pp. 119-130; Papert, 1980). By the 1990s, LEGO-LOGO was all the rage, and continues to be an indispensable part of the TE = ET equation. The rest is history, but there is more.

If identities were blurred during the early and mid 1980s, by the early to mid 1990s, distinct identities for TE and ET were nonexistent. Differences were unrecognizable. A TE lab looked and functioned basically like an ET lab. Practices were nearly identical in each locale, even if the tools were different. To make matters worse, the practice in computer science, or computer studies, in the schools was changed to information technology. Rarely in the schools these days, except in the most specialized of instances, does one refer to computer courses as computer science. Information technology (IT), or information and communication technology (ICT), is the name of the game today. During the 1980s, course titles in TE were changed to communication technology (CT) or IT. By the mid 1990s, about two thirds of ET was IT or ICT, and about one third of TE was IT, ICT or CT.

As if this was not enough of a convergence, something else happened. The masses began to refer to ET as TE, understandably enough. The revolution was about technology, not merely computers. Dissatisfied with the connotation of ET as AV, ET began to refer to itself as TE. And dissatisfied with the narrow connotation of computer literacy, ET began to advocate technology literacy. These were power moves, and this is the stuff that makes our tasks as analysts necessary.

Currently, the ITEA is promoting its standards for "technological literacy" and ISTE is promoting its standards for "technology literacy." In one glance or one sustained study, it is readily apparent that both are the same. One may be a subset of the other, but they are cut from the same cloth. Now, twenty years after the dawn of the microcomputer revolution, the identities of TE and ET are indistinct. There is no definition that will alter this. Both TE and ET were on the move during the last twenty years. And the movement was toward convergence. Both TE and ET have shifted from a discourse of use and utility (i.e., technology is a tool to be used) to a discourse of engagement (i.e., technology is a subject to be studied). The movement was from the mere technocratic use of technology toward the study of technology as a social force and product. This is the momentum, albeit against long traditions of ET and TE and other areas of education, such as the arts, where technology is seen as a mere tool (Petrina, 2002, 2003). This is also a movement that is counter to the naïve notion that technology ought to be integrated and not studied as a separate subject (Bryson, Petrina, Braundy, and de Castell, in press).

At this moment, both the National Teachers Association (NEA) and the American Federation of Teachers (AFT), representing the masses of teachers, conflate TE with ET. The Mid-continent Research for Education and Learning group (McREL), that publishes *Content Knowledge*, the most exhaustive compendium of standards in the world, see no difference between TE and ET standards. The masses are correct. The convergence has happened. TE = ET. Those of the ITEA among us may complain that teachers in ET classrooms are not doing IT right. Those of the ISTE among us may complain that teachers in TE classrooms are not doing IT right. Whine as they might, the convergence has happened.[1]

The Associations and the Masses

The convergence does not sit well with the ITEA and ISTE. After twenty years of defining TE and ET against each other, after twenty years of witnessing the convergence erode away the definitions of distinction, the associations continue to persuade the masses that their beliefs are wrong. After twenty years, the associations continue to fail! The masses know what has been true for some time. Recall that in the mid 1990s, the ITEA carried this message to the masses:

> Technology education is different from instructional technology, also called educational technology. Educational technology, which involves using technological developments, such as computers, audio-visual equipment, and mass media to aid in teaching all subjects, is concerned with creating the optimum teaching and learning environment through the use of technology. Technology education is a school subject designed to develop technological literacy, while educational technology is used as a tool to enhance teaching and learning. (ITEA, 1996, p. 27)

ET was a monster, said the ITEA, a bad imposter! The ITEA tried an old trick: isolate one discipline (or culture) in time and define it in terms of stability, and isolate another and define it in terms of change and progress. ET, as we noted, was never merely "a tool to enhance teaching and learning." ET has been on the move, just as TE. ET, like TE, is a culture and practice that cannot be locked in time.

More recently, the associations themselves converged for a time, once again, to take their message to the masses. Understandably, the masses did not

[1] For NEA and TE, see (http://www.nea.org/technology/). For AFT and TE, see (http://www.aft.org/esea/downloads/qatech.pdf). For McREL and TE, see (http://www.mcrel.org/compendium/browse.asp).

change their beliefs in the mid 1990s. In fact, the masses witnessed the convergence of ET and TE. They would not be persuaded by a mere definition! "There is much confusion today when attempting to understand the differences between technology education and educational technology," the associations asserted. "Both are important components of education; however, the confusion harms both fields of study" (Dugger and Naik, 2001, p. 31). Surely, the masses are not so easily confused! There was, in fact, no confusion! There was no confusion because the masses were not foolish! They believed what they witnessed. The two spokesmen for the associations continued:

> Unfortunately, there is major confusion between technology education and educational technology. Many times superintendents, principals, curriculum development specialists, and others simply do not know the differences between technology education and educational technology. This is unfortunate since those responsible for administering education in the states and localities around the country are ignorant about two major areas of education. It is unfortunate that they confuse how to use technology with technology education. Without proper knowledge about important areas in education, confusion will cause even more misconceptions and lack of understanding in the future. (Dugger and Naik, 2001, p. 35)

But to call the masses "ignorant" is foolhardy! To try and reconvert the converted is futile! Do not believe what you see, they tell us. Believe the associations, they insist, for the mere existence of two separate associations is proof that TE is not ET. Yet, their proof is no proof at all. The emperors of TE and ET have no clothes!

The associations insist, once again, that definitions – denotations – prevail over observations – connotations. They give us definitions; they cite the liturgy:

> **Technology education** (sometimes referred to as technological studies) is "a study of technology which provides an opportunity for students to learn about the processes and knowledge related to technology that are needed to solve problems and extend human potential" (ITEA, 2000, p. 242)…. Educational technology is sometimes referred to as instructional technology or informational technology. A very careful analysis of words and terms related to educational technology gives one a better understanding of the differences between it and technology education.
> **Educational technology** is concerned with technology in education. It is involved in the use of technology as a "tool" to enhance the teaching and learning process across all subject areas. (Dugger and Naik, 2001, p. 32)

But we believe our observations. We believe what we see in practice, not their definitions. And we see that TE is ET. We see that in the schools, ET has danced around, calling their practices IT. We see that TE has danced around, calling their practices IT and CT. We see that ET is IT and TE is IT. We see that IT is IT and ET is TE.

We see the students in the schools using the computers in the TE labs. We see the range of information and communication technologies in TE: cameras, CD and DVD burners, MIDI, networks, plotters, printers, projectors, robots, scanners, servers, and speakers, for example. We see the students in TE animating virtual worlds, creating web sites, programming LEGO robots, publishing e-zines, giving presentations, managing spreadsheets, and configuring networks. We walk into ET labs and see the same activities and the same technologies. We see the problem and project based learning in ET that characterized TE for a century. We see the resemblance in practice and know it to be the same. We have witnessed the convergence.

We cannot – we will not – be persuaded by the doublespeak of the associations. The associations insist that the masses do a "very careful analysis of words and terms." They want us to believe only *their* words and terms. They do not want us to believe what we see in practice. But we believe the reality of what we see in practice! We see the same goals, objectives and standards in TE and ET. We see the intent of the ITEA's and ISTE's standards to be the same, even when they tell us they are different. We see that the ITEA's "technological literacy" is the same as ISTE's "technology literacy," even though we are told they are different. We see the organizers for the ITEA's standards for technological literacy to be the same as the ISTE's standards for technology literacy (ISTE, 2000; ITEA, 1996, 2000) (Table 1).

Granted, ET may be a subset of TE; the Standards for Technological literacy cover a fairly comprehensive range of technologies that include the information technologies. But when it comes down to IT, TE and ET teachers are technology teachers. They are the same. They use the same infrastructures and tools (e.g., labs, cameras, computers), pursue the same goals (e.g., technology or technological literacy) and conduct the same practices (e.g., design. problem solving, projects). So, the masses are not foolish, as the associations make them out to be.

In teacher education, TE educators are ET educators, or instructional designers as well. Any boundaries that once existed between TE and ET have eroded in the universities as well as the schools. For example, in the US, "TE" professors who teach communication technology courses necessarily practice TE and ET at the same time. Most, if not all, of TE's digital technology practices (e.g., animation, digital portfolios, graphics) in CT are the same practices found in ET. In my own practice at the University of British Columbia, distinctions between TE and ET are unnecessary. My students and I practice what my ET colleagues practice: IT, ICT, digital design, digital portfolios, digital videos, on-line learning, Web-CT and etcetera. I present, publish and write in TE and ET journals. Last year, I published a major history of ET, and this year will publish a history of TE (Petrina, 2002; Petrina and Dalley, in press). The history yet to be written is the history of convergence,

Table 1
The Technological Literacy Organizers of ITEA and ISTE

ITEA Organizers	ISTE Organizers
• Technological Concepts and Principles	• Basic Operations and Concepts
• Technological Design • Developing and Producing Technological Systems • Utilizing and Managing Technological Systems	• Technology Communications Tools • Technology Productivity Tools • Technology Problem Solving and Decision Making Tools
• Linkages • Nature and History of Technology • Assessing the Impacts and Consequences of Technological Systems	• Technology Research Tools • Social, Ethical, and Human Issues

such as I sketched out in the previous section. I find more and more TE colleagues attending ISTE conferences and the like. It is unnecessary to distinguish between ET and TE. Technology educators are technology educators and it is time that what is true in practice be recognized in theory!

Rise up for IT!

In theory, the associations continue to tell the masses that ET is not TE. In practice, the masses are unwilling to accept the lines drawn in theory by the associations. Long ago, Max Weber noticed that bureaucracies, such as professional associations, often exist to justify their own existence. So from this perspective, we can see the politics necessary to define TE differently than ET. There are two associations rather than one. The ITEA is wants IT both ways: ITEA made IT a core subject and wants to coexist with ISTE. ISTE wants IT both ways as well: ISTE made IT a core subject and wants to coexist with ITEA. The associations want to do the same thing with IT, but claim that they are doing different things with IT.

The associations are wont to paint over the political conflicts that unfold daily at the grass roots levels of school and teacher education practices. When ET and TE are reduced to IT, effective political strategies are essential. In practice, neither ET nor TE is willing to give IT up to the other. And it is no wonder. The digital technologies happen to be the hottest, most relevant technologies in the schools these days. Whoever teaches IT, be it TE, ET or business education will harness the tremendous power and resources that IT brings. For example, in 1998, the British Columbia government committed $123 million to spend between 1998 and 2004 in IT and telecommunications networks.

When the Educational Testing Service (ETS) (2002) produced their report on ICT literacy, they did not refer to either ET or TE. They avoided the politics of difference by propping up ICT literacy as an issue of policy and measurement. As they are wont to do, the ETS recommended large scale assessments of ICT in the US and most countries in the world. Large pools of resources will be forthcoming and any form of technological literacy that does not include a fair component of ICT literacy will be nearly irrelevant. Whoever defines itself against IT will *not* be a player in future technological literacy scenarios. It is time to switch from a politics of difference, which has been practiced with few tangible results over the past twenty years, to a politics of commonalties.

But, the identity of IT is also on the move and under contention. As a field of study, IT is both a sub-discipline of computer science, business management and engineering technology and a school subject (Figure 1). Currently, the *term* "information technology" (not the practices) is losing its currency, as most researchers argue that the new digital technologies extend well beyond information and communication technologies. Digital technologies engage a wide range of actions and senses and are not merely conveyances of information with technology. Digital design is becoming the new term of choice. Digital design focuses on the design of animated and interactive content for the internet, TV, CD, DVD, and other media environments. Digital design signifies the new digital curriculum in the schools, such as animation, computer aided design, web design and digital video.

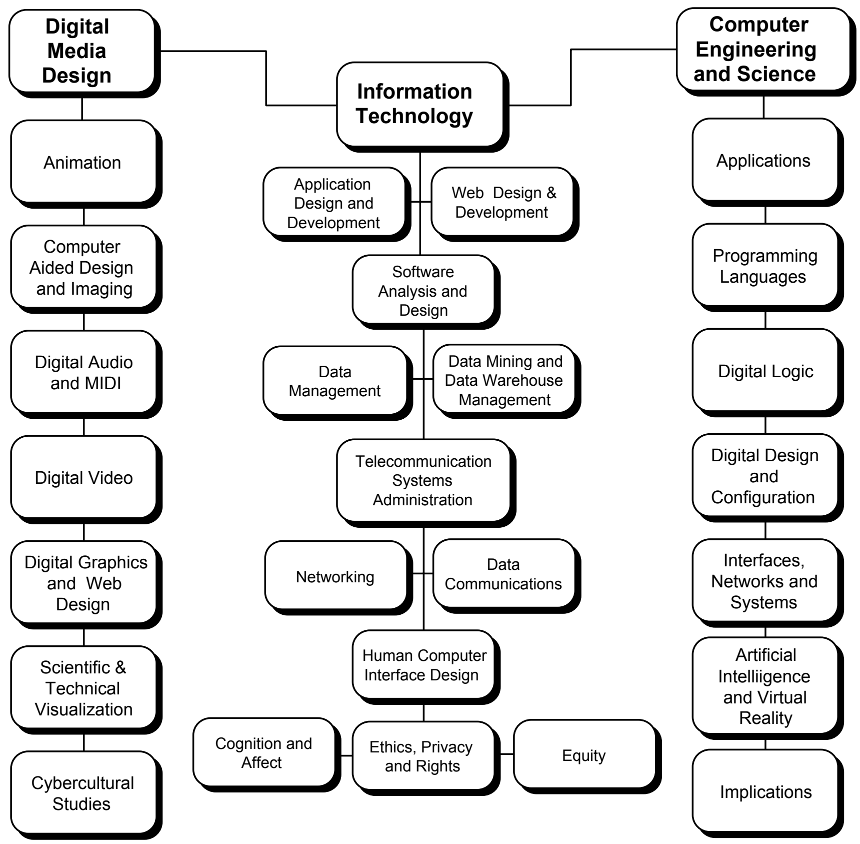

Figure 1. *The Scope of IT*

So now is the time to rise up and take hold of IT. Do not be discouraged by the associations and their accusations that the masses are confused. Rise up for IT and accept no more quibbling about whether IT is TE or ET. The masses know that ET is TE. We do not care to split hairs between the ITEA's technological literacy and ISTE's technology literacy. We will not let the resources and power of IT slip through our hands through a politics of difference. ET is TE. Ed Tech is Tech Ed. We are technology teachers, in one, big unhappy family of technology studies (Petrina, 2003). We are one, united in practice. Divided we fall in policy and theory!

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Miscellany

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