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Dr. Jane M. Smink, Editor

Technology Education as an Integrator:

Addressing Concerns about North Carolina's

New ABCs Regulations

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Technology Education as an Integrator: Addressing Concerns about North Carolina's New ABCs Regulations

Introduction

In 1997, the North Carolina Department of Public Instruction (NCDPI) implemented the School-Based Management and Accountability Program after two years of field testing and statistical analysis. This regulatory program is commonly referred to as the ABCs Plan. Among other things, the ABCs Plan requires local educational agencies (LEAs) to demonstrate that their students grow in academic achievement. Some people in the field of technology education are concerned that the ABCs Plan could result in the closing of some technology education programs. Whether or not closings occur, one way to address this concern is to use technology education as a central integrator of academic subjects.

The North Carolina "end-of-grade" test is the means by which LEAs measure their students' growth in academic achievement. The ABCs regulations use data from that achievement test to measure growth in academic achievement. Under the ABCs Plan, it is quite possible for administrators and teachers to be dismissed when students are not achieving at appropriate levels. At the same time, the plan rewards schools and teachers whose students achieve above a certain level. NCDPI is implementing the ABCs Plan at the same time North Carolina is experiencing growth in site-based management. Under site-based management, a school is given a certain amount of money and resources and a certain amount of freedom in deciding how those resources will be used. Often the principal and a site committee of parents and community leaders make these decisions. A similar approach, known as "charter schools," is currently being piloted in many LEAs.

It is conceivable that in an effort to commit resources to improve academic achievement, LEAs and site-based management committees will eliminate some non-essential programs and course offerings in their schools. There are two fundamental reasons that some technology education programs could be eliminated. Technology education is currently an expensive elective subject that is not included in end-of-grade academic achievement testing, and technology education is not widely perceived as academic general education.

Technology Education as an Integrator of Academic Subjects

There are several reasons teachers use curriculum integration. Among other outcomes, curriculum integration is *believed* to:

- improve achievement by providing students with the opportunities to learn at higher cognitive levels by providing reinforcement across the subject areas; and,
- improve student interest and motivation by demonstrating relevance among the subjects.

Scope and methods of technology education. Technology education is a natural integrator of academic subjects because its curriculum overlaps with many disciplines. Mathematics, science, and social studies are especially suited for integration with technology education. Technology education is a natural integrator because its unique instructional methods provide learning opportunities that traditional academic instruction does not offer. Solving technological problems using authentic processes, tools, and materials provides opportunities to learn at higher levels. Technology education students apply, analyze, synthesize, and evaluate important concepts in the context of real-life technological problems.

Research in technology education hands-on instruction and curriculum integration. While Korwin (1986) found that the cognitive achievement of technology education students who received hands-on instruction was superior to those receiving no hands-on treatment, the fact remains that there are few studies on the effects of hands-on instruction in technology education. Evidence should be inferred from studies outside the field (LaPorte & Sanders, 1995). There are some studies on the effects of curriculum integration in technology education, but this is also an area of research that has been relatively ignored. Among the more interesting studies, Brusic (1991)found a significant increase in the curiosity of students receiving science and technology education curriculum integration over the curiosity levels of the control group. Dugger and Johnson (1992) found that vocational education students who would not have taken physics, but who studied Principles of Technology for one year, performed significantly higher on the Principles of Technology post test than did regular physics students. Scarborough and White (1994) found similar results for non-physics students who studied their Phys-Ma-Tech curriculum. While the lack of quasi-experimental research in technology education needs to be addressed by the profession, technology education teachers can cite evidence that technology education curriculum integration has helped non-academic students achieve in academic subjects.

Despite the relative lack of empirical evidence, the technology education teacher should join an interdisciplinary team at his or her school and develop integrated curricula or instructional units. Where technology education teachers are able to overcome the constraints to curriculum integration, their students, co-workers, administrators, and parents see value in the technology education program (LaPorte & Sanders, 1993). It is plausible that a principal seeing students applying academic content in the technology education laboratory will be less likely to sacrifice that program to save precious resources. Suddenly technology education is perceived as a means of improving achievement and motivation in the face of the ABCs and end-of-grade testing.

Approaches to Curriculum Integration

Of the many variations of curriculum integration there are three basic approaches (Van Til, Vars, & Lounsbury, 1961; see Jacobs, 1991). Curriculum correlation is most often used at the secondary level. While many secondary schools have implemented block schedules, the academic structure and subject-area segregation make curriculum correlation a viable approach. Curriculum correlation involves an interdisciplinary team who identify areas of overlapping content, sequence the instruction and develop the activities. In this approach, mathematics is taught in the mathematics classroom. At approximately the same time, science, social studies, and English are taught in their own classrooms.

Correlation is the approach that LaPorte & Sanders (1993) used in developing the *Technology, Science, Mathematics Connection Activities* (see LaPorte &

Sanders, 1996). During the development and field testing of their instructional materials, LaPorte and Sanders observed that academic teachers get excited about technology education activities. The academic teachers were often enlightened about technology education when they were able to see the amount of overlapping content their subjects share.

The second basic approach to curriculum integration is known as fusion. Fusion is usually implemented as a course of study. An academic example might include a course called Latin American Studies that integrates social studies with Spanish. A very popular course taught by both technology education and science teachers is known as Principles of Technology. Principles of Technology is curriculum fusion insofar as it combines physics, technology, and the related mathematics in a single course (see Dugger & Johnson, 1992; Dugger & Meier, 1994).

The third basic approach to curriculum integration is known as core. Core integration uses content from any discipline as long as it relates to the central theme or issue upon which the class is focused. Usually taught by one teacher in a self-contained classroom, core curriculum integration is not popular at the secondary level because it lacks a definitive curriculum structure, and as the content becomes more sophisticated at the high school, it becomes more difficult for one teacher to *effectively* teach across three or more disciplines. This approach is often used in the lower elementary school grades.

Constraints to Curriculum Integration

No matter how promising curriculum integration sounds, the technology education teacher faces many constraints to implementing it (LaPorte & Sanders, 1993). Nothing will get accomplished if there is a lack of interest and support on the part of the academic teachers or the administration. Teachers need time to plan curriculum integration. While many middle schools have formed interdisciplinary teams that have common planning times, the technology education teacher is rarely included. While the teachers are planning together, their students are in technology education class. One year in advance of implementing an integrated activity, the technology education teacher should get the principal and the school counselor interested in the idea of including technology education on the interdisciplinary team. This will give the administration the lead time it needs to change the class schedule. With scheduling support and interest, the technology education teacher could join the interdisciplinary team and encourage the other teachers to participate.

In curriculum correlation, the technology education teacher might only teach two or three of the participating mathematics teacher's students. Therefore, of the twenty to thirty students in mathematics, only three will benefit from integration. Having few students in common with other teachers is a difficult constraint to overcome. Often the academic students will come to visit the technology education teacher for special instruction during his or her planning period. However, this is not an optimal solution because it consumes the technology education teacher's planning time and provides only cursory instruction for the academic students. The few students who are in technology education could take their technological solutions and artifacts to their academic classes where all students could analyze and test them by applying related academic content. Sometimes a majority of the students in one or two technology education classes will come from the same academic teacher. That teacher is the person with whom the curriculum should be correlated if he or she is willing.

Prominent reform reports have called for less emphasis on the amount of content students cover in lieu of more emphasis on the authentic processes and problem solving within respective disciplines (AAAS, 1989; NCTM, 1989). Despite this, each subject area that is represented in the correlation process will offer constraints because of the scope or sequence of instruction. For example, correlation may not be convenient if the mathematics teacher covers a particular concept in the beginning of the year but the technology education teacher covers the related concept near the end of the year. Every subject area has prerequisite concepts that must be taught as a foundation for further learning. Because of NCDPI regulations requiring vocational assessments, even the technology education teacher must cover a prescribed amount of content. This is an easy constraint for the technology education teacher to overcome if he or she is teaching in a general laboratory. Often academic teachers are required to teach in a particular sequence, while the technology education teacher has more flexibility. The technology education teacher can simply change the sequence of the technology education curriculum to more closely match the sequence of the other academic courses.

It may be more difficult to affect integration if a vendor-developed modular laboratory is the primary approach to technology instruction. Most modular labs in technology education provide programmed instruction in which student pairs move from one module to another. One module might teach students about transportation and another might teach about manufacturing. In mathematics class, this would be like teaching multiplication and division simultaneously. Generally, academic teachers provide group instruction. For example, when the mathematics teacher is providing regular instruction on division, he or she is teaching all of the students about division.

Having taught in a new modular lab himself, the author knows through experience that modular labs are excellent for exploration and for implementing new content and equipment in the program. Nevertheless, there might be only one module that overlaps with current instruction in the academic classes. Only two students will benefit from curriculum integration. Another problem might be that the two students who are shared by the team might be studying a module that is different than the one that is currently needed in the curriculum integration unit.

The teacher could change the rotation of students through the modules. However, given the relatively complicated management systems of most modular labs, the teacher may be reluctant to change the rotation. When teachers first have their modular labs installed they are very busy learning the lab's system of management and modular content. While a teacher could develop his or her own module that directly addresses the integration activity, it would likely be overwhelming during the first year in which the modular lab is implemented.

Often when modular labs are installed, the older general equipment and materials are discarded due to a lack of laboratory space. That general equipment lends itself well to technological problem solving and curriculum integration. Without that general equipment, the scope of curriculum integration may be limited. To overcome this limitation the technology education teacher can begin to acquire smaller bench-top and portable equipment.

Planning for Curriculum Integration

Once an interdisciplinary team is formed, the teachers need to explore how their content overlaps. Technology education often provides excellent themes, technologies, and technological problems around which the integration can be organized. The team can begin to construct a web (Levy, 1980) or planning wheel (Palmer, 1991) to graphically see what academic and technological content relate to the theme or problem at hand. See figure 1. The web also allows the team to see how specific concepts are related across subject areas.

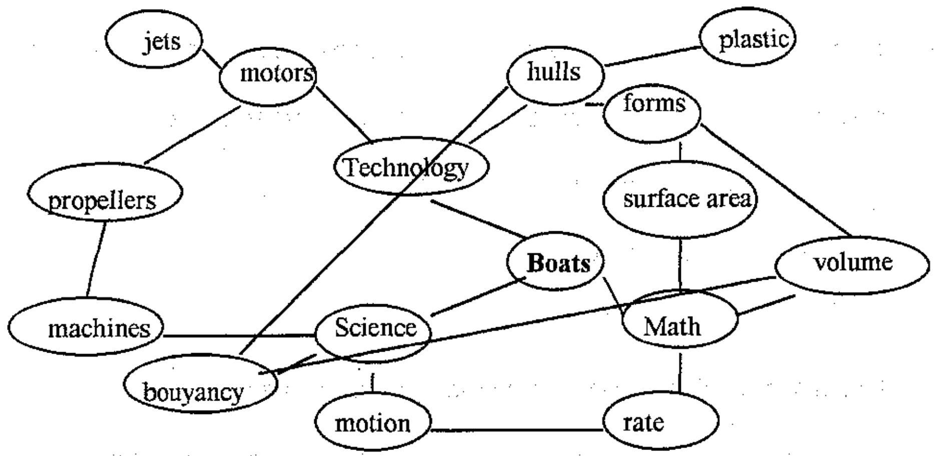

Figure 1. Webbing.

The web is then used by each teacher to outline the sequence of instruction *within* his or her subject. The team meets again to determine an appropriate sequence of instruction *across* the subjects. For example, in a unit on boats students may be challenged to design a working model that uses alternative energy (LaPorte & Sanders, 1996). In order to design the boat more effectively, the science teacher should teach about potential and kinetic energy prior to or during the design activity. In order to test the performance of the model, the mathematics teacher should teach students about "rate" before students collect data.

Finally, teachers develop the activities that they have conceptualized and begin instruction. During implementation, the interdisciplinary team should meet regularly to discuss logistical problems and the progress and achievement of students.

Working Toward Solutions

Correlating technology education and academic curricula with an interdisciplinary team that shares many students in common is certainly an optimal approach to curriculum integration. This is especially true when instruction across the subjects is sequenced for relevancy and to enhance the short-term mastery of the student. The approach is also enhanced when the technology education facility includes general resources in addition to a modular lab.

However, there are many ways to help improve less than optimal circumstances. In the first year curriculum integration is attempted, it is very important that the team try not to accomplish too much. One correlated or interdisciplinary unit may be enough as a pilot study. Many technology education teachers are doing an excellent job of curriculum integration under less than ideal circumstances. Technology education teachers should emphasize self-contained approaches such as modules that independently integrate curricula. Teachers should not exclude using a module simply because it is not specifically designed for integration. Teachers should give serious consideration to implementing fusion courses such as Principles of Technology.

A considerable number of technology education students are not academically advanced or are not in the college track. As cited in the aforementioned studies, these students are, more than any others, the chief beneficiaries of well designed and taught curriculum integration units. Correcting under achievement is a principal purpose of the ABCs Plan. At the same time, academically advanced students will become aware of the excellent opportunities provided by the technology education program when they experience them through curriculum integration. Program concerns related to the ABCs Plan might be addressed, in part, through curriculum integration. But, this requires the technology education teacher to plan carefully and communicate clearly on a sustained basis with his or her colleagues and community. Concern over the ABCs Plan should not be the primary motivation to make technology education the integrator of academic subjects. Any technology education teacher who has overheard a mathematics student say, "Why do we have to learn this?" knows that no matter how many constraints the teacher faces, curriculum integration with technology education will provide relevant instruction. No teacher in the school is in a better position to provide authentic instruction that demonstrates the necessity of academic achievement than the technology education teacher.

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Evolving Technology and Graphics in Secondary Education: A New Curriculum in Scientific Visualization for North Carolina

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Evolving Technology and Graphics in Secondary Education: A New Curriculum in Scientific Visualization for North Carolina

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Abstract

A new curriculum, Scientific Visualization, is being taught by high school technical graphics, technology teachers and science teachers for the first time. This curriculum reflects a broadening application of computer graphics techniques in the workplace and represents a rich area for graphic communications teachers at all levels of education. The goal of the two-course sequence at the high school level is to give students expertise in manipulating both geometry and the visual characteristics of geometry, such as color and texture. These visual elements are used to construct 2-D and 3-D graphic images which support the understanding of scientific and technical principles. These courses are meant to complement rather than replace more mainstream graphic communications courses. The proposed student populations taking the scientific visualization courses are not only the traditional vocational track students, but also pre-college students planning on studying in scientific, engineering, and technical fields. Work is underway developing an extensive set of support materials and sample problems for use in the newly developed curriculum. Implications for teaching technical graphics in higher education will be discussed in this paper as well as the impact this curriculum may have on colleges and universities with technology education students.

Introduction

For the past year, a group of educators from NC State University, Wake Technical Community College, the State Dept. of Public Instruction of North Carolina, and numerous high school teachers throughout the state have met to develop a new two-course curriculum in Scientific Visualization. The main goal for this curriculum is to expand the teaching of technical graphics to a new audience: science and pre-engineering students. This new curriculum will be taught by high school technical graphics, technology education, and science teachers for the first time in the Fall of 1997. This curriculum reflects a broadening application of computer graphics techniques in the workplace and represents a rich area for graphic communications teachers at all levels of education to be involved in.

While contemporary high school drafting (technical graphics) programs now use sophisticated graphic tools to create 2-D and 3-D wire frame and solid models, their focus has remained narrow. It is now apparent that changes primarily brought about by advances in technology have created new opportunities to use similar tools to promote and enhance the study of the physical and social sciences, including mathematics.

This new curriculum is designed to articulate into scientific visualization and technical graphics curriculums at both 2-year and 4-year colleges and universities. These courses are meant to complement rather than replace more mainstream technical graphics courses in architectural and mechanical graphics.

The proposed student populations taking the scientific visualization courses are not only the traditional vocational track students, but also pre-college students planning on studying in scientific, engineering, and technical fields. Most of those aware of this emerging technology accept the premise that graphic tools can and should be used to better understand abstract and numerical concepts. Sophisticated graphic tools are used in the sciences, business and industry, finance, higher education and virtually all major areas of our economy. Cognizant of the above concerns, representatives from MCNC (Microelectronics Center of North Carolina); NC State University Department of Math, Science, and Technology Education; Wake Technical Community College Engineering Technology Division; as well as the NC Department of Public, technology education division, sought ways in which to build a strong secondary program in Scientific and Technical Visualization, focusing on the use of sophisticated graphics tools for the purpose of studying math and sciences. Momentum for this high school-level scientific visualization curriculum developed out of a revision of the complete high school technical graphics curriculum developed by the same team now working on the scientific visualization curriculum (Clark, Wiebe & Shown, 1996). It became clear that a scientific visualization track could both broaden the scope of the technical graphics curriculum as it was currently structured and attract a new group of students to technical graphics.

Curriculum concerns

The old technical graphics curriculum in the NC high schools suffered from many of the same attacks which have been leveled at college and university technical graphics courses. Criticisms of technical graphics tend to center around one central theme: relevance. A common argument to be used is the relevance of teaching students manual drafting techniques. Even after the move of many programs to 2-D computer-aided drafting (CAD), there was still the question raised of the relevance of teaching a highly specialized graphics language (whether it be mechanical or architectural) to a broad population of students. Though many in the technical graphics field have argued the general benefits of traditional technical graphics as a means of developing spatial visualization skills (e.g., Bertoline & Miller, 1989; Devon, Engel, Foster, Sathianathan & Turner, 1994; Leach & Matthews, 1992; Miller, 1990; Rodriguez, 1992; Sorby & Baartmans, 1994; Zsombor-Murray, 1990), most look to our field as a source of applicable skills.

Like architectural and mechanical graphics, scientific visualization may be used to represent a physical object, but that object may be as small as a molecule or as large as a solar system. In addition, scientific visualization may be used to represent more abstract *systems*. A system represents a physical or abstract model which contains a series of interrelating elements. The goal, typically, will be to design an experiment in which the system is *probed* and the system's responses are *recorded*. To bring this description back to earth, an example might be setting up an experiment to better understand an industrial boiler, the system. The boiler is probed by applying heat to it and its response is measured by recording its pressure at various temperatures. A traditional mechanical drawing could be made of this boiler, and though these drawings could be useful in the construction of it, it would not very helpful in understanding how the boiler functioned as a system. On the other hand, a graph could be created of the relationship between temperature and pressure. In addition, a three-dimensional model of the system could be constructed and the effects of internal pressure on the boiler walls could be simulated and represented as rendered pictorials. In addition, an interactive, dynamic multimedia presentation could be created as a teaching tool to demonstrate the basic physical principles represented by this system. All of these graphical representations are examples of how scientific visualization is used to both explore and explain systems.

Unlike the architectural and mechanical tracks, the scientific visualization track is not likely to prepare students for a vocation directly out of high school. Instead, this track is likely to prepare for a program directly related to scientific visualization at the community college level or enrichment for a scientific or technical career in areas such as engineering, technology, medicine, or the physical sciences. Therefore, students who are likely to be attracted to this course sequence are ones who are largely on an academic track and may never have taken a vocational course before. The conceptual basis of scientific visualization makes well suited for cross-disciplinary activities with traditional academic tracks such as chemistry, earth sciences, and physics. In addition, schools with pre-engineering and technology education programs will also have other courses which mesh well with the scientific visualization sequence.

The scientific visualization courses cover a range topics which give students both exposure to all of the major conceptual areas of what is commonly understood to be scientific visualization and experience in a broad range of graphic techniques. Unlike many of the graphic techniques covered in the architectural and mechanical areas, the techniques in the scientific visualization area are more broadly applicable. On the other hand, reflecting the more academic leanings of this track, the theoretical and operational basis as to why particular graphic techniques are used are covered in more depth. In outline, the primary areas covered in the first and second level courses are as follows:

- Introduction to scientific visualization
- Graphing/Plotting
- Image Processing
- Animation and Simulation
- Presentation and publication

Introduction to Scientific Visualization

This area places scientific visualization in context with other technical graphic communication methods. The concept of the exploration of systems is introduced along with a review of the general types of systems which might be explored, analyzed, and presented using scientific visualization techniques. A foundation is built around an understanding of the different types of data variables which may be used to describe both the probing and recording techniques used on the system.

Graphing/Plotting

A taxonomy is presented which classifies visualization methods used based on both the types of data variables which are used and the intended audience of the visualization. In addition, the basic graphic elements used in graphing plotting are introduced along with a review of two-dimensional coordinate systems used for organizing the graphic elements. Graphing and plotting exercises are done based on a number of different application areas. In some cases, data can be collected from experiments students create themselves. In other cases, data may be gathered from both print and electronic (e.g. Internet) sources. The primary focus in this section will be 2-D graphing/plotting methods, done both by hand and using computer-based tools.

Image Processing

This area focuses on area rendering techniques using image processing techniques. Coupled with this section is an introduction to color theory: both its perceptual basis and computer-based generation methods. Through the use of image processing software, the basic principles of how such software is designed and functions is explored. Image processing exercises are based around data gathered from published sources, both from images created by the students (either using all digital or a combination of photographic and digital methods) and with images acquired through the Internet.

Throughout this section techniques used by professions which rely on image processing techniques (i.e. medical and earth sciences) are examined.

Animation and Simulation

Two major new areas are introduced in this area: dynamic visualization and 3-D modeling techniques. Dynamic visualization through animation and simulation is shown how the change in a system over time or as a real-time response to user input can be represented. 2-D simulation is explored using software tools modeling either physical (e.g. kinematics/ dynamics) or conceptual (e.g. virus models) systems. Similarly, 3-D modeling tools can be used to create representations of systems which can then be manipulated to represent some process. Using these software tools, animations are created to represent a dynamic process. Coupled with the creation of animations from 3-D models is an introduction to rendering techniques, including proper use of lighting, color, and camera position.

Presentation and publication

This last area focuses on the integration of information used to represent and analyze a system into a form which can be presented to an audience. Information sources include textual and numeric data in addition to the graphics created as part of the visualization. The focus will be on the clear and concise presentation of necessary information to the intended audience. Exercises will use multimedia presentation software which allows the integration of both static and dynamic graphics. This last area can be used as part of a capstone project encompassing both the scientific visualization course and other related courses. The presentation process emphasizes the use of multi-media types being integrated into a project that extends from a comprehensive study about a given scientific subject.

Application of scientific visualization

In the creation of a visualization, the initial design is typically driven by classification of the graphic along two factors. First, is the visualization going to be concept-driven or data driven. A concept-driven visualization is typically generated from the development of a concept or theory devoid of any empirical data. It does not mean that there doesn't exist any data that either supports or refutes the theory, but this particular exploration does not require one. For example, if the goal is to represent the development of a volcano over time or the affects of harmonics on a suspension system on a car it may be more effective to use diagrammatic techniques to represent the phenomena than to graph data values. For this type of visualization, the marks often have symbolic (semantic) meaning which is either assumed to be generally understood or are explained through text. A data-driven visualization uses empirically or mathematically derived data values to formulate the visualization. In this case, a specific relationship between data values and the characteristics of the marks is defined so that a characteristic varies in some predetermined fashion. In both types of visualizations, additional graphic elements can be used to support the interpretation of the primary marks.

The second factor initially considered is whether the visualization is going to be represented in two or three dimensions. Evaluation of both the information to be presented and the capabilities of the computer hardware and software being employed also become factors in deciding on the dimensionality of the visualization. If the visualization is going to represent time as one of its variables, then a decision also has to be made as to whether time is going to be represented as a geometric dimension (e.g., an axis on a graph) or through another means such as animation. Since both concept-driven and data-driven visualizations can be represented in either two or three dimensions, a matrix of four possible visualization types is derived. Though it is somewhat arbitrary, the four visualization types are: 2-D concept-driven, 3-D concept-driven, 2-D data-driven, and 3-D data-driven. These types can be used to as means of classifying assignments and examples in the scientific visualization course.

Concept-driven visualizations use diagrammatic techniques which are somewhat problematic to classify. When describing the classification or flow of information traditional charting techniques such as hierarchical charts or flow charts can be used. When representing complex biological or ecological processes, graphic elements can represent simplified or symbolic versions of components of the original system. For example, a virus invading a healthy cell might be represented by a collection of geometric primitives whose shape and color represented the major components of the cell and virus. Often a decision has to be made concerning the realism of the representation; weighing direct visual connection with the real object and the clarity and simplicity of a more abstract representation.

Data driven visualizations, by their very nature, are more easily classified. The type of visualization and the mark characteristics to map to the data can be chosen using a taxonomy of data characteristics (Bertoline, Wiebe, Miller & Nasman, 1995). First, since data are derived from empirical work or mathematical expressions, independent and dependent variables can be identified. However data are being derived, the experiment or formula can be thought of as a 'system' that has both inputs and outputs. The independent variable(s) is/are manipulated by the researcher/engineer/ technician and 'input' into the system while the dependent variable(s) is the observed 'output' results. The variables, both independent and dependent can, in turn, be further described as being either qualitative or quantitative, with quantitative data being further classified as being either absolute, ratio, or relative values.

Impact on future curriculums

A curriculum of this type will directly influence the type of student that will want to take a graphics class at the secondary level, as well as the visualization skills of students take with them either to college or work. With a scientific visualization curriculum, secondary education graphics teachers will have students wanting to understand visual science theories and apply these visual techniques to more than just mechanical or architectural areas. In North Carolina high schools, technical graphics has mainly been offered to students wishing to study a vocational drafting curriculum that emphasizes either mechanical or architectural areas. The new scientific visualization curriculum will bring a new type of student to the classroom; students that want to apply visual techniques to areas of interest beyond these traditional areas and into academic areas that include math, science, technology, chemistry, physics, and biology. This new curriculum will allow these nontraditional vocational students to see how visual science can be applied to other career focus areas. Although the basics of visualization is the same no matter what career focus a student may have, students going through the scientific visualization curriculum will have a broader background in using their visual skills in nontraditional ways.

Although this new curriculum is developed as a vocational track, the concepts and information used throughout the curriculum can easily be integrated into math, science, and technology education classes. Technology education teachers throughout the state can use the curriculum structure, as well as its data or conceptual-based problems, to teach technology students ways to manipulate technical, mathematical, and science related data and visually see the results. This is yet another way for technology education teachers to develop visualization skills within their students through classroom instruction and laboratory-based problems, as well as demonstrate the direct integration of technology to other scientific related areas.

Scientific Visualization Curriculum Outline

The curriculum team for this project consisted of teachers and administrators from both secondary and post-secondary education. These professionals came from the disciplines of technical graphics, biology, physics, science, technology education, community college instructors of scientific visualization, State Department of Public Instruction, and representations from the university system. Each member contributed to the curriculum representing their expertise in a major field of study directly related to the scientific visualization curriculum. Although this project was an integrated approach to curriculum development, over half of the participants were teaching or had taught technical graphics.

After one year of development, a first year course in scientific visualization was produced and distributed to graphic teachers across the state (Carolina, 1997). The curriculum team decided to have five major competencies for this new curriculum. The first competency, mandated by the North Carolina State Department of Public Instruction, centered around leadership development. This competency is designed to give students basic leadership skills, as well as develop a career plan that will include the information taught within this curriculum. The second major competency developed for the curriculum is designed to teach students the basics of problem solving using design concepts through the process of involving visual science theory. Total Quality Management (TQM) tools are included within this competency to aid the students in finding solutions to problems and develop consensus building measures. While students are working on problem solving and critical thinking skills, competency three teaches the students how to use the computer as a tool for visualizing scientific data and information. The fourth and fifth competencies are the most demanding from the student. These competencies require students to learn different visualization principles needed for analyzing information and apply this knowledge towards a scientific problem using a computer. Eighty percent of the course is conducted around these two competencies. Major focus areas for competencies four and five include the following: coordinate systems, spatial relationships, time representation, geometric shapes, terminology, orthographic projection, pictorial projection, shape properties, color, qualitative and quantitative data, dependent and independent variables, scales, and technical presentation skills. Listed in Table 1 are the major components and concepts for this curriculum.

Training needs for secondary teachers

One part of the grant received for developing the scientific visualization curriculum included funding for training educators to teach this new curriculum area. The Graphic Communications program at North Carolina State University was awarded this funding to provide a one week workshop each summer for two years beginning in 1997.

Table 1 Scientific and Technical Visualization I Curriculum Outline

1. Leadership Development:
   - Basic techniques for parliamentary procedure
   - Steps for processing a motion/vote
   - Establish goals
   - Identification of career goals

2. Apply Problem Solving and Design Concepts:
   - Explain the concepts and principles of problem solving and design
   - Apply problem solving and design methodology

3. Basic Computer Knowledge and Concepts:
   - Identify and explain basic computer terms and concepts
   - Advantages and disadvantages for using computers in scientific visualization
   - Apply concepts and principles of computer file management

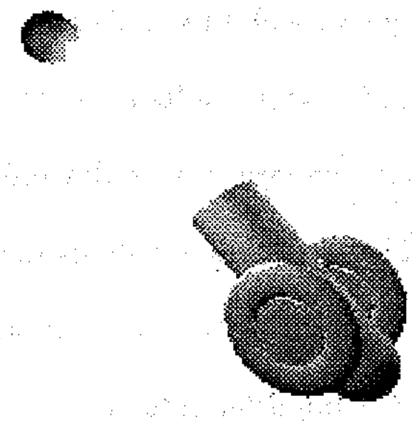
4. Visualization Principles:
   - Identify and explain the application of description systems for space and time
   - Explain the fundamental concepts of shape description
   - Identify and explain visual properties of objects
   - Describe visual methods for representing data-driven visualizations
   - Describe visual methods for representing concept-driven visualizations

5. Apply 2-D and 3-D Visualization Techniques:
   - Design and evaluate a simple visualization
   - Produce computer-based concept visualization projects

The workshops were designed for teachers that have been involved with the project the previous year, as well as for new schools to become involved with the project. Each workshop was 20 hours in length, with the advanced workshop emphasizing problems to be used with students for the curriculum, and the introductory workshop to begin the basic development of what the new curriculum entails. Both workshops used the Internet as its primary resource of information and the teachers were taught how to access this information and use it during the new school year.

Example problems

Scientific problems were developed for the teachers to use in the classroom. These problems were in areas related to design, technology, biology, physics, chemistry, and earth science. These scientific visualization problems with example solutions were placed on a website that was accessed during the workshop and can be used by the teachers for the coming year with their students (Wiebe & Clark, 1997). Each problem begins with an introductory statement explaining the background information needed for starting the problem and the data or information needed to find solutions to the problem. References are indicated for each problem, as well as a comprehensive listing of websites that students can use to find the needed information or background to begin work towards the solution. Downloadable files are included in some problems for additional aid in working the problem. These files included .jpg still images, .avi animation files, and .gif screen captures that can demonstrate what the problems entails or can be used in working the problem to completion. Each problem requires the students to use research, visualization, and computer graphic skills. Some problems require the use of a graphing software package, others needed a modeling package. Most problems can be enhanced through the use of advanced modeling strategies and incorporating animation into the final visual solution. Listed below are some example problems used during the workshop:



Physics Problem Example (Figure 1):

(Wiebe, 1997)

Though many areas of physics lend themselves to visualization, Newtonian physics stands out as an excellent example of how 3-D and 2-D visualizations can help support learning about physical principles. Formulas representing the principles of Newtonian mechanics often use coordinate space values both as independent and dependent variables. These values can not only be represented in traditional graphs, but also as symbolic models. In this problem, we will take the example of a cannonball being shot from a cannon and model it in a 3-D modeling package, TrueSpace™ (Figure 1).

Numerous elements of weather systems can interact to cause catastrophic events. One example of this is the flooding in the Red River

Valley this past spring Earth Science Problem Example (Figure 2): (Wiebe, 1997). What were the factors that converged which help cause this particular event? Allen Voelker, a meteorologist with the National Weather Service, put together a short essay entitled, Anatomy of a Red River Spring Flood. In explaining why the Red River flooded this spring, but not in 1994, Voelker points to temperatures in the early spring as a key factor. In this exercise, we will graph data on: temperature, precipitation, river height, and river volume (discharge). The raw data was collected from web sites listed on the resource page, imported into an Excel™ spreadsheet, cleaned up, and then imported into DeltaGraph™.

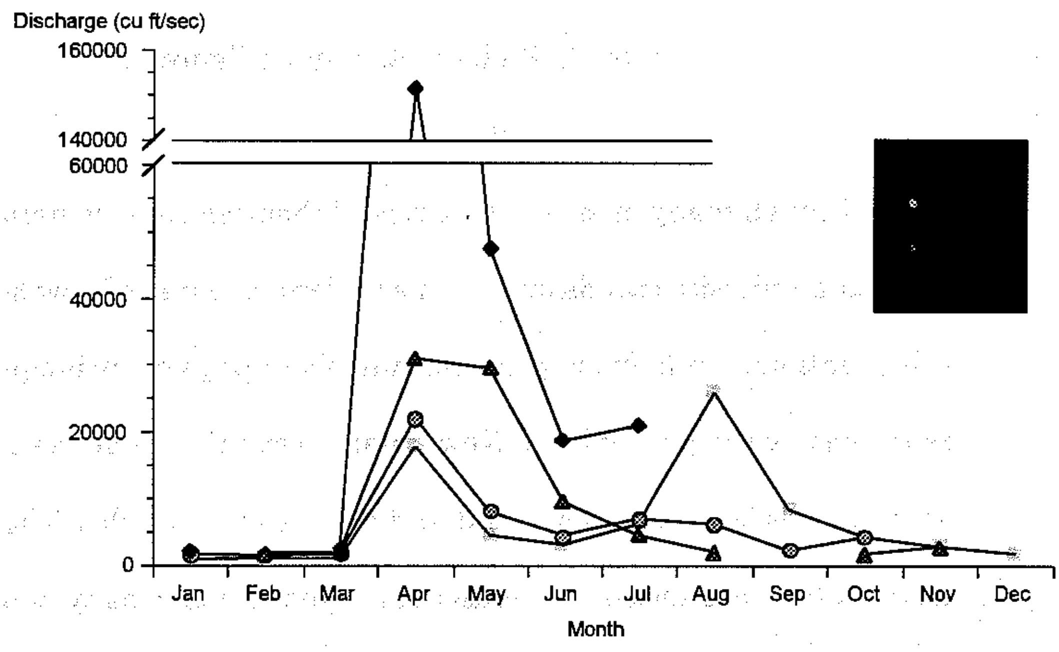
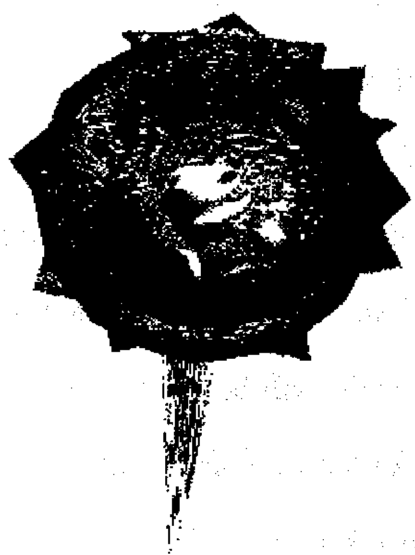


Figure 2

(Wiebe, 1997)



Biology Problem Example (Figure 3):

(Clark, 1997)

In 1892, a Russian biologist by the name of Dimitri Ivanowsky made a revolutionary discovery. After years of research and experiments on tobacco plants infected with the tobacco mosaic disease, he transmitted the disease to healthy plants by rubbing them with juice extracted from the infected plants. In 1935, a scientist by the name of W. M. Stanley found that viruses are very different than bacteria, in that viruses have a noncellular organization. As research continued, information about the structure of viruses became known and that parts of any virus included a chromosome-like part, surrounded by a protein coat, and all viruses have a capsid, DNA or RNA (inside the head of the virus), and a tail (or tail fiber). Each virus type has a different known shape or structure that allows it to be recognized, as well as a life cycle for which it can reproduce (Mader, 1993).

Since viruses can only be seen by powerful microscopes, this scientific visualization modeling problem is to acquaint students in recognizing the various shapes and life cycles of viruses through the process of making both a simple physical model and a virtual model of a virus type on the computer. The physical model will be used to demonstrate the major parts of a virus and the computer model will be used to actually model all components of the virus. Animation can later be used to show movement of the virus through its life cycle. Scientists often make these types of models to study possible viral structures, and model ways viruses may bind to host cells. Modeling materials and Truespace will be the primary resources needed for completing this problem (Figure 3).

The Next Stage: Scientific and Technical Visualization II

During the 1997-1998 academic school year, teachers that developed the introductory curriculum over the past year began piloting classes in their schools starting in the fall of 1997. During this same time, teachers are meeting to talk about and perfect this introductory curriculum, as well as write a second year course titled Scientific and Technical Visualization II. These teachers will also work with the new teachers that came to the introductory workshop and help train and develop their knowledge in the teaching of this curriculum. During this year, both the veteran and starting teachers involved with this project will receive training on software and computer hardware to be used for both Scientific and Technical Visualization I and II.

This second year course will mainly center on 3-D graphics and image processing. Since it is a second level vocational course, the curriculum will deal with more applications than cognitive knowledge-based learning. The end result for the project is to have a curriculum were students understand and apply their visualization skills in scientific related fields. It is the goal of the curriculum that upon completion

of both classes, students may want to pursue a career using these skills in a science related profession, or relate these visual skills to other professions while enhancing their capabilities at using graphics as a career related function.

Technology Education's' Role within Scientific Visualization

Scientific Visualization uses current technology to better describe and analyze scientific and technical concepts, as described in the above examples and information. Technology education within the state has many things to consider during the development and implementation of this new curriculum. First, scientific visualization does not limit itself to just vocational bound students, but is a process and skill that all students can use once graduating and working within scientific and technological areas. Therefore, basic visual communication skills traditionally taught through technical drawing and graphic arts within the state's technology education communications curriculum needs to include the basics of scientific visualization and teach students how visualization skills can be used outside of engineering fields. Since our goal in technology education is to provide a general education in technological literacy for all students, scientific visualization will broaden our curriculum to include those areas of visual communication currently being left out and will prepare students to integrate these visualization skills in other professions.

Second, technology education teacher educators need to consider the demand for a "well-rounded" teacher for teaching this type of curriculum. Currently, teachers involved in the pilot sites using this new curriculum are science and vocational technical graphics teachers. Science teachers know the content, but graphic teachers know the processes for visualization. Scientific visualization, with it's content and visual processes, requires the integration of both the academic and vocational areas related to the subject. Science teachers are prepared through a four-year degree to teach one or more areas related to science education. Vocational technical graphics teachers are hired usually from industry and most have no formal training in teaching or have a baccalaureate degree related to science or education. It is the opinion of these authors and other professionals in the field of technology education that graduates with a traditional four-year degree in technology education are better prepared to teach this type of integrated curriculum. Therefore, students who have graduated with a degree in technology education and have gone through the extensive science, mathematics, physics, education, and graphics courses during their teacher preparation are the best catalyst for integrating the science, visual, and technological principles together that this new curriculum requires.

Finally, the role of technology teacher education in the future preparation of technology teachers for the state needs to include scientific visualization. As technology education teacher educators in North Carolina, it is our duty to look towards the future and determine what new concepts and content of information is needed to better prepare technology teachers for successful employment. Scientific visualization is a concept that technology teacher educators need to consider as a part of their teacher training. Through the use of better and more advanced software and hardware, scientific visualization will continue to grow within its related professions and need more people to understand its use and overall function within the scientific community. This objective for the integration of the sciences with technology is one competency our profession needs to address. Technology education teacher educators can aid in this endeavor by providing that basic, overall understanding of what is scientific and technical visualization and train new teachers to teach this content area so they can in return, teach it to their students, our future scientists and technologists learning to live in a technical world.

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Cross Gender Interaction in

Technology Education

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Running head: Cross Gender Interaction

Cross Gender Interaction in Technology Education

Though the traditional "industrial arts" programs of the 1950's which involved woodworking, metalworking, and other "shop" areas were heavily male dominated, modern technology education appears to be more appealing to females. At one time there were very few female students and almost no female teachers in industrial arts courses, but as the discipline began to evolve towards a study of technology during the 1960's and 1970's a trickle of females joined our ranks. This trend has continued, and now there is a growing female influence in our various programs in the USA and in other countries as well.

In the 1950's, the boys who enrolled in industrial arts shop courses, and the men who taught those courses, viewed them as a "man's world" and there was little effort to be "politically correct" in the modern sense of that phrase. Though there was great variety, some shops even had somewhat of a "locker room" atmosphere in which speech patterns and jokes that would be unacceptable in general public were largely ignored. As females began to enter the field of industrial arts, male teachers and students had to become more sensitive about what they said and how they expressed themselves. Now that there are many more females in technology education than ever before (and the number is still growing), to what degree have we established a common understanding of what may be said or done within our profession? In other words, are there recognizable cultural mores for acceptable cross gender interaction in technology education upon which the men and women in our profession can agree?

At the same time that more females have been entering technology education, changes have been occurring in what is considered acceptable behavior in general society. In the 1950's there were fairly clearly understood lines of speech which most people generally knew were not to be crossed. This especially was true in regard to sexually oriented comments, jokes, gestures, and speech--it was well understood that such things were not talked about in "mixed company". The liberal movement of the 1960's began some change in those cultural mores and today much of what would have seemed absolutely taboo in the 1950's is presented openly on television during the "family hours" both in programs and in commercial advertisements. So, on the one hand a male technology teacher who wishes to make his classes more appealing to females might feel he should maintain a very conservative atmosphere within the class, but on the other hand the females may not expect that in today's liberal social climate. How can males and females interact most comfortably within technology education?

Though some research has been done concerning fairness of opportunity, attractiveness of topics/approaches, and ways to encourage more females to enter the profession (ITEA, 1994; Liedtke, 1995; Markert, 1996; and Silverman & Pritchard, 1996), there is still a need to determine how men and women feel about the cultural atmosphere within our profession, our classrooms and laboratories, and how teachers and students interact. This study was a beginning in the effort to assess how professionals in technology education feel about certain issues and whether the perceptions of men and women differ on those issues concerning cross gender interaction in technology education. Since some of the topics are sensitive in nature, perhaps some are even taboo for some people, this work and its findings must be viewed as establishing a starting place rather than as etching permanent conclusions. Likewise, the cultural mores of our society and within our discipline will not likely stagnate today, so continuing work will be needed to track the evolving cultural climate within our discipline as it relates to the world around it.

Methodology

A survey of technology education professionals was conducted at the 1997 Technology Student Association (TSA) national conference in Washington, DC, June 23-27, 1997. Volunteer participants were sought at the "Advisors' Update" meetings held each day of the conference. Respondents were asked to complete the form while at the conference and return it. Questionnaires were distributed to volunteers at the door and a brief announcement describing the study was made during the meeting. Of the 150 questionnaires distributed, 113 were returned. However, 8 of those were incomplete, so the final sample consisted of 95 (39 females and 56 males) for a response rate of 63.3%. A few forms were returned with disparaging remarks such as "None of your _____ business!" and "I'm here for the benefit of my students, not to do your survey ...". One man brought the questionnaire back to the researcher and said he was offended by the questions and refused to participate, so there is some admitted degree of controversy involved here.

The questionnaire included a brief demographics section to find respondents' gender, age, marital status, years of technology teaching experience, numbers of male and female siblings, and ages of students they taught. These demographic factors were used in analysis of some issues considered in the survey.

Most of the survey consisted of 52 items intended to determine respondents' perceptions on issues or situations. Rather than using traditional Likert scales for these items, each statement was followed by a continuum and respondents were instructed to mark each continuum with an "X" to indicate their perception. This was a variation of a technique used by Thurstone nearly 70 years ago and altered by others following him (Mueller, 1986). Each continuum was marked "0" on the left end, "100" on the right end, and had the center marked with "50". These three points on each continuum also had verbal descriptors related to the item. In all cases, the left end of the continuum represented conservative (1950's) values or perceptions and the right end represented liberal "anything goes" viewpoints. This was noted in the general instructions at the beginning of the questionnaire.

Participants' responses were scored by actually measuring the position of their "X' on each continuum and entering the measured point (any whole number from 0 to 100) into the computer. Thus, all marks below 50 would represent some degree of conservatism, but a mark at the 13 point on the continuum would be considerably more conservative than a mark at the 37 point on the same continuum. Some respondents actually circled the keywords occurring at the 0, 50 or 100 points on the continuum for some items, and their scores for those items were entered as 0, 50, or 100 respectively.

Since participants' response marks could vary between 0 and 100, the data were treated as continuous and were averaged and analyzed via comparison of means with SAS statistical software. Omnibus tests used the GLM variation of ANOVA and comparison of means used the LSD option for t testing. The .05 level of significance was used for all tests.

A series of open response items at the end of the questionnaire also provided opportunities for respondents to comment more freely. The entire instrument was lengthy and the four colleagues (2 male and 2 female) who field tested it required an average of just over 17 minutes to complete it all, so there were many respondents who did not respond to the open response items or who only commented on one or two of them. The four colleagues who helped to field test the instrument agreed that it was long but that the difficult nature of the problem and its importance outweighed this consideration. Only minor editorial revisions were made after the initial field test.

Findings

The demographic section of the questionnaire found that there were 39 female and 56 male respondents. Other demographic information is displayed in Table 1. Some of these factors were used in later analyses to see if they influenced respondents' perceptions of the issues.

The first substantive item asked how participants felt about the feminist movement. With the continuum marked "0=against it", "50=disinterested", and "100=a NOW activist", the mean response was 57.5 and there was no significant difference between the perceptions of men and women. Another item asked how women should feel when a man holds a door or offers to carry a parcel. The mean of 14.5 was very near the "pleased" end of the continuum and there was no difference between male and female perceptions.

The next issue was "In terms of acceptance of 'off color' sexually oriented speech and behavior, I consider myself to be:" "0=A real prude", "50=average", "100=lewd". The overall mean was 39.6 with a range of 5 - 81 for women and 0 - 100 for men. There was no significant difference between the groups. In the following item, participants were asked how they felt their colleagues would perceive them on this same continuum and both groups moderated slightly toward the center with an overall mean of 43.7 and ranges of 17-83 for women and 0-83 for men.

One continuum was used to determine whether participants thought men and women are treated fairly in technology education. The three points identified on the continuum were "0=advantage men", "50=fairness", and "100=advantage women". There was no significant difference between the means of males and females on this item, though there was a slight trend for women to indicate preferential treatment favoring the men. The overall mean of 44.4 indicates relative fairness with only slight advantage to men. The means and ranges of the two groups were: Women 41.7, 0-70, and men 46.2, 16-100.

A series of six continuums were used to assess participants' perceptions of "sexually oriented comments, jokes, gestures or speech". Each continuum was marked: "0=absolutely forbidden", "50=OK if tasteful", and "100=anything goes". Half of these items specified situations in which only "your own gender" is present and the other half included "the opposite sex". There were three situations: 1) students present; 2) on duty, but no students present; and 3) off duty (lounge or eating out at a conference). There were no significant differences between the means of men and women on any of these continuums and all of them were below 36, indicating some degree of prohibition. There was, however, a definite pattern in the means. Means were a few points higher (more liberal view) when only one gender was present and they also were higher for the "off duty" settings. When students were present, the means were much lower, indicating that a higher standard of decency is expected when working with students. These means are presented in Table 2. Of all of the analyses performed with various demographic sub groupings, the only one which was significant was that women who had one or more brothers were less tolerant of such comments and jokes in mixed company than were women who had no brothers, $F(1,37) = 7.01$, $p=.0119$.

One item asked how participants felt about the changing social climate: "The social trends of our times have led to more apparent general acceptance of crude and sexually oriented language in many settings. In my view this change is:" "0=disgraceful", "50=OK", "100=open & healthy". The overall mean of 23.4 indicates a conservative viewpoint and there was no difference between the views of males and females. However, teachers with more than ten years of experience were more conservative in their perception than their less experienced colleagues $F(1,90) = 4.87$, $p=.0298$. This likely reflects a trend in general society for each succeeding generation to be more liberal than it predecessors.

Another item stated: "I enjoy telling and hearing sexually oriented jokes in general". The continuum was marked: "0=never", "50=in limited settings", "100=very much". The overall mean was 29.7 and there was a significant difference between the views of men and women on this item, $F(1,88) = 4.87$, $p = .0300$. Though both groups' means were considerably below the midpoint of 50, men (34.4, range 0-90) reported that they enjoy these sorts of jokes more than women (23.1, range 0-77). The less experienced teachers also liked these jokes more than teachers with over ten years of experience, $F(1,88) = 6.36$, $p = .0135$.

A series of four items asked about gender specific but non pornographic jokes. As before, half of these items involved situations in which only one's own gender was present and the others included mixed company. Two of the items asked about jokes which were "gender specific but not derogatory (or only mildly so), with plays on 'male macho' or 'female sensitivity'". There were no significant differences between the genders on these two items, but there was a trend that showed more liberal views when only one gender was present: One gender mean = 36.7, mixed company mean = 33.9. The remaining two items in this series concerned jokes which are "gender specific and intentionally derogatory but not pornographic (male immaturity/impatience, impulsiveness, PMS, driving, 'dumb blonde', etc.)". These means were lower than those for the less offensive jokes above. There was no significant difference, though the trend showed slightly greater enjoyment of these jokes by males when only with other males. The overall means were: One gender mean = 33.6, mixed company mean = 30.8.

One item was intended to summarize our profession's current social climate. It read: "In most regards, I feel that professionals in technology education correctly recognize the expected language and behavior patterns in cross gender relationships, and they act/speak accordingly." The continuum for this item was marked: "0=No! Too crude"; "50=Yes, OK"; and "100=No! Too stilted". Men and women did not differ in their perceptions on this item and the overall mean was 45.2, just slightly lower (cruder) than the "OK" point on the continuum. Again, as in several other items, teachers with more than ten years of experience held significantly more conservative viewpoints, $F(1,91) = 5.06$, $p=.0269$.

Another series of items concerned appropriate ways to greet colleagues and students. The continuums for all of these items were marked: "0=No!, forbidden"; "50=OK"; and "100=Yes, encouraged". Participants agreed that it is appropriate to greet both, same sex and opposite sex professionals and students with a handshake--the means were 83 for both genders of professionals and 77 for both genders of students.

Greeting with an embrace, however, was not encouraged in general. There was no significant difference between the viewpoints of males and females on the appropriateness of greeting opposite sex professionals with an embrace, and the overall mean was 39.9 which is below the 50=OK point on the continuum. However, when asked about greeting same sex professionals with an embrace, men and women differed significantly, $F(1,92) = 9.06$, $p=.0034$. The overall mean was 36.81

and the responses of both men and women had a range of 0 to 100, but the mean for women was 46.1 and the mean for men was 30.2 indicating that (with some exceptions) men rarely thought it was appropriate to greet each other with an embrace and women felt it was very near the "OK" point on the continuum. Both men and women agreed that it is not appropriate to greet same sex or opposite sex students with an embrace (means of 18.6 and 19.1 respectively).

A series of six items asked about the appropriateness of touching of colleagues or students "on the shoulder". In all of these items, men had significantly higher means than women, showing that they encouraged touching more, and in each case the men's mean was a little above the "50=OK" point on the continuum and the women's mean was just below that central marker. The overall means were: Touch same sex professional, 57.8; touch opposite sex professional, 52.8; touch same sex student, 48.5; and touch opposite sex student, 45.3.

The overall mean response to the query: "Americans are too cold and insensitive, we should encourage touching among professionals" was 40.8, about ten points below the "OK" point on the continuum, but it was the men who marked this item significantly higher (women = 28.3, men = 49.6), $\underline{F}(1,92) = 14.09$, $\underline{p}=.0003$.

Likewise, the statement "We should touch and positively stroke students" had an overall mean of 32.2, and both men and women agreed that it should be considerably below the central "OK" marker. However, again it was the men who scored it significantly higher than the women, $F(1,90) = 4.23$, $p = .0426$, with means of 37.4 and 24.5 respectively.

The subgroup of teachers with less than ten years of experience had significantly higher means (showing greater levels of acceptance) than their more experienced peers on:

-- "Greet opposite sex student with embrace", $F(1,91) = 5.86$, $p = .0175$;

-- "touch same sex professional", $F(1,92) = 11.68$, $p = .0009$;

-- "touch opposite sex professional", $F(1,92) = 16.13$, $p = .0001$;

-- "we should encourage touching among professionals", $F(1,92) = 3.99$, $p = .0488$; and

-- "we should touch and positively stroke students", $F(1,90) = 10.68$, $p = .0015$.

The last series of items using continuums for responses was titled, "What would you do if:", and it asked respondents how they would handle potentially embarrassing or otherwise uncomfortable situations. Each continuum was marked: "0=No! Chastise"; "50=OK, Ignore it"; and "100=Yes, Encourage". None of these situations was marked 50=OK or higher by either men or women, but there were some significant differences in how harshly men and women would react to some situations. The statements for which there was no significant difference between male and female viewpoints are listed below along with their overall means:

-- "A colleague touched you and you did not like it", 25.3;

-- "A student complained about being touched", 18.2;

-- "A student said something sexual that you did not like", 8.2;

-- "A student said something that offended other students", 5.7;

-- "A student used a crude, but not sexually oriented, word", 13.2; and

-- "A male student uninvitedly "takes over" a difficult task from a female student who was struggling to do it", 26.6.

Three other statements were rated equally low by both males and females, but yielded significant differences in sub analyses from the demographic data:

"A colleague said something you did not like" had an overall mean of 18.8, but women who had one or more brothers rated it significantly lower than women with no brothers, $\underline{F}(1,35) = 5.48$, $\underline{p} = .0251$.

Likewise, "You noticed a professional of the opposite sex taking an obvious, but uninvited, 'second look' at you" had an overall mean of 36.9 and no significant difference between the means of males and females, but there was a significantly lower mean for women who had one or more brothers, $\underline{F}(1,37) = 7.03$, $\underline{p} = .0117$.

Similarly, "A student comments on another student's body/sex appeal" found no difference between means of males and females (overall mean = 13.2), but men who had one or more sisters rated it significantly lower than men with no sisters, $\underline{F}(1,50) = 5.75$,

p= .0232.

The men were significantly more tolerant and less likely to chastise than the women in each of the following situations: (the overall mean and the F test results are given with each statement)

-- "A student touched another student who seemed not to mind the action", 35.4, $F(1,89)= 5.48$, $p= .0215$;

-- "A student touched another student who recoiled", 11.22, $F(1,89)= 4.11$, $p= .0457$;

-- "A student used derogatory slang about homosexuals", 11.33, $F(1,87)= 10.93$, $p= .0014$;

-- "A student called another student a 'fag'", $F(1,87)=$ 8.25, $p= .0051$; and

-- "A colleague used a crude, but not sexually oriented, word", 24.8, $F(1,87)= 4.73$, $p= .0323$.

One item was only to be answered by the women. The statement was, "A male colleague uninvitedly 'takes over' a difficult task from you when you are struggling to do it (males omit)". The mean for this item was 25.0 and none of the demographic subgroupings were found to be different.

The final section of the questionnaire consisted of the open response items. The first of these was, "If a colleague asks you out, and you do not wish to go, how many times may they try again before you feel they have crossed the line to be harassing you?" The overall mean response on this item was 2.12 and there was no significant difference between the means of men and women. The ranges of responses were: Men = 0 - 7, Women = 1 - 5.

Three items asked how respondents would signal that they disapproved of actions or speech of others. Facial expressions, frowns, backing away, and looking away were all mentioned frequently. Only a few respondents said they would confront the offending party openly, and they would do this only if the situation became a severe problem. Most respondents agreed that normal people would recognize these "signals" of disapproval, and that they generally respond accordingly.

One item asked: "If a colleague desired to tell a crude or sexually oriented joke in mixed company and asked permission (hinting at its content), would you feel uncomfortable about answering truthfully?" To this question, 21 respondents answered yes and 40 answered no. This was followed with: "In most cases, would you allow them to tell it?" Responses were yes = 37, and no = 24. So, despite the fact that (in an earlier item) the mean for appreciation of such jokes was below 30 on a scale of 100, and the fact that another previous consensus mean of 23.4 showed that respondents believe our society is becoming too crude, over 60% of the respondents would allow someone to tell "off color" jokes in mixed company if they were asked for permission. Many people evidently tolerate behavior that they do not appreciate.

Three items concerned respondents' general comfort level within technology education. "Do you generally feel comfortable among opposite sex colleagues in technology education?" (yes =

59, and no = 4). "Do you feel that colleagues of your own gender generally speak and act in appropriate ways around people of the opposite sex?" (yes = 61, and no = 5). The final item in this series asked if respondents felt that "inappropriate or excessive use of profanity, gestures, and/or sexually suggestive language and jokes by males is a major factor in explaining why more women do not enter the technology education profession?" Only one of the 59 participants who responded to this item answered yes.

Other free response items also yielded some interesting findings. Of those who chose to respond, thirty (19 male and 11 female) said that they would "tell them" if a colleague said something they found offensive. Only three who answered this question said they would "ignore it", and all three of these were females.

A followup item asked if there are "universally understood signs which let most people understand that something they have said or done has crossed the line of the recipient's comfort or sense of decency" and what those signs are. Of those who responded, 20 males and 32 females agreed that there are such "signs", but they listed a broad range of examples from "the evil eye" to "slap!". Most examples, however, could be grouped into a few categories: Facial expressions were cited by 22 respondents (10 male, 12 female); avoidance or backing away were mentioned by 21 participants (6 male, 15 female); and more assertive techniques (ranging from "flip the bird", to confrontation, to "slap") were cited by the remaining nine participants.

When asked to describe events in which a colleague made them feel uncomfortable, 13 participants chose to respond. Of these, seven cited the telling of offensive jokes by colleagues (one of these cited both sexual and racial jokes). Two respondents said students often talk too explicitly about sexual matters. One female said that a male colleague talked openly to her about his sexual problems, and she did not know how to stop him since she had already tried avoidance and facial expressions but did not want to confront him. A male respondent condemned the posting of a cartoon about AIDS with a hate message against gay people at work. A young female had two complaints: That an older colleague seemed to target her with offensive jokes despite her avoidance techniques, and another male colleague who nearly always greets with a hug which she does not appreciate. The most offensive event was reported by a female who said a male colleague made suggestive comments about her body in the presence of others! As offensive as these examples are, however, only 13 of the 95 participants responded to this item at all.

Of the 21 responses to the final free response and "comments" item, 10 were entirely positive and commended our profession on its positive cross gender interactions. Four respondents mentioned problems they had experienced with dating within the profession or being asked out when they did not wish to go. The following quotations are noteworthy:

-- "Need more communication";

-- "We should all monitor the reactions of others and adjust";

-- "All people should be treated with respect";

-- "Less emphasis should be placed on divisive issues: Race, sex, religion, etc.";

-- "Getting girls into TE earlier will increase female #'s and any problems will disappear"; and

-- "The type of personality of women encountered in a male dominated area usually provides for an easier mix of attitudes and does not allow for slurs to be seen in every action."

This last comment was from a 6-10 year veteran female teacher. Though her responses to items describing herself and her views showed her to be relatively conservative, and her comfort level within the profession was very high, she seems to indicate here that a certain "type" of woman would feel more at home in technology education than other women would. Thus, her comment could appear to be a positive one in that it expresses a reasonable comfort level, but it also has a very negative connotation if it excludes a (large) portion of females from being comfortable within our profession. This was the only respondent who even hinted at this perception in any of the free response items--hopefully it is both a minority and a false impression. If only certain "types" of women are attracted to technology education, then we still have a good bit of work to do to make our profession attractive to all "types" of men and women.

Considerations

It is difficult to draw startling conclusions from this research for two reasons. First, it was a very broad attempt to open a new area of inquiry within our profession and, like most early efforts, it likely does have some flaws that would limit its interpretation. Among those are: Only a small percentage of technology teachers attend the National TSA Conferences; participants were all volunteers from that group of attendees; due to the location of the conference, the eastern end of the USA was likely represented more than other regions; and requesting participants to complete the questionnaire while at the conference may have caused many potential respondents to decline the opportunity just due to their burden of other duties at the conference. Thus, the findings may only represent the views of those who felt strongly enough about the issues at hand to complete the survey despite all of these potential distractions. Still, should not these voices be heard?

The other reason for hesitation at deeming "conclusions" to be fixed and valid is the unusual nature of the instrument itself. Collecting the data via continuums may have been novel to most participants, even confusing to some, and may be lower in reliability than the more well known Likert scales. However, this technique did allow participants to mark each response exactly where they thought it should be on a continuum instead of "force fitting" their real perceptions into statements or categories previously devised by the researcher. So, having conceded that drawing firm conclusions may be fraught with potential hazard or even error, the following "considerations" are offered.

Most of these professionals perceived themselves as slightly conservative in their views and acceptance of "off color" behavior. They consider a man holding a door for a woman to be a courtesy and ranked themselves slightly positive in terms of their concern about the feminist movement. Both the men and the women felt there is relative fairness in treatment of both genders within our profession, with a slight advantage still favoring the men.

One of the central issues of the survey concerned how professionals feel about our changing social climate and the appropriateness of sexually oriented speech, jokes, and behavior in various settings. There was consistent agreement that this sort of discourse is not acceptable around students and there is good evidence that the general perception prohibits it to varying degrees in all of the professional settings presented. There was more toleration when no students are present, when only one gender is present, and when off duty, but there was still some degree of prohibition even in those situations. There were some respondents (both men and women) who consistently indicated that this behavior is "absolutely forbidden" even in the settings which were segregated by gender, away from students and "off duty". None of the means in this whole series of items even approached the central "OK if tasteful" point on the continuum, so it appears evident that, despite societal trends to be more tolerant and the liberal presentations in the media and on television, technology education professionals view the telling of "dirty" jokes and use of foul language and gestures to be somewhat taboo in all professional settings.

In fact, these technology education professionals indicated that the change in our society (which in general is more tolerant of crude behavior and sexually oriented humor) is not a positive trend. This view was held by both men and women and only a few individuals indicated that the change is "OK" or "healthy". The older, more experienced, professionals were significantly more conservative in their views than their junior colleagues, so some change in our social climate is underway, even within our profession. Despite the influence on our society of crude behavior in popular television shows such as Roseanne, our profession appears to be more conservative at the present time and reflects some 1950's viewpoints in regard to sexually suggestive behavior. Perhaps this or similar research should be conducted again in ten years to track this evident change.

The men reported greater enjoyment of sexually oriented jokes than women in general, but both groups rated themselves considerably below the "50=in limited settings" midpoint on the continuum. The younger, less experienced, professionals reported significantly greater appreciation of these jokes than their senior colleagues--this may be another indication of approaching change in the social climate of our profession.

Jokes which are gender specific but not pornographic appear to be more acceptable to both genders than the sexually explicit types, but the intentionally derogatory forms were less appreciated. It appears that caution should be used to determine the preferences of those present before telling such jokes because there were some individuals of both genders who indicated that they felt these jokes are "absolutely forbidden" in all of the settings presented in the survey. However, recall that (in a later item) many respondants reported that they would allow the telling of a joke even though they did not appreciate it themselves, so asking permission does not give free license!

In four items evidence was found that people who had one or more siblings of the opposite sex differed significantly in their views from colleagues with no opposite sex siblings. It appears that women who had brothers expected a higher standard of modesty from men than women without brothers--they did not condone "off color" jokes in mixed company and they were more likely to chastize men who said something they did not like or who took an uninvited "second look" at them. In these cases, the women with brothers appeared to have somewhat of a "they know better" attitude while the women without any brothers seemed to exhibit more of a "men will be men" resignation. In another item it was found that men who had sisters were more likely to chastize students for making comments about another student's body/sex appeal than were men with no sisters. Perhaps growing up in a home with sisters allowed men to sense how personally such comments can be hurtful, especially to developing teenage girls. There were only four items in which significant differences such as these were found, but there were numerous items in which the non significant trends showed people of both genders who had opposite sex siblings to be more sensitive to the issues and more conservative in their viewpoints.

The handshake appears to be the most acceptable form of greeting for most situations within our profession. Greeting with an embrace is generally not condoned, however, there was great variety of opinion. Though both men and women generally agreed that greeting opposite sex professionals with an embrace is permissible in some situations, they differed in their views toward greeting their own gender with an embrace. The women indicated it is relatively "OK" to greet each other with an embrace, but the men did not favor embracing other men. Both men and women agreed that teachers should not greet students of either gender with an embrace.

In most of the settings presented in the survey, both men and women felt it was generally "OK" to touch either sex students or colleagues "on the shoulder". There were very mixed findings concerning touching and "positive stroking" in various settings, so individual preferences rather than group thinking may be the primary influence. The men and the younger, less experienced, professionals indicated greater levels of acceptance for touching in general, but the results were not always consistent. Perhaps, here again, there is some indication of approaching social change within the profession.

In general, professionals of both genders indicated that they would confront (to some degree) persons who offended them or their students. Men are, evidently, more tolerant in some settings and less likely to chastise offenders than women. It was noteworthy that men were significantly more tolerant than women of derogatory statements about homosexuals and students calling each other a "fag". This could be partially due to the fact that males go through a stage in their early adolescent development in which such slurs are frequent, so they expect to hear them and view them as "innocent" regardless of the potential for real defamation which they carry. Alternatively, it could be that men are more tolerant of both anti homosexual speech and actions due to either the phenomenon of homophobia or genuine disapproval of homosexuals and their lifestyle. In either event, since prejudice of any sort cannot be allowed in the public schools, male teachers and professionals are encouraged to chastise anti homosexual speech, slurs, and actions with the same fervor that they do other abusive behaviors, regardless of their own personal views on homosexuality.

From the free response section of the survey, it appears that there is a reasonably healthy relationship between the genders within our profession. It seems that many technology education professionals feel that most colleagues recognize and uphold a level of good taste in their speech, and that a facial expression or simple rebuff is all that is generally required to indicate when one is offended by something someone else has said or done.

Several statements were made that indicated that women wanted to be perceived for their abilities rather than their gender, and that could possibly be a key point. Perhaps the closest thing to a true "conclusion" that can be drawn from this initial work is that all technology education professionals, should regard the schoolhouse as a setting requiring more conservative demeanor than society at large, should realize that their colleagues are likely a little more conservative than the social trends of our times, should be sensitive to gauge the appropriateness of their own actions and adjust them according to the reactions of others, and should treat all persons with respect and fairness--judging them on their performance and ignoring all other potentially divisive factors. Observation ofthe "golden rule" (do unto others as you would have them do unto you) probably states this clearly enough.

Though our field is still predominantly male, there does not appear to be a major male cultural influence driving females away and the number of females entering our courses and the profession should continue to increase. Technology education, of today, is no longer a "man's world" and our profession appears to be, in most regards, "politically correct" enough to provide a comfortable home for both males and females. There does appear to be some level of common understanding among males and females concerning the appropriate cultural mores for our profession at the present time and the majority of professionals evidently do conduct themselves accordingly.

In addition to simple replications or variations with other groups of technology education professionals, three areas of inquiry should probably be probed as continuation of this work. First, the finding that women who had brothers were less tolerant of coarse male behavior needs to be studied--was it a valid finding or a fluke because one might expect those women who had brothers to be more accustomed to male behavior and expect it more readily than women who did not grow up in homes with boys. Second, comparisons need to be made between the views of technology education professionals and those of professionals from other disciplines within education. Lastly, comparisons also need to be made with professionals in other technical (traditionally male dominated) fields outside of education. Perhaps the social climate is changing more or less in some of these other settings than it is in technology education--could similar changes be approaching for our profession?

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Table 1

Demographic Information

	Groupings Used in Data Analysis	
Gender	male, 56 (59%)	female, 39 (41%)
Age	40 years or less, 46 (48%)	41 or older, 49 (59%)
Experience	10 years or less, 51 (54%)	11 or more, 44 (46%)

n = 95

Table 2

Perceptions on Sexually Oriented Jokes and Speech

Situations	Mean Responses Males M (SD) (Range)	 Females M (SD) (Range)	 Overall M
Mixed Company:			
Students Present	11.7 (14.2) (0 - 49)	12.7 (18.1) (0 - 50)	12.1
On Duty, No Students	24.3 (18.7) (0 - 50)	27.0 (20.9) (0 - 51)	25.4
Off Duty	31.1 (21.4) (0 - 75)	34.4 (18.3) (2 - 65)	32.5
Same Sex Only:			
Students Present	17.8 (15.7) (0 - 50)	16.9 (20.6) (0 - 59)	17.4
On Duty, No Students	28.5 (17.8) (0 - 78)	28.9 (22.2) (0 - 58)	28.7
Off Duty	35.1 (20.7) (0 - 87)	34.8 (20.7) (0 - 65)	35.0