Advanced Teaching Methods for the Technology Classroom

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Chapter XI

Classroom Management, Facilities Design and Safety

Introduction

Classroom and facilities management require more than a series of techniques. Management and safety require a philosophy. Veteran teachers who "make it look easy" have not perfected the techniques of management inasmuch as they have integrated certain techniques into a system and philosophy of C&I, assessment, discipline, facilities design, and safety. We can think of our combination of techniques and philosophies as flexible superstructure that complements our somewhat inflexible infrastructure of architectural units, devices, software, tools, and machines. The greatest amount of anxiety for new teachers tends to be over classroom management, and specifically the way that individual students are disciplined for incivilities. Rather than confronting incivilities, effective management and safety depends on *preventive* infrastructure and systems that are in place. This point cannot be stressed enough. Students will test new and veteran teachers alike. Veteran teachers may have the benefit of experience in dealing with incivilities such as bullying, but they rely on their infrastructure and systems of prevention rather than their reactive techniques. They know how to deal with individual incivilities but prefer preventive measures by setting a tone for acceptable classroom behavior. We will explore a range of techniques, including humor, for dealing with classroom behavior.

This chapter focuses on specialized classroom management techniques in technology environments, and specifically in technology laboratories (CAD, communications, electronics, information technology), studios (new media, radio, and television production), and workshops (manufacturing, production, transportation, etc.). The theme of the chapter is *prevention* and *discipline with dignity*, and a large range of classroom management issues that are specific to technology environments are addressed. Applications of theory to the micro-issues (routines, procedures) and macro-issues (philosophies, systems) of management are explained. Special needs and abilities are situated in the larger context of discipline with dignity and macro-management. We will also address the role of architectural aesthetics, ergonomics, form, and utility in the management of instruction and safety. A brief history of facilities design is provided and analyzed—from traditional workshops to modular labs to information technology labs, digital studios and learning plazas. In this new era of technology studies, the nature of facilities has changed. The main intention of this chapter is to provide support and assistance to develop a framework for professional preparation in classroom management, facilities design, and safety.

Components of Professional Practice

Most researchers identify classroom management as one of the most important components of professional practice and teachers' responsibility. The routines, rules and procedures that are put in place, the environment that the teacher designs, the

Table 1. Components of classroom management (Adapted from Danielson, 1996)

Creating an environment of respect and rapport
- Teacher interaction with students.
- Student interaction.
- Establishing a culture for learning.
- Importance of the content.
- Student pride in work.
- Expectations for learning and achievement.

Managing classroom procedures
- Management of instructional groups. Management of transitions.
- Management of materials and supplies.
- Performance of noninstructional duties.
- Supervision of volunteers and paraprofessionals.

Managing student behavior Expectations
- Monitoring student behavior.
- Checking incivilities.

Organizing physical space
- Safety, cleanliness, and arrangement of facilities.
- Accessibility to learning and use of physical resources.

Maintaining accurate records
- Assessment.
- Completion of assignments.
- Student progress in learning.
- Safety records.
- Noninstructional records.

tone that is set, the modes of communication used and the system of discipline the teacher creates all impinge on classroom management. Some teachers go as far to suggest that content and methods are secondary to classroom management. In other words, until a safe, inspiring and respectful environment is created instruction is next to impossible. Curriculum and instruction are next to impossible without a system of classroom management that works. In the case of technology studies, the show of C&I does not go on until the stage of ethical and safe behavior is established through classroom policies. Of course, this is relative, as some teachers tolerate much more than others. Some teachers are willing to gamble with liability while others operate strictly by the book. Each teacher is responsible for a range of components of classroom management (Danielson, 1996) (Table 1).

Subjects requiring labs, studios or workshops (e.g., art, business, home economics, science, technology) place additional responsibilities on teachers. Classroom management within complex facilities is demanding but technology teachers would be the first to argue that the management of classrooms where students must remain seated most of the time opens up an entirely different form of challenges. Whether a lab, workshop or classroom, each component of classroom management ought to be considered prior to actually teaching. **Repeat:** Reactive management is no match for proactive management. Prevention is the operative word.

Code of Ethics

Professionals, such as engineers, lawyers, nurses, and teachers are governed by codes of ethics. A Code of Ethics for teachers is maintained and overseen by professional bodies that include the American Federation of Teachers, Canadian Teachers Federation, and the National Education Association. The Code of Ethics places expectations on teachers and governs the generalities of classroom management. Teachers cannot merely make up their own rules—we are obligated to abide by principles that provide a measure of professionalism for behavior toward students, peers, and parents. The following Code of Ethics (BC Teachers Federation, 2003) governs teachers in Canada:

1. *The teacher speaks and acts toward pupils with respect and dignity, and deals judiciously with them, always mindful of their individual rights and sensibilities.*
2. *The teacher respects the confidential nature of information concerning pupils and may give it only to authorized persons or agencies directly concerned with their welfare.*

3. *The teacher recognizes that a privileged relationship with pupils exists and refrains from exploiting that relationship for material, ideological or other advantage.*
4. *The teacher is willing to review with colleagues, students and their parents/guardians the quality of service rendered by the teachers and the practices employed in discharging professional duties.*
5. *The teacher directs any criticism of the teaching, performance, and related work of a colleague to that colleague, and only then, after informing the colleague of the intent to do so, may direct in confidence the criticism to appropriate officials who are in a position to offer advice and assistance. (See note below)*

NOTE: It shall not be considered a breach of Clause V of the Code of Ethics to report reasonable grounds for suspecting child abuse to proper authorities according to legal provisions and official protocol requirements. (BC Teachers Federation, 2003)

In addition to a Code of Ethics, guides to professional practice constitute the basics of teachers' responsibilities for the emotional, intellectual, physical and social development of the students entrusted to their care. This means that teachers assess educational needs, prescribe and implement instructional programs and evaluate the progress of individual students. Teachers must be mindful of their students' safety and rights to equality of opportunity, and must be considerate of their personal circumstances. Teachers are obligated to regard as confidential any information of a personal nature concerning students, and cannot divulge this information, other than to appropriate persons. Regardless of the temptation, teachers ought to speak constructively of students in the presence of students, teachers, officials, or other persons. These guidelines require that the teacher respect the uniqueness of each student's home, and share with the parent(s) (or guardians) information that will assist in the growth and development of the student. Teachers also must necessarily accept as a professional and individual responsibility the duty of reporting in an appropriate manner all matters harmful to the welfare of the school. Keep the Code of Ethics and these guidelines in mind as you develop policies and procedures for classroom management.

Managing Students and Facilities in Technology Studies

Technology studies offers the best conditions and the worst conditions for learning in the schools. The inheritance of infrastructure, laboratories, and workshops offers

the potential for learning that is not anchored or tethered to desks and textbooks. This also produces conditions for accidents and attitudes that pit industrial philosophy against educational philosophy. There is the danger of mistaking an educational site for a worksite—a lab or workshop for a sweatshop. Technology teachers quite often slide down the slippery slope from classroom management to industrial management. Hence, their tolerance for unacceptable classroom behavior increases. What we would find on a jobsite is suddenly acceptable within a school site. Excuses proliferate: "A dirty cluttered lab or workshop is a sign that things are getting done." "This kind of language is what students will find in the real world so they better get used to it." "Safety systems break down everyday and you have to be quick on your feet to adjust." "They do it like this on the job." And so on—everything to deny the fact that education is a specific environment for fostering and modeling high ethical and behavioral standards. The question of what school labs and workshops are for, and the types of behaviors fostered and tolerated have been with audiovisual education and industrial education since its earliest days. For example, in the mid 1930s, a prominent educator in the U.S., wrote:

In industrial-arts shops, so much is heard about industrial processes and so little about education that it seems appropriate to raise the question, if perchance, industrial arts shops are primarily industrial plants and only secondarily educational institutions. It is one thing to cooperate with industry, but quite another to light educational lamps at its altars. (Ganders, 1934, p. 221)

In order to understand classroom management and facilities design, we have to address basic questions of purposes and ends. What are laboratories, studios, and workshops in the schools for? What should we tolerate? What are the consequences?

What are laboratories and workshops in the schools for? In the preface to this book, we clarified the mission of technology studies in the following statement: Providing experiences for young people to develop and question feelings, knowledge, and skills that empower them to participate in all facets of technological endeavor—from the practical to the political. This means that we demystify technology and its applications *as well as* resensitize students to the implications of their technological decisions and surroundings. This means that we establish a balance of the head, heart, hand, and feet in our lessons, activities, projects and courses. We strike a balance as we teach *about, through* and *for* technology. To meet this mission, we have to be diligent in the classroom tone we set, the behavioral and safety standards we establish, the activities and materials we use and the environment we design. Everything—what the students eventually know, do, and feel about our subject—is dependent on our diligence and vigilance in classroom management and facilities design. Technology teachers may have the most exciting activities, best teaching materials and the most current equipment, yet will fail miserably in their mission if they do not set a tone that is clean, welcoming and comfortable.

What should we tolerate? For their success, technology teachers have no alternative but to adopt and model the highest standards of behavior, ethics, equity, hygiene, and safety. We cannot tolerate the level of standards that we might find on a jobsite, in a factory, office, or studio outside of school. The world of work is different from the world of school. For example, while technology teachers might find acceptable levels of occupational safety standards on a construction site, there is a good chance that they will find low levels of gender and racial equity standards. While we might find high productivity standards in an animation lab, we will probably find low ergonomic standards. For technology studies in the schools, we cannot tolerate low standards in any category. We have to accept the fact that technology studies in the schools is about education, not training. Our mission is to educate students about, through and for technology and not to indoctrinate them in the narrow workings of a single industry.

Image and status are the consequences of what we accept as our mission and of what we tolerate. Tolerate foul language, inequities in participation, messiness in organization and a training mentality and your image will be appropriately disrespected. Accept indoctrination and the development of narrow tool skills as your mission and your status will be appropriately low. Through your image and status, you will be a minor player in the schools. Technology teachers can no longer afford to present themselves as minor players in the education of students. How you present yourself will determine your image and status in the schools. Your outlook and practices of classroom management will derive from your philosophy or your mission and what you want to accomplish and tolerate. Consider the following two true scenarios.

The philosophy for one secondary school that I have visited a number of times is oriented toward the humanities and performance arts. It is a magnet school for students who generally see themselves as expressive. The industrial technology program in the school is heavily oriented toward woodworking. The program has been reduced over the past six years from three technology teachers to one. Throughout this time, the technology teachers excessively complained about how unsupported they were. They ranted about the arts and humanities philosophy of the school and the lack of appreciation for the trades. The facilities were reduced at this time from two workshops and one lab to just one woodworking shop. It is among the drabbiest and messiest I have ever seen. The windows are painted over with battleship gray paint for a reason that I have yet to discern. When I asked why, the teacher answered that it was "done some time ago." I have never seen a girl in the shop. As you can imagine, the classroom management of the teacher reflects the overall atmosphere of the program. It is a depressing place by any standards. The program is shrinking. What would you do if you were hired to teach in this school?

Another school where I often place student teachers promotes a comprehensive educational philosophy. Like the school previously described, the overall atmosphere

is progressive. The technology program promotes an integration of information and industrial technologies. The facilities were redesigned to accommodate this philosophy. Two information and communications technology labs (i.e., digital media design, CAD) are separated by a general workshop. The two technology teachers schedule times to supervise students in the workshop. Both the labs and the workshops are clean, well lit, and organized. They consider their program to be central to the mission of the school and the students walk into their courses with high expectations. The upper level electives are extremely popular and the enrolment typically includes about 40% females. The environment is smartly decorated with numerous examples of student projects from the past. The classroom management system is consistent across the two technology teachers and is characterized by a strict, zero-tolerance atmosphere. Yet high independence and autonomous learning also characterize this atmosphere. The program is growing. What would you do if you were hired to teach in this school?

Setting the Tone

The first technology teaching position that I accepted resembled the first school previously described, but worse! This was 1984. It was in a rural district in central Pennsylvania. Dependent on logging and mining, the community was depressed with a 17% unemployment rate and all of the problems associated with hopelessness (e.g., high divorce rates, substance abuse, teen disillusionment). The secondary school (grades 10-12) had about 300 students. I was the third new technology teacher in as many years. The students had the notion that they would run me out of town just like the previous two technology teachers. The facility was a general workshop in horrible condition—literally a mess and a shame. There was not a working vise in the room. The wooden work benches were ball-peen hammered into a mess and had hundreds of nails driven into them. Most of the hand tools were broken and the power tools had severed cords or broken switches. The machines were out of alignment, dull and outright dangerous to use. Storage rooms were so cluttered that I could not walk. There was no chalkboard or bulletin board. No books. Other than the fact that it was in a school, there was nothing to suggest that it was an educational facility.

With an environment like this, you can imagine the behavior patterns of the students. Those who were enrolled in the technology course in the previous years wanted to go about their business and finish demolishing the place. The new students wondered what they were doing there. Intuition told me that nothing would change until the environment changed. I began working with a small group of interested students who helped out during the day, stayed after school and came in on a few Saturdays. We painted the walls, resurfaced the tables, repaired the tools and machines, constructed

Table 2. Parameters for setting the tone for acceptable classroom behavior (Petrina & Braundy, 1999)

A Student's natural tendency is to be fair and just!	***Two core assumptions***	**A teacher's natural tendency is to be fair and just!**

Parameters for setting the tone:

- ***Provide*** and maintain a ***clean***, ***inspiring*** classroom ***environment***
  - ***o Architectural space.***
  - ***o Infrastructure, furniture, tools, machines, and resources.***
  - ***o Curriculum and information.***

- Set ***clear guidelines***, ***define boundaries*** and maintain ***clear expectations*** for acceptable classroom ***behavior*** and ***language***
  - o Practice ***inclusive language*** without tripping over the words.
  - o Discuss ***personal and social space*** and cultural differences that might apply.
  - o Discuss ***interpersonal relations.***
  - o Highlight ***respect*** for ***personal and school property.***
  - o Discuss expectations for in-class ***tasks*** and ***work.***

- ***Model*** classroom ***guidelines*** and ***expectations***
  - ***o Model respect*** and insist that students ***model respect.***
  - ***o Model gender and racial equity.***
  - ***o Model skills*** *without* reinforcing traditional gender roles.

- ***Consistently confront*** and address ***each act*** of offensive classroom behavior
  - o Insist that ***students confront*** offensive behavior.
  - o Doing ***nothing means*** one is ***complicit*** with offensive acts.
  - o Use ***situation-based*** responses.
  - o Stop ***humor that is stereotyped***, personal or is at the expense of a group of people (grouped by ability, class, ethnicity, gender, race, religion, sexuality).
  - ***o Stop*** gender and racial ***slurs***, and swearing, in their tracks.

- ***Convene meetings*** (informal and formal) with parties to help resolve problems
  - o Students Parents
  - o Teachers Administrators

- ***Stay present***--Keep eyes and ears open and tuned-in to behavior and language

- *Show empathy* with feelings and words

- Read individual situations with an *eye toward prevention*

a chalkboard and frame, a bulletin board, bookshelf and a magazine rack. We built frames for new posters and placed them around the workshop. It took about two months to prepare the workshop for education. The students who were not helping just hung out during this time. I figured that as long as they were not destroying things or fighting, I was making progress. Eventually, they all got the message that I was on their side and trying to create a healthy environment. The process was bonding and nearly all of the sophomores I taught that year stayed with me for the next two years. For the second half of the year we built drafting boards for the instruments I ordered. I also bought two Macintosh computers and we began to do CAD. What

saved me from failure was noting more than a can-do attitude and a no-nonsense, zero-tolerance tone of classroom management. A tone was set for education. A tone was set for what was acceptable and unacceptable.

Setting the tone is the single most important challenge a teacher will face during their first two years. The tone is set by your actions, commitment, disciplinary policies, and environment. Interesting activities and projects will follow, but initially have little to do with setting the tone for education. Setting the tone means that you take control of your classroom. You demonstrate leadership and model what you expect your students to do. If you want students to play by the rules, you have to play by the rules. And the rules ought to be primarily your rules—rules that promote achievement, equity, honesty, integrity and respect. The parameters provided in the box were established during my first two years of teaching and refined with a colleague.

Humor

In South Park's classic "Tweek vs. Craig" episode, the joke is on technology studies and home economics. This is either gut-splitting humor or low, despicable stereotyping, depending on your disposition. Everything that is right and everything that is wrong with humor is exposed in one twenty-minute episode. What is right is the reality of something laughable when a mirror is held up to reality—a scruffy, old shop teacher who grumbles and says not much more than "quit screwin' around;" a prissy home economics teacher who has perfected domesticity but is above it all; boys systematically reducing boards to scraps, girls attentively digesting tips for landing a husband, and a mixed-up kid who somehow copes in both shop and home ec. There is something accurate and hilarious in the caricature. What is wrong is the flagrant exploitation of stereotypes that have for three generations been unfairly foisted upon an entire group of caring, dedicated teachers. It borders on kicking someone when they are down. Enough already about shop and home economics! So much for the analysis humor—it takes most of the fun out of it. Now we feel guilty for laughing.

Humor studies researcher David Collinson (1988, 2002) distinguishes between functional and critical approaches to humor. Functionalist approaches follow prescriptions for reaping the benefits of humor but often result in situations that teachers manipulate with hopes of controlling the humor tap by turning it on and off. Critical approaches note that humor reflects alienation and disenchantment in students, and is a powerful form of resistance to authority. In this case, the joke may literally be on the teacher or classroom. Teachers who recognize that humor is often about power relations are inclined to overlook a fair amount of joking, expecting

that this will diffuse unrest and create group coherence or unity. At times, teachers may have to suppress oppositional or subversive humor to maintain their authority or ethical boundaries.

There are numerous reasons to promote humor in the classroom: it is therapeutic, erodes barriers, encourages creativity, challenges worldviews, and motivates (Decker, 2004). Students up to about 8 years old enjoy physical comedy, clowning, exaggeration, literal humor, practical jokes and riddles. Students from 8 to about 13 years old appreciate a wider range of verbal humor, such as puns and word play, and increasingly turn to teasing in relationships. Older students tend to sharpen their teasing and appreciate verbal wit, sarcasm satire, irony, and parody (Shade, 1996, p. 111). Humor is age appropriate and, as Flowers (2001) cautions, should always be qualified by "judicious use" in education. As they manage behavior in general, teachers manage or mismanage humor. In many ways, the type of humor tolerated in a classroom directly reflects a teacher's policy on acceptable behavior and language. What is the role of humor in setting a tone for classroom management?

The optimal level of humor in setting a tone is a balance of teacher and student initiated wit. When the balance is tilted toward the teacher, he or she risks the charge of entertainer or inflated personality eager for attention. Doing the work of humor, he or she risks falling into the trap of the joke. When the balance tilts toward students, humor can quickly degenerate into cruelty and raise the question "who is in charge?" Finding an optimal level of wit is challenging, and teachers have to figure out how to let the students do the work of humor in the classroom. This may result in letting a class clown take the stage at times, but this strategy backfires in situations where you are forced to shut down the clown. The class may interpret this as a betrayal of trust. One key to establishing a balance is honoring the line between students and teachers. Avoid "reducing" yourself to the students' level of humor. Rather than eagerly trying to play a part in student culture, maintain your role in teacher culture. Otherwise, you risk *trying* to be funny rather than actually being funny. In *Being There*, Peter Sellers is funny for not doing anything to try to be funny. Difficult as it may be, the teacher's primary job is to model a tone for acceptable behavior, and monitor all actions and materials that tend to use individuals and groups as targets of humor. This means monitoring yourself, and even contradicting or transforming your core beliefs about humor.

Teachers are usually in safe territory with subject-specific humor. Art teachers draw on art-based humor, math teachers on math, and so on. Technology-specific humor has a history of drawing on a full range of genres, from slapstick to practical jokes to sarcasm and irony. Most technology teachers have executed technology-specific humor or were the brunt of it and can draw on these experiences to introduce a professional element of levity in the classroom. Technology-specific humor has a long history and one needs to merely consult popular magazines from the early 1900s to get a sense of this history. Browsing the Web turns up numerous technology and

humor sites, where gems such as *CyberDork* are found among a large volume of juvenile or offensive humor. Comic strip author Scott Adams made his character *Dilbert* famous for bumbling office technologies and captured the gendered nature of this with the now-legendary declaration: "Technology—No Place for Wimps." Rich Tennant's *The 5th Wave*, published in *Computerworld*, and Randy Glasbergen's *Technology Bytes* are similar to *Dilbert*. R. Crumb popularized a genre of dystopian technology-specific humor in the 1960s and 1970s, and in the northwest, we have been treated to Ken Avidor's critical humor such as *Roadkill Bill*, published

Figure 1. Sexist humor (Source: Washington, 1976)

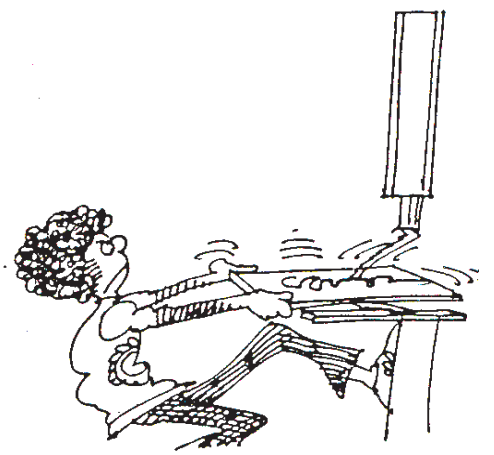
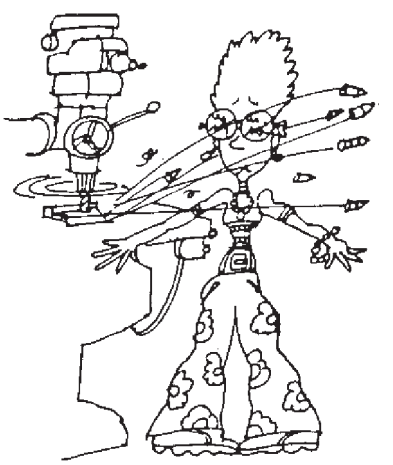


Figure 2. Sexist humor (Source: Washington, 1976)



by Car Busters. *Megatoons: Cartoonists Against Nuclear War* is a classic example of this dystopian genre from the mid 1980s. Leo Elshof's (2001) PhD research demonstrated that critical humor is effective in eliciting insights from students and teachers. Female cartoonists—Nitrozac's *The Joy of Tech*, Heather Vaughn's Tech High, and a number of women in *Dignifying Science*—tend to provide a reality aspect to technology-specific humor. Like any genre, this has a gender component to it and should be used with this in mind.

A good example of technology-specific humor at the expense of a group of people is in *Washington State Industrial Arts Safety Guide*, the popular industrial education guide from the mid 1970s (M&M Protection Consultants, 1976). Although the enrollment of girls in industrial education was only about 6% in 1976, 75% of the 32 cartoons in the guide depicted girls and women looking foolish or doing reckless things around machines (Figures 1, 2). The two reprinted here are among the mildest. Done in the thick of the women's liberation movement, the cartoons were backlash. The sad conclusion is that there are still teachers today who photocopy and distribute the handouts from the guide, complete with the cartoons on the same page as the safety rules. Many thousands of girls and boys were exposed to this insensitive humor over the past thirty years. What are the messages?

Gender, Sexuality, and Diversity

Under no circumstances should harassment or discrimination based on ability, age, class, gender, race, religion or sexuality be used or accepted within any educational context. This also holds true outside of schools. Yet, through personal accounts and research, we know that neither schools nor workplaces are free from harassment and discrimination. Prejudice such as racism and sexism can be overt or covert, specific or structural. In many institutions, optics, or the management of appearances, work to control what is seen. On the surface, appearances suggest acceptance and fairness, but just below the surface are conditions that work against full participation or dignity. Conditions such as a privileging of certain norms of behavior and loyalties, exclusion from spheres of influence, good 'ol boy networks, tacit quid pro quos, and the favoritism or preferential treatment resulting from these conditions account for a fair amount of systemic prejudice, racism and sexism. Hence, equity is complex and can be elusive even under the most innocent-looking conditions. Vigilance is the operative word.

Equity typically refers to qualitative concerns for fairness and justice. To address equity, we may have to demand *unequal* treatment (equal treatment is *not* always the answer). Some groups (i.e., girls in technology) may require differential treatment to have a fair chance to participate and perform. Equal outcomes may require

differential treatment. *Equality* normally refers to quantity and concerns with parity across groups on some index for measurement (e.g., access to technology, pay scales). We have to attend to barriers as well as intervene in *status quo* conditions to achieve equity and equality in technology studies. We may have to make special measures for reasonable accommodation of differences. In the U.S., Title IX of the Education Amendments was passed in 1972 to prohibit sex discrimination in all aspects of federally funded education programs, including technology studies. However, as noted in Chapter VII, girls in the U.S. and Canada continue to be relegated to traditionally female programs, which ultimately impacts their earning power and job prospects. The existing state of equity forced the National Women's Law Center (2002) to conclude that "biased counseling, the provision of incomplete information to students on the consequences of their career training choices, sexual harassment of girls who enroll in non-traditional classes, and other forms of discrimination conspire today to create" a system "characterized by pervasive sex segregation" (p. 3).

What are some reasons that students may be different from each other? What differences are moderated by gender and sex? Difference should *not* suggest failure, helplessness or inability, but it is often constructed this way. Students are different for any number of reasons. Differences in confidence around certain technologies, and in turn capability, are especially moderated by gender. These differences are not derived from essences of the sexes. In other words, confidence with industrial or information technologies and resultant aptitudes are not determined by one's biological sex. The issue is rarely, if ever, technophobia per se. A large majority of girls and women across the world demonstrate high levels of comfort and skill with domestic or office technologies. Others excel in technical trades and high tech careers. Instead, these differences are dependent on sociocultural factors such as bias, overt discrimination, differential treatment, isolation, socialization, and stereotyping. A student's upbringing and socialization play extremely powerful roles in forming her or his abilities and confidence. "Early childhood socialization," according to Ehrhart and Sandler (1987):

reinforced not only by parents and teachers, but also by the media—teaches children roles, attitudes and behaviors thought to be 'appropriate' for each sex. In general, boys are encouraged to be active and independent, to explore and to learn how things work. Girls are 'taught' to be passive, verbally oriented, and dependent. Boys receive chemistry sets, building toys, trucks and sports equipment; girls receive dolls, kitchen equipment, and sewing and embroidery kits. Parents' expectations that their children's interests and achievements will follow traditional sex roles will steer girls away from certain areas; in contrast, encouragement from parents to succeed in math, science, and technology is crucial in a girl's decision to take these courses in high school. (p. 3)

Psychologist Leonard Sax (2005) argues differences in socialization are manifested in neurological and physiological differences between the sexes. Hence, differences become "hard-wired" over time and are not so easily overcome. Sax uses this as a justification for single-sex courses in certain subjects, such as math, science and technology.

Stereotypes more or less derive from gender norms and sex roles. Once students reach school age and adolescence, gender stereotypes are fairly well established (de Castell & Bryson, 1998). We generally stereotype boys by what is deemed appropriate or considered masculine attributes and girls by feminine attributes or traits. Portrayals of adults reinforce stereotypes for students. Men are stereotyped as work-oriented and portrayed as breadwinners; women are stereotyped as relationship-oriented and portrayed as familial caretakers. Powerful peer pressures work to maintain gender norms and stereotypes. A psychological and social toll is exerted on students who do not fit into the gender roles. Emotionally coping with isolation or labels of deviance is incredibly demanding. Expectations are changing and it is becoming more acceptable to see students contradict norms but gender works in subtle ways. Researchers report that it remains more difficult for boys than girls to contradict traditional gender norms. Messages students receive are mixed. On one hand, stereotyping in school is common; on the other hand students are told that they can act out and pursue the life-style that they want. Boys and girls see their female role models juggling work outside the home with domestic responsibilities. Schools combine equal opportunity and "just do it" messages with stereotyped course enrollments and biased treatment by counselors and teachers. What are you willing to do about this as a teacher?

Biases are hidden and subtle as well as obvious. Sex-biased or sexist curriculum materials (e.g., books, clothes, equipment, posters, software, tools, videos, Web sites) in technology tend to give girls the message that they are not important or portray them in roles of helplessness or mindless decoration. History materials in technology courses tend to emphasize inventions and innovations made by men, and in most cases, white men. Contemporary examples refer to men and male-dominated industries or technologies. Projects in these courses by and large appeal to a traditional form of masculinity and disregard the interests of most girls and a number of boys. Isolation or conformity is usually the only option. As mentioned in Chapters I and VII, language that is not consciously gender-specific tends to default to the male in technology courses. Active bias is often much easier to challenge than more subtle forms. The target is clear and intervention can be rapid and specific. Equity requires a commitment to intervene through classroom management and all forms of educational influence and practice.

Equal opportunity and equity interventions are ranked on a scale from equal access, equal treatment and equal outcome to systemic reform. Equal access means that

administrators, policy makers and teachers have removed obvious barriers to full participation in education (e.g., courses, sports). The doors are open for all courses. Equal treatment means that all students are treated the same—teachers withhold preferential treatment and maintain a climate of equality. Boys and girls receive the same treatment. Equal outcome means that special accommodations are made and treatment is differentiated to achieve equal results. You may spend more time with certain students in your class to "bring them up to speed" to perform at equal levels with their peers. You "give them a fair chance," so to speak. You may also make adjustments to projects to incorporate the interests of girls or a multicultural perspective. Equal outcome interventions often receive accusations of reverse discrimination. What are the shortcomings of these levels of interventions? How do they work together? How common are they? Systemic reforms aim for the roots of inequities and the causes of overt or covert bias and discrimination. Systemic reform challenges the "additive" mentality that characterizes surficial or superficial reform. Instead of adding a few items or projects that may have s gender-specific purpose or multicultural theme to an existing course or curriculum, systemic reform means that we address the biases, discrimination and stereotypes already built into the course or curriculum. Systemic reform typically means that teachers address their personal positions on gender and work through issues that mitigate an expansion of masculinities and a pro-feminist outlook.

Researchers of feminisms and masculinities are finding that people are not unidimensionally or uniformly gendered (Braundy, 2004; Connell, 2002). Remember, gender should *not* be reduced to biological sex. Feminism, generally associated with the rights of girls and women, is best understood as the plural *feminisms*. Masculinity, mainly associated with the expression of power by boys and men is similarly best understood as the plural *masculinities*. A key finding is that individuals and biological sex groups demonstrate a range of gendered positions within a continuum inasmuch as they demonstrate a range of political positions on a continuum (Figure 3). Positions are dependent on circumstances and issues. Theorist of gender Judith Butler argues that gender is something we perform—points on the continuum are intentional and not determined by biological sex. Few people are polarized on the continuum, and most perform or demonstrate combinations of traits. While educators have found gender role reversal to be an effective method for altering students' perspectives, the central point for classroom management is that teachers must anticipate and accommodate students on any and all points of the continuum. Effective classroom management in technology studies requires that we necessarily accept or celebrate a full range of expressions of gender and sexuality. Doing technology—being a(n) engineer, technician, trades worker or technologist—is not limited to one or two points on the continuum. A technology environment and classroom management style that encourage a single, narrowly defined masculinity

Figure 3. Gender and sexuality

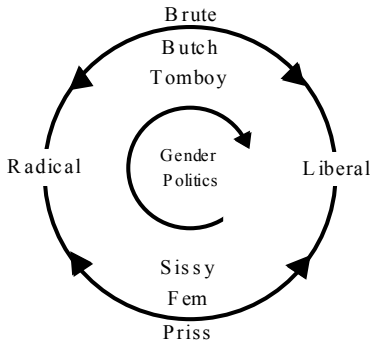
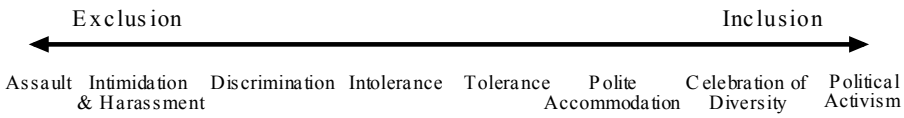


Figure 4. Diversity Continuum (Vancouver School Board, 2004)



violate equal access conditions.

Equity is a question of diversity. About 96.5% of all students take at least one technology studies course in grades 8-12, which is due to requirements in grades 8 or 9 in North America. About 61.5% (Females 58%, Males 65%) take three or more technology courses, which include business and information technology. In the U.S., African American, American Indian and Hispanic students take more technology courses on average than white students. Asian Americans take one technology course less on average than other students (Tabs, 2003, p. 44, 64, 122, 150). This is consistent in Canada, where Asian students are up to three times more likely to transition directly to a university. Students in technology studies are diverse, perhaps more diverse than we acknowledge or accommodate with curriculum materials or classroom management styles (Rider, 1998). And the question of diversity is one of inclusion versus exclusion (Figure 4). As William Chase (1994) put it in "The Language of Action," "Diversity… is not polite accommodation. Instead, diversity is, in action, the sometimes painful awareness that other people, other races, other voices, other habits of mind, have as much integrity of being, as much claim on the world as you do. And I urge you, amid all the differences present to the eye and mind, to reach out to create the bond that will protect us all. We are meant to be here together." (p. 2).

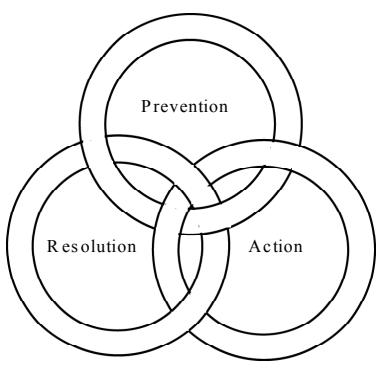
Discipline with Dignity

Example 1. Sketchy management (Source: Budnikas, 1998)

> Mr. Humphry gave a demonstration on dimensioning and assigned an exercise to be handed in at the end of class. Peter's drawing of a dimensioned object was completed long before most students had their paper taped to the table. He pushed his books aside and began to draw a building. Fifteen minutes later, he completed a detailed sketch of a cottage. Mr. Humphry approached Peter and the following ensued. Mr. Humphry: "How many times have I told you not to waste time drawing this crap on good paper?" Peter: "But I completed my assignment." Mr. Humphry: "No you haven't. You didn't put your name on it. You aren't going to lunch until your name is on it. And erase that." Peter began erasing and didn't stop until he wore a hole through the paper. He crumpled it up, threw it in the trashcan, and sat there staring at the assignment through the lunch period.

In this incident, how would you have reacted as the teacher—or as the student? There was obviously a trend to Peter's behavior and to Mr. Humphry's reactions. Mr. Humphry used behavior modification to discipline Peter but the results were mixed. More than likely, Peter will resent Mr. Humphry even though he may reform his behavior in class. If the consequence is the opposite—Peter increases his tactic of drawing in class—then Mr. Humphry has issued a reinforcement rather than a punishment. In behavior modification, the consequence of the discipline following a behavior determines whether a reinforcement or punishment has been given. Behavior modification, which consists of positive and negative reinforcement and punishments, works with some students better than others. It still has its place in education although theorists question the efficacy and ethics of certain rewards and punishments. An exhaustive study of behavioral modification in the schools during the late 1970s led Rutter, Maughan, Mortimore, Ousten, & Smith (1979) to conclude

Figure 5. Discipline with dignity (Mendler & Curwin, 1983)



that high levels of corporal punishment led to worse student behavior.

Discipline with dignity originated during the 1970s. Now trademarked and successful, Discipline with Dignity™ offers teachers a sound alternative and complement to behavior modification techniques. Curwin and Mendler (1988, 1999) refer to discipline with dignity as "three dimensional discipline" (Figure 5):

- **Prevention:** What can be done to prevent problems?
- **Action:** What can be done when misbehavior occurs to solve the problem without making it worse?
- **Resolution:** What can be done for the out-of-control student?

The premise of these three dimensions is straightforward: *prevent* discipline problems from occurring, *solve* problems when they do occur and *resolve* difficult and out of control behavior. Technology teachers find these three dimensions to be essential to safety as well as classroom management. Discipline with dignity means that values such as open communication, mutual respect (dignity) and commitment to common goals are backed up with classroom management techniques for prevention, action, and resolution. Remembering simple techniques, such as proximity, eye contact and privacy (PEP), for discipline translates into discipline with dignity. Curwin and Mendler (1999) recommend these guidelines:

1. The most practical discipline technique is to welcome every student.
2. It takes less time at the end when you spend more time in the beginning.
3. When students withdraw, make an even bigger invitation.
4. Discipline responses require a two-stage approach: stabilize and teach.
5. Model effective expressions of anger with your students.

Most schools have fairly standard discipline rules and procedures for dealing with students: Breaking rule X begets punishment Y. One purpose is to minimize referrals to the administrative office; the implication is that teachers must resolve many problems within the classroom. Only major offenses, such as foul language directed at a teacher, aggressive bullying, theft and vandalism, possession of illegal substances or a weapon, or intoxication, require direct referral to administration. The bulk of incivilities have to be resolved in the classroom, where power struggles test even the most experienced teachers. Here, interactions are not so easily reduced to a simple equation where infringement X = punishment Y. Adept at avoiding power struggles, effective teachers individualize discipline, work with clear classroom rules and procedures, monitor compliance with the rules, deal with consequences quickly and consistently, insist on student responsibility and accountability for behavior,

Table 3. Seven principles for discipline with dignity (Source: Mendler, 1993, p. 1-4)

1. **Long-term behavior changes vs. short-term quick fixes.** People take time! Dealing with discipline takes time.
2. **Stop doing ineffective things.** With regard to discipline, some kids simply do not respond to "common sense" or "empirically sound" strategies.
3. **I will be fair, and I won't always treat everyone the same.** Some who read the preceding scenario will be concerned about the disciplinary message to other kids.
4. **Rules must make sense.** Rules viewed as stupid are least likely to be followed. Rules in schools should be the guidelines needed for success to happen.
5. **Model what you expect.** Let students see you living by the same code of behavior you expect.
6. **Responsibility is more important than obedience.** Obedience means, "Do not question and certainly do not be different." Responsibility means: Make the best decision you possibly can with the information you have available.
7. **Always treat students with dignity.** This is perhaps the most important of all the principles, because without dignity, students learn to hate school and learning.

and clearly communicate information. In many ways, the intent is to off-load the responsibility for discipline to students, through self-discipline and self-control. Humanists tend to advocate permissive, laissez-faire techniques, believing that autonomy is instilled through maximum freedom. On the other extreme, militant disciplinarians advocate law and order, believing that strict comportment leads to responsibility. Some argue that the result of these approaches is spoiled brats or helpless conformists. Discipline with dignity means finding a middle ground. Discipline with dignity provides a framework to scaffold rules and procedures:

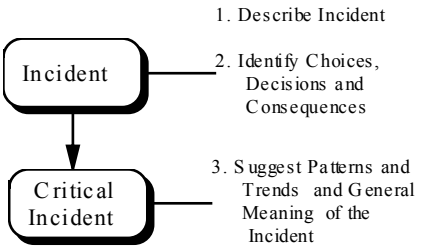
Example 2. Angela's embarrassment (Schneider, 2000)

> When quiet was restored the lesson continued, but so did Angela's conversation. Mr. Davis spoke directly to her in a calm but stern voice: "Angela, if you wish to sit with your friends you'll have be quiet. If you're not, I'll ask you to return to your usual seat." Looking innocent but visibly embarrassed, Angela nodded in agreement. Again the lesson continued and, after a brief respite, so did the talking. Mr. Davis again addressed Angela directly and again with a calm, stern voice: "OK Angela, I need you to go back to your usual seat so I can finish the lesson." "No, no, please?" Angela pleaded, now red in the face. "Quickly now," said Mr. Davis. And when she took her old seat, "Thank you Angela." The lesson continued without much interruption but the classroom tone had changed.

Critical Incidents of Behavior

In the previous incident, Angela faces two clear courses of action: be quiet or be moved to a new seat. With the warnings unheeded, Mr. Davis is forced to follow

Figure 6. Critical incident method (Source: Tripp, 1993, p. 26)



through with action. A critical incident is a situation or event that marks a significant turning point in the behavior of a student, or a commonplace situation where a student has at least two clear courses of action to take. These incidents are critical when they are indicative of motives, patterns, and trends. Critical incidents do not have to be dramatic or obvious and for the most part, are routine until rendered critical by the teacher through description. It is a technology teacher's responsibility to monitor her or his lab or workshop for incivilities but critical incidents remind us to be observant of all forms of behavior. A critical incident can be a situation or event that reflects a turn in behavior that is either negative or positive. Like discipline with dignity, the critical incident approach is a method for maintaining an effective program of classroom management (Tripp, 1993). The critical incident method trains teachers to recognize and connect the behavioral choices students face, the decisions they make, the consequence that occur and underlying behavioral motives, patterns and trends. This method helps teachers record situations "as observed" and analyze the situations for motives, patterns and trends. It helps teachers document situations from within and move outside situations to analyze.

Ideally, teachers will not incur any classroom incivilities and will merely focus on C&I. Realistically, this will never happen. Behavioral and emotional problems will always occur and the task of classroom management is to minimize their frequency and limit their consequences. Basically, the critical incident method involves six steps (Tripp, 1993) (Figure 6). First, train your senses to observation. This requires that you recognize details within larger contexts. Second, focus on behavioral or intercommunication situations of your students in addition to their skills-based activities. Remember, even commonplace situations can be rendered into critical incidents if you notice turning points, patterns, or trends. Fourth, provide an accurate and detailed account of the incident. Try to pinpoint "what happened" without embellishing. Fifth, describe the choices the students(s) faced, decisions made and the consequences incurred. These consequences may be negative or positive. Sixth, render this incident critical by describing the patterns or trends that are in play. By focusing on critical incidents you will be able to document and monitor the

progress of your students' behavior and social interactions. This will be invaluable in maintaining and reforming your classroom management style and techniques. The critical incident method is not to be used to create a dossier for each student. Rather, this method helps teachers view classroom management from the students' perspective as a series of choices, decisions and consequences. It is the teacher's task to generate and administer consistent modes of punishment and rewards that correspond to consequences or incivilities.

Classroom Incivilities

Classroom incivilities encompass teacher initiated and student initiated disruptions to acceptable, civil, orderly classroom conduct. The value of exploring and addressing classroom incivilities is that we are reminded that teachers are not innocent in the causes of classroom problems. Simply put, classroom incivilities refer to disruptions born out of disrespect and irresponsibility (Boice, 1996). Examples include incidents where a teacher is unprepared, insensitive to ethical expectations or an equitable climate, disinterested in their subject, or disrespectful toward specific student rights. Examples include incidents where a student is intentionally indifferent, arrives late or walks out, without prior agreements, distracts with unrelated tasks (e.g., computer browsing, text messaging), delivers loud, sarcastic gestures, remarks and insults or carries on a conversation at the expense of others. Classroom incivilities may be indiscrete disruptions that affect the cohesion or progress of the group or relatively discrete distractions that affect a smaller pool of individuals.

Classroom incivilities are culturally specific in that expectations and tolerance for disruptions differ from culture to culture. In North American classrooms, incivilities are common for whatever reasons. Some cranky commentators blame the students and their upbringing—"the young, by the time they are ready to enter college, have established within themselves a mental fixity born of fear and disorientation that is strikingly narcissistic in its monadic self-encapsulation, in its fear and resentment of authority, and in its conformist rigidity and intellectual lassitude. The result is the high-tech barbarian" (Bartlett, 1993, p. 308). A certain level of disrespect and irresponsibility seems normal and the question is how much a teacher (or a student) is willing to tolerate? Classroom incivilities take their toll, resulting in a large turnover of new teachers, leaves of absence for veteran teachers and disillusionment in students. High levels of incivilities are embarrassing for teachers and coping mechanisms kick in to create reactions that seem rational. Some teachers ignore a large volume of incivilities or become retaliatory or aloof, creating other incivilities in turn. They may shift from the use of prosocial motivators ("Do you understand what I'm saying?' or "You can do better than this") to antisocial motivators (threats

and guilt induction). Some resort to winning students over by pandering or thinking that entertainment is a necessary replacement to education. Teachers risk being taken for deserving targets without the tools to address incivilities.

Example 3. Blaming Albert

> Albert quickly tired of the CAD demo and started fidgeting with small scraps of cardboard on the table. Fidgeting alone was not satisfying for long and he began to throw the small scraps in Joyce's direction every time Ms. Roberts was busy looking elsewhere. If the opportunity was good, Albert threw a piece in other directions. Twenty-five minutes into the demonstration, Ms. Roberts needed something that she didn't have at her workstation and got up to get it. The flying scraps got worse. "Cut it out," Ms. Roberts cautioned to Albert. Albert smiled, threw another piece and said, "cut what out?" Stop throwing the cardboard, Albert. "What are you talking about? I never threw anything."

How should Ms. Roberts deal with Albert? What is the problem? As indicated, some of the best techniques for classroom management include clear parameters that set the tone for acceptable behavior, discipline with dignity and a critical incident approach to documenting and analyzing incivilities. Correctives and preventives for many incivilities involve little more than these basic techniques, which draw on accessibility, empathy, friendliness, and responsibility. Researchers find that students' misbehavior and resistance often depend on how they interpret the teacher. Teachers who appear disorganized, distracted, irresponsible, uncaring, or overly casual will see similar behavior in their students. Giving off these types of cues will almost invariably escalate toward chronic incivilities. Prosocial motivators that preserve dignity for all parties are key tools for reducing incivilities. Incivilities drop off dramatically with prosocial skills, such as verbal and nonverbal signals of care and warmth. A majority of students often blame teachers who allow classroom problems to go unchecked (undisciplined or without dignity) for incivilities that occur in the classroom. In labs and workshops, unchecked incivilities can be disastrous and result in a damaged infrastructure or injury. Certain forms of incivilities—aggressive and exploitive behavior, homophobic intimidation, racism, and sexism—must be stopped in their tracks. There is often a thin line between incivilities or disruptions and bullying or hazing.

Violence, Bullying, and Hazing

Violent behavior among adolescents and teens in North America has been increasing over the past two decades, but in the 1990s the teen homicide rate decreased by

33%. Although well publicized, school-based homicides or life-threatening assaults are rare. Violence in schools is likely to be in the form of fights and bullying. The concept of "bullying" tends to trivialize the realities of school violence while exaggerating the influence of the bully. The Columbine High School tragedies demonstrated quite clearly that it is not always bullies who are dangerous. The bullies are merely overt with their violence, taking pride in their capabilities to influence and intimidate their peers. In effect, bullying compensates for underlying behavioral or emotional disturbances and imbalances. It is anti-social but nonetheless common. Violent behavior in school is much more prevalent than commonly perceived when violence is redefined to encompass bullying and hazing. Bullying is defined as the convergence of a power differential between two or more students, the intention to exploit this power differential with intimidating and obnoxious behavior, and the opportunity to exploit the differential over and over. Technically then, there must be a power differential, intentionality and repetition to define behavior as bullying. There are physical and verbal bullies as well as bully-victims who feel forced to retaliate with bullying behavior. Research suggests that about 10% of students in any school exhibit bully behavior and about 5% are bully-victims who retaliate but not necessarily against their bullies. In other words, bullying creates increasingly larger circles of bullies and victims (Elias & Zinns, 2003; Vaillencourt, Hymel, & McDougall, 2003).

Nearly one third of K-12 students report that they experience bullying, either as a victim or as a perpetrator, according to a survey of 15,686 public and private school students in the U.S. (Nansel et al., 2001). More than 16% said they had been bullied occasionally during 2000 and 8% reported bullying or being bullied at least once weekly. Of the 30% who reported being involved in bullying, 13% reported that they had bullied, while just over 10% said that they were victims. Approximately 6% of the students reported that they had, at different times, been bully and victim (bully-victims). Frequencies suggest that bullying is most prevalent among grade 6-8 students and slows down in grades 9-10. About half of all boys surveyed said it was ok to hit someone who made them angry while one in five girls felt the same. About 11% of boys were bullied once a week while 6% of girls were involved in bullying at least once per week. For boys, bullying normally takes the form of threats, physical harm, and name-calling. For girls, bullying normally involves name-calling, teasing, rejection, and the swiping of personal belongings. Bullying is also linked to technology, where emails, hate Web sites, blogs and instant messages convey forms of aggression that are emotionally damaging. Students report that bullying and violence generally goes unreported and happens with few consequences at school.

Bullying and hazing have emotional and physical consequences, and about 75% of students involved report injuries, academic problems, fights with parents, retaliation toward others, eating and sleeping problems, anger, confusion, embarrassment and guilt. Hazing is a form of ritualistic bullying—"acceptable intimidation"—and is

most prevalent among high school students. About 48% of students who belong to a clique or gang are subjected to hazing activities, and about 43% are subjected to humiliating activities. Both female and male students are subjected to hazing but males are at the highest risk of dangerous hazing. Hazing is not limited to at-risk students and even groups typically considered safe, such as church groups, haze new members. Students who are bullied or hazed report loneliness and difficulty making friends, while bullies are more likely to have poor academic performance, smoke and drink alcohol. However, how students perform in school and the peers they hang out with are the best predictors of whether they drink alcohol, smoke cigarettes, or carry weapons. The National Longitudinal Study of Adolescent Health in the U.S. contradicts the common view that race and socioeconomic level are the predominant predictors. Regardless of their race or sex, students who said they had "frequent problems with their schoolwork" were more likely to use alcohol, smoke cigarettes, become violent, carry weapons, and attempt suicide. The numbers are extremely high—25% of grades 7-12 students carried some form of weapon to school during 1999 and 10% drank on a weekly basis—but school performance is the best predictor of whether a student becomes involved with drugs or violence. Poverty, nevertheless, remains the driving force behind at-risk students and learning disabilities.

At-Risk and Special Needs Students

"At-risk" and "special needs" are contemporary concepts to recognize that some students require specific instructional and classroom management strategies tuned to their unique circumstances. At-risk refers to any student who encounters major obstacles to the successful completion of school or who is prone to developing a disabling condition. The causes may be biological or socioeconomic, with signs such as alienation or alcohol and drug abuse. These students tend to be perennially on the verge of dropping out. Other students are at-risk of committing an offensive act or recidivism. Students who are at-risk typically have a range of special needs and not the least of is their need for respect and success. Technology studies has a long history of dealing with at-risk students and most technology teachers often tell stories of their "problem" students who progress from at-risk to on-time and motivated. These teachers proudly note that the worst students in the school are sometimes their best students. Historically, a majority of administrators and counselors viewed laboratories and workshops as "dumping grounds" and last resorts for at-risk students. Perhaps mistakenly, some technology teachers internalized this, interpreted the principle role of their facility to be occupational therapy and isolated their subject from the majority of the school. Such is the legacy. Placing five or six at-risk students in a single technology course, with expensive, dangerous

equipment made for a volatile mix. This practice submitted technology teachers to significant and often impossible challenges to manage these students and the others in the facilities. The safety net for at-risk students was more likely to be a sympathetic teacher than the content or equipment of the curriculum. The key is to *identify* with students, whether at-risk or not. But a connection with students does *not* mean that teachers are reduced to the students' friends. Students need caring role models, not more friends.

In the U.S., the dropout rate is 12-18% and in Canada the rate is a bit higher (e.g., BC dropout rate is 20%). In the U.S., as many as 380,000 students drop out of grades 10-12 each year, but dropout rates correlate with race and socioeconomic status. For example, 8-17% of white students, 14-26% of black students, and 30-46% of Hispanic students drop out. The percentages increase if the students are foreign born and immigrated to Canada and the U.S. In Canada, 45% of all First Nations (North American Indian) students drop out. In large urban school districts, where a majority of students are from poor families, dropout rates are 25% and in one out of four of these districts the dropout rates are 35%. The poorest of the poor districts have dropout rates that exceed 45%. Sadly, the lack of a high school diploma correlates tightly with unemployment and incarceration rates. In Canada and the U.S., where incarceration rates are the highest in the world, 68% of all prison inmates are high school dropouts. Dropouts are likely to be unemployed, exposed to violent crime and convicted of criminal behavior before they reach 21 years of age. There are high correlations between dropout rates and poverty, and again between dropout rates and behavioral or emotional problems.

At-risk students are not special needs students per se. About 10% of the overall school population is diagnosed with some special need (mild or severe), and percentages range toward 30% depending on geographic region or socioeconomic and racial status. Educational systems in Canada and the U.S. have enabling legislation to ensure that all students have a universal access to public education. In the U.S., the *Individuals with Disabilities Education Act* (1975) protects all students who have special needs. In Canada, provincial laws range from mandatory to permissive provisions for access. Equity legislation tilts the tables toward dignity of risk for students, allowing for inclusion or integration in "mainstream" classes rather than exclusion of segregation in special education classes and extracurricular activities. Students with special needs are required to be accompanied by an Individualized Education Plan (IEP) that guarantees a specifically tailored program to meet the special needs of students who have disabilities. The IEP is a contract developed by administrators, disability specialists, teachers along with the student and her or his parent(s) or guardian. IEPs may or may not include a plan for work in technology studies and it is the technology teacher's responsibility to see that their subject is included in the IEP.

Due to family circumstances and poverty—disabling conditions—at-risk students often have special needs that derive from one or another behavioral, emotional or

Table 3. Indicators of behavioral or emotional difficulty or disorder (Adapted from Disability Resource Centre, 1997)

Behavioral indicators	Social indicators
• Low self-concept. • Troubled relations with peers. • Inappropriate relationships with teachers, parents or other authority figures. • Deficits in speech and language. • Difficulties in auditory and visual perception. • Poor quantitative and computational skills. • Deficits in basic motor skills. • Other signs of social-emotional problems • .	• Poor social perception. • Lack of judgment. • Lack of sensitivity to others. • Difficulty making friends. • Problems establishing family relationships. • Social problems in school. • Social disabilities of adolescents and adults.

developmental difficulty, disturbance, disorder or disability. Behavioral problems frequently occur with emotional problems such as depression and anxiety. From behavioral or emotional disturbances, students may develop intellectual and learning disabilities, language difficulties, or an attention deficit hyperactivity disorder (ADHD). Students in poverty are more likely to develop difficulties or depressive symptoms and internalize disorders. Other special needs include hearing and visual impairments, or special gifts and talents. Some students attend school with chronic health impairments, autism, or with general learning difficulties that are not considered special needs. Although there is a range of indicators of behavioral and emotional difficulties (Table 3), teachers should not immediately conclude that a particular student is "disabled." The act of labeling students generates a host of social problems for the particular student.

Difficulties, disturbances, disorders, or disabilities may be transitory rather than permanent. Researchers caution that diagnoses or judgments of disability ought to be reserved for students who exhibit these indicators over a long period, to marked degrees and when educational performance is adversely affected. *Severe* behavioral disabilities mean that the student demonstrates these three qualifications and one or more of the following:

- An inability to learn, which cannot be explained by intellectual, sensory or health factors, or
- An inability to build or maintain satisfactory interpersonal relationships with peers and teachers,

Table 4. Guidelines for accommodating cognitive or intellectual disabilities (Adapted from BC MOE, 2000, p. 21)

Language and text organization	General
• Avoid complex sentences. • Use simplified vocabulary; avoid dialect or idioms. • Express concepts at a literal level. • Provide clear, simple instructions that can be broken down into component steps. • Highlight important information for easy recognition. • Provide advance organizers, definitions of key vocabulary with illustrations. Visuals • Include illustrative material (pictures, graphs, etc.) That supports text.	• Provide multi-sensory instruction. • Avoid unnecessary complexity in activities. • Provide opportunities for approaching concepts at various levels of complexity. • Illustrate concepts by real-life examples connected to students' experiences. • Include explicit aids for remembering and procedural instructions. • Offer group work and paired peer activities. • Provide summaries of important information. • Be appropriate to age level, even if adapted in language, conceptual complexity, and structure to meet intellectual ability.

or

- Inappropriate types of behavior or feelings under normal circumstances,

or

- A general pervasive mood of unhappiness or depression, or
- A tendency to develop physical symptoms or fears associated with personal or school problems.

Of course, disabilities vary from pervasive disorders (autism, schizophrenia) to physical conditions (blindness, hearing impairment) to intellectual disabilities. Students with intellectual disabilities function significantly below the norm for students the same age. Indicators include significant deficits in language and concept development, a concrete learning style and difficulty with abstractions, the need for direct instruction with frequent review, difficulties in generalizing, problems with focusing on what is important, and difficulties with independent learning. Use the following guidelines to facilitate instruction for students with cognitive or intellectual disabilities (Table 4) (BC MOE, 2000, p. 21):

In addition to students with intellectual or cognitive disabilities, some students have a range of physical difficulties with vision including blindness, partial sight, or low

vision. Others have hearing impairments and may be hard of hearing or deaf. Some have mobility impairments that are neurological or orthopedic. Still others have learning disabilities.

Learning Disabilities

A learning disability is defined as a deficit in ability to process information. Students with learning disabilities have normal cognitive potential with disorders in their learning: significant difficulties in perception and the acquisition and use of listening, speaking, reading, writing, reasoning, and mathematical abilities. These difficulties often impact memory, problem-solving abilities, and attention span. Students with learning disabilities may have trouble processing, generalizing, or expressing their ideas in writing even when they understand the content. Learning disabilities are *not* behavioral or emotional problems. Learning disabled students who otherwise have no emotional impairments have difficulty integrating or producing information. Some students have difficulty reading and following printed directions—key safety requirements in technology studies—but respond to oral directions. Some students struggle with calculations, also key to technical work, but respond when given extra time and an environment free of external pressures. Some students have trouble writing and cannot produce written materials under strict time constraints. These types of difficulties may manifest themselves as behavioral or developmental problems (dyslexics are overrepresented in prison populations), but these problems should not be conflated with learning disabilities. For the most part, learning disabilities are detected rather late, most often identified between the ages of 11 and 17. Learning disabilities are common, with about 3 million students in the U.S. diagnosed and in special education classes (Disability Resource Centre, 1997).

Dyslexia, dysgraphia and dyscalculia, are the most common learning disabilities. When students with dyslexia look at a page or screen of text, they see the letters. They can tell someone the letter's names. But is takes time for them to articulate the words that the letters form. Some dyslexic students can easily decipher longer words such as *electricity* but trip over shorter words like *four* or *year*. Dyslexia affects about 20% of all students, boys and girls alike (Gorman, 2003). Understandably, dyslexia usually accompanies dysgraphia, or the ability to write. Assistive technologies for both include audio and videotapes of instructional materials, and voice recognition software. Accommodation also means that teachers provide reading and written materials well in advance of deadlines, the use of highlighting to emphasize important points, sequential organization of material and control of distractions. Dyscalculia refers to difficulties in recognizing order in numbers, an extremely important skill for mathematics. Assistive technologies such as calculators are helpful as well as the types of accommodations used for dyslexia. Considered

to be special needs students, those diagnosed with a learning disability will travel through school with an IEP for monitoring progress, describing challenges and indicating helpful assistive technologies.

Assistive Technology

In 1999, the National Federation of the Blind (NFB) filed a class action lawsuit against America Online, Inc. (AOL). The NFB alleged that AOL's Internet browser and services were inaccessible to the blind and did not comply with the accessibility requirements of Title III of the *Americans with Disabilities Act* (ADA). The NFB claimed that AOL's online service sign-up form, welcome screens, and chat rooms were inaccessible because screen reader assistive technologies could not read text hidden within graphic displays. On July 26, 2000, the NFB and AOL litigation reached a settlement. AOL agreed to make its internet browsing software compatible with screen readers, which make AOL software accessible to blind users. AOL also agreed to make the existing and future content of AOL services largely accessible to the blind, to publish an Accessibility Policy and post it on its Web site and to pursue other actions to implement accessibility features for blind users. Shortly after the settlement, President Clinton proposed a comprehensive initiative to bridge the "digital divide" by broadening access to the Web and promoting online applications that will help all differently abled persons use new computer technologies to their fullest potential.

The AOL case was decided on the policies spelled out in the ADA for the requirements of assistive technologies in schools and workplaces. Assistive technologies refer to devices, software or pieces of equipment or systems (both off-the-shelf and customized) used to increase, maintain or improve the functional capabilities of people with disabilities. This includes devices and services as well as training that help an individual to select and utilize a device or aid. Assistive technology services include evaluation, maintenance or repair and training for students, professionals or families. Assistive technologies include, but are not limited to:

- Augmentative communication devices, including talking computers
- Assistive listening devices, including hearing aids, personal FM units, closed-caption TVs and teletype machines (TDOS)
- Specially adapted learning games, toys and recreation equipment
- Computer-assisted instruction and design software
- Electronic tools (scanners with speech synthesizers, voice recognition software)

- Curriculum and textbook adaptations (e.g., audio format, large print format, Braille)
- Copies of overheads, transparencies and notes
- Architectural adaptation of the learning environment, such as special desks, modified learning stations, computer touch screens or different computer keyboards
- Adaptive mobility devices for education in labs and workshops
- Orthotics such as hand braces to facilitate writing skills

For some, existence problems associated with everyday functions require technologies such as adapted utensils, dressing aids, adapted toilet seats, and occupational therapy services. Communication problems associated with the need to receive, internalize, and express information require amplifiers, captioned video, speech aids, magnifiers, sign language training, drawing aids or alternative computer input devices. Body support, positioning, and protection problems associated with the need to stabilize the body require prone standers, furniture adaptations, support harnesses, slings, headgear or orthotic stabilizers. Travel and mobility problems associated with the necessity to move require wheelchairs, scooters, ambulators, canes, crutches, or orientation and mobility services. Environmental problems associated with needs to use equipment require special switches, remote controls, adapted ramps, automatic door openers, driving aids and rehabilitation engineering services. Education and transition problems associated with needs to participate in education require adapted instructional materials, educational software, computer adaptations and creative arts and crafts therapy. Sports, fitness, and recreation problems associated with needs to participate in sports, play and hobby activities require modified rules and equipment, adapted aquatics switch-activated cameras, Braille playing cards and adapted physical education services (Blackhurst & Edyburn, 2000). All schools and public institutions as well as most private businesses have a duty to accommodate and this requires the creative design and use of assistive technologies.

While the intention of the ADA is the removal of architectural and communication barriers, the law also requires that assistive technologies be considered in the development of an IEP. Assessment processes must provide for students to be evaluated or screened in all areas related to the suspected disability, including (where appropriate to the needs of the student) health, vision, hearing, social and emotional status, general intelligence, academic performance, communication status and motor abilities. Consideration of technologies should be an integral part of the assessment processes to ensure the IEP reflects each student's unique needs. For example, for required assignments and projects, teachers should determine how assistive technologies might allow a student to communicate and access the instructional program. A student's need for assistive technologies, training and support services must be

considered on a case-by-case basis in developing the student's IEP. If the participants on an IEP team, which includes parents, determine that a student requires assistive technology in order to receive an appropriate public education and designate such technology as either an educational or related service or as necessary to maintain the student in a regular classroom, the student's IEP must include a specific statement of such services. Related services may include occupational therapy, physical therapy and speech therapy.

Disabilities legislation prohibits discrimination against disabled persons in the full and equal enjoyment of public accommodations. A "public accommodation" includes any private (non-governmental) entity, regardless of size, that offers goods and services (e.g., education) to the general public. Discrimination includes the failure to provide appropriate auxiliary aids or services (e.g., sign-language interpreters, assistive listening devices, Braille, or audiocassettes for individuals with sensory impairments) where necessary to ensure effective communication with students with disabilities. For education, digital technologies have great advantages over print media because delivery can be in multiple formats. However, the design of digital technologies for persons with cognitive, physical, sensory, and other impairments must be intentional; visually impaired students, for instance, rely on screen readers, which are dependent on text rather than graphic displays. Assistive technologies and other accommodations for special needs are essential to classroom management, safety and facilities design strategies.

Safety

In the world of work, a vast majority of accidents involve young adults between the ages 15-24. According to the Workers Compensation Board (WCB) of BC (1998), about 46 young workers are injured each day and five are permanently disabled each week. The injury rate for young male workers is 70% higher than the rate for all other workers in North America. The rate for young girls is half the average for all workers. About 80% of these accidents result in bruises, cuts and strains. There are a number of reasons for these high rates. First, adolescents and young adults have less experience in recognizing hazardous situations than older workers. Second, young workers are less likely to ask questions or question practices that look unsafe. Third, young workers, especially males, are more likely to take risks and increase the pace of their work. Some feel pressured to match the pace of their peers or other workers and generate conditions that are unsafe. The fourth reason can be attributed to employers who often exploit young workers or neglect conditions that lead to accidents. Turning to the schools, nearly all accidents can be accounted for by any combination of these. Indeed, classroom management has to necessarily account for these reasons for accidents. Technology teachers have

been known to remark that a workshop in school is akin to running a business with the most inexperienced, untrained workers one can find. The conditions are ripe for incidents and accidents.

Accidents in school workshops are common—more common than should be the case. The extent of school lab and workshop injuries is generally underestimated because the submission of Student Injury Reports (SIR) by school authorities to central provincial or state health departments is voluntary. Teachers and nurses complete the SIRs and not safety professionals trained in accident investigations, and the extent of the injury is also underestimated. The best research we have suggests that 7% of all school injuries occur in technology labs and workshops. For example, in the state of Utah between 1992-1996, 14,133 students were injured and 1,008 were injured in labs and workshops (Knight, Junkins, Lightfoot, Cazier, & Olson, 2000). Nearly half of these occurred in grades 8 and 9, and 87.3% were male. About 88% of all the injuries were equipment related. Power saws accounted for about 25% of these, which some may find troubling given that the use of power saws by minors in the workplace is prohibited by law. In school workshops, no such regulations exist. To put this in perspective, across North America 40% of school injuries are caused by falls, 34% by sports activities and 10% by assaults. We do not yet have comparative data, but perhaps one of the more significant results in the transition from industrial education to technology studies was the reduction of school workshop accidents. The equipment has changed and students are placed in fewer potentially dangerous positions than three decades ago. Nonetheless, there remains a wide range of hazards in technology studies that must be managed.

There are basically three reasons for safety management. The first is moral and assumes that every technology teacher is a caring human being with an innate desire to protect those who are younger or less informed, as students usually are. The moral aspect of safety indicates that instructors should possess a natural predisposition to do what is possible to keep students safe from injury. The second reason is financial. Preventive maintenance is less expensive than litigation. “It costs more to have accidents than it does to safeguard against them,” This applies to financial losses that may result from injury to students as well as to property damage, destruction of resources and tools, legal counsel, court and medical costs, fines or loss of a teaching position. The third reason is legal; duty of care and due diligence mean that administrators and teachers are responsible for the health and safety of students entrusted to their care. Students are legally under the charge and guidance of the teacher to whom they are assigned at any given time. The legal reason also refers to safety regulations and provisions required by local, provincial or state and federal governments (Louisiana Technical College, 1992). These three reasons require both philosophical and technical considerations.

Philosophically, safety ought to be oriented toward prevention but teachers must also plan for what to do as a problem is occurring and afterwards. Safety managers refer to these three stages as pre-event, event and post-event controls. Interventions

can be made in any of these three stages to control an outcome, either by preventing it or minimizing any downgrading affects when a problem occurs. We should ask ourselves: What am I doing to prevent this or that accident? What will I do as this or that accident is occurring? What will I do after it occurs? The optimum strategy is to focus on the pre-event stage and anticipate any problems. "Deep knowledge," says the Taoist *Book of Balance and Harmony*, "is to be aware of disturbance before disturbance, to be aware of danger before danger, to beware of calamity before calamity…. By deep knowledge of principle, one can change disturbance into order, change danger into safety, change destruction into survival, change calamity into fortune." This is intuition—sensitivity to impending danger or probable changes (Montante, 1991, p. 32). Safety is a complex, open system involving environmental and human factors—people, resources, technologies, processes, feedback, policies, procedures, regulations—that must be balanced (DeLuca & Haynie, 2000).

Pragmatically, safety begins with policies, procedures, guidelines, and specific safety rules for individual processes. Technology teachers ought to practice with a clear and workable set of policies, rules and procedures that are written down and spelled out for students and other interested parties. Behavioral rules correspond to what you expect for setting the tone for acceptable classroom behavior. General procedures correspond to the conduct of a normal class session in your lab or workshop (e.g., 1. Enter the Lab or Workshop with a Positive Attitude. 2. Adopt a "Ready to Work" Attitude. 3. Find your Seat for Attendance and Necessary Announcements and Lesson. 4. Begin Work (Safely) on Projects, etc. 5. Be Ready for Cleanup. 6. Put your Things Away and Cleanup. 7. Exit Quietly). General safety guidelines are those that govern all activities and work in the facility under your charge. Specific safety rules are for individual devices, machines and processes (chemical, heat, mechanical, etc.) associated with any type of danger. Teachers must share all of these with their students as professional handouts and posters, and prepare to explain the consequences for violations of policies and procedures.

Do accidents just happen? How can anyone foresee them? As mentioned, accidents are caused by unsafe acts, unsafe conditions, inattentive or negligent supervisors or by a combination of the three. A key component of a safety program is to prevent harmful events in the future by assessing hazards today. This is also a critical factor in liability. This requires that teachers routinely assess the conditions of their workshops and labs, and observe students to identify and correct unsafe acts and poor work practices. This may require the close supervision of some students and additional instruction to correct carelessness, poor work habits and risk-taking. In some cases, teachers may have to discipline students to ensure that they observe safety policies and rules. Regretfully, teachers themselves are rarely disciplined for failing to carry out their health and safety responsibilities. That is, teachers typically escape discipline until an accident is combined with litigation and the liability question is raised.

Liability

Do not confuse responsibility and accountability with liability. Technology teachers are ethically responsible, whether legally liable or not, for accidents and incidents that could have been prevented in any way. Responsibility extends to all facets of classroom management, from equity to special needs, from bullying to humor, from facilities design and ergonomics to safety. Teachers can be held accountable for oversights and carelessness but not held liable. When students are emotional or physically injured under a teacher's care, he or she will feel the moral damages of responsibility regardless of any financial damages of negligence and liability.

Liability revolves around the concepts of duty of care and due diligence. Duty of care is the first standard against which a teacher is held: they must act as a "careful or prudent parent." Due diligence means taking all reasonable care to protect the well-being of those over which one has a duty of care. To meet the standard of due diligence, teachers must take all reasonable precautions to ensure the safety and health of students. In prosecutions for violations of safety and health laws, the prosecutor must prove that the accused violated standard practices or due diligence. To be acquitted, the accused must establish that on a balance of probabilities all reasonable precautions to comply were taken in the circumstances. This is the defense of due diligence. Teachers and administrators are not expected to anticipate and prevent every possible accident. They must, however, take all the precautions that a reasonable and prudent person would take in the same or similar circumstances. Courts recognize formal defenses of due diligence in prosecutions. Compliance with safety and health regulations standardized and monitored by governmental agencies such as the WCB in Canada or Occupational Safety and Health Agency (OSHA) in the U.S. is a necessary first step in defenses of due diligence. Administrators and teachers are often mistakenly under the assumption that WCB or OSHA regulations stop at the schoolhouse door. However, the WCB and OSHA consider schools to be workplaces. Students are not treated as unpaid workers. Rather, the logic is that if health and safety standards are maintained for teachers they will be by default maintained for students. If WCB or OSHA regulations are in effect and working well, a teacher will generally be able to establish due diligence. If there are specific hazards, a teacher will also have to establish that special steps in controlling this hazard were taken to show due diligence in particular circumstances. Generally, the greater the risk, the greater the need for specific policies, practices and other measures to control the equipment or hazard (WCB, 2003). Demonstrating due diligence and upholding the standard of duty of care requires an organized system of record-keeping to provide a history of activities related to safety and health regulations.

In general, in order to uphold liability claims in courts against a teacher, the plaintiff's (student) lawyer's must show that injury occurred because the teacher exceeded authority, used poor judgment, (duty of care), or failed to take reasonable precautions (due diligence) resulting in a charge of negligence and liability. As mentioned

in the previous section, the best way to demonstrate that you are not negligent is to maintain an active safety program that encompasses instruction, supervision, inspection, and documentation. In litigation, the defendant (teacher) may have to provide documentation for any or all of the following (Louisiana Technical College, 1992):

1. The teacher was in the classroom when students were working with potentially dangerous materials, machines, or processes.
2. Hand tools and machines were maintained and in good working condition.
3. Each student was required to pass safety tests. Test results were filed in the teacher's records.
4. Regular inspections were made of the tools and equipment used by the students.
5. Complete instructions, including handouts, were given to students before they were allowed to operate machines. Instructions were professionally written, understood, and supplemented with oral assessments.
6. The operation of machines was supervised to ensure that equipment was operated correctly and the instructions were followed.

Table 5. (Source: Rempel, 2000)

Teacher liability safety checklist

- ✓ Well-maintained equipment with proper guards
- ✓ Safety equipment in good condition
- ✓ Adequate safety policies and procedures in shops or lab
- ✓ Student attendance records
- ✓ Adequate supervision practices
- ✓ Student safety tests on file
- ✓ Student notebook with safety and procedure sheets
- ✓ Current day book
- ✓ Visible safety posters and stickers

Legal liability depends on the existence of five elements:

- ❑ A duty of care.
- ❑ A breach of the standard of care.
- ❑ Damage or injury that results from the breach.
- ❑ Reasonable foreseeability of causation.
- ❑ Plaintiff suffered some actual loss.

Duty of care- "careful or prudent parent" related factors include:

- ❑ Number of students being supervised.
- ❑ Nature of the activity.
- ❑ Age and skill level of the students.
- ❑ Nature and condition of the equipment.
- ❑ Competency and capacity of the students.

7. Safety procedures were reviewed periodically.
8. Proper eye, face and safety protection was required for students.
9. Director, principal or Safety Committee was notified, in writing, of any unsafe conditions that were not immediately corrected.
10. An accident report was completed and included signed statements by witnesses.
11. Actively promoted safety policies in area of work.

Some technology teachers resort to consent and waiver forms for parents to deal with participation in high-risk activities. Here, the weight of deciding on the level of risk acceptable to a family is taken from the teacher and placed back on the parents. Nevertheless, the teacher is not relieved of liability by a signature on a waiver slip to approve of the student's participation in hazardous activities in the school. This may be an acceptable public relations procedure but a parent cannot sign away a student's right to file a tort liability suit. The law indicates that an injured person has the right to seek monetary damages from a person who bears responsibility for causing that injury. In carrying out their responsibilities, it is necessary that teachers exercise due care and diligence to guard against negligence. For better or worse, liability and the possibility of litigation raise the standards to which teachers and schools are held accountable..

Public school educators who are members of their teachers' federations or unions receive an educators' liability benefit. This liability benefit covers payment of the legal costs of defending civil proceedings (excluding civil rights cases) brought against teachers in the course of their work as an educator, and $1 million to $5 million in damages assessed against a teacher as a result of such proceedings. In the course of their work, technology teachers are frequently exposed to situations that may give rise to legal actions and which can involve personal liability. If a student or a student's parent(s) file suit against a teacher, this policy provides insurance protection for the vast majority of cases. The program also reimburses for damage to personal property in assault-related incidents. Fortunately, for science and technology teachers, liability protection for activities in all lab and workshop facilities is covered.

Class Size

Class sizes are linked to economics and demographics. For example, average secondary school class sizes in Canada and the U.S. increased from 20 in 1915 to 31 in 1932. Average class sizes in primary schools, traditionally higher than in secondary

schools, reached 39 in 1932. In the early 1930s at any given time, New York City students were crowded in classes that numbered over 50. Industrial arts classes were no exception but IA teachers were used to large classes. They often crammed 30-40 students next to the manual training benches and there were few who escaped the effects of mass education. In the early 1970s, the baby boom combined with a recession to swell class sizes again. Currently, for mixed reasons, many technology teachers are watching class sizes increase, from a mid 1990s average of 21 upward to 30. Governments are tightening budgets and school districts are not filling vacated positions. Some are laying teachers off.

With declining enrollments in their technology courses and classes of 30 students in other subjects, technology teachers can ill-afford afford to complain. Yet without agitating for caps on class size, we face increasingly difficult management and safety issues. Class-size dynamics necessarily alter classroom management. However, economists note that there is no relation between class size and student performance (e.g., Hanushek, 1998). Given our accident reporting data, nor can we argue a relationship between class size and safety. Intuitively, it makes sense that smaller classes are optimally safe but without adequate data, we lack evidence. We may also think that instruction is individualized in smaller classes but data suggest that teachers do not readily adjust to class size. Intuitively, it seems that reduced class sizes result in fewer behavioral problems. Again, the data are incomplete with the best research concentrated on grades 1 and 2 (Finn & Achilles, 1999; Finn, Pannozzo & Achilles, 2003). What are the recommended class sizes?

Capacity and occupancy loads differ across grade levels. Middle and secondary school technology facilities are commonly 1,250-1,800 sq. ft. The Building Officials and Code Administrators (BOCA) recommend a space allocation of 50 net sq. ft. (4.6 net sq. m) per student and some governments increase this to 78 net sq. ft in secondary schools. A decrease in the BOCA allocation has to be approved by an "authority having jurisdiction" (i.e., fire marshal, state safety officer). Some teacher unions have negotiated a cap of 30-32 students for middle and 28 for secondary classes, acknowledging threats of liability. Due diligence requires that professionals who are aware of unsafe working conditions make changes to avoid an accident.

Facilities Design and Management

The large investments into industrial technology workshops during the 1920s and again in the 1960s served technology teachers well. However, forty years after the 1960s boom we are entrapped within a vicious circle. Since we have these workshops, we have to use them or lose them. But their use has determined what and how we teach. The design of infrastructure is a powerful force on the design of C&I. There

is no getting around this. So we have to be careful about controlling this force lest we be completely determined by the facility we create or inherit.

Unit shops, or a workshop for a single material or technology (e.g., metalworking, woodworking), proliferated in North America during the 1920s. The number of unit shops increased in the U.S. from about 9,250 in 1924 to 22,950 in 1938. Unit shops for junior high woodworking increased by 300% (4, 250 to 10, 500) during the same period. This legacy was both a blessing and a curse. Until recently, in most of these unit shops, the material defined by the infrastructure determined the curriculum: woodworking was taught in the woodworking shops and so on. Unit shop investments of the 1920s were reinforced with huge investments during the 1960s and 1970s. For example, the *Federal Technical and Vocational Training Assistance Act*, enacted in 1960, provided $243 million in its first two years for establishing industrial and vocational education programs in Canada, and $2.16 billion through 1970. The *Training Act* covered 75% of capital expenses for provinces, mostly in the form of buildings and school equipment. Through the late 1960s and early 1970s, there was a huge IE building boom in North America with expansive additions and full IE wings added onto schools. Automotive garages, power mechanics shops and electronics laboratories were built and equipped to round out the IE curriculum. In the late 1960s, capital investments for a single shop were about $8,300 for each of the electronics, mechanics, metalworking and woodworking shops and $11,000 to equip each automotive garage. By comparison, a home economics lab cost $1,800 to equip and most academic classrooms cost less than $1,000 (Petrina & Dalley, 2003). By the mid 1970s, industrial education received 12.3% of education funding, exceeding all subject except for English.

Beginning in the late 1970s and early 1980s, technology studies began to take on the infrastructure of computer labs, often expansions of electronics, graphics and drafting facilities. At the same time, schools invested in central computer lab facilities, which partially severed information technology from the balance of technology studies in the schools. In the early and mid 1970s, individual terminals cost between $6,000-$9,000 and relied on a mainframe costing anywhere between $50,000-$80,000. Estimates for full labs (20 students) were between $200,000-300,000. The microcomputer revolution changed the infrastructure but not necessarily the cost. Apple II computers were introduced into the schools during the late 1970s and early 1980s in Canada and the U.S.. By 1981, 80,000 microcomputers were installed in U.S. schools, laboratories were assembled in the high schools of Canada and the U.S., and courses were offered in computer studies. I bought two Macintosh computers for my high school drafting course in 1984, effectively transforming the curriculum from board drafting to computer aided design (Petrina, 2003). By the mid 1990s, the average cost of labs was still about $200,000.

In technology studies, the popularity of modular facilities increased throughout the 1990s. Modular facility refers to a self-contained (i.e., “everything” is there for the

student) instructional *system* defined by devices and infrastructure. This includes instructional systems ranging from self-contained packages to desktop technology trainers and kits (e.g., LEGO-Logo, Principles of Technology, Fischertechnik trainers) to architectural structures and infrastructure (e.g., Lab 2000, Synergistic Systems Labs). Currently in the U.S., 72.5% of technology education programs in public schools use teacher-made modules and 48.5% use commercially vendored modules (Sanders, 2001). During the 1990s, the commercial production of modules became an attractive endeavor for vendors who marketed their curriculum at prices ranging from $8.00 for a paper packet to $12,980.00 for turnkey learning systems (Noble, 1993; Petrina, 1993).

Both teachers and vendors reconceptualized what a technology workshop or lab ought to look like at the same time that new ideas for school architecture and infrastructure were presented in reports such as *New Designs for the Comprehensive High School* (Copa, 1992). Many teachers spent weekends and summers renovating their infrastructure for a new era of technology studies. Vendors such as Creative Learning Systems offered the most imaginative designs for technology environments with their SmartLab 2000 and Creative Learning Plaza. These are high tech versions of the general shop, combining communication, fabrication and digital media design "cells" and "islands" in a clean environment (e.g., Green, 1994). New teachers are faced with the challenges of rethinking the physical spaces of their facilities

Figure 7. Conventional row lab plan

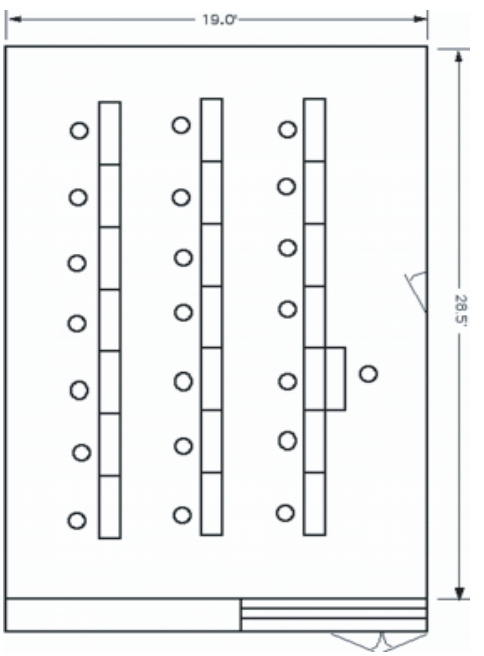
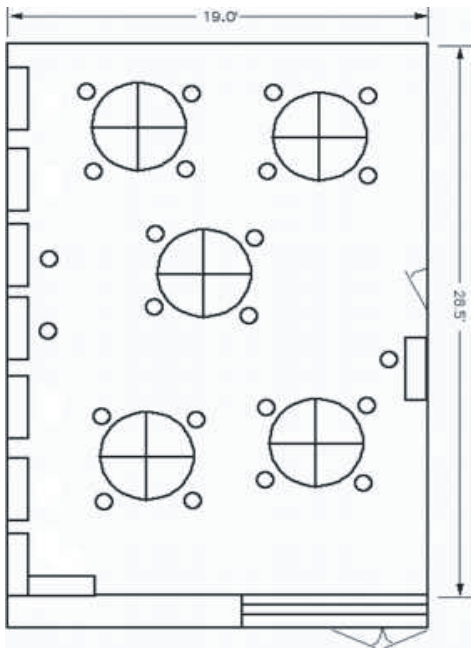


Figure 8. Island pod studio plan



to reflect their classroom management philosophies and new curriculum (Polette, 1991). One of the first tasks is gathering information on the district's small renovation and maintenance policies. Technology teachers have been the most innovative in taking advantage of loopholes. Large districts receive 15,000 work orders per year but only fill about two thirds. Hence, union maintenance specialists typically understand and tolerate changes that can be done without excessive infringements on their contract agreements.

The challenge is to think creatively about technology environments. Any workshop or lab will accommodate any combination of redesigns, renovations, and improvements. For example, following five figures describe a variety of ICT lab designs. Some present basic infrastructure challenges, such as access to power. Figures 7, and 8 require ethernet and electrical line drops from the ceiling or feeds from under the floor to network and power the workstations. The current wave of laptops offers flexibility beyond standard lab or studio designs but present their own problems of durability. T1 and ethernet still provide significant benefits over WiFi.

The double-U shaped and extended row plans (Figures 9, 10) allow for flexibility and accessibility in ways that the conventional row plan does not. Where students hide behind their monitors in the conventional row plan, the double-U and extended row plans maximize visibility. In the double-U plan, the inner tables do not have

Figure 9. Double U-shaped lab plan

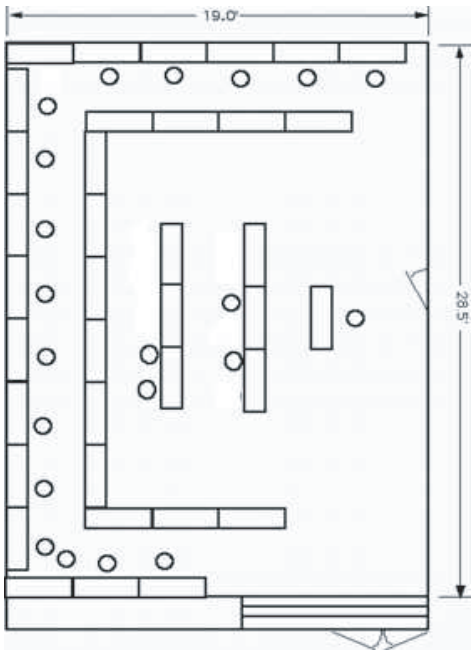


Figure 10. Anchored row studio plan

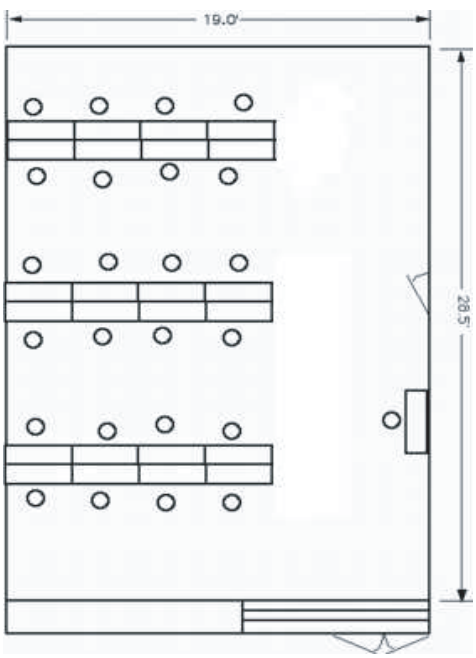
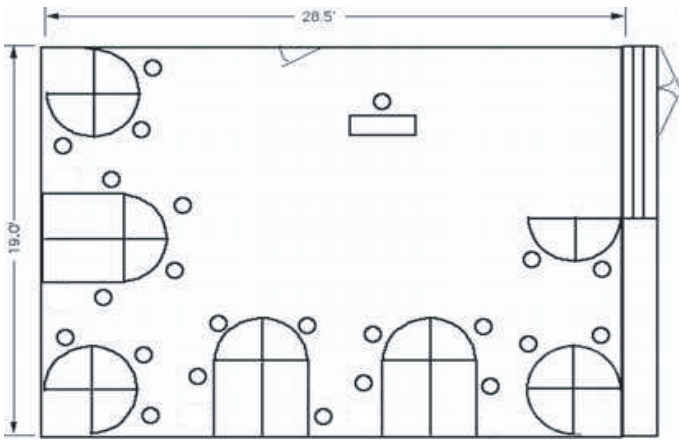


Figure 11. Tethered pod lab plan



workstations; they are placed for group work, presentation, and demonstrations at the front of the room. Students must literally turn their chairs, placing their backs to their monitors when the teacher gathers for a lesson. There is a similar effect with the extended row and tethered pod (Figure 11) plans. These are good examples of how facilities design facilitates and hinders classroom management.

As mentioned in the beginning of this chapter, a clean, well-organized facility is the

Table 6. CREATE scale of facilities and curriculum design (Adapted from Peterson, 2000)

	1	2	3	4	5	**1- Never 2- Seldom 3- Sometimes 4-Often 5- Always**
1	o	o	o	o	o	Students are intrinsically motivated
2	o	o	o	o	o	Students have original ideas
3	o	o	o	o	o	Students are enthusiastic
4	o	o	o	o	o	Students find technology to be personally challenging
5	o	o	o	o	o	Students take initiative to solve problems
6	o	o	o	o	o	Essential information is available for problem-solving
7	o	o	o	o	o	Time is allocated for students to produce original ideas
8	o	o	o	o	o	Sufficient tools and machines are available to design and produce artifacts
9	o	o	o	o	o	Sufficient materials are available to produce designs and artifacts
10.	o	o	o	o	o	Computers are available to access information
11.	o	o	o	o	o	Models and example of creative work are displayed

Table 6. continued

12.	o	o	o	o	o	The facility inspires creativity
13.	o	o	o	o	o	The facility is attractive
14.	o	o	o	o	o	Students like to work in the technology facility
15.	o	o	o	o	o	Posters of creative people are displayed
16.	o	o	o	o	o	Students are trusting and open
17.	o	o	o	o	o	Creativity is recognized and rewarded
18.	o	o	o	o	o	Students are free to choose their own approach to solving problems
19.	o	o	o	o	o	The class has a dynamic, cooperative spirit
20.	o	o	o	o	o	The class is able to critique and debate ideas
21.	o	o	o	o	o	Students use a systematic process to produce their best solution
22.	o	o	o	o	o	Students are able to generate multiple ideas and designs
23.	o	o	o	o	o	Students can elaborate and improve ideas
24.	o	o	o	o	o	Students can produce novel or original ideas to practical problems
25.	o	o	o	o	o	Students apply relevant knowledge to effectively solve practical problems
26.	o	o	o	o	o	Peer teachers support and encourage creativity
27.	o	o	o	o	o	Administrative personnel recognize and reward creativity
28.	o	o	o	o	o	Parents value the creative efforts of their children
29.	o	o	o	o	o	Creative people and role models are used as community resources
30.	o	o	o	o	o	The technology teachers models creative behavior
Total				**30-75** Environment is seldom creative		**76-105** Environment is sometimes creative
						106-150 Environment is often creative

most effective facility. This is true despite your habits at home or your inheritance from previous teachers. Facilities design specialists, such as Polette (1991), advise new teachers to adopt multi-purpose philosophies even in unit workshops. I can also attest that it pays off to take time to organize and reorganize your facility. Reallocate space for designing if necessary. Teachers have been known to collect a handful of computers, cobble them together in the form of a network and request upgrades for the design facility that administrators "forgot" was there. One measure of any technology facility is its infrastructure for creativity and design.

Facility Evaluation

Criteria for evaluating a facility ought to be fairly evident at this point: Resources and décor that promote equity and sustainability, a clean environment, safety policies, procedures and devices that anticipate problems, philosophy of prevention, ergonomic design and a flexible, forward-looking curriculum. Richard Peterson (2000) recommends evaluating facilities as a measure of creativity (see Table 6).

Ergonomics of Labs and Workshops

More than any other subject, technology studies creates conditions requiring ergonomic attention. Computer labs, studios, and workshops offer situations that require repetitive micro-movements, awkward lifting and challenging machine interfaces. Technology teachers can control certain aspects of ergonomics while other aspects are beyond control. Ergonomics or human factors is the study of interaction between people, technology and systems in their (work) environment. It includes environmental, physiological, and psychological aspects of the interaction. The goal is to find a balance between the capabilities of humans and the demands required by the technological environment. The benefits of ergonomics include increased quality and safety, as well as a decrease in musculoskeletal injury (MSI). MSI is an injury or disorder of the muscles, tendons, ligaments, joints, nerves, blood vessels, or related soft tissue including a sprain, strain and inflammation, that may be caused or aggravated by work. It includes overuse injuries such as tendonitis as well as overexertion injuries such as a muscle strain.

Ergonomic solutions in labs and workshops are often obvious, such as platforms for shorter and younger students to use certain devices or machines. Special fixtures may be necessary to basically guarantee the safe use of dangerous equipment. Although the virtues of industrial quality equipment versus equipment customized for school use or young students are debatable, equipment scaled down for young students results in a better ergonomic fit. This reduces anxiety and produces greater confidence, making for a safer environment. Desktop equipment was built for light duty work and educational objectives; it was never designed for industrial use. Teachers may have to increase the visibility of buttons and switches or audibility of alarm, warnings, and signals to respond to ergonomic problems. Most technology teachers find themselves constantly addressing problems of traffic flow, which test even the most seasoned of ergonomic psychologists. Other ergonomic challenges may not be so obvious, such as monitoring students in computer labs for repetitive strain. Given that health researchers are documenting more and more strains in younger and younger students, technology teachers have a responsibility to monitor

the conditions under which their students work. Signs such as swelling, redness, difficulty moving a particular body part or clenching hands may suggest ergonomic problems. Students may report symptoms such as numbness, tingling sensations, or pain, which can clue teachers into ergonomic problems. Of course, the best intervention is prevention.

Ergonomic specialists recommend that teachers monitor repetitive use and duration of use of devices, tools and machines for their students. Teachers may view the use of preventive measures such as rest and recovery cycles or stretch breaks as overkill but the bigger picture means that students habituate the importance of these measures in their lives outside of school. Forces required for the use of certain devices, tools and machines are reduced by upgrading and maintaining the equipment. The provision of fixtures and jigs to support work items may have to be provided to resolve ergonomic problems. Students have to be taught proper techniques for handling objects and work pieces, using digital equipment and working with machinery. For reasons of safety and ergonomics, teachers must do what is necessary to decrease stress and stressful situations. Teachers are responsible for maintaining a comfortable work environment free from stressors.

Budgets and Inventories

Funding cycles for the acquisition of curriculum and instructional resources begin at the federal, provincial and state levels. Funds are then allocated to districts (budgets, grants, trust accounts) and then redistributed from the district to the schools (operating and trust accounts). On top of everything else, teachers must understand how funds are allocated in order to facilitate their own budgeting process. Some districts and schools use site-based management to make budget decisions while others use very centralized models. Budgets are developed through accounting systems such as zero-based budgeting, line item budgeting, performance budgeting, etc. The purpose of the budgetary process is to determine unsatisfied needs, to devise strategies for meeting those needs, and to provide fiscal and program accountability. When developing a budget for the acquisition of resources, school districts and teachers can (BC MOE, 2000):

- Budget for the purchase of learning resources that support the implementation of the K-12 curriculum
- Budget for the purchase of newer learning resource formats and ICT
- Budget for the purchase of expensive items, unusual items, and/or other curriculum-related items for loan to schools

- Develop per student or per school allocations or other processes for providing equitable funding
- Make projections of future learning resource needs and build long- and short-term budgets to support the acquisition of resources
- Use a consultative process to develop a comprehensive budget for purchasing learning resources
- Evaluate the impact of previous budget decisions
- Align with federal, state, district, and school policies and procedures for resource funding

In most cases, an inventory will accompany the ordering process. Some teachers prefer to keep an on-going inventory, documenting the progressive consumption of materials while others prefer an annual inventory. Most teachers despise the record keeping that inventories demand, but accept the process as part of their obligation toward facilities management. A good inventory should:

- Indicate missing, lost, or damaged items
- Identify resources in need of replacement
- Indicate gaps in the collection of materials and resources

Ordering and purchasing follows the budget and inventory practice. The primary goal of the purchasing is to acquire resources and to make them available as quickly and efficiently as possible. Some districts will require competitive formal bidding, while others allow more flexibility in the choice of vendor. The most organized districts provide a system for aggregating and centralizing purchases in order to drive down costs. Teachers across different schools who combine purchase orders find significant savings. Vendors respond to bulk orders, which also has an impact on the purchasing of learning resources. Most districts have a timeline for their yearly purchasing cycle and it is up to teachers to frequently monitor the timeline. They have to stay aware of policies and procedures for the requisitioning and purchasing of resources (e.g., fiscal year carryover) and be aware of costs associated with donations (i.e., cataloguing, processing, repair, storage). Most technology teachers maintain a file to quickly access current resource information (e.g., vendor catalogues, Web sites).

For ICT, licenses must be negotiated with vendors and again, volume drives down costs. The biggest mistake that districts make is decentralized orders of software. Rather than mass licensing, most districts make the mistake of individual software packages, which are costly and redundant. Key servers are available to limit the

use of software while making it accessible to a wide pool of students or teachers. For example, a key server can distribute an expensive package such as 3D Studio Max, allowing for a limited number of users at any given time but also rendering it accessible to anyone with access to the server. Currently, many teachers are reconsidering their investments into commercially licensed software and operating systems and are exploring open source software. Open source software, such as the operating system Linux, is encompassing more and more applications. OpenOffice will do what Microsoft Office does and it is free. Mozilla and Firebird browsers are popular across the world, and include built-in Web design applications, actually an upgraded Netscape Composer. Gimp is an effective Open Source graphic file manipulation package, the standard Open Source CAD programs are ArchCad and Qcad, and Blender is a powerful 3D modeling and animation application. Open Source is allowing schools to avoid costly cycles of investments into expensive software packages.

Projection and Reflective Practice

In the previous chapter, we dealt with assessment and evaluation. Some teachers suggest that an assessment system of penalties and rewards is the basis of classroom management. However, in this chapter, we noted that classroom management is dependent on a range of components including facilities design and safety. Classroom management requires a philosophy that accounts for the gender and diversity, cultural backgrounds, students with learning and physical disabilities and a range of common incivilities that occur on a daily basis. One of the most effective approaches to classroom management involves discipline with dignity. More than a series of rules and procedures, which are absolutely necessary, discipline with dignity offers a philosophy for dealing with behavioral problems. Similarly, safety requires a philosophy that focuses on prevention but responds to events and post-event situations that invariably occur in technology facilities. And the fact is that some labs and workshops work better than others for technology teachers. Some are more future-oriented and progressive than others. All facilities are *not* equal. Some make classroom management difficult by design while others create ergonomic and safety nightmares. As R. Buckminister Fuller once said, “Reform the environment; stop trying to reform people. They will reform themselves if the environment is right.” “Reforming environments” is what makes technology teaching so challenging and rewarding. “Putting it all together” is the hallmark of professional practice.

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