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Technology Education and Integrated Learning for Adult Learners

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by

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Adult learning and achievement in technology education can be enhanced through the process of integrated learning, rather than through learning skills in isolation. An integrated learning program helps provide the opportunity for instructors to help their students make connections and form relationships across the boundaries of classroom, discipline, skill, and background. Situated cognition refers to the idea that cognitive processes (including thinking and learning) are located in physical and social contexts. By providing technology education using information contexts (histories, stories, explanations, backgrounds), adult learners can draw on both what they have learned in life and are learning in the classroom.

Adult Learners and Learning

During the past two decades, a significant number of books, articles, and conference proceedings have appeared focusing on adults as learners. Many adults are returning to universities and colleges to take classes for skill improvement, job advancement, and personal understanding. In business and industry, the demand for training programs to help workers keep current and competitive is growing. It is likely that more and more adults from all walks of life will be continuing their learning in a variety of settings.

Various authors have written about adults as learners. For example, Apps (1981) talks about adults who are returning to college campuses. Smith and Associates (1990) devote an entire book to the concept of how adults learn across the lifespan. Mezirow (1991) describes the dynamics of how adults learn and how their perceptions are transformed by learning.

It is difficult to define who should be considered an "adult learner." One widely accepted definition comes from Arthur Chickering, of the National Commission on Higher Education and the Adult Learner, who defines an adult learner as "an individual whose major role in life is something other than full-time student" (Chickering, *Arthur Chickering on Intentional...).* This broad definition also includes adult "Lifelong Learners" and/or "Third Age Learners." Lifelong Learners simply enjoy learning new skills, ways of thinking, or participating in an educational setting. The University of Pittsburgh has programs designed for those 55 years or older, which they consider to be Third Age. The University's web site (University of Pittsburgh) for the program tells them:

> You are not seniors … You are not the elderly … you are healthier and more vital than any generation ever before. Youth and middle age – the first two stages of your life – are chronologically behind you. You are in the Third Age

> of your life, when work and family responsibilities are lessened and curiosity and intellectual inquisitiveness now propels (sic) you to new dimensions.

The University of Texas at Austin has a "Third Age University," but their web site declares "With retirement no longer defined by one's age, the Third Age is the period of life to concentrate on 'becoming' instead of preparing (formal schooling) or doing (career)" (University of Texas).

The types of learning projects that adults engage in are important in helping us to understand what motivates adults to learn. For example, a great number of learning projects are related to a person's job or occupation. Some of the other projects include learning for home and personal responsibilities, for interest or leisure, for improving a broad area of competence, or for curiosity or to answer a question about a certain matter. Allen Tough summarized research about adult learning projects in his article "Major Learning Efforts: Recent Research and Future Directions" (252):

1. Ninety percent of adults conduct at least one major learning effort each year.
2. The average learner conducts five distinct learning projects in one year.
3. The average person spends an approximate 100 hours per learning effort – a total of about 500 hours/year.
4. Seventy-five percent of the learning projects are motivated by some anticipated use of the knowledge or skill to be learned.
5. The learners themselves plan approximately seventy-five percent of the learning projects.

Tough defined a learning project as "a highly deliberate effort to gain and retain certain definite knowledge and skill, or to change in some other way" (250). The learning project must have taken at least 7 hours of time during the past year, but the sustained effort must have taken place within a six-month period. Examples of learning projects described by adult learners were: learning how to repair a car, how to weatherize a house, taking a graduate course, learning to be a parent, learning how to speak publicly, and studying about another country before taking a trip.

Tough's research shows that adults have a rich reservoir of experience that can serve as a resource for learning. They have accumulated a foundation of life experiences and knowledge that may include work-related activities, family responsibilities, and previous education. Since adults' readiness to learn is frequently affected by their need to know or do something, they tend to have a life-, task-, or problem-centered orientation to learning as opposed to a subject-matter orientation. Motivational factors add a further complexity to adult education. Adults may be motivated to learn due to internal or intrinsic factors such as helping their child with homework or the luxury of having an opportunity to learn more about a subject in which the individual has always been interested. Motivation can also be from external or extrinsic forces such as the possibility of a raise in salary or the dismal prospect of losing a job.

Jerome Bruner's *The Culture of Education* discusses the implications of combining adult potential with adult instruction in his description of four critical elements of learning that have achieved increasing attention in recent years:

- The idea of ***agency*** involves learners' taking increasing control of their own mental activity. In this view learners are "proactive, problem-oriented, attentionally focused, selective, constructional, directed to ends," and what "gets into" their minds is more a function of the approach than the information they are bombarded with (93).

- The idea of ***collaboration*** requires "sharing the resources of the mix of human beings involved in teaching and learning." (87). Agency combined with collaboration provides synergy between teachers and learners.
- The idea of ***reflection*** helps students make sense of what they learn, "not simply 'learning in the raw' but making what you learn make sense, understanding it" (87).
- The idea or notion of ***culture*** is "the way of life and thought that we construct, negotiate, institutionalize, and finally end up calling 'reality' to comfort ourselves" (87).

Adult learners come to learning with a wide range of previous experiences, knowledge, self-direction, interests, and competencies. One of the most difficult aspects of education is determining how to relate a given topic or concept to the particular frameworks of many individuals. Agency, collaboration, reflection, and culture offer adult learners, who differ dramatically in the learning skills and strategies they currently possess, opportunities for active engagement, cooperation, and cultural expression in the classroom. Finding an appropriate conceptual hook for each individual is crucial to the development of meaningful learning opportunities. Adult learners, because they have more life experience than younger learners, also have the potential of offering more hooks for the instructor to use to "get into their minds."

Adult learners have a wide range of educational needs. Currently, one of their most pressing needs is technology education. This is true in adults' personal lives, where the use of information technology may be a valuable enhancement to their way of life. The use of information technology is also increasingly common in the workplace. A strong foundation in technology education will help students develop an understanding of the nature of technology and its appropriate selection and use (including computer applications).

Why Adults Pursue Technology Education

Although many social changes taking place today affect people throughout the world, within the United States several changes have stimulated increased interest by adults in learning. One of these is the ever-increasing rapidity of technological change. Another is the job insecurity (economic anxiety) experienced by many adults, caused by workplace downsizing, global competition, and job obsolescence (National Research Council 7). The educational response has been mid-career counseling and re-tooling, re-training for displaced workers, and complete career shifts often through extensive back-to-school movements. A third force is that the American population is a steadily aging one (United Nations 9). This creates a potentially large pool of older adults interested in learning opportunities.

Allen Tough's study of adult learners, "Major Learning Efforts," is now a quarter of a century old. It would be illuminating to reproduce his study, adjusting the questions to include current computer usage. It is likely that there would be changes in the types of learning projects that adult learners engage in and the methods by which they pursue them. In a revised survey, the number of learning projects that involve using a computer and computer applications would undoubtedly increase. The learning projects that adults undertook in 1978 might now involve Internet research. Formal coursework, such as taking a graduate course, is also available on-line.

Technology education for adults traditionally takes the form of "skills learning" with the major interaction taking place between the student and a machine. Indeed, learning basic computer skills is increasingly necessary to function in today's workplace or to pursue many personal interests. This knowledge gives people a practical understanding about how their computers and printers operate, how to troubleshoot problems, how to locate an Internet web site, and a host of other technology-based skills that help an adult to be more successful in the technological world.

A solely vocational emphasis used during technology training may be overly constraining for third-age or lifelong learners who are taking a class out of "curiosity" or "intellectual inquisitiveness" or for "becoming," words traditionally used to describe characteristics of lifelong and Third Age learners. Intellectual capabilities, motivation, conceptual knowledge, and contemporary skills associated with information technology are all important factors that come into play when designing a technology skills course for adult learners. Segmentation of knowledge or skills "poorly serves a world where career changes are frequent and cross-disciplinary communication is needed to solve systemic problems" (National Research Council 53).

"Skills" learning is essential but can be enhanced tremendously through the use of innovative learning strategies. One educator, not speaking specifically about technology, wistfully writes: "The best days for me were those when my students and I were on the same journey and none of us knew exactly where it would take us" (Curtiss 30). Deciding in advance that only a specific skill or skills are important significantly narrows a student's way of thinking and reduces the chances of serendipitous discovery of something unexpected or wonderful by confining learning technology-related skills to simply mastering a skill set, rather than having that skill set put in a sociological, historical, philosophical or literary context. Also, enlarging the learner's role through an eclectic derivation of approaches during instruction creates an active environment for the students, resulting in more personal ownership for their learning efforts (Hiemstra and Sisco 5).

Today's technology educator must also teach information literacy skills so that students understand how to use technology to access information, assess the validity and importance of information, and determine how to best use information. While the challenge of teaching students how to efficiently retrieve information, evaluate it, and/or knowing how to use a wide variety of software packages can seem formidable, technology education can be made more valuable and more interesting if it does not correlate only to the mastering of isolated skills. According to the American Association of School Librarians and the Association for Educational Communications and Technology: "Cognitive psychologists define learning itself as the active building of knowledge through dynamic interaction with information and experience" (2). Adding information from various liberal arts subject areas to a technology training session adds relevancy and relatedness to technology education. Using this approach may be what, as Bruner (*Culture* 93) refers to it, "gets into" the students' minds and makes them more receptive to the educational experience they are having.

The compartmentalization of technology education into skills training may frequently be a necessary time saver, particularly when training takes place in the work force. However, through the use of innovative learning strategies, adult learning and achievement can be enhanced in the area of adult technology education.

Situated Cognition and Integrated Learning

Higher education is beginning to shift from a paradigm organized around "providing instruction" to one aimed at "producing learning" (Barr and Tagg 13). The same philosophy should hold true in educational settings for adult learners. The idea of person-situation learning is not new in psychology or education. Most contemporary perspectives on learning and development assume that beliefs and knowledge are formed as people interact in situations (Bertrand 103-38). This emphasis contrasts with the classical information processing model put forth by Newell and Simon (1972) that highlights the sequential processing and movement of information. The classical information processing model postulates that cognitive processes are executed in a series, one after another, and would suggest that students compartmentalize lectures and do not think laterally. Research within a variety of disciplines – including cognitive psychology, social cognitive learning, and specific content domains – shows this to be a limited view and that thinking involves an extended reciprocal relation with the context (Bandura, 1986; Greeno, 1989). Bandura and Greeno challenged the idea that cognitive processing is primarily serial. They suggested that cognitive processing is primarily parallel, meaning that humans actually process large amounts of information simultaneously. Psychologists David Rumelhart and Jay McClelland also have proposed a theory that they call "parallel distributed processing" models of the mind. These models theorize that many types of information processing occur at once, rather than just one at a time.

Integrated learning provides the opportunity for instructors to help their students make connections and form relationships across the boundaries of classroom, discipline, skill, and background. Situated cognition refers to the idea that cognitive processes (including thinking and learning) are located in physical and social contexts (Anderson, Reder, and Simon 1996; Greeno and Goldman, 1998). Cognitive processes involve relations between a person and a situation; they do not reside solely in a person's mind (Greeno, 1989). Michael Moore (1989) identified three types of interaction: learner-content, learner-teacher, and learner-learner. Additionally, "few chances to interact with the instructor limits students' ability to clarify and negotiate instructional goals, explore alternative methods, or construct meaning within in a social context based on personal knowledge" (Garrison 204). This can be the case in a very focused technology training situation where the student's main interaction is with his or her computer.

Alfred North Whitehead in *The Aims of Education & Other Essays* suggested: "The solution which I am urging is to eradicate the fatal disconnection of subjects which kills the vitality of our modern curriculum. There is only one subject matter for education, and that is Life in all its manifestations. Our aim is to teach all the discrete subjects and skills of the elementary curriculum and to teach the interdependence of all the components—the ecology of the classroom" (10). Examples of this are teachers who weave together the reading, writing, math, science, social studies, and art components of an elementary school curriculum. These teachers realize that a day in the life of a child in school should not be a sequence of unrelated lessons, but a tapestry of integrated pursuits.

An important variable in instruction lies in the teacher's success "at providing the stimulus for learners to become excited about a subject area, want to learn about it, and be willing to dig into available resources" (Hiemstra and Sisco 9). Promoting positive learning attitudes and individualizing planning can correlate to the issues of self-confidence and self-initiative on the part of learners. Similarly, Knowles (31) has identified several key characteristics about adult learners that have been supported by research and form the foundation for working with adults. The first three are as follows:

1. Adults are motivated to learn as they experience needs and interests learning will satisfy; therefore, these are the appropriate starting points for organizing such activities.

2. Adults' orientation to learning is life centered; therefore, the appropriate units for organizing adult learning are life situations, not subjects.

3. Experience is the richest resource for adults' learning; therefore, the core methodology of adult education is the analysis of experience.

There is a need for congruence between what it means to be an adult and what it means to be a learner. Successful instructors of adults realize this and look for ways of integrating the specialized circumstances, abilities, and experiences among all adults in their learning activities. Understanding what motivates an adult to learn, and using that knowledge in the classroom, is a key factor in improving student satisfaction with technology training.

Adult learning and achievement in technology education can be enhanced through the process of integrated learning, rather than through learning skills in isolation. As technology educators plan units of study they should not isolate subject matter. By providing technology education using information contexts (histories, stories, explanations, backgrounds) adult learners can draw on both what they have learned in life and are learning in the classroom. This can be done even in a one-hour class that is solely technical in focus. An example of this might be inserting an amusing slide, such as the image below, into a PowerPoint presentation in an "Introduction to Personal Computing Class."

Fig. 1. "Superman's Girl Friend, Lois Lane"

This might be the hook that awakens someone's interest in what they are learning. Aside from providing a laugh and lightening the mood, the image might pique curiosity or inspire a personal memory for a class member to share.

Motivation, Curiosity, Mood, and Learning

"Ideally," Jerome Bruner writes in *The Process of Education*, "interest in the material to be learned is the best stimulus to learning, rather than such external goals as grades or later competitive advantage"(14). Bruner argues that schooling and curricula should be constructed to foster intuitive "graspings." He proposes a "spiral curriculum" concept to facilitate structuring a curriculum "around the great issues, principles, and values that a society deems worthy of the continual concern of its members"(85). Educators need to be concerned with facilitating motivation through the use of strategies that enhance learner effort, comprehension, and understanding. Effective strategies for facilitating motivation include purposeful learning activities, guided by practices that enhance positive emotions and intrinsic motivation to learn, and methods that increase learners' perceptions that a task is interesting and personally relevant. (American Psychological Association)

Motivation can be either extrinsic or intrinsic. "Intrinsic motivation is a state where the relevance for the learner of the content of the material is the main reason for learning. Extrinsic motivation for learning is a state where the reasons for the learning effort have nothing to do with the content of the learning material" (Marton, *What Does…*, 128). Extrinsic motivational factors are externally administered. Extrinsic motivation can be increased through the receipt of rewards such as promotions, money, or grades. Intrinsic motivation involves a drive to succeed that comes from within a person. In "What Does it Take to Learn," Marton and Säljö write: "If we want to utilize people's intrinsic motivation, we must focus on what they are interested in and link the study material to it" (51).

Instructors can use Abraham Maslow's "Hierarchy" to understand students' motivational needs and to create an environment to enhance learning. Maslow (1968, 1970) believed that being directed toward goal attainment unifies human actions and that behaviors can serve several functions simultaneously. Most human action represents a striving to satisfy a set of hierarchical needs. According to Maslow, an individual's lower-order needs have to be satisfied adequately before higher-order needs can influence their behavior. Physiological needs, the lowest on the hierarchy, concern necessities such as food, air, and water. The next three needs, safety, belonging, and esteem, produce deficiencies that motivate people to satisfy them (Maslow, 1968). For an adult, securing these necessities depends on having and retaining a job or a secure place in their community.

At the highest level of the hierarchy is the need for self-actualization, or the desire for self-fulfillment. Self-actualization manifests itself in the need to become everything one is capable of becoming. Behavior is not motivated by a deficiency but rather by a desire for personal growth (Maslow, 1968). Maslow (1968) also defined self-actualization in terms of frequency of peak experiences:

> In other words, any person in any of the peak experiences takes on temporarily many of the characteristics which I found in self-actualizing individuals. That is, for the time they become self-actualizers. We may think of it as a passing characterological change if we wish, and not just as an emotional-cognitive-expressive state. Not only are these his happiest and most thrilling moments, but they are also moments of greatest maturity, individuation, fulfillment - in a word, his healthiest moments. (97-98)

Self-actualization should provide not only a skill set, but also a new perspective. Within the classroom, the students should be able to contribute from their own life experiences and feel comfortable in doing so. Situating a course in this way does not necessarily take time away from learning the required skill set. It does require extra effort on the part of the instructor to create a curriculum that broadens the student's perspective on what they are learning and makes it more relevant to their intrinsic as well as their extrinsic needs. Donald Schön (1987) writes: "Ideally, motivation should be intrinsic. Students should want to study the subject for its own sake or for the sense of accomplishment in learning something new. Since many students are not intrinsically motivated, however, extrinsic rewards can sometimes offer a first step toward increased motivation"(3). Intrinsic motivation may have far greater long-term benefits for learners. Intrinsic rewards are "the good feelings people get from the work itself, feelings like enjoyment from the very act of performing the tasks involved, excitement about confronting and overcoming challenges, satisfaction in helping others or accomplishing something worthwhile, and pride in doing a job well" (Deeprose 72). Appealing to a learner's sense of curiosity may increase their intrinsic motivation. Curiosity is an eagerness to investigate or learn more about something. Curiosity will be elicited, Lepper and Hoddell (91) believe, by activities that provide students with information or ideas that are surprising, incongruous, or discrepant from their existing beliefs and ideas. Inserting non-traditional learning concepts into a very focused or traditional curriculum can do much to develop student motivation. Instructors can do more to foster motivation by encouraging independent approaches, by offering a variety of opportunities to choose from, by providing frequent feedback on progress, and by fostering a collegial learning environment. Another motivational factor - but one frequently left "unseen" - is the instructor's interest in the material and a clear indication of this to the students. Schön (1987) states: "Teachers who are well-prepared and enthusiastic about their subjects and are able to convey their enthusiasm to their students are likely to increase the students' interest in the material" (2).

Technology education confronts students with a variety of learning demands. If the training is required by their workplace, the students frequently are in attendance to be able to retain their current jobs or to gain promotion. They are rarely in attendance for intrinsic reasons such as purpose, passion, or mission. Nor is much of what the students are presented with often perceived as stimulating, or exciting, or interesting. Yet, what they need to learn is important to their livelihood. The way the contents of a particular course are presented can intensify or suppress the students' interest and understanding of the content material. It can either stimulate active involvement or make a student feel lost, intimidated, or inadequate. One aim, however, of technology education for an adult learner is to cultivate learning motivation not only within the training period but also so motivation persists beyond the classroom.

Does a person's state of mind, or mood, during technology training affect motivation, intentions, and the usage of the new technology? Motivational and emotional factors influence both the quality of thinking and information processing as well as an individual's motivation to learn. Positive emotions, such as curiosity, generally enhance motivation and facilitate learning and performance. Negative emotions (e.g., anxiety, panic, rage, insecurity) and related thoughts (e.g., worrying about competence, fear of failure, or ridicule) generally detract from motivation, interfere with learning, and contribute to low performance. (American Psychological Association).

The purpose of a study done by Venkatesh and Speier in 1999 was to determine the effect of mood on employee motivation and intentions when using a specific computer technology. Positive mood was expected to enhance both intrinsic and extrinsic motivation and the resulting intention to use the new technology. In contrast, negative mood was expected to depress both intrinsic and extrinsic motivation, thus lowering intention to use the new technology. Long-term effects of mood were hypothesized to be comparable to the short-term effects with the exception of extrinsic motivation. The results of the study suggested that "while no differences are observed in extrinsic motivation, the positive mood intervention has short term effects on intrinsic motivation and behavioral intention and the negative mood intervention has lasting effects on intrinsic motivation and behavioral intention" (Venkatesh and Speier 16). Mood intervention by an instructor through the use of an innovative curriculum can make students feel better about the educational setting they are in and potentially engage them in a new way of thinking about what they are learning and how they might apply it. Because the intrinsic effect may be short-term, giving students a creative and engaging assignment to complete after the class gives them the opportunity to apply what they have learned in the classroom and may increase their long-term motivation if they find the application rewarding.

Schön (1983) describes a way of thinking that is applicable to many professions and that is particularly useful for teachers seeking to improve their instruction. He calls it "reflecting-in-action" (54-56). Schön goes into great detail about the reflective practitioner in architecture, psychotherapy, the science-based professions, and town planning. He draws his ideas from interviews with major league baseball players and jazz musicians; professionals who must learn to adjust once they are "out there." Although he does not apply his theory to pedagogy/andragogy, it is this way of thinking and teaching that could provide one way for both educators and students to experience self-actualization.

Schön begins with the assumption that "competent practitioners usually know more than they can say" (*Reflective* viii). He calls this "knowing-in-action." Utilizing "reflecting-in-action" is "learning to adjust once you're out there" (55). Schön describes jazz musicians "reflecting in action" this way:

> Listening to one another and to themselves, they feel where the music is going and adjust their playing accordingly. They can do this, first of all, because their collective effort at musical invention makes use of a schema – a metric, melodic, and harmonic schema familiar to all participants – which gives a predictable order to the piece. In addition, each of the musicians has at the ready a repertoire of musical figures which he can deliver at appropriate moments. Improvisation consists in varying, combining, and recombining a set of figures within the schema which bounds and gives coherence to the performance. (55)

This is an exciting concept to apply to technology education. With a broad-based liberal arts background, the instructor can draw from a wealth of "figures" to deliver at the appropriate moment. Schön elaborates:

> Much reflection-in-action hinges on the experience of surprise. When intuitive, spontaneous, performance yields nothing more than the results expected for it, that we tend not to think about it. But when intuitive performance leads to surprises, pleasing and promising or unwanted, we may respond by reflecting-in-action. (56)

Instructors engage in "reflection-in-action" by adjusting their teaching to the reactions/feedback received from students. As a class unfolds, the instructor reflects and reacts, using a broad base of skills and knowledge. James Kidd envisions the educator as a craftsman:

> As is true in some other fields, the agent in learning is not only an artist, but a craftsman as well and needs to take over some of the attitudes, such as the concern about skill, the devotion to self-improvement, the slow maturation of skill that is the hallmark of the genuine craftsman. (297).

Motivation, curiosity, mood, spontaneity: when these elements are added to a curriculum, they can make a learning situation more relaxing and fulfilling to an adult learner and increase his or her involvement with the material being presented. For the instructor, including these elements in the curriculum means being able to adjust a "performance" like a jazz musician. A technology educator can bring artistry to the classroom through knowing-in-action and reflection-in-action. The instructor should possess and demonstrate mastery of technology-related skills, but should also have command of complementary subject matter appropriate to the interests of the learners. For a technology educator, it means being able to elaborate the skill set being taught with relevant instructional vignettes of material that will appeal to the "audience" and broaden their perception of the material being presented.

Technology Education in Transition

The field of technology education has gone through considerable revision in the past thirty years. During this time technology educators have instituted multiple changes in curriculum, program requirements, and facilities (Volk 1993). Daugherty and Boser (1993) stated that in the preceding decade "the philosophy, curricula, and methodologies used to guide the discipline may have changed more dramatically than they have in the preceding one hundred years" (31). Waetjen (1989) supported this assertion when he indicated that the last decade has witnessed a startling change in what was once industrial arts and has now evolved into technology education. As the field of technology education continues to evolve, its unique mission to provide relevant and meaningful learning experiences that reinforce academic content and enhance higher-order thinking skills is becoming clearer (Johnson, 1992).

New technologies are an enabler for many new types of educational opportunities. A computer with the appropriate software loaded allows a user to take advantage of word processing and spreadsheet software packages. A computer with telecommunications capacity can give its user access to the Internet and much of the world's digital information. Technology education (dealing with the application of computers) and technical education (dealing with mechanical or business sciences) have both been inserted into the educational system as very specialized subjects.

During the late nineteenth and early twentieth centuries American universities began to shift their emphasis from institutions' whose "clearly defined perception of its central role [was] in developing young adults who think and act morally" (Nucci and Pascarella 271-72) towards an institutional emphasis on discipline-specific technical or vocational training in place of a more liberal education. William May observed: "The liberal arts college of the nineteenth and early twentieth century tended to define its responsibility as the cultivation of the well-rounded person. Subsequently, the twentieth-century university accepted as its ideal the training of the technically proficient person" (29). However, there is evidence that the focus on vocational training in specific programs has resulted in some dissatisfaction among employers. The accounting profession is one example of this. Irvin Nelson writes:

> The unfortunate consequence is that accounting students have become even-more narrowly-educated. Graduates have become increasingly technically proficient but less well-rounded in the tradition of a classical education. Communication, interpersonal, critical-thinking, and professional skills, as well as general knowledge of cultures, history and the arts and sciences, have diminished. Additionally, the quantity of technical material covered has grown so voluminous that the depth of understanding regarding the issues and theories underlying memorized accounting rules has become very shallow. (65)

The pressure to add technical content to the curriculum due to the expansion of the body of accounting knowledge caused an increasing focus on vocational training. For many years employers remained relatively content with the quality of accounting graduates, since accounting tended to attract the "best and brightest" students. But with a decline in the quality of applicants to accounting programs, the effects of an inadequate liberal education became more apparent (Nelson 67). These developments culminated in 1989, with the release of "Perspectives on Education: Capabilities for Success in the Accounting Profession." Authored by the largest public accounting firms, the article strongly criticized accounting programs for failing to develop well-rounded individuals who possess critical thinking skills (Arthur Andersen et al. 1989). As a result, some university accounting programs have made significant curriculum revision efforts and require fewer technical courses in accounting and business and more courses in the liberal arts (Nelson 72).

This broadening of curricula in technology/technical education provides opportunities for students to develop and exercise their critical thinking abilities. The University of Arizona College of Engineering and Mines has begun to offer a Bachelor of Arts degree program in Engineering. Their web site (University of Arizona, *BA*) welcomes students to "the home page of a revolutionary project dedicated to Engineering with a Liberal and Technical Education." They foresee the need for "a well rounded education that combines the quantitative analytical approach of engineering with the societal and cultural dimensions of the traditional liberal arts ... [the program] will prepare graduates who have the breadth of vision to lead this nation into the twenty-first century. (University of Arizona, *BA*). One of their cross-disciplinary seminars is called "Culture and Materials Technology" and its students will "investigate the ways in which systems of technology are embedded in a cultural context and the resulting impacts on invention, innovation, and conservation, technology transfer, and cultural change" (University of Arizona, *Ideas*). This program anticipates that after these students leave the university environment, they may also find the need for the interdisciplinary skills they learned in demand in the workplace.

In today's workplace, information technology is increasingly common. There are few job classifications that require no knowledge of information technology. For adult learners in the workforce, technology education/training is almost always presented in the same fashion as vocational subjects such as the industrial arts. It is highly specialized and focused. Despite the importance of solid technical/technology backgrounds, a call for a liberal arts background in the technical workplace has been issued by Joe LoCicero, Head of Organization and Training at the Harley Davidson Motor Company, Tomahawk Operations:

> It is clear to most organizations that people are their only long-term competitive advantage and that diversity among employees is a real strength. Many organizations have employees with a technical education, but diversity in education is important as well. I believe the broad knowledge of a liberal arts education can provide the kind of educational diversity that is in short supply in many organizations. (LoCicero, *What Can I Study?*)

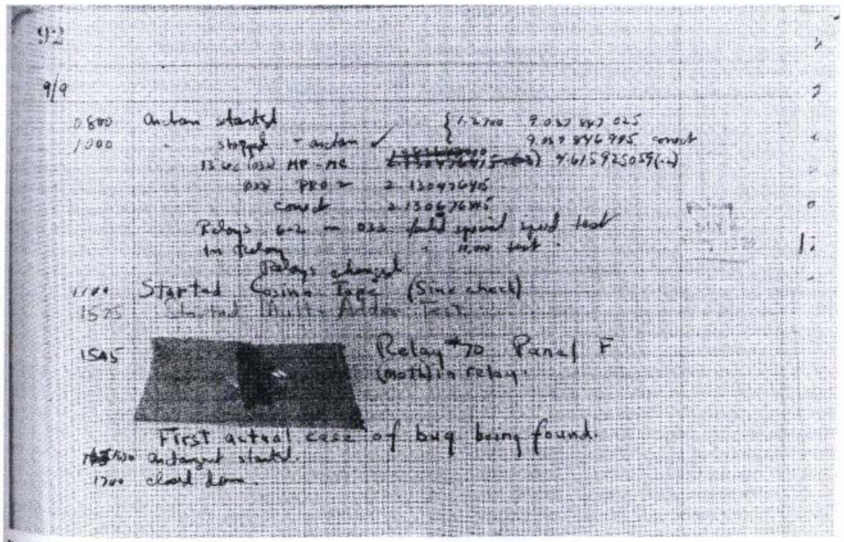
The changes in technology education within higher education and the awakening awareness of the need for changes in skill sets in the technical workplace have implications for adult learners. Technology training for adult learners takes place within a much shorter time frame than an undergraduate education, but there are many ways that an instructor can include social, literary, or historical insights into a technology learning situation, whether it is a one-time, one-hour session or a semester length class. Technology training should also emphasize good teaching, not just good technology.

Technology Skills and Integrated Learning for Adult Learners

While an undergraduate or graduate student studying computer technology is undergoing a formal educational process, adult learners are likelier to be engaged in a technology training process. A formal educational process takes place in an established educational institution with approved curricula. The teachers in these settings are masters of their subject areas. The instruction in a particular subject occurs over a lengthy time-span. Technology training for adult learners, on the other hand, may take place in a work place, a borrowed classroom, or some type of informal setting. The training is often of short duration and is specialized and focused. The instructors may also be masters of the subjects that they are teaching, but it is likelier that their own educational background in their area of instruction has been acquired informally or is self-taught.

To many adult learners, a computer is a very serious thing. There is nothing fun about a computer. There are computer jokes, but they aren't affectionate. Computer cartoons are likely to involve the impending doom of the machine at the hands of a frustrated user holding a large mallet. Many people work with a personal computer eight hours a day and would never give it a name. Cars, boats, and airplanes (even bombers) are sometimes affectionately called "she" and have names painted on them. A computer is likely referred to as "It," if not something worse. Why do students so often immediately feel an almost adversarial relationship with this inanimate object? Many older adults have memories of failed attempts to master a new skill, a new language, some new appliance or machine and are not eager to repeat the experience. The computer can be particularly intimidating to those first approaching it. A technology educator can do a great deal to ease the concerns of adult learners by using motivation, mood, and curiosity to relieve the tensions that occur during so many technology training sessions. A brief example of contextual, integrated learning is as follows.

In computer technology a bug is a coding error in a computer program. Some students' interest might be piqued to learn more about the origin of the term "bug" by placing it in historical and visual contexts. In 1944, Admiral Grace Hopper, then a young Naval Reserve officer, went to work on the Mark I computer at Harvard, becoming one of the first people to write programs for it. As Admiral Hopper, she later described an incident in which a technician is said to have pulled an actual bug (a moth, in fact) from between two electrical relays in the Mark II computer (Raymond 94). Raymond writes: "this wording establishes that the term was already in use in its current specific sense …indeed, the use of *bug* to mean an industrial defect was already established in Thomas Edison's time" (94).



Page of log showing original bug. (Photograph Courtesy Naval Museum, Naval Surface Weapons Center.)

Fig. 2. First Actual Case of Bug Being Found in ["Anecdotes"], *Annals of the History of Computing*, 285.

Along with “bug,” the computer world is filled with slang and words “layered” for use as technological terms (e.g, cookie, alias, backbone, evergreen). Providing some contextual information, along with the technical information when the term is introduced to the learners is just one small way to provide some student interest in a short period of time. Kidd (282) writes: “If the attention of the learner is fully engaged he will want, in increasing measure, to experience the subject matter in all its fascination, or its difficulty, even its bewilderment.” While adult learners may be very focused on learning a specific skill set, there is a wealth of history, literature, and humor for technology educators to draw from and insert into a short or long-term technology-related course. Within a longer curriculum, the use of story-telling in tandem with specific skills training can be valuable to reach the instructor’s audience.

Technology might be more effectively taught to adult learners by embedding that instruction in the broader issues of the liberal arts, or through inserting short segments of what might be thought of as marginally relevant material into a short, focused technology training session. Kidd (129) writes: “The learner reacts to all experience as he perceives it. The learner is at the center of experience; in a very real sense he occupies a ‘private world’.” When instructing students, for example, in using a software package such as a spreadsheet application, the teacher should remember that the best place to begin is by placing the learner at the very heart of the learning program and using an instructional approach that actively engages learners in constructing their own understanding. In other words, put the learner in the center (of the spreadsheet program) and then enable them to achieve their desired result as quickly as possible. For example, learning how to use a spreadsheet program involves learning, among many other things, what the following things are and what they can do: a spreadsheet cell, a worksheet, and a spreadsheet formula. One way to introduce these concepts to students would be to have them create a generic worksheet called "Cash Flow Projection for an Unknown Company: 2004." Alternatively, the instructor can interject the learner into the center of the learning experience by having each student calculate a matter of personal relevance such as the student's own projection for monthly personal expenses. Oluic-Vokovic (60) writes:

> All this calls into question the one-way directionality of many previous approaches and paradigms, showing explicitly that successful implementation of systems requires both a technical component, concerned with the design and use of systems, and a social component, concerned with understanding how users seek, obtain, evaluate, use, and categorize information.

Another example of broadening perspective in technology training to make it personally more relevant involves Internet instruction. Many learners find the World Wide Web (WWW), one component of the Internet, a series of blind alleys. To them, the Internet was born the day that he or she started using it. It has no history or context and its addresses (URLs – uniform resource locators) seem meaningless. A technology educator can decrease the student's sense of confusion by providing a panoramic view of the Internet's history and sociology. What is the student's personal relationship to this interconnected online world that will give them perspective? At what stage of its development was the Internet when the student was young? For many people, it is inconceivable that there was even a glimmer of the Internet that long ago. The technology educator should center the student in an Internet learning experience. One way to approach this is to show two ways to find genealogical information on the Internet. In one exercise, the instructor shows the student how to search for the information on the Internet in a way similar to how they would search for the information in a physical library. In a more user-centered exercise, the instructor shows the student how to find out some personally relevant genealogical information using generic search engines. After performing these two exercises, the students know more about themselves, more about how information on the WWW is organized, and can apply that knowledge to other situations.

Just as the type of adult technology learner varies, so does the type of instructor and the instruction. Instructors bring a range of experience and assumptions to the process. They may wrongly assume that the students have high interest in the material to be covered, or that they have low ability in the technical arena, or that older learners do not want to waste precious time on unnecessary information. Successful instruction does not happen accidentally. It requires that an instructor has a good knowledge of the subject matter and its context, an understanding of the "clientele," careful planning, and a good deal of flexibility. Successful instructors also are able to offer students a relationship between technical knowledge and a sociological, historical, philosophical or literary context that sparks motivation, curiosity, or a positive mood. Theodore Roszak (1994) writes:

> When we grant anyone the power to teach us *how* to think, we may also be granting them the chance to teach us *what* to think, where to begin thinking, where to stop. At some level that underlies texts, and tests and lesson plans, education is an anatomy of the mind, its structure, its limits, its powers and proper application. (241)

Venkatesh and Speier's study of mood during computer technology training suggests that individuals who have positive moods at the time of training will have greater intentions to use that technology than those individuals who had neutral or bad moods (16). A person arrives at a training session in a certain mood. An instructor can choose to ignore that, or to capitalize on it by restructuring the mood of the classroom if necessary to include brief, pleasant, and unexpected diversions from the material to be covered.

If an instructor only has a 2-hour time slot to give 25 adult learners an "Introduction to Computers" training session it may seem overwhelming, or a waste of time, to include marginal material. Yet this type of information often "speaks" to certain people and arouses their interest in the class. Weinstein writes: "Learning begins when feelings are stirred and thought swiftly flows because of habits that are rendered useless and new strategies are necessitated environmentally" (55). Roszak concurs: "We do not go far wrong from the viewpoint of any discipline by the general cultivation of the mind" (244). The history of technology is full of blood, sweat, tears, and software. Helping students interconnect a particular piece of technology to its historical, political, or sociological roots can give them a sense of context and integration when they are engaged in a technology educational situation.

From Theory to Practice

Like the adult learner, the teacher of adults also brings a great deal to the learning situation. James Kidd writes: “The adult educator cannot simply be a person of good will and generous impulses – and large ignorance. He must know something well” (298). Knowledge about a subject is made up of basic units of information or basic units of skill that can be assembled into more advanced and complicated information. The teacher communicates the knowledge and the students receive it. A positive learning experience can occur when the learner acquires the knowledge he or she expects to receive. On the other hand, dissatisfaction can occur for a variety of reasons. Kidd describes this scenario:

> If, in a course in musical appreciation, in the way that musical examples and musical form are analyzed the learner comes to hate music, there has been a disastrous error both in the selection of the learning experience and probably in the methods employed. (377).

The body of knowledge to be conveyed to the student is extremely important and so is the method by which it is conveyed. Kidd also notes: “Learning happens as the result of engagement, and the task of those guiding learning is to bring about that engagement. Naturally this does not happen by chance or by luck” (278). An important variable in the success of this approach lies in the instructor’s ability to provide the stimulus for learners to become excited about a subject area and want to learn about it.

Technology instructors should engage or interest the students with the technology itself as well as trying to teach good practices in the use of various technology-related skills. Some students may only need knowledge of the skill set to be learned to be satisfied with a class. Others may need a broader context in which to “place” the skill set to stimulate their interest. Technology has automated tasks that frequently involve great physical or mental labor, repetitiveness, or were difficult to accomplish because of physical distance. Computers, computing, and many things enabled by them are all around us. Some of this is highly visible, like personal computers and the Internet; much is invisible, like the microprocessors in cars and appliances, or the programs that fly our planes and keep our telephones and power systems and medical equipment working, or the systems that collect and share personal data about us. Even though most people will not be directly involved with creating such systems, everyone is strongly affected by them.

Many people must learn at least a part of some technology-based system to function in their workplace or community. Some adults literally have to acquire certain technical skills to perform their jobs. Others want to use the Internet to engage in informal learning projects, or to be able to communicate with their grandchildren in another state or country without being deluged with pornography. While it is necessary for the instructor to be well-grounded in the subject material he or she is teaching, it is also possible to add some personal relevance and deeper understanding of underlying concepts to the course content. To do this, the technology educator may have to reach beyond the course outline each class session and incorporate a little known fact or tell a short story that literally makes the technology relevant to the student. In a *The New Yorker* article Tobias Wolff muses on his Prep School teachers:

> How did they command such deference – English teachers? Compared with the men who taught physics and biology, what did they really know of the world? It seemed to me, that they knew what was most worth knowing. Unlike our math and science teachers, who modestly stuck to their subjects, they tended to be polymaths. Adept as they were at dissection, they would never leave a poem or a novel strewn about in pieces like some butchered frog reeking of formaldehyde. They would put it back together with history and psychology, philosophy, religion; even on occasion, science. Without pandering to your presumed desire to identify with the hero of a story, they

> made you feel that what mattered to the writer had consequence for you, too (71).

These teachers sound like Schön's "reflective practitioners." In *Educating the Reflective Practitioner*, he describes the way engineering students should be taught to frame a problem in design:

> They can be encouraged to reflect ... on conflicting professional, organizational, and societal values at stake in framing a design problem. Here exposure to the humanities, in the form of examples drawn from literature and literary criticism or from history and philosophy, may be brought into fruitful conjunction with the task. (325)

Technology is mirrored by historical and literary reflections; history and literature are filled with our tools and technologies. In *Thinking Through Technology: The Path Between Engineering and Philosophy*, Carl Mitcham writes:

> An indicator of the great divide in the history of technology is the dominance of artistic design in the ancient world and engineering design in the modern. Before the development of modern mechanics and its calculus of forces, artisan and architect tended to focus on formal, not to say aesthetic, properties in their structures. With the development of mechanics attention shifts toward concern for material, energy, and spatial efficiencies in products and structures as well as in processes of fabrication and construction. (246)

An "Introduction to Personal Computing" class, whether one hour or one semester long, can include information on the history of technology and computing, as well as including images and stories that might provide the hook to engage some learners in the course material. The class might also (briefly) examine how they feel about using a computer and hear excerpts from literature dealing with transformational technological moments in history. Students in word processing, spreadsheet, and or database applications can learn that data entry and mechanical calculations have roots that span centuries. Similarly, an Introduction to the Internet class can learn about the history of mass communication, about the layering of traditional words for Internet use, or muse, with Studs Terkel: “the trouble with me and the Internet is that it’s about facts and figures and information … the human touch, that’s what’s missing.” The instructor can bring the human touch to technology education through delivering technical course content in a liberal arts context.

Examples of Integrated Learning

"*The world is a civilised one, its inhabitant is not: he does not see the civilisation of the world around him, but he uses it as if it were a natural force. The new man wants his motor-car, and enjoys it, but he believes that it is the spontaneous fruit of an Edenic tree. In the depths of his soul he is unaware of the artificial, almost incredible, character of civilisation, and does not extend his enthusiasm to the principles which make them possible*" (Ortega y Gasset, 1930).

We have inherited a tremendous history from technology. Eras can be described by their most important technological developments. The plow, the factory, and the computer are icons that define the agrarian age, the industrial age, and now, the information age. New technologies can make the difference between life and death. Military and political forces use technologies on battlefields and in intelligence operations. Research in medical technology is of great importance and the ethical, practical, and scientific issues that arise from new medical discoveries are immense. Ancient peoples called upon gods and goddesses for answers to the big and small questions in life. When science began to play a larger role in the lives of ordinary people, many began to look to the seemingly endless promises of new technology to answer their questions and assure their futures. Providing an historical perspective in technology education and training is important for not only for students to be able to make accurate ethical judgments and to learn from the mistakes of history, but also to give them a sense of the interconnectivity of the past and present. The following are some examples that could be used by a technology instructor to bring context to various technology-related learning situations.

The Loom and the Luddites

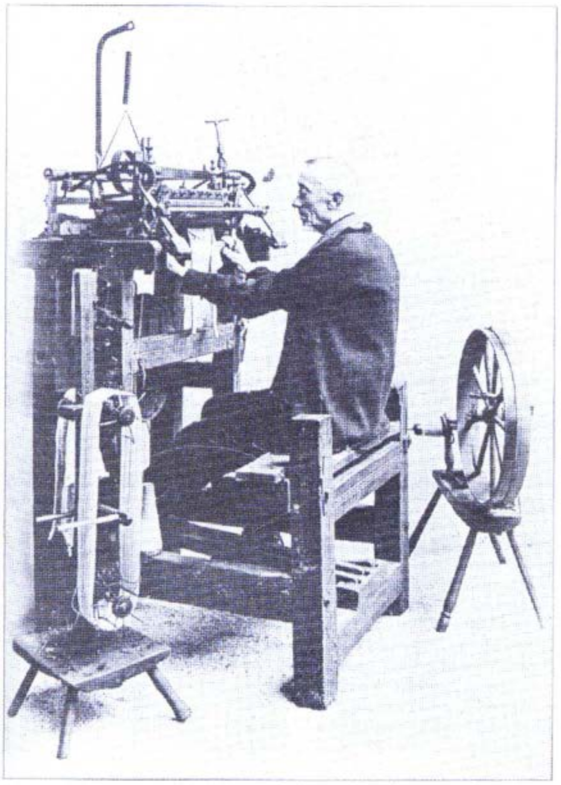
Some software packages can be used to store and rapidly retrieve information. While teaching data entry skills (e.g., spreadsheet and/or database applications) or an "Introduction to Personal Computing" skills to adults, it is possible to show how these applications evolved from one of the earliest arts, weaving.

In *Weaving: A Handbook of the Fiber Arts*, Shirley Held writes:

> Few other human endeavors enjoy such glamorous origins as the art of weaving. The history of the fiber arts features goddesses, spiders, dragon's blood, betrayals, spells, sleeping princesses, heroes, and long-lasting love. The vocabulary of weaving and spinning has interpenetrated our modern language: the thread of life, the fabric of society, a spinster aunt. While myth points to the significance of the fiber arts, we turn to anthropologists and archeologists for a systematic account of the probable evolution of the craft. Fiber structures predate recorded history, reaching far back into the Paleolithic period when tools beyond rocks and sticks did not exist. (3).

Weaving was a domestic art that took place in all parts of the world (Held, 1999, 4). The skill of weaving developed out of the necessity to turn raw materials into cloth for clothing and shelter. Weaving is the process of making cloth by crossing two sets of threads over and under each other. Held (1973) notes that early weaving was done with the fingers or through a combination of fingers and sticks (156) and "until medieval times families supplied all their textile needs from fabrics made in the home" (Held, 1999, 28). During the middle ages "the manufacturing of cloth gradually moved out of the home and into the workshop" (Held, 1999, 28). By this time, the use of a loom was common. A loom is mechanical device for holding the yarns in their proper positions while the weaver creates a pattern with the fibers. (Held, 1973, 90).

The weaving and spinning inventions developed during the 18th century marked the transition from the old era of domestic craftsmanship to the tremendous organized textile industry of today.



A framework-knitter at work. This old photograph shows one of the last survivors of the Midland cottage industry at work on a machine which had changed relatively little since the sixteenth century

Fig. 3: "Framework Knitter," Bailey, 131

The Jacquard loom was introduced in France in the early 1800s. This loom is of great importance in modern technology. Jacquard had perfected an attachment applicable to the power loom invented in the mid-1700s whereby any design might be woven on it, including highly complicated designs (Held, 1973, 99). The results made the mass production of intricate weavings available as shown in this example:

Fig. 4: "Jacquard woven portiere," *The Victorian Web*

Jacquard was "arrested on orders from Napoleon … and charged with, in effect, technological blasphemy, for having pretended 'to do that which God Almighty cannot do, tie a knot in a stretched string' " (Held, 1973, 99).

In 1806, the Jacquard loom was bought by the state of France and declared public property. The mechanized loom replaced countless workers and quickly spread to other industrializing nations (Held, 1973, 69). The relationship between technology and textiles is not surprising as producing clothing is essential in almost all societies, and provides ways for people to display their social position, wealth, health, and lifestyle.

Until the Industrial Revolution, spinning and weaving were time-consuming and essential household tasks. The Industrial Revolution began, in large part, as mechanization of the production of textiles. In 1811, enraged former textile workers broke into a newly established factory in Nottingham, England and smashed the mechanical looms that had displaced them in a futile effort to halt the Industrial Revolution (Held, 1973, 69). They were called Luddites, perhaps after Ned Ludd, an 18th century Leicestershire workman who reputedly initially destroyed mechanized stocking-making machinery (Bailey 40). These groups of early 19th century English workmen were destroying laborsaving machinery as a protest against technological change. “Seen at its simplest level, the movement was a prolonged outbreak of machine-breaking by desperate textile workers intent on self-preservation. Ever since, similar resistance, usually accompanied by a romantic nostalgia for a paradise lost, has met technological advances” (Bailey ix).

There is an interesting parallel between the Jacquard loom and early computation. “The Jacquard loom operated on the same principle as a player piano or a modern computer … a series of cards, one for each weft (the crosswise element) shot are punched with holes in a preordained pattern. The cards are then arranged in sequence and laced together to pass through the machine” (Held, 1973, 99).

Fig. 5. “Jacquard Punch Card Loom,” *The Victorian Web*

In 1949, Andrew Hamilton wrote in a *Popular Mechanics* article:

> Ever since Blaise Pascal, the French philosopher and mathematician, invented an ‘arithmetic machine’ in 1647, scientists have been trying to devise computers to save wear and tear on human brains. Adding machines and I.B.M punched-card machines are both fairly recent examples of this. But it was not until the late 1930s and World War II that the real, giant-size ‘mechanical brains’ and ‘electronic brains’ appeared. As in the early days of automobile industry, they assumed various shapes and were equipped with several types of motive power. (167)

This early "electronic brain" looks remarkably like a loom.

Fig. 6. "Mark II calculator 1945," Hamilton, 167

Punched cards were first utilized in modern computing "in 1895 when Herman Hollerith used his punched card system for cost accounting in the railroad industry. This happened in parallel to his work for the United States Census Bureau. In 1908, after approximately ten years of development and a major change in construction, the Hollerith punched card system was ready to be widely used in industry and trade" (Kistermann 223). Punched cards and tabulating machines were a step toward automated computation. Computer punch cards were dropped in a card reader. The cards moved between brass rods, and the card reader sensed the holes electronically. The numbers were entered in memory units and the machine then had the necessary data to solve a problem. Often the text was also printed at the top of the card, allowing humans to read the text as well. The cards could be produced by a card-punch machine (called a "key-punch"), which was like a large, very noisy, typewriter (Kistermann 223). Punched card systems became mostly obsolete by the early 1980s as disk and tape storage became cost effective. Interactive terminals also meant that users could edit their work with the computer directly rather than requiring the intermediate step of using punched cards.

When we are performing data processing today, we are carrying out a method of mechanized data entry that began over two centuries ago. The Luddites live on, however. According to Nicols Fox in her book *Against the Machine* (2002): “One-third of computer users admit to physically attacking a computer. More than 70 percent confess they swear at them. Frustration, anger, and exasperation - minus the swearing and the hitting – affect 67 percent” (ix). Today, Luddite is a term used to describe a “person who regards technology as causing more harm than good in society, and who behaves accordingly.” (*WhatIs*, “Luddite”). This behavior is not necessarily violent. Daphne Merkin, in an article about author and psychotherapist Adam Philips, theorizes that one reason why he refuses to communicate via electronic mail may be a “pragmatic decision not to squander hours at the beck and call of everyone with a keyboard and a screen name” (40). In another context, a well-meaning person who believes that members of society have a responsibility to look long and hard at new technologies before making them parts of our lives may be derogatorily referred to as a Luddite.

The Interstate Highway System and the Internet

Adults who are learning about the Internet/World Wide Web for the first time may consider it an overwhelming task. One way to bring context to the learning situation is for the instructor to make comparisons between the Internet and something very familiar. The Internet is often referred to as the Information Highway or Superhighway and the instructor can use that analogy in a variety of ways. If the instructor is teaching the e-mail component of the Internet this can be done at a very basic level: an analogy between email addresses and postal addresses. Individual postal addresses are composed of a name, a street address, a city and state, and a postal code/country. Think of this simply as name <at> address. This is the same information that is included in an email address: your name @ the address of your Internet service provider. A broader context can be presented using the analogy of the birth of the Interstate Highway System and the Internet/World Wide Web.

Following World War II, the post war economic boom and growth of disposable income in the United States increased the demand for mass production of the automobile (Jackson 232-33). The desire to travel easily became widespread and there was political and economic pressure to expand the national road network. In 1954, President Dwight Eisenhower appointed a committee to study the possibility of building a new national network of expressways and in 1956 Congress approved the Interstate Highway Act (Kunstler 106). "The chief political justification was that the new expressways would ease the evacuation of cities during a nuclear attack" (Kunstler 107). Widespread travel became feasible with the automobile, which provided mobility in combination with the Interstate Highway system, which provided roads to many places. James Kunstler writes: "The 1920s [economic] boom had cemented the idea in the American psyche that the best economy was an explosive technocentric economy" (96). After WWII, in the United States, the auto industry and the urban road network expanded.

After the successful orbit in 1957 of the Soviet satellite Sputnik, President Eisenhower indirectly created another network to secure the United States' presence in the "space race": ARPANET. ARPA (Advanced Research Projects Agency) and its computer network, ARPANET, was also formed so that "in case of war and the loss of any group of sites (of computers), remaining sites would still be able to communicate along alternate routes" (*WhatIs*, "ARPA"). Originally intended as a communications network for military command and control, by 1969 ARPANET had evolved into a system that would allow researchers across the country to share super-computers. On January 1, 1983 the 400 or so computers linked to ARPANET switched to a communications protocol called TCP/IP that allowed multiple networks to coexist and permitted applications like the World Wide Web to develop and thrive. (Internet Society 9) The Internet that we now know had been born.

Gradually, technology has become a vehicle for moving information and data as well as for moving people. Consider this 1996 statement by former U.S. Secretary of Transportation Rodney Slater given on the occasion of the 40th anniversary of the Interstate Highway System:

> The Interstate System is a tremendous engineering achievement, but it represents far more than concrete, asphalt and steel. The Interstate System changed the way we live and the way we work. It is an engine that fuels our economy, creates jobs and serves as a gateway to opportunity. It is truly the tie that binds, a system that connects all of us to this wonderful land, America the beautiful. (2)

And this portion of former Vice-President Al Gore's speech at the 1994 Information Superhighway Summit:

> Let me be clear. I challenge you, the people in this room, to connect all of our classrooms, all of our libraries, and all of our hospitals and clinics by the year 2000. We must do this to realize the full potential of information to educate, to save lives, provide access to health care and lower medical costs. Our nation can and must meet this challenge. The best way to do so is by working together.

The Internet is one more chapter in a long history of technological developments. Our computers now take us for journeys through virtual communities and home (pages) located on the Information Superhighway, the Internet.

Spam

Spam is unsolicited, usually commercial, e-mail messages sent to a large number of addresses via the Internet. From the sender's point-of-view, it is a form of bulk mail sent by companies that specialize in creating e-mail distribution lists (*WhatIs*, “Spam”). To the recipient, it usually seems like junk e-mail. In March 2003, The Washington Post reported: “roughly 40 percent of all e-mail traffic in the United States is spam, up from 8 percent in late 2001 and nearly doubling in the past six months” (Krim A01). Adults who are learning to use, or trying to become more proficient in the use of, electronic mail are probably going to encounter spam in their on-line mailboxes. They will need technical knowledge to decide about issues such as filtering their mail or how to effectively combat spamming. They may also benefit from approaching the annoyances that come with the plethora of spam through some historical background, along with a little humor. One approach an instructor can use is explaining what the relationship is between junk e-mail and the word spam.

“The story of Spam begins,” Carolyn Wyman writes, “with thousands of pounds of nearly worthless pork shoulder meat” that in 1937 the Hormel Food Company spiced and canned (1). The resulting product was called Spam. During World War II “canned pork luncheon meat was an early favorite of the armed forces central food purchasing office in Chicago because it was nutritious, filling, affordable, and shelf-stable” (Wyman 17) and Because it could be mass-produced, did not need refrigeration, and could be shipped in compact containers “Spam began its life as a cultural icon in the 1940s when it became one of the most widely used and widely ridiculed military foodstuffs of World War II” (Wyman v). “Between 1939 and 1942, its net sales doubled to almost $120 million. … In fact, before the war was over, the army alone had received 150 million pounds" (Wyman 16-17). Spam became a source of military jokes, cartoons, and complaints.

Fig. 7. "WWII Spam cartoon," *Wyman*, 19

A new generation became aware of Spam in 1970. A famous *Monty Python Flying Circus* comedy skit was about a restaurant with an all-Spam menu. Part of the Spam litany included a variation on: "Well, we have Spam, tomato & Spam, egg & Spam, Egg, bacon & Spam..." (*BBC*). Simultaneously, a couple in the cafe could not hold a conversation over the din of Vikings yelling and singing, "Spam, Spam, Spam, Spam (*BBC*)". Their practice of yelling the word "Spam" at various volumes and pitches was applied to unwanted e-mail. Wyman discusses how, to those in the computer world at this time, this was analogous to the problem of having an intelligent conversation on a newsgroup when there was a mass of unrelated unsolicited email to wade through (123). "That Monty Python skit, in turn, inspired the Internet term of spamming, which refers to the sending of unsolicited electronic messages" (Wyman v –vi). Today, when someone broadcasts unsolicited mass email or newsgroup postings to spread a message, it makes it difficult for recipients to find what they are looking for within their electronic mail boxes.

Fig. 8, *BBC,* "Monty Python SPAM Skit"

To an older generation, however, there may be a closer parallel between ubiquitous unwanted email and the boundless blitz of Spam during the World War II era. Spam/spam has touched three generations in unique ways. This makes it a prime candidate for reaching the interest of a wide variety of age groups in an Internet training session.

Coda

The University of Virginia's Center for Technology and Teacher Education web site contains a component that includes lesson plans for integrating technology into classrooms. These particular lesson plans prepare K-12 teachers to integrate technology effectively in the content areas of English, mathematics, science, and social studies. The English education section is "created with concern for the holistic impact of technology on learners and teachers, rather than simply focusing on training to acquire technical skills" (University of Virginia). The Center's science group has developed "compelling examples of technology-enhanced science lessons for science education methods courses" (University of Virginia). Within the social studies module, there is a lesson plan on "U.S. History in *The Great Gatsby*" (University of Virginia 1-2). Students are asked to complete a worksheet that requires them to search the Internet to find more information on historical events that occurred within the novel. This is one example of integrating technology (the Internet) within the classroom to enhance the subject area being taught (United States History). It also combines the use of literature (*The Great Gatsby*) to demonstrate the integration of history and literature to the student. The *Education World* web site includes a lesson plan called "Revisiting Walden Pond in 2003" (Modenbach) that offers many cross-discipline options in history, math, science, language arts. The module also provides a computer lab option. Hyperlinks to web source material on *Walden* related essays, old and new photographs, maps, and poetry are included for students to learn more about Thoreau and Walden Pond.

It is also possible to tweak this learning strategy for adult technology students. During a class/course on a technology-related skill, brief portions of literature can be included to take advantage of the students' existing knowledge. Doing this can illustrate the interaction between technology and society, show how works of literature reflect technology's influence on culture and identity, and point out the recurring theme of technology as a motif in literature.

Telling stories is a major method of transmitting information and sentiment via popular culture. Leo Marx pointed out in his insightful study *The Machine and the Garden* that many American literary works "have at their heart the unresolved conflict that results from the increasing domination of the physical world by the machine. Indeed it is difficult to think of a major American writer upon whom the image of the machine's sudden appearance in the landscape has not exercised its fascination" (16).

Adult learners have probably been exposed to some variety of literature, whether classic or contemporary. In Ellen Ullman's current best-seller *The Bug*, she reinvents the famous story of Dr. Frankenstein and his monster as an allegory for the birth of the computer, setting her story in the subculture of programming engineers in Silicon Valley in 1984. A review of Ullman's book captures the tone of the novel: "The machine sitting on your desk that you gaze into every day for hours at a stretch, the one that brings you e-mail, news, information, culture and a multiplicity of templates with which to organize the fruits of your mind's labor – Ellen Ullman wants you to know that it's a monster" (Anastas 6). Edward Tenner's book *Why Things Bite Back* contains a chapter titled "Ever Since Frankenstein," in which he describes literary takes on "industrial and postindustrial humanity's perennial nightmares … the machine that passes from stubbornness to rebellion" (3). Tenner uses Rod Serling and Stephen King as examples of two modern authors that have carried on the tradition of Mary Shelley's *Frankenstein* and the unintended consequences of technology. Readers of comic books may be familiar with the character Brainiac "a ruthless extraterrestrial villain - in reality an ingenious humanoid computer - created by the sinister computer tyrants of a far-distant planet- who has been an implacable foe of Superman since July, 1958" (*Superman Through* ....). These authors are reaffirming a literary motif of the computer/technology as an enemy that began many years ago.

Historically, the dramatic transition between the agrarian and industrial ages was the Industrial Revolution of the 18th century. This was a period of social and technological change in which manufacturing began to rely on steam power, fueled primarily by coal, rather than on water or wind. Shortly after the steam engine was developed, the steam locomotive and the first steam-powered ship were invented. These inventions, and the fact that machines were not taxed as much as people, caused large social upheavals. This is reflected, as Marx (3) notes, in many American literary works.

Adult learning is sometimes impeded by anxiety and tension (Kidd 99). Dwayne Harapnuik writes that helping adult learners overcome their fear of technology is one of the first steps in creating a successful learning environment. What are adult technology students afraid of? According to Harapnuik: "Fear of wrecking the computer; fear of breaking the system; fear of loosing their data and a whole host of related or even unrelated fears" (9). Those unrelated fears might also correspond to wariness towards change or to a lifetime of absorbing literature of all types in which the computer/technology is an adversary, rather than an ally. In *The Bug*, Ellen Ullman describes a fictional character's "deeply human response to this machine that presents itself as infallible: the quick, intimidated fear that whatever had gone wrong could only be the fault of the human being, whose nature it is to err" (69). By incorporating themes from various literary works into a technology-training class/course, an instructor can provide a diverting stimulus to the material at hand and also show students that maybe they are feeling the same way as many literary giants once did. Henry David Thoreau's novel, *Walden*, provides an excellent example of the man versus machine scenario in literature.

Walden

Men say they know many things;
But lo! they have taken wings -
The arts and sciences,
And a thousand appliances;
The wind that blows
Is all that anybody knows (33).

Walden (1854) was published as the Industrial Revolution began to have a dramatic effect on the United States. Some technological themes from Henry Thoreau's *Walden* that could be explored in an adult technology class/course are: technology creates more needs than it satisfies, it leads us to dependence on other people, and it requires a tightly ordered society so the technology can function. Thoreau does not feel hostility towards new inventions; they are, he says, "but improved means to an unimproved end" (188). Walden Pond is a bucolic paradise for Thoreau and the bordering village of Concord is its antithesis.

Leo Marx describes the machine - epitomized by the locomotive that cuts a sharp path through the landscape - as the metaphor for industrialization in America. With locomotives and steamships, goods could be transferred very quickly across a country or ocean. In a 1988 interview with Judith Lee, Marx wrote: "the general faith ... was that things were going to get better and better - not only materially but also morally, politically, and socially - and this predominant view assumed that advancing technology was a sufficient basis for that progress" (Lee, 35).

Thoreau's major technological opponent in *Walden* is the railroad and all that it represents. He writes:

> Such is the universal law, which no man can ever outwit, and with regard to the railroad even we may say it is as broad as it is long. To make a railroad

> round the world available to all mankind is equivalent to grading the whole surface of the planet. Men have an indistinct notion that if they keep up this activity of joint stocks and spades long enough all will at length ride somewhere, in next to no time, and for nothing; but though a crowd rushes to the depot, and the conductor shouts "All aboard!" when the smoke is blown away and the vapor condensed, it will be perceived that a few are riding, but the rest are run over, -- and it will be called, and will be, "A melancholy accident." No doubt they can ride at last who shall have earned their fare, that is, if they survive so long, but they will probably have lost their elasticity and desire to travel by that time. (189)

Those who are fortunate enough to ride on the railroad may not realize what others have sacrificed in order to make it all possible. Thoreau also states: "We do not ride on the railroad; it rides upon us" (223). Although we assume we are the ones in control of our lives, there are many other factors that influence how we live. One of these things is the technology that we use everyday.

Thoreau does not seem as anxious about new technology, as much as he believes it is foolish and that individuals' personal lives will somehow be diminished. He obviously was a bit wary of railroad trains. He also took issue with the telegraph; that it made communication almost instantaneous between Maine and Texas, though it didn't ensure that the people in Maine and Texas necessarily had anything to say to each other (188). Thoreau realized that an old way of life was passing. In his opinion new inventions, while more efficient, were not necessarily an improvement.

Walden is a literary parallel to Sir Isaac Newton's "third law of motion:" for every action there is an equal and opposite reaction. Technological progress comes at a cost. Edward Tenner writes:

> Technology tends to replace life-threatening problems with slower-acting and more persistent problems ...business is now conducted at a pace and with an accuracy that 19^{th} century scientists would not have dreamed of. On the other hand, the benefits of automated data and word processing have not quite been

> as expected. The revenge effects are physical: what had promised to make work painless unexpectedly attacks muscles, tendons, and vertebrae. The revenge is also financial: what had promised to make services more efficient has returned astonishingly low net benefits. These matters are of course linked; disability, health, comfort, and stress are reflected in financial statements, too (161).

The sub-title of Tenner's book is *Technology and the Revenge of Unintended Consequences*. While it is important to recognize and to take into account that there will always be small or large trade-offs with technological inventions, it is undeniable that it is not the technology itself that causes all the damage or that technology does not save lives. Frankenstein's monster was his master's creation. But that is another story.

Conclusion

The number of adults involved each year in technology training or education endeavors is steadily increasing (Hiemstra and Sisco, 3). Adult learners seek out new skills and education for a number of reasons. Some need professional training in the skills necessary to perform their jobs. Others need to evaluate the information they are finding on the Internet. Many want to be able to communicate with friends and family in another state or country. All have a need to learn that is grounded in their daily lives. Adult learning and achievement in technology education can be enhanced through the process of integrated learning, rather than through learning skills in isolation. An integrated learning program provides the opportunity for instructors to help their students make connections and form relationships across the boundaries of classroom, discipline, skill, and background. By providing technology education using informational contexts (histories, stories, explanations, backgrounds), adult learners can draw on both what they have learned in life and are learning in the classroom.

Gilbert Highet, in *The Art of Teaching* describes some of the personal qualities that tend to distinguish good instructors from poor ones. These include exceptionally wide and lively intellectual interests and a good sense of humor. Highet suggests that an effective instructor is one who is able to select and use a variety of strategies depending upon the situation. There is not one correct strategy. There are times when a particular element, model, or strategy will work well with a group of adults. For example, a strategy following a fairly strict sequence of events might be appropriate for a group of adults with lower literacy skills who need more structure and guidance initially. The key is for instructors to avoid relying upon one instructional strategy or approach at all times and be prepared to make adjustments as warranted. Kidd writes: "Everyone is in agreement that for a field of work that is relatively new, and where there are more unresolved problems than certainties, enthusiasm and a sense of humor are indispensable" (301).

According to Donald Schön in *The Reflective Practitioner*, doctors, architects, lawyers and engineers are all trained in schools that emphasize technique but neglect the key element of artistry that distinguishes the true professional. The same statement might also be applied to educators. To teach skills of improvisation and problem-framing, Schön feels our universities should borrow the methods used in art studios, dance conservatories, athletics coaching, craft apprenticeships and psychoanalytic training. In all these settings, a dialogue between student and coach in a low-risk atmosphere encourages creativity. Schön's theory of "knowing-in-action," or the assumption that "competent practitioners usually know more than they can say" (*Reflective* viii) can be given a good workout in the field of technology education.

Harry Overstreet writes: "The adult educator cannot simply be a person of good will and generous impulses – and large ignorance. He must know something well" (38). The educator must possess subject mastery, but should also be able to shift into the improvisations described by Schön in his description of jazz musicians in action (*Reflective* 55). The following is a "Searching the Web" lesson plan from the *AskEric* web site. It was designed for use in higher education, vocational education, and adult/continuing education. The goals of the course are to be completed in three 45-minute sessions. The goals are 1) to research and evaluate the accuracy, relevance, appropriateness, comprehensiveness, and bias of electronic information sources concerning real-world problems and 2) to explore what constitutes a reliable web page for research projects and papers. These are the objectives:

1. Students will be able to define World Wide Web terminology.
2. Students will apply evaluation criteria to specific web sites.
3. Students will conduct a search on the Web and develop a list of relevant and credible web resources on a given topic.
4. Students will explore various search techniques to find educational resources effectively.
5. Students will be able to explain the importance of authenticating online resources.
6. Students will recognize the signs of bias and omission in information and validate online information.
7. Students will be able to authenticate web sources based on site authorship or ownership, content, and currency.
8. Students will be able to describe the structure of uniform resource locators (URL's) and how URLs can be used to determine authorship and credibility.

The lesson plan includes vocabulary, activities, resources, references, and an assessment method. The instructor clearly must have an in-depth knowledge of the Internet to communicate the knowledge necessary for students to achieve all the objectives. The time frame involved is not extensive. What might be done to incorporate some of the instructional principles espoused by Kidd and Schön in this lesson plan?

The instructor could introduce some diversion and improvisation into the class by including some history of the Internet and its parallel with the Interstate Highway System across the 3 class segments. The vocabulary terms listed in the lesson plan are: HTTP, HTML, URL, Search Engine, AUP, and Netiquette. The word “spam” and its history could be included. If there is interest in more of this type of information, the instructor might ask, why, if the Internet is referred to as the Information SuperHighway, is browsing through web sites often called "surfing" the web? According Jean Armour Polly:

> Yes, NEXIS credits me with first published use. You have to remember that in 1991-92, the Internet was NOT as we know it today. It was MUCH harder to use, there were no indices as we have now, and you had to know a lot of arcane commands. It was an art, not a science. Today we navigate ships using GPS, in those days navigating the Net was more like ancient Polynesian wayfinding by memorized star pairs, reading patterns of phosphorescence in the waves, and knowing the habits of pelagic birds ... I wanted something that expressed the fun I had using the Internet, as well as hit on the skill, and yes, endurance necessary to use it well. I also needed something that would evoke a sense of randomness, chaos, and even danger. I wanted something fishy, net-like, nautical. (Polly, *Studio B Interview*)

An important catalyst for the creation of both the Internet and the Interstate Highway system was the Russian satellite, Sputnik. Some students might be intrigued to hear the original telemetry from Sputnik I as it passed overhead that can now be heard over the Internet at <http://www.hq.nasa.gov/office/pao/History/sputnik/index.html>

If the lesson plan has to do with entering data into a spreadsheet, portions of the "Loom and the Luddites" segment of this thesis could be used to give perspective to the history of data entry. The etymology of the word "spreadsheet" (Power) could be incorporated as a diversion into the field of accounting, as could the word "chad" (AboutUs) for the intertwining of the mechanized loom, punch cards, and the year 2000 Presidential election.

James Kidd, in his "Ten Commandments for Educators," wrote that there are certain ideals that all good instructors should profess, the last of which is: "Thou shalt remember the sacredness and dignity of thy calling and, at the same time, Thou shalt not take thyself too damned seriously" (306). Earlier in this thesis, the lack of sympathetic computer humor and the use of cartoons in the technology classroom have been discussed. This concept might be complemented through the use of music. The instructor could challenge the students in an "Introduction to Personal Computing" class to come up with brief lyrics for their PCs in the vein of "Little GTO," the 1964 hit by Ronny and the Daytonas, in which Ronny describes the GTO in loving technical detail: "Three deuces and a four speed, and a 389" or the Beach Boys' "409":"My four-speed, dual-quad, posi-traction 409!" (Leo's Lyrics). The instructor can also stimulate some thought and discussion by questioning how seriously we can take technological predictions that we hear today. Consider this quote by IBM executive Robert Lloyd, speaking in 1968 about the microprocessor, the heart of today's personal computers: "What the hell is it good for?" (Cerf 209) Or this expert prediction from 1949: "… computers in the future may have only 1000 vacuum tubes and perhaps weigh only 1 ½ tons" (Hamilton 258).

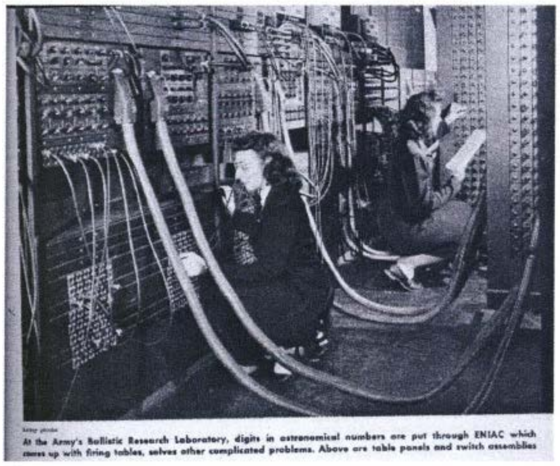


Fig. 9. "Researchers and ENIAC," *Hamilton* 163

Traditional bastions of science education are beginning to realize the benefits of broadening the outlooks of their students as well as some of their curriculum. In "Art is a

Necessity for Techies, Too" Ann Wilson Lloyd writes about an infusion of the visual arts at the Massachusetts Institute of Technology (M.I.T.). Jerome Friedman, the Nobel laureate and a M.I.T. physics professor, said:

> Visualization is so important in science and technology. Teaching about art challenges students creativity ... It forces them to look for unprescribed solutions and liberates their thinking. The changing paradigms of art history run parallel to scientific revolutions, whereby no model is sacred but must be continually tested in terms of new experiences (52).

Visual models are crucial to the understanding of many ideas in the physical and biological sciences. Dance is linked with kinesiology. Music and physics are interrelated; the physics of sound is the physics of music. This broadening of curriculum, instruction, and perspective should also apply to technology education.

By designing improvisations to challenge thinking and visualization, by being both reflective and reflexive, the technology educator can provide a human touch in a technology-related educational setting that will interest and motivate the learner through the use of innovative learning strategies.

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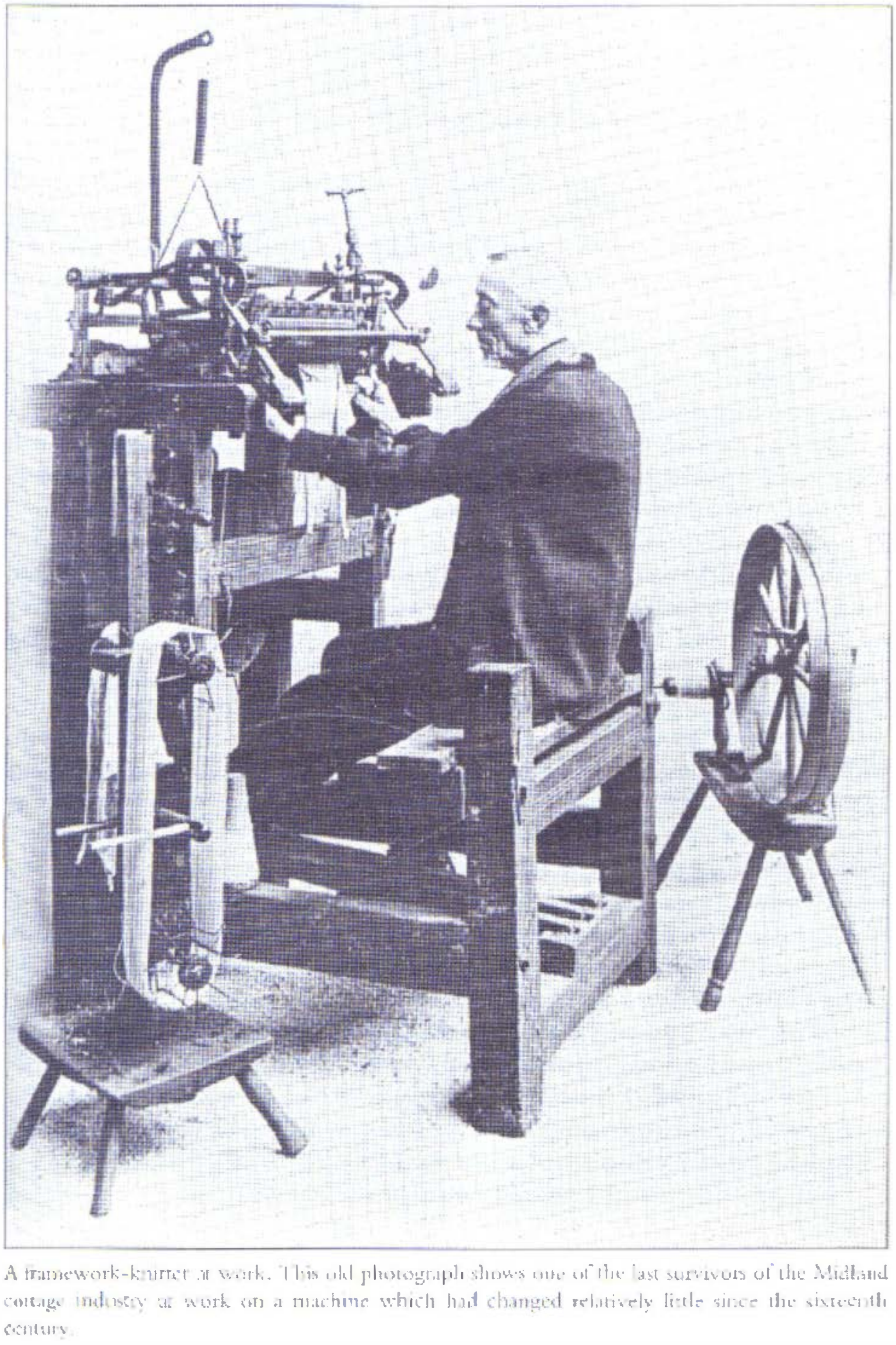
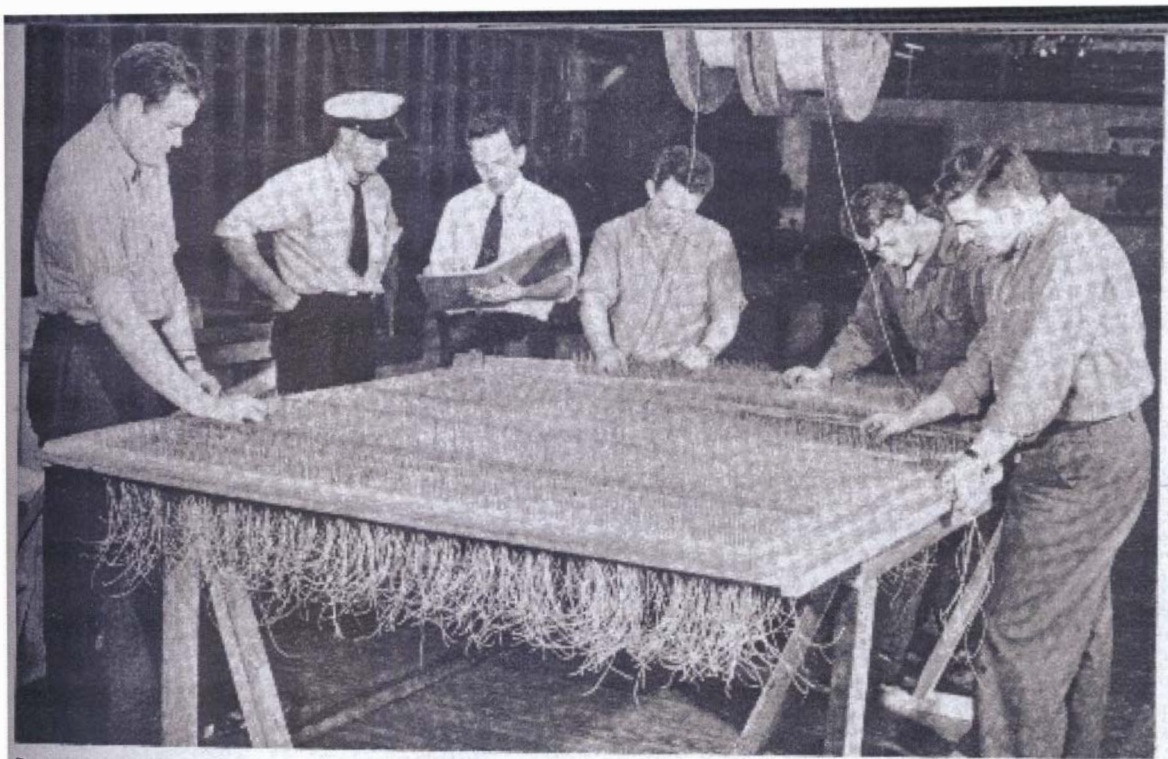


A framework-knitter at work. This old photograph shows one of the last survivors of the Midland cottage industry at work on a machine which had changed relatively little since the sixteenth century.

Appendix A

<u>The Luddite Rebellion (131)</u>

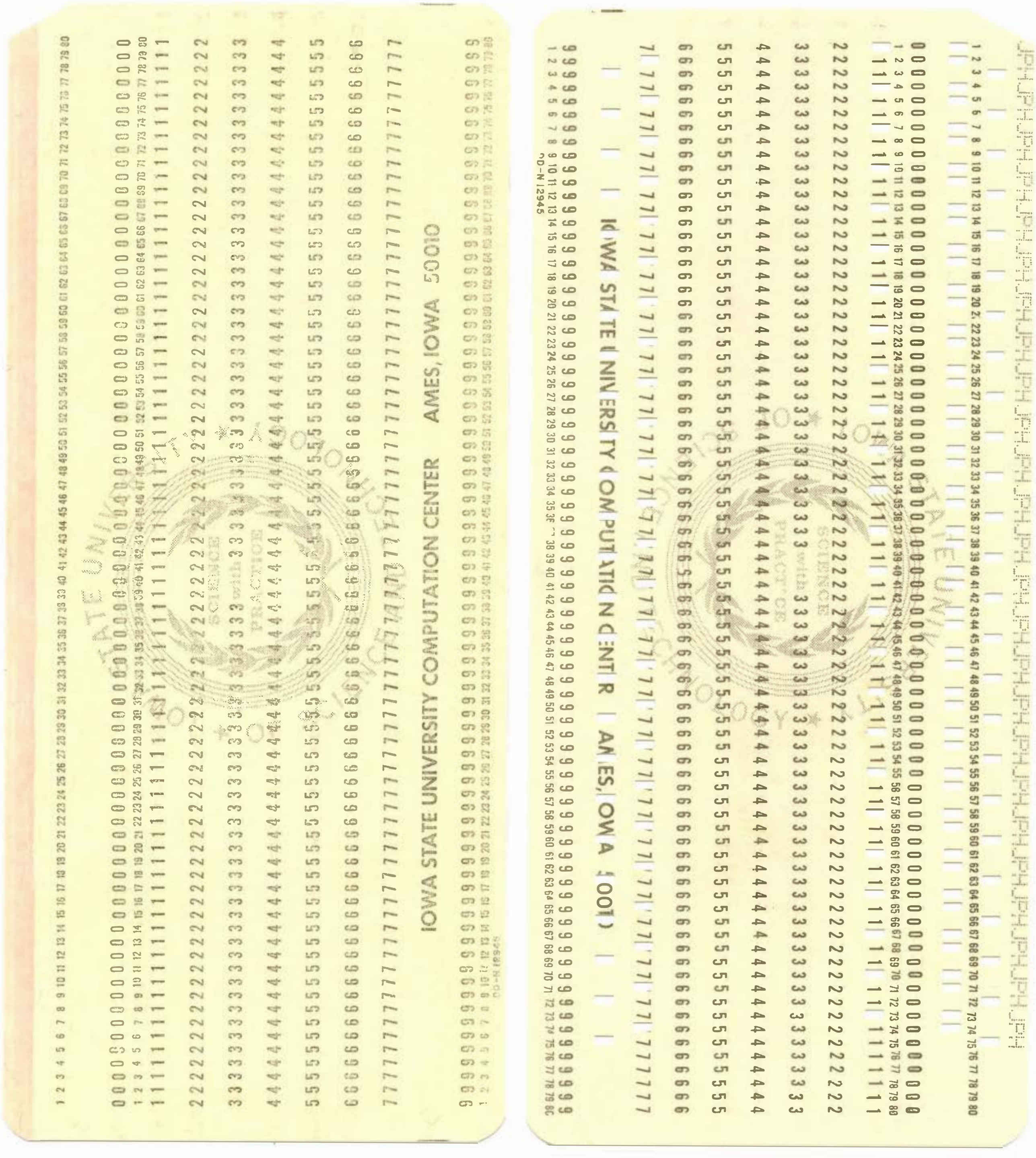


[illegible] University photo

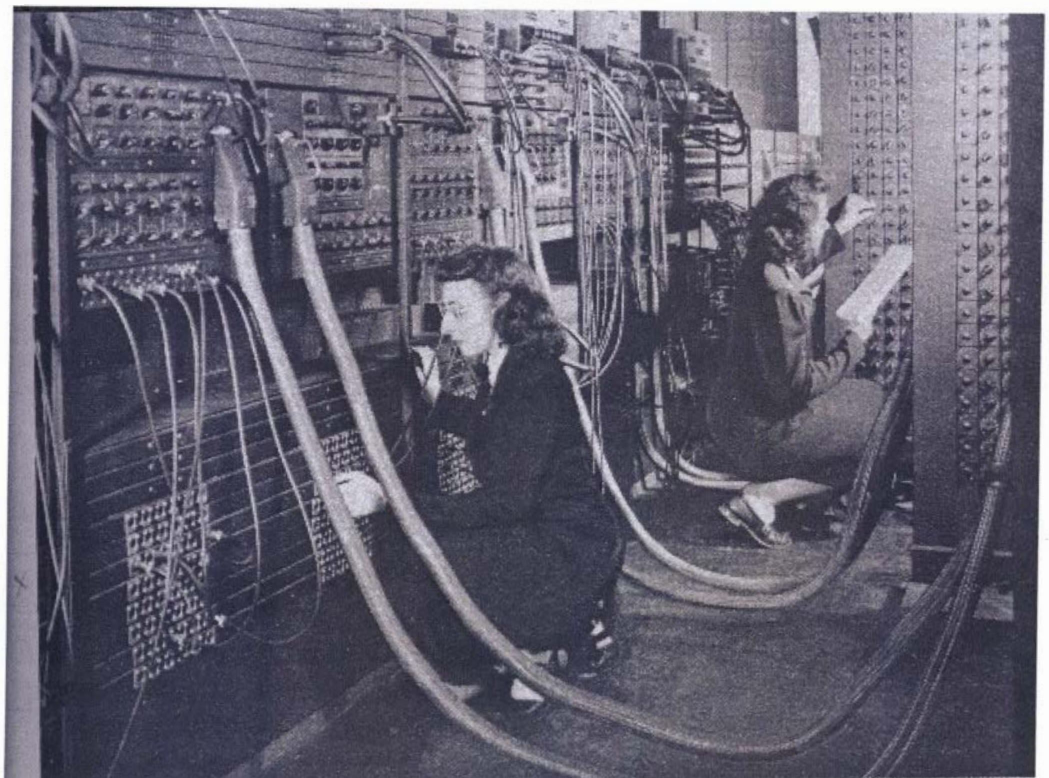
Where does the next wire go? Jig used on Aiken Mark II calculator shows complicated wiring in each panel

Appendix B

"Brains That Click" (167)



Appendix C
Punch cards (before and after)



Army photo

At the Army's Ballistic Research Laboratory, digits in astronomical numbers are put through ENIAC which comes up with firing tables, solves other complicated problems. Above are table panels and switch assemblies

Appendix D

"Brains That Click" (163)

Appendix E

"Superman's Girl Friend, Lois Lane"

Appendix E

"Superman's Girl Friend, Lois Lane"