

Willis, J. (2001). Foundational assumptions for information technology and teacher education. *Contemporary Issues in Technology and Teacher Education*, [Online serial], 1(3) 305-320.

Foundational Assumptions for Information Technology and Teacher Education

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In this paper I would like to propose a set of foundational assumptions about our field: information technology and teacher education (ITTE). This is an expansion of the 'Ames White Paper' (Thompson, Bull, & Willis, 1997), which is a statement of perspective on ITTE by the Coalition for Innovation in Teacher Education. It is available at this web address: <http://www.aace.org/site/SITEstatement.htm>. In this expansion I propose a set of assumptions or 'givens' that, I believe, are so well established in the scholarly and professional practice knowledge of the field that they can be used as starting points for both research and practice. I do not present these assumptions as Truths, however. They are certainly open to discussion and debate—and I invite you to do just that by responding to this article with an article of your own. In my own work I treat them as truths'guidelines that can be used until they are replaced by other lowercase truths that win the competition for people's minds and hearts in our profession.

ITTE involves three aspects: (a) the technology, (b) the application context, and (c) the process of change and diffusion. For convenience, I have organized the assumptions (givens) about ITTE around these three focal points. There is a significant body of scholarly and professional literature in all three aspects. For example, in the technology diffusion literature there are a number of models of change that can be applied to both higher education and K-12 education. They include the work of Agryis and Schon (1992), Fullan (1991, 1992, 2001), Hall and Hord (1987, 2000), Rogers (1995), Schon (1990), and Schein (1997). See also the double special issue of the *Journal of Information Technology for Teacher Education* (Volume 5, Issues 1 & 2, 1996). Based on a review of the relevant literature (Willis, Thompson, & Sadera, 1999; Willis & Mehlinger, 1996), as well as my own experience, I propose a set of assumptions for ITTE.

Technology Assumptions

Technology Changes Quickly

The pace of technological change has accelerated to the point that almost any personal technology currently being explored is likely to be not only commercially available within ten years but also available cheaply enough for mass publicly-funded use by students. The rule of thumb over the nineties that the power of a PC doubles every 18 months without any increase in

real cost (or the same power is available at half the cost) is starting to break down it is too conservative (Education 2020 Project, 2000).

New and experienced teachers will regularly come in contact with new technology they have no experience with. They will thus need to learn how to approach and master new technologies, as well as existing technologies already in the classroom. Teacher education programs should not simply prepare students to use the technology currently in schools, they should anticipate future developments and help students cultivate strategies for learning and using new technology as it becomes available.

There Are Unintended Consequence

Advances in technology, even those that appear to be highly desirable and beneficial, often have unintended negative consequences. Better sanitation, for example, virtually eliminated intestinal parasites such as worms as a health problem for 19th-century Britons. Some medical historians, however, argue that the job of the protein IgE was to fight these parasites. When the parasites disappeared as a health problem, another problem replaced them: hay fever. It is caused by the same protient, IgE, which has been freed from its original purpose by better sanitation.

Technology applications in schools also carry unintended as well as intended consequences (Apple, 1992; Link, 1997). In her discussion of the Internet, Kim Polese (as summarized by Jonathan Friendly, 2000) pointed to possible unintended consequences of the Internet by comparing it to some technological developments in the 14th century:

She cited as a parallel the 14th-century development of a foot-pedal that freed the hands of European weavers at their looms. That created a shortage of thread that was solved by the importation of the Chinese spinning wheel, which caused a shortage of wool, which led to the use of flax. That made it possible for people to wear linen, but old linen then turned out to be a cheaper material than pulp for paper, which made mass-marketing of books possible. And along the way gave rise to riots by weavers who feared the loss of their jobs and protests from the cloisters where manuscripts were no longer unique property.

The personal computer is the loom, she said, and the Web browser is the wheel and between them they have wrought a 'tectonic shift in commerce and communication.'

Teachers should learn about possible negative side effects as well as potential benefits. They should develop skills in analyzing classroom uses of technology with an eye toward both negative and positive outcomes. For example, some software used in schools is gender-biased (for more information see the web site at <http://www.enc.org/focus/equity/documents/0,1948,FOC-001782-index,00.shtm> and at <http://www2.thomas.edu/students/d/dolloffk/genissues.htm>). Teachers should be sensitized to that possibility, and other types of biases, and be able to make thoughtful decisions about what software to use and what not to use. Since different groups see various forms of technology use in different ways, this involves helping preservice teachers see technology in schools from multiple perspectives.

Professional Literacy is Required

General computer literacy (operating systems, word processing, spreadsheet, database, and telecommunications) is not sufficient to prepare preservice teachers to use technology in their classrooms (for more information see the Milken Family Foundation web site at: http://www.mff.org/edtech/article.taf?_function=detail&Content_uid1=116). What is needed is *professional literacy*'a basic understanding of how computers and related technology can be used in education, as well as *specific novice skills* for integrating technology into the curriculum at the grade level and in the subject(s) the preservice teacher plans to teach. Professional literacy is not, however, simply learning recipes for certain types of technology use. Successful introduction of technology into a classroom, whether in higher education or K-12, is a complex process that calls for far more than the technically correct implementation of a plan developed by someone else. It calls for problem framing, on-the-fly problem solving, and many other higher level skills.

Education/Teacher Education Assumptions

Teaching and Learning Strategies Are In the Foreground

Papert (1995) used a parable to illustrate the point that it is not enough to add technology to existing practices; we must use technology to reform practice: "Physicians of a bygone era greet new medical technologies such as anesthesia and asepsis as providing an opportunity to improve their procedures...for example they see ways to achieve wonderful improvement in the use of leeches for blood-letting."

And, to drive his point home, he told another parable:

Nineteenth century researchers seeking to improve transportation stumble on the idea of a jet engine and propose to use it to augment the power of horses pulling stage coaches. Researchers of a rival school ridicule the idea of using technology to solve the problem and suggest that the better way is to train the coachmen. They cite careful experiments to show that stage coaches are slowed down by friction in the axle bearings. They demonstrate that a statistically significant improvement in speed can be obtained simply by training the drivers to use more and better grease.

Of course the anti-technologists were probably right in the short term. But the revolution in transportation was not going to come from studying axles and grease or by training coachmen in better skills. It would come through the invention of the airplane.

Technology should be in the background; it can never be *The Focus*. In the foreground should be innovative teaching and learning strategies. Technology cannot be inserted into education in the abstract. The way it is used supports a particular approach to teaching and learning. In numerous ways, the approach it supports is more important than the technology. A computer in the back of

a classroom could, for example, deliver drills to students on basic sentence punctuation, or it could support a group project such as a class newsletter. Preservice teachers should be aware of numerous forms of teaching and learning including 'teacher-centered' or direct instruction, as well as the many forms of student-centered instruction. And they should understand how technology can support these forms of instruction. Improving education depends, not on teaching teachers to apply better axle grease more often, but on transforming teaching and learning into something quite different than it is today.

Technology Integration Across the Curriculum Is Critical

Most teacher education programs have operated as loose collections of program elements: foundations, methods, student teaching, liberal arts core, and content area courses. In this process, technology has often been treated as a separate element, often represented in a single course taught by the 'technology' faculty. That will not work but it is a commonplace approach to technology in teacher education. The Office of Technology Assessment (OTA, 1995) report, *Teachers & Technology: Making the Connection*, concluded that "technology is not central to the teacher preparation experience" (p. 165) and that teacher education programs tend to treat technology as an add-on to the curriculum that is not integrated across the entire teacher education curriculum.

Technology should be integrated across the entire curriculum, and participants in all areas of teacher education should help to develop and implement an integrated plan that provides students with the models, mentors, content, practice, and experiences needed. If teacher education students are to graduate with strong skills, positive attitudes, including the idea of lifelong learning, and a thoughtful approach to using technology in their classrooms, it will be necessary for them to experience technology at all levels of their preparation. Teaching preservice students basic computer literacy—the traditional topics of operating system, word processor, spreadsheet, database, and telecommunications topics—is not enough. When the National Council for Accreditation of Teacher Education (NCATE) Task Force on Technology and Teacher Education (1997) published their report, *Technology and the New Professional Teacher: Preparing for the 21st Century Classroom*, it unambiguously made this point:

To what degree are higher education institutions meeting their responsibility for preparing tomorrow's classroom teachers? Bluntly, a majority of teacher preparation programs are falling far short of what needs to be done. Not using technology much in their own research and teaching, teacher education faculty have insufficient understanding of the demands on classroom teachers to incorporate technology into their teaching. Many do not fully appreciate the impact technology is having on the way work is accomplished. They undervalue the significance of technology and treat it as merely another topic about which teachers should be informed. As a result, colleges and universities are making the same mistake that was made by K-12 schools; they treat "technology" as a special addition to the teacher education curriculum requiring specially prepared faculty and specially equipped classrooms but not a topic that needs to be incorporated across the entire teacher education program. Consequently, teachers-in-training are provided instruction in "computer literacy" and are shown examples of computer software, but they rarely are required to apply technology in their courses and are denied role models of faculty employing technology in their own

work.

As with any profession, there is a level of literacy beyond general computer literacy. In education this more specific or professional literacy involves learning to use technology to foster the educational growth of students. To develop that professional expertise students will have to see instructors model appropriate uses; have opportunities to learn how to use technology to support learning; see technology used appropriately in schools; and have many opportunities to develop and teach technology-supported lessons themselves under circumstances that support professional growth.

Learning Is Contextual

The dominant framework for teacher education today is constructivism, and one of the core concerns of constructivism applied to education is context. Constructivism, and related theories of learning and meaning making, argue forcefully that isolated learning, learning out of context, is generally not as useful or as valuable as learning in context (National Conference on Teacher Quality, 1998). If we accept that assumption, then technology should be introduced and explored in context.

Professional literacy is best learned in context. That is, preservice students should learn many uses of technology because they are integrated into their course work and field experiences. They are 'authentic' experiences instead of laboratory exercises. They should see their professors and mentor teachers modeling innovative uses of technology; they should be expected to use it in their own learning, and they should have ample opportunities to explore creative uses of technology in their own teaching. Preservice teachers should be exposed to regular and pervasive modeling of technology by preservice teacher educators, content specialists, and mentor teachers. In addition, opportunities for preservice students to teach with technology in K-12 should be ubiquitous.

Learning is Facilitated by Cohort Groups

'Cohort groups of preservice teachers who have an opportunity to bond both within the group and with their K-12 mentors and university professors, will experience a richer and more powerful preparation program than students who complete the program as isolated individuals' (Anonymous, 1993). One principal, commenting on preservice teachers who had completed a program that emphasized learning in context and cohort groups, had this to say:

There's absolutely no comparison between these graduates and previous candidates. After several years of this program, we now have at least four or five new teachers who have hit the ground running—prepared for real classroom experiences at rigorous levels and trained to put a rational, systematic emphasis on the way kids learn. From day one they have had practice in working with diverse student populations in student-centered classrooms. Frankly, they can do things that are unheard of even for many experienced professional teachers. (Hoffman, 1993)

Cohort learning is one of many terms now in use to emphasize that students should learn in groups rather than individually. Learning communities are another expression of this idea. Regardless of the term used, however, the idea is that learning is a social activity and that cohort

groups is one way to do that in teacher education. Today an increasing number of teacher education programs are incorporating the idea of cohort groups or learning communities into their program philosophy.

Tacit Knowledge Is Required and Not Easily Taught in College Classrooms

The idea of tacit knowledge has its roots in the reaction against externalization and decontextualization of knowledge. Hannele Koivunen (1997), a cultural affairs officer in the Finnish Ministry of Education, has succinctly explained the origins:

During the Enlightenment, the concept of information emphasised that knowledge is external to the human being. In the information society, knowledge has been defined in the vein of the scientific-technological tradition as external data, facts or information which flow like natural gas in a pipeline. The flow of knowledge is a torrent of signs and requires an ability to identify and analyse these signs. If the information society were to be defined on the basis of internal knowledge, it would highlight the human being's own orientation and signification, own compass and own choices.

Physicist and chemist Michael Polanyi created the concept 'tacit knowledge' in the 1950s. Tacit knowledge is difficult to define, but according to one definition it includes all the genetic, bodily, intuitive, mythical, archetypical and experiential knowledge the human being has, *even though it cannot be expressed by means of verbal concepts*. [emphasis added] Tacit knowledge is present in the human being as a whole: it includes manual skills, knowledge of the skin and of thoughts. Tacit knowledge present in the individual guides his or her choices in the information flow. Based on this tacit knowledge the human being can pass by enormous amounts of useless information without ever having to react to it. Tacit knowledge is emerging as an increasingly important element in the definition of the contemporary information society. (Koivunen, 1997)

Polanyi, as well as the Austrian philosopher Ludwig Wittgenstein, emphasized that not all knowledge can be converted to words and communicated to others through language. As Wittgenstein (1988) put it in the preface to his first major book, "Was sich überhaupt sagen lässt, lässt sich klar sagen; und wovon man nicht reden kann, darüber muss man schweigen" (*What it possible to say at all, it is possible to say clearly, and if you cannot speak about something, you should be silent*. Translation by Nina Semko). Wittgenstein later expanded his ideas about knowing. Yes, anything that can be said should be said clearly, but there are also some things that can be known but not said. This tacit knowledge is embedded in the context of experience and it is difficult, if not impossible, to extract.

How could human behavior be described? Surely only by sketching the actions of a variety of humans, as they are all mixed up together. What determines our judgment, our concepts and reactions, is not what one man is doing now, an individual action, but the whole hurly-burly of human actions, the background against which we see any action (Wittgenstein, 1981, no.567)

The term, tacit knowledge, is one of many terms used to discuss the type of knowledge that is best acquired in context and through learning experiences such as apprenticeships, cases,

mentoring, anchored instruction, and other forms of 'authentic' learning. It is involved in Sternberg's distinction between *practical intelligence* (which emphasizes tacit knowledge) and *academic intelligence*. Sternberg's (1985, 1988) *triarchic theory of intelligence* has three basic components: conceptual, creative, and contextual. Contextual aspects of intelligences can be thought of as practical intelligence or common sense. Practical intelligence is based on tacit knowledge, 'the informal knowledge one needs to get ahead in specific situations but that rarely is taught explicitly' (Good & Brophy, 1995, p. 526). Tacit knowledge is also part of Howard Gardner's (1993, 1999, 2000) concept of multiple intelligences.

The concept of tacit knowledge (or practical intelligence, or common sense, or folk psychology, or craft knowledge) has had a significant impact on our idea of what constitutes appropriate preparation for professional practice (Sternberg & Horvath, 1998). It is a foundation for Donald Schon's (1990, 1994) reflective practice model of professional development and a critical piece of many other current frameworks and theories of teacher education and teacher professional development (e.g., *communities of practice*).

Successful technology-using teachers have developed a considerable store of tacit knowledge, or craft knowledge, that is difficult to transmit to a new generation of educators through reading texts and listening to lectures. If students are to benefit from the expertise of master technology-using teachers, they need other avenues than articles from the scholarly literature. Fortunately, the information technologies we want teachers to understand and use are also technologies that can support and enhance tacit knowledge instruction. For example, the use of multimedia video cases is a promising strategy. Of course, observation in the classroom, opportunities to ask questions and discuss the *whys* and *whats* of integration with a successful teacher, and the chance to teach under the thoughtful and analytic eye of experienced mentors are also critical.

Technology Diffusion/Organizational Change Assumptions

Use a Participatory Change and Reform Process

Involving end users and stakeholders in organizational change efforts, as well as research and decision making, is a logical extension of the basic idea of democracy. A core concept in everything from collaborative learning to site-based decision-making is *participation*. In educational research there is a growing emphasis on involving people who once would have been simply the objects of study in every aspect of a research study or effort to improve practice. This approach, called Participatory Action Research or PAR (Seymour-Rolls & Hughes, 1995), has emerged as a powerful method of improving practice. It is

...a participatory, democratic process concerned with developing practical knowing in the pursuit of worthwhile human purposes, grounded in a participatory worldview which we believe is emerging at this historical moment. It seeks to bring together action and reflection, theory and practice, in participation with others, in the pursuit of practical solutions to issues of pressing concern to people, and more generally the flourishing of individual persons and their communities (Reason & Bradbury, 2001, p. 6).

PAR and related approaches are increasingly used as a way of solving real problems in the professions. A number of recent books offer detailed suggestions about how to do this type of research/reform work (Arhar, Holly, & Kasten, 2000; Berg, 2000; Cherry, 1999; Cousins and Earl, 1995; Dick & Dalmau, 1999; Kemmis & McTaggart, 1988; McTaggart, 1997; Smith, Willms, & Johnson, 1997) as well as a number of web sites:

(<http://www.open.k12.or.us/arowhelp/webbased.html>;<http://parnet.org>;
<http://www.bath.ac.uk/management/carpp/>;
http://modules.royalroads.ca/r ru_handbook/action.htm;
<http://www3.extension.umn.edu/people/fhoefer/educdsgn/actresrc.htm>;
<http://www.scu.edu.au/schools/gcm/ar/arhome.html>; <http://www.uea.ac.uk/care/carn/>;

and journals such as:

Educational Action Research (<http://www.triangle.co.uk/ear/index.htm>),

Networks (<http://www.oise.utoronto.ca/~ctd/networks/>), and

Action Research International
(<http://www.scu.edu.au/schools/gcm/ar/ari/arihomet.html>),

Participatory involvement is also a critical component of many successful education reform efforts based on frameworks other than PAR. In her dissertation at the University of Helsinki, Merja Kärkkäinen (1999) reported that:

Educational reform networks are becoming increasingly important as alternative methods by which teacher and school can institute reform. In their study, Lieberman and Grolnick (1996) found that regardless of differences in the reform networks, the sixteen they studied appear to have had formats more collaborative than individualistic; leadership more facilitative than directive; thinking that encouraged more diverse perspectives; values that were both context-specific and generalized; and structures that were more movement-like than organization-like.

Studies of universities that had outstanding ITTE programs also reported that participatory approaches were commonplace (Mergendoller, Rockman, Willis, & Johnson, 1994a, b; Strudler & Wetzel, 1999).

Participation is also an important component of several models of design (Schuler & Namoika, 1993), including instructional design models (Cennamo, Abell, & Chung, 1996; Willis, 1995, 2000), and it is a critical component of site-based decision making (SEDL, 1991), and Senge's (1994) concept of a *learning organizations*. For ITTE the concept of participation suggests that any effort to reform or revise teacher education to meaningfully include technology should involve all the stakeholders in the process. Successful change is neither a top down nor a bottom up process. Fullan (1991, 1992, 2001) has repeatedly made the point that successful change efforts involve administrators and leaders (top) and teachers as well as students (bottom) in planning, decision-making, and implementation.

'Solutions' are Local, not Universal

What works in one setting may not work in another setting. This assumption has two major implications. First, you cannot create self-contained solutions and export them intact to other settings without increasing the risk of failure. What is needed are 'generic technologies,' to use Richard Clark's term, that have built-in adaptability. Many profitable companies today specialize in 'localization—adapting products, software, and procedures to different countries, cultures, and industries (a search for the term 'localization' using the Google.com search engine produced 453,000 hits in 2001!). Education, on the other hand, has often taken the opposite approach. Throughout much of the 1960s and 70s reformers tried to produce 'teacher proof' educational materials that were designed in such a way as to prevent teachers from using them 'incorrectly' (e.g, localizing them). According to Cooley and Johnson (2000), this was also a problem with much of the early educational software:

Early forms of educational technology pre-dating the Internet (e.g. instructional film, radio, and television) were often rejected by teachers because they were incompatible with their philosophy of teaching and the daily realities of the classroom. Those early educational technologies required teachers to give up control of the content and presentation while the technology was running. Teachers needed to stop teaching, and students were generally unable to ask questions or have information repeated during the instructional delivery. Because the materials were designed to be teacher-proof, teachers typically received no training or inappropriate training focused only on the technical aspects of using the technology. The futurists were typically non-teachers, largely unaware of factors that would limit the technologies' successful integration into the curriculum.

Much of the education reform effort today is still tied to the idea of teacher proofing, which has at its base a belief that teachers are not competent professionals and that experts of one sort or another are better candidates to make decisions about *what* should be taught and *how* it should be taught. The national standards movement, state and national curricula, performance based teacher pay, and national testing are all current expressions of this. An alternative is to assume that there are no universal solutions'no national standards that can be meaningfully adopted for all children in all schools, no national tests that can measure all the important goals of schooling, and no objective, standardized way of comparing teachers as if they were sides of meat in a packing plant. The best can be labeled *USDA Prime*, while others are only Choice, Select, Standard, or even a lower quality such as Commercial, Utility, Cutter, or Canner. In ITTE an alternative to this approach is to promote national and international discussions of everything from what students can experience in their teacher education program to the technology integration methods they can practice. Sharing ideas and experiences does not, necessarily have to lead to rigid standards or requirements that are so inflexible they cannot be adapted to local needs and conditions.

A second implication of the need for localization relates to how curricula and resources are developed. If the local context is critical, local participants should be involved in the planning and implementation in ways that give them considerable decision-making power over what they do and how they do it. Nationally available materials like textbooks and other resources should be open and flexible so that teacher educators can revise and adapt them to their context. They should be 'teacher enabling' instead of 'teacher proofed.' Even material created for local use should allow for differences from group to group and year to year.

End With a Vision'Don't Start With One

Although a number of change theorists insist that reform efforts start the process with a clear, specific vision of what they want to accomplish, approaches based on postmodern epistemologies as well as chaos theory suggest that the reverse is preferable. Michael Fullan's (1991, 1992, 2001) theories of educational change have emphasized this point over and over. Bringing ready-made, fully formed visions to an organization is fraught with problems. The vision may not fit the local context, and those who must implement the vision may feel little, if any, ownership. Visions should emerge across a change and renewal effort, and they should come from participants at all levels.

Emergent vision approaches to change and reform go against a more traditional approach, based on the work of Herbert Simon and Allen Newell (Newell, 1990; Newell & Simon, 1972) on problem solving. Their General Problem Solver (GPS) model assumes that we should begin with a precise definition of the end goal, which is then broken down into subgoals. Solutions are then developed for the subgoals and the overall goal. Many of the linear instructional design models (e.g., Dick & Carey, 2000) use the same approach'start work by precisely defining the goals and objectives. Much of traditional organizational change theory is also based on the GPS model of Simon and Newell.

GPS makes the most sense when you accept Newtonian physics and assume a deterministic, linear model of the world. GPS, and professional practices such as linear instructional design models, make less sense if you reject Newtonian physics and adopt a perspective more in tune with Heisenberg's law of indeterminacy and Einstein's theory of relativity. Such an approach embraces *indeterminacy* (Greenleaf, 1994; McDiarmid, 1999; Shotter, 1993) and a nonlinear or chaotic view of the world. Nonlinear systems theory (Kapitaniak, 1996), also known as chaos theory (Gleick, 1988; Williams, 1997) does just that. And it introduces concepts such as strange attractors and initial setting conditions that help us think in nonlinear ways.

This approach has begun to have an impact throughout society:

In modern society the relative importance of stabilised, formal knowledge'on which institutionalised education is based'is decreasing. The decline of hard and fast values, the rise of such scientific paradigms as indeterminacy, relativity, fuzziness and chaos theory and last but not least the impact of extensive distributed multimedia networking are indicative of and contribute to such a shift. What's more, in the field of professional know-how, the need to constantly change and adapt in a cut-throat competitive world puts a premium on other types of knowledge than those that take years to materialise. (Anonymous, 1996)

Nonlinear systems theory, or chaos theory, is one of the foundations for new approaches to artificial intelligence (e.g., fuzzy logic), and for approaches to instructional design and organizational change that reject the idea that you begin with well-formed visions, goals, and objectives. The beginning is not the place for that to happen. Instead, they should emerge, evolve, and change over the life of a project or program.

In ITTE this model suggests that we should approach efforts to reform and revitalize teacher education in a flexible and open manner. We should not begin the process with a precise goal (e.g., to add a computer literacy class to the curriculum). It is quite likely, in fact, that a nonlinear

approach to organizational change may take us to places none of the participants anticipated when we began the journey.

Change Is a Developmental Process

Several theories of change include the idea that the process, for individuals and organizations, is ongoing and developmental (Hall & Hord, 1987). Another recent expression of this idea is Senge's (1994) concept of *learning organizations*. If we view change and reform as an ongoing and developmental process, then ITTE will always be in flux. We will not arrive at The Answer and then settle comfortably into a routine that involves applying that Answer to each generation of teacher education students. Nontechnology using teacher educators often comment that if advocates of technology integration were ever successful they would be out of a job. That assumes the goal of technology integration is a fixed and well-defined target. In fact, it is not. It is a moving and ill-defined target. In each of the past three decades technology integration in education, and in teacher education, has meant something different. I have no doubt that the meaning will change over this first decade of the 21st century. For the foreseeable future, there will be a cutting edge (which some refer to as the bleeding edge) where ITTE specialists will work, and they will mentor and collaborate with teacher educators in other areas to develop new applications, new theories, and new pedagogies that take advantage of advanced information technologies.

In Summary

To summarize, I have outlined 12 basic assumptions about ITTE which are organized into three groups:

Technology

- Technology changes quickly.
- There are unintended consequences.
- Professional literacy is required.

Education/Teacher Education Assumptions

- Teaching and learning strategies are in the foreground.
- Technology integration across the curriculum is critical.
- Learning is contextual.
- Learning is facilitated by cohort groups.
- Tacit knowledge is required and not easily taught in college classrooms.

Technology Diffusion/Organizational Change Assumptions

- Use a participatory change and reform process.
- 'Solutions' are local, not universal.
- End with a vision; don't start with one.
- Change is a developmental process.

These three sets of assumptions can guide and direct our work in ITTE. They are general principles or guidelines that are subject to interpretation, even contradiction, but I believe our current level of knowledge supports each of them. If they are considered as we think about the many and varied issues associated with ITTE today, I believe they can provide a lively locus of discussion. I welcome your comments, criticisms, and revisions.

Note: I would like to express my appreciation to Betul Ozkan, a Ph.D. student at Hacettepe University in Ankara, Turkey and Visiting Scholar at the Center for Technology in Learning and Teaching at Iowa State University, for her thoughtful review of this paper. The same expression of thanks also goes to Nina Semko, a Ph.D. student at Iowa State University and a collaborator on several teacher education reform projects in Eastern Europe.

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Using information technology in education has basically made it possible for students from all over the world to come together and share experiences, the geographical distances notwithstanding. Information technology in education has also made students develop an appreciation for cultural diversity and in turn, create a more tolerant and unified world. 4. Using audio and visual material as learning aids. The use of information technology in education has made it possible for tutors to teach students much more easily. By using audio and visual materials, students can develop a better understand The use of information and communication technologies (ICT) opens up new opportunities in the teaching of its subject, allows increasing the effectiveness of training, the intellectual level of trainees, instilling the skills of self-education, self-organization, and facilitating the solution of practical problems.Â The modern teacher deals with various kinds of professional activity: teaching, educational, scientific, methodical, managerial. He has different opportunities to use computer or information technologies to receive, transfer, organize, process information, and also to communicate between colleagues, students, their parents, etc. Informatization of education puts forward the requirements of the correspondence of the professional training of teachers. Educators, policymakers, administrators, and teacher preparation and professional development programs now should embed these tools and resources into their practices.Â Education stakeholders should develop a born accessible standard of learning resource design to help educators select and evaluate learning resources for accessibility and equity of learning experience. Born accessible is a play on the term born digital and is used to convey the idea that materials that are born digital also can and should be born accessible.Â Revise practices, policies, and regulations to ensure privacy and information protection while enabling a model of assessment that includes ongoing gathering and sharing of data for continuous improvement of learning and teaching. Teacher education TE (TE) or teacher training refers to the policies, procedures, and provision designed to equip (prospective) teachers with the knowledge, attitudes, behaviors, and skills they require to perform their tasks effectively in the classroom, school, and wider community. The professionals who engage in training the prospective teachers are called teacher educators (or, in some contexts, teacher trainers). The main educational value of information technology in that they allow you to create infinitely more vivid multisensory interactive learning environment with an almost unlimited potential opportunities, and is at the disposal of the teacher and the student. In contrast to conventional means of training information technology can not only satiate a lot of student knowledge and develop intellectual, creative abilities of students, and their ability to independently acquire new knowledge, to work with different sources of information. Â« In the 21st century, digital media are the natural envir