



Developing Technology Competencies in a College of Education

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Colleges of education across the country are implementing initiatives to promote new and more effective teaching methods grounded in information technology and the improvement of teaching skills of graduate and undergraduate students in professional education programs. The goals for participating faculty members are to integrate information technology competencies into not only the content of the courses that they teach, but also into their instructional methods of teaching. An initiative grounded in existing coursework, extant resources, and prior experience is described in this article. Working from a state-accepted list of basic and advanced instructional technology competencies, a course-by-competency matrix was articulated to support the development of instructional technology competencies among faculty and students. Faculty and student development activities to infuse technology into teaching, using existing resources and facilities, were designed, field-tested, and evaluated. The activities were modified for use in subsequent semesters as vehicles for building or extending competencies of undergraduate and graduate students preparing for professional positions as teachers, administrators, and counselors. To support continued implementation and improvement, practical, hands-on experiences were supervised by information technology specialists, knowledgeable faculty members, and graduate students with demonstrated competence. A team of professionals with expertise in instructional technology monitors all faculty and student development activities. The effort provides a comprehensive, practical model for addressing the growing need for altering instructional methods to accommodate technology innovations for school personnel in meaningful ways.

The information age has created increasing needs for teachers and other school personnel at all levels of education to develop, use, and disseminate skills for including technology as the driving force behind integrated, cross-disciplinary learning experiences that prepare students for life in the "real" world (Bailey, Ross, & Griffin, 1996; Petrakis, 1996; Stanley, Linauer, & Petrie, 1998). Technology has a significant foot in the door of America's classrooms, and the schools will never be the same (Fisher, 1997; Funnell & Owen, 1992; Lowther, Bassoppo-Moyo, & Morrison, 1998; Lumley & Bailey, 1996; Mehlinger, 1996). Yet, most educators are provided little training in how to use new technologies so it is no surprise that many of them continue doing what

they were doing rather than spend time learning how to use the innovations that are being provided for them (Bailey, Ross, & Griffin, 1996; Furst-Bowe, 1996; Hill & Somers, 1996; Hunt, 1995; Ley, 1997; Stanley, Linauer, & Petrie, 1998). Too often, technology innovations go unnoticed, ignored, or seldom used in today's schools; and, the effects of failing to keep up continue to downgrade America's educational system. The exclusion of information technology from the processes of planning, managing, and implementing curriculum innovations keeps change in education moving at a snail's pace and serves to maintain stagnant, sometimes mediocre instruction as the rule in efforts to "reform" the schools (Morton, 1996). There is a growing and continuing need

for systematic efforts to infuse instructional technology in relevant ways in all professional education programs preparing administrators, teachers, and counselors (Hill & Somers, 1996; Kitagaki, 1995; Northrup & Little, 1996; Otter, 1992).

While the evidence for need is widespread and overwhelming, models and illustrations providing practical steps to take in bringing technology into professional education programs are less pervasive (Bailey, Ross, & Griffin, 1996; Fisher, 1997; Hill & Somers, 1996; Hunt, 1995; Ley, 1997; Petrakis, 1996). In other words, the problem has been identified, but the solution is still under construction. In this article, we describe an effort to enhance the professional education programs in a college of education through learning experiences designed to assist university faculty members and students, as well as practicing public and private school teachers, counselors, and administrators, to master and use information technology competencies in relevant ways in schools. The project was designed to address problems associated with inadequate preparation of educators. It offers a well-reasoned model for others in professional development schools to consider when addressing information technology education needs.

Project Design and Workplan

The first step in successful implementation of any innovation is commitment on the part of representative stakeholders (Mehlinger, 1996). Supported by a statewide initiative to assist public schools by increasing the technology-related competence of the educational workforce of approximately 80,000 educators, the schools and departments of education on the campuses of the university system committed to ensuring that all faculty members who prepare professional educators and all graduates of professional education programs can use information technology to enhance instruction. For purposes of this effort, technology not only included computers but also computer networks and telecommunications multimedia and hypermedia, camcorders and VCRs, instructional television and interactive video, CD-ROM and videodisk players, graphing calculators and video microscopes, telephone and voice mail technologies. The goals of the effort were:

1. To enhance basic and advanced information technology knowledge and productivity of faculty and students related to computer operating systems, word processing, spreadsheet programming, database management, page layout and design, Internet resources and use, presentation software, statistics and data processing, and instructional design courseware.
2. To develop instructional modules to help faculty members infuse information technology content into the teaching and learning processes that are

the foundation of all professional education coursework.

3. To evaluate improvements in faculty member and student competence and productivity that result from these efforts to enhance information technology use in instruction.

Responsibility for designing, implementing, and coordinating this response was assigned to a team composed of eight individuals responsible for teaching research, evaluation, and technology courses. Seven implementation objectives (see [Figure 1](#)) and formative evaluation activities drove the team's effort to accomplish the overall goals: (1) clarify and refine technology competencies, (2) articulate curriculum linkages, (3) acquire necessary information technology resources, (4) develop faculty member competence, (5) assess faculty member competence, (6) develop student competence, and (7) assess student competence. Members of the team organized and chaired a series of task forces to design, implement, and evaluate faculty and student development activities related to each of seven implementation objectives. To ensure adequate representation of the perspectives of those who would be affected by the activities, each task force included an appropriate mix of faculty and students who were directly involved in teacher, counselor, and administrator education programs (each department in the college was represented on each task force). The design and workplan for implementation objectives are described below. The article concludes with a discussion of expected benefits and recommendations to support others' efforts to initiate and implement change toward developing information technology competencies among professional educators.

Technology Competencies

Two clusters of technology competencies served as overall guiding principles in developing learning objectives:

Basic competencies represented entry-level skills related to basic computer operation and the use of an array of software that supports and enhances professional productivity.

Advanced competencies extended the application of basic competencies to teaching, administration, and counseling and to other professional activities of both students and faculty.

The value of and commitment to these competencies was enhanced by the statewide mandate that required their demonstration for initial licensure of teachers and administrators; the former, by means of a state test, and the latter by means of a portfolio assessment. Significant overlap existed between these

competencies and those identified as "recommended foundations in technology for all teachers" by the International Society for Technology in Education (see **Figures 2** and **3** for representative examples).

Working from the state's list of basic and advanced technology competencies, a task force clarified and refined the specific information technology competencies that professional education faculty members and students were expected to have and use in their teaching and education programs. The "basics" included knowledge and skills in the following areas: computer operating systems, setup, maintenance, and troubleshooting; word processing and introductory desktop publishing; spreadsheets and graphing; databases; networking, telecommunications, media communications, and multimedia integration. Advanced information technology competencies enable teachers and other education professionals to use multiple forms of technology to enhance learning in their classrooms (e.g., using school television resources to support teaching, using technology tools that are specific to a discipline, using technology to design and manage learning environments and resources).

Curriculum Articulation

To support the development of information technology competencies among both faculty and students, a second task force developed a course-by-competency matrix that identified which competencies ought to be developed, enhanced, and applied in each course or other instructional activity in each professional education program (i.e., elementary, middle, secondary, special, and counselor education and school administration). Each course in the college was evaluated relative to each competency to determine goodness-of-fit between the current curriculum and the intended technology-enhanced agenda. This activity served as the basis for all subsequent planning and implementation efforts. This provided a conceptual and logical base on which to evaluate existing activities, identify information technology instructional needs, and plan faculty and student development efforts.

Technology Resources and Facilities

In collaboration with the College's Information Technology Advisory Committee (ITAC), a third task force developed policies, procedures, descriptive materials, and other mechanisms to ensure that professional education faculty members and students had access to the technology resources and facilities they needed to develop, enhance, and apply their growing repertoire of instructional technology competencies. These facilities and resources included:

- Networked desktop computers in faculty offices.
- An instructional technology classroom with 20 PC computers, instructional workstation, ceiling

mounted sound and video projection equipment, and networked laser printers.

- An information technology lab with 19 PC computers, 10 Macintosh computers, networked laser printers, a color scanner, and a color printer.
- A faculty development lab with two multimedia PC and two multimedia Macintosh computers, networked laser printers, a black and white scanner, 2 color scanners, and a color printer.
- A "high-end" multimedia production lab available for faculty member use and located in the university library.
- A suite of one large and five small interactive video labs with networked video cameras and VCRs, a roof mounted satellite dish for ITV reception, duplex intercom system, and a video feed to ceiling mounted video monitors in a large "smart" classroom.
- Two model classrooms for teaching methods courses -- one focused on teaching science and the other focused on teaching reading, language arts, and social studies -- each with four computers, instructor's workstation, portable projection equipment, and networked laser printer.
- Four college Novell servers to operate the technology classroom, the technology lab, and the model classrooms, provide access to special school-based courseware using IBM Classroom LAN Administration System (ICLAS), and provide shared network services (printing, file sharing, and an administrative database).

The task force and college information technology committee continuously monitor resources and carry on additional efforts to address needs required to maintain, enhance, and expand information technology capabilities. In addition to a portion of the college's operating budget, resources are being sought from internal (i.e., a university student computing fee) and external (i.e., grants from federal and state agencies as well as businesses and industry) sources.

Faculty Member Competencies - Assessment and Development

A fourth task force reviewed the basic and advanced information technology competencies and developed a survey instrument (available upon request) to determine the faculty members' perceptions of their capabilities within broad areas (e.g., word processing, communications, desktop publishing), their levels of use of information technology, and their opinions about priority areas for faculty development activities. Results of this assessment were used by a fifth task force to design, develop, and implement group training programs,

computer-assisted instruction activities, print learning materials, peer tutoring, short courses, and workshop presentations by which faculty enhanced their mastery and use of the expected technology competencies. For example, higher levels of competence were indicated for basic skills related to disk operating system functions (e.g., making backup copies) and word processing (e.g., editing or creating headers) and lower levels of skills were evident for database functions. Relative to ratings for use, operating systems, word processing programs, and Internet programs reflected higher levels of use and ratings for database programs, multimedia programs, presentation programs, and statistical processing programs reflected lower levels of use. In response to evidence of these needs, a series of individual and group professional development activities was planned and delivered to interested faculty. Participants were provided general information as well as specific suggestions for how to use the technology (e.g., databases, multimedia and presentation programs) in their courses. Additionally, a "help-desk" was established as a vehicle for identifying needs and problems and formulating alternatives and solutions. Case study illustrations and templates were also an important part of the professional development activities. The same assessment protocols and procedures were used for determining and documenting both formatively and summatively the degree to which professional education faculty members in the college acquired and used the state's basic and advanced technology competencies (and any others refined or added in the future) in their teaching and other professional activities.

Student Competencies - Assessment and Development

A sixth task force reviewed the competencies and developed a second survey instrument (available upon request) for use in evaluating students' perceptions of their abilities within broad areas (e.g., word processing, communications, desktop publishing). This information served a needs assessment function and provided baseline data for subsequent formative and summative evaluations. Analyses of these data led a seventh task force to the design, development, selection, acquisition, and modification of an array of methods, programs, activities, materials, and other mechanisms - some "course-imbedded" and others "stand-alone" - by which students could develop and enhance their mastery and use of the expected information technology competencies. These same assessment protocols, as well as a portfolio assessment procedure currently in the conceptual stage of development, were used within the college for determining and documenting both formatively and summatively the degree to which students have and use the state's basic and advanced technology competencies (and any others refined or added in the future) in their professional education courses and in their own teaching.

Formative Evaluation and Feedback

Using appropriate models (e.g., Kirkpatrick's four levels of evaluation), data were collected to evaluate the efforts to achieve the seven implementation objectives and the overall goals for infusing information technology content in existing and planned teacher education curricula and classrooms. Formative evaluation reports were prepared at the end of each semester and these evaluation data were used in a feedback loop to refine the seven implementation objectives and the associated activities.

A faculty member within the College of Education with extensive experience in quantitative and qualitative evaluation methods was responsible for overseeing the design, execution, and reporting of this aspect of the project. The following questions guided the evaluation effort:

1. To what extent are attitudes toward and knowledge about information technology (including, but not limited to, word processing, spreadsheets, data base management, statistical processing, presentation software, Internet use) similar for faculty members and students participating in innovative training experiences and their peers not participating in training?
2. To what extent are the proposed training experiences provided to students appropriate and beneficial? Is instruction presented effectively? Do faculty and students receiving it produce products that meet accepted functional and practical standards? Do students demonstrate mastery of the basic and advanced competencies as measured by the state information technology test and through portfolio assessment?

A pretest/posttest control group design was used to address questions about attitude and knowledge; an expertise-based evaluation was conducted to address questions about the value of products (Gall, Borg, & Gall, 1996). A total of 15 faculty members participated in the proposed instructional activities each semester. Faculty with comparable general levels of knowledge in all of the education disciplines will be available to serve as a no-treatment control group to be included in development activities in subsequent years. Since random assignment is not possible, statistical equivalence of the control group will be established on key moderator variables (e.g., age, prior content knowledge, area of education expertise) using matched selection criteria.

Conclusions and Recommendations

Because information technology has the potential to stimulate learning, because it is more and more pervasive in schools and society, because computer-based skills must be taught to children, because of the speed at which computers support and stimulate change, and

because of the expanded vision computers and their related technologies provide teachers and students, it is surprising that colleges of education often exclude technology-based learning experiences from curriculum enhancement efforts (Morton, 1996). Feedback from school representatives and the public in general indicates that competence in information technologies is important, but all too often lacking in teachers, counselors, and administrators in public and private schools.

Hill and Somers (1996) described how one college of education was working toward making better use of technology in the preparation of future educators. Their position paper focused more on the process for arriving at valued goals than on efforts, plans, or models for attaining them. In concluding, they echoed the widely recognized need for a common theme in colleges of education grounded in modeling and providing instruction in the educational use of technology (cf. Bailey, Ross, & Griffin, 1996; Lumley & Bailey, 1996). The project we described addresses that need by illustrating how one college of education is enhancing basic and advanced information technology knowledge and productivity of faculty and students. This goal is being achieved by following a model emphasizing careful planning and evaluating of improvements in competence and productivity that result from enhanced information technology instruction. The following benefits have been or are expected to be accrued:

- Systemic change within the college concerning the ways in which faculty members teach and manage instruction.
- Enhancement of the information technology competencies for participating faculty members in a non-threatening manner.
- The skills of graduate and undergraduate students to use information technology as an instructional tool in the schools are not taught in isolation but are integrated into coursework across the teacher preparation curriculum.
- Assisting inservice educators (i.e., teachers, administrators, counselors) to master competencies for the infusion of information technology into their professional activities.
- Preparation of a set of integrated instructional modules for use in developing and extending the information technology skills of graduate and undergraduate students.
- Preparation of innovative, computer-assisted assessment methods to determine the mastery of specific information technology competencies.
- Preparation of continuing education workshops showing professional educators how and when to apply information technology to specific content and skill areas in the curriculum.

- Preparation of continuing education workshops showing counselors and administrators how and when to apply information technology to the instructional support functions of the schools.
- Making graduate and undergraduate students aware of the range of educational applications of information technology, including ones to which the schools may not as yet have access.
- Adopting and adapting computer-assisted instruction projects required of students in a master's degree program in instructional systems technology for use in training faculty and students in professional education programs in the use of information technology.
- Providing opportunities for students in a master's degree program in instructional systems technology to design, direct, and evaluate information technology workshops for faculty and students in professional education programs.
- Building excitement and increasing anticipation of professional educators for the use of information technology to enhance instruction in schools.

Selected relations between these benefits and activities and evidence of change within a college of education implementing technology change are illustrated in **Table 1**.

In general, the UNC Charlotte experience offers direction and reflects a successful process for addressing the need for enhancing technology competencies in institutions of higher learning. While future research illustrating effects of this and similar efforts is needed, there is promise evident in this effort.

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Appendix

Table 1: Examples of Benefits and Activities/Evidence

Benefit	Activities/Evidence
Changes in how faculty members teach and manage instruction	<p>Multimedia technology based presentations replace stand-alone lecturing and traditional overhead transparencies.</p> <p>Electronic gradebooks replace pencil and paper records.</p> <p>Internet feedback replaces individual conferences, often difficult to schedule and use effectively within a typical course.</p> <p>On-line course materials, practice tests, and review materials used to broaden interactions and instructional opportunities.</p>
Enhancement of competencies in a non-threatening manner	<p>Individuals and small groups of faculty solve problems grounded in their current and future teaching assignments.</p> <p>Faculty and students work collaboratively in addressing important educational issues.</p> <p>Solutions are based on practical rather than presumed needs.</p>
Skills to use technology are not taught in isolation	<p>Future teachers learn to use electronic resources in doing research.</p> <p>Future teachers learn to use technology for presentations and projects.</p> <p>Future teachers learn to use technology to replace traditional tools.</p>
Inservice educators master competencies for infusion into their professional activities	<p>Practicing educators learn to use electronic resources in doing research.</p> <p>Practicing educators learn to use technology for presentations and projects.</p> <p>Practicing educators learn to use technology to replace traditional tools.</p>
Students are aware of the range of educational applications available	<p>First year teachers enter profession with latest knowledge.</p> <p>New inductees in teaching profession take key positions in relation to technology and innovation.</p>
Faculty and students are engaged in adopting and adapting projects	<p>Relations between faculty and students reflect cooperation.</p> <p>Collaboration becomes effective means for solving problems.</p>
Providing opportunities for students to design, direct, and evaluate workshops in professional education programs	<p>Students receive "on-the-job" experiences under supervision.</p>

Figure 1: Implementation Objectives and Formative Evaluation Activities

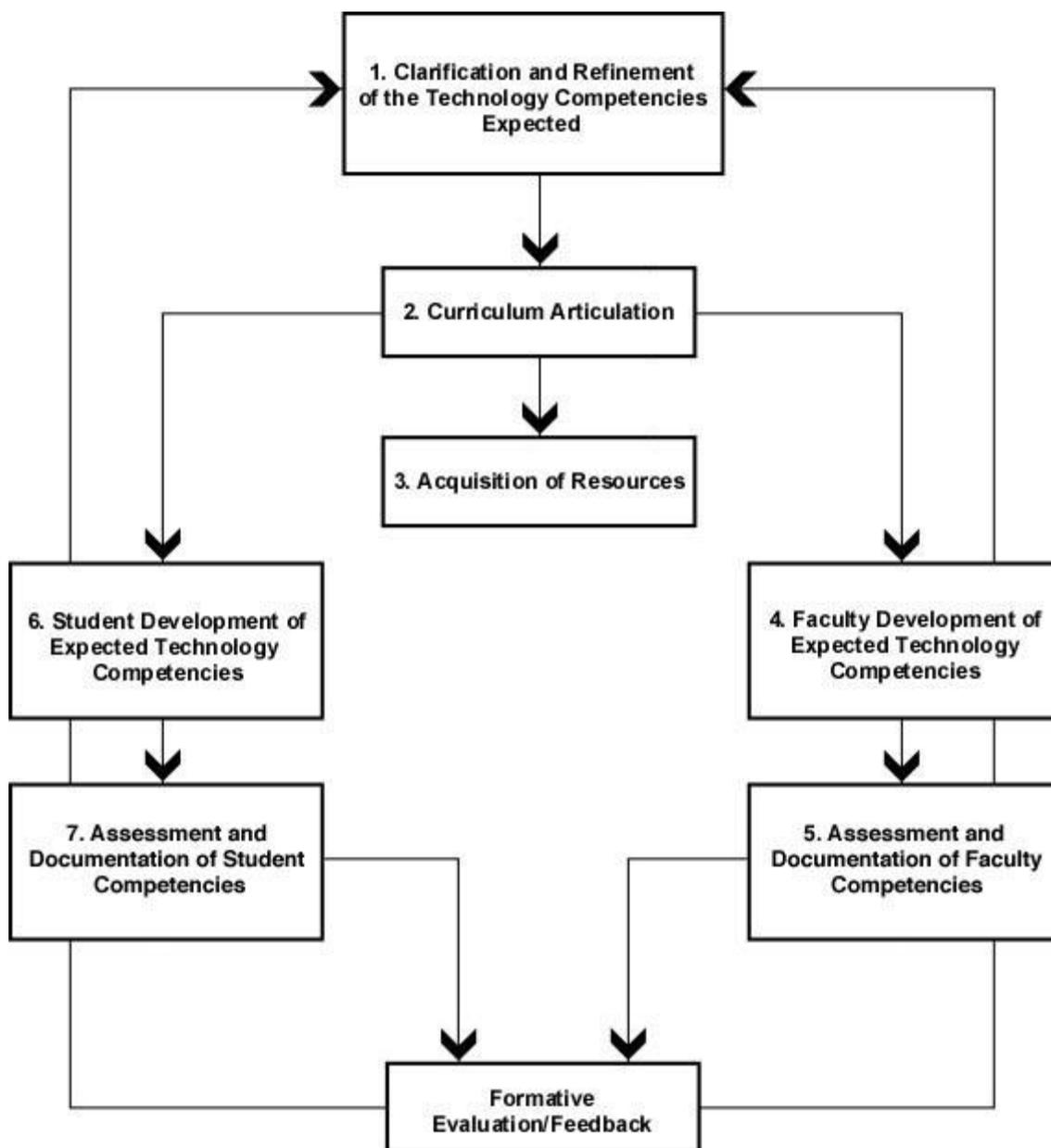


Figure 2: Basic Technology Competencies for All North Carolina Educators

1.0 Computer Operations Skills

Essential Knowledge and Skills

Demonstrate These Skills:

1. Start up and shut down computer system and peripherals
 - Use correct startup/shut down procedure according to computer type
 - Start up and shut down printer
 - Start up and shut down CD-ROM
 - Start up and shut down scanner
2. Identify and use icons, windows, menus
 - Point, click, double-click, click and drag with mouse
 - Maximize and minimize a window
 - Use pull-down and expanded pull-down menus
 - Select, open, and move an icon
 - Select, open, move, and close a window
 - Resize a window and title/stack windows
 - Scroll up/down, left/right within a window
 - Make a window active/inactive
3. Start an application and create a document
4. Name, save, retrieve, revise a document
 - Name a document
 - Save a document using both the Save and Save As Commands
 - Retrieve a document from floppy disk
 - Retrieve a document from hard drive
 - Rename a document
 - Edit and re-save a document
5. Use printing options
6. Insert and eject floppy disk and CD-ROM
7. Initialize, name/rename floppy disk and hard disk
8. Copy document from hard disk to floppy disk and vice versa
9. Create and name/rename subdirectories/folders
10. Save, open, place documents inside subdirectories/folders
11. Open and work with more than one application at a time
12. Use special operating features for people with disabilities

Figure 3: International Society for Technology in Education

ISTE Recommended Foundations in Technology for All Teachers

The National Council for Accreditation of Teacher Education (NCATE) is the official body for accrediting teacher preparation programs. The International Society for Technology in Education (ISTE) is the professional education organization responsible for recommending guidelines for accreditation to NCATE for programs in educational computing and technology teacher preparation.

I. Foundations. The ISTE Foundation Standards reflect professional studies in education that provide fundamental concepts and skills for applying information technology in educational settings. All candidates seeking initial certification or endorsements in teacher preparation programs should have opportunities to meet the educational technology foundations standards.

- A. **Basic Computer/Technology Operations and Concepts.** Candidates will use computer systems run software; to access, generate and manipulate data; and to publish results. They will also evaluate performance of hardware and software components of computer systems and apply basic troubleshooting strategies as needed.
 1. operate a multimedia computer system with related peripheral devices to successfully install and use a variety of software package.
 2. use terminology related to computers and technology appropriately in written and oral communications.
 3. describe and implement basic troubleshooting techniques for multimedia computer systems with related peripheral devices.
 4. use imaging devices such as scanners, digital cameras, and/or video cameras with computer systems and software.
 5. demonstrate knowledge of uses of computers and technology in business, industry, and society.
- B. **Personal and Professional Use of Technology.** Candidates will apply tools for enhancing their own professional growth and productivity. They will use technology in communicating, collaborating, conducting research, and solving problems. In addition, they will plan and participate in activities that encourage lifelong learning and will promote equitable, ethical, and legal use of computer/technology resources.
 1. use productivity tools for word processing, database management, and spreadsheet applications.
 2. apply productivity tools for creating multimedia presentations.
 3. use computer-based technologies including telecommunications to access information and enhance personal and professional productivity.
 4. use computers to support problem solving, data collection, information management, communications, presentations, and decision making.
 5. demonstrate awareness of resources for adaptive assistive devices for student with special needs.
 6. demonstrate knowledge of equity, ethics, legal, and human issues concerning use of computers and technology.
 7. identify computer and related technology resources for facilitating lifelong learning and emerging roles of the learner and the educator.
 8. observe demonstrations or uses of broadcast instruction, audio/video conferencing, and other distant learning applications.
- C. **Application of Technology in Instruction.** Candidates will apply computers and related technologies to support instruction in their grade level and subject areas. They must plan and deliver instructional units that integrate a variety of software, applications, and learning tools. Lessons developed must reflect effective grouping and assessment strategies for diverse populations.
 1. explore, evaluate, and use computer/technology resources including applications, tools, educational software and associated documentation.
 2. describe current instructional principles, research, and appropriate assessment practices as related to the use of computers and technology resources in the curriculum.
 3. design, deliver, and assess student learning activities that integrate computers/technology for a variety of student group strategies and for diverse student populations.
 4. design student learning activities that foster equitable, ethical, and legal use of technology by students.
 5. practice responsible, ethical and legal use of technology, information, and software resources.

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Authorship is listed in alphabetical order. These six individuals constitute the team responsible for implementation of the technology initiative described in this article and participated equally in the preparation of the manuscript.

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