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The University of Montana

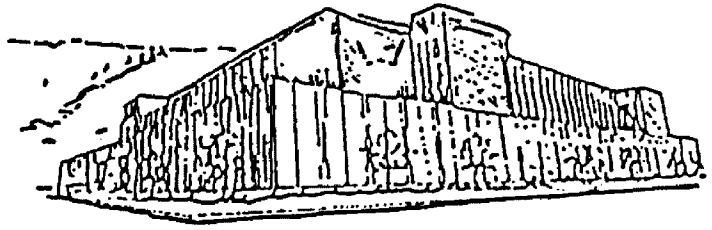
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***Technology Competencies for Teachers and Instructional
Technology Specialists: A Comparison of Programs***

By

Arthur J. Sikkink

B.S. Bemidji State University, 1976

presented in partial fulfillment of the requirements

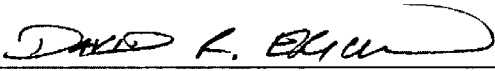
for the degree of

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1996

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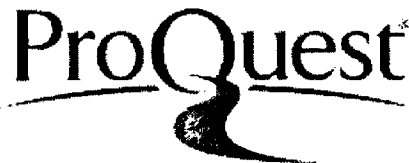


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Introduction

We are in the midst of an ever expanding information and communications age. Not only is there an explosive growth in the amount of information available, but recent advancements in communications make that information instantly available to anyone with the skills to access that information. Schools must provide future citizens with the skills necessary to properly access, evaluate, and utilize the available information. This project seeks to determine the readiness of beginning teachers in the United States to meet that challenge. It evaluates the preparedness of teachers in the area of educational technology, and the preparedness of computer science teachers and technology specialists to act as support persons for those teachers.

The definition of educational technology is still developing. Sullivan (1993) described a teacher preparation program that included an emphasis on the knowledge and use of technology. That program specified classroom computer use, computer management, CD-ROM applications, laserdisc usage, and computer managed testing as aspects of educational technology. Hurst (1994) suggests that teachers be trained in the use of computer applications such as word processing, spreadsheet, database, desktop publishing, electronic communications, and multimedia. Hancock and Betts (1994) propose a minimal list of technologies to include research verified learning aids such as calculators, distance education, computer assisted instruction, individualized learning systems, videodisks, micro-computer based labs, presentation software, and telecommunications. They then expand the technology base to include computer adaptive training, interactive multimedia, multi-user dimensions, text-to-speech, voice mail, word processing, broadband networking, groupware, knowbots, pen-based computing, speech-to-text,

and virtual reality. In the two short years since Hancock presented these latter technologies as emerging and future technologies, today's students have access to many of them at the local video arcade and at home.

For the purposes of this study, I am defining educational technology as the normal classroom use of:

- Computers** (any software, CD-ROM, computer networks, or computer telecommunications),
- Recorded audio** (production or use of recorded audio tape, records, or CD-ROM),
- Recorded video** (production, recording, or use of film, video tape, and laserdisc),
- Distance learning** (telecommunications through computer or television and facsimile or mail), and
- Broadcast video** (cable, satellite, and broadcast television) for instructional purposes.

Although not encompassing all forms of technology, I believe this definition is inclusive enough to provide an accurate portrait of technology while remaining broad enough to assure comprehension by a wide audience.

Shermis, Quintana, and Estes (1990) contend that training in technology is a prerequisite for implementation of technology. They utilize the failure of the "teaching machines" of the late 1950's as an example of technology placed in the classroom without the necessary involvement of the teachers. Lamon and Sanner (1991) found additional evidence for increasing instructional technology training in a 1989 survey of Oregon high school department chairs. The Lamon study revealed that more than 85% of the department chairs responding had less than 3-units (45 hours) of college credit in computer-related training. More than 50% had less than the equivalent of one unit (15 hours). The Oregon survey also showed that individual teachers or groups of teachers heavily influence hardware acquisition.

These reports indicate a need for all teachers to receive training in instructional technology for financial, as well as instructional reasons. Geoff Fletcher, Director of the Educational Technology, Texas Education Agency, observed that "the most likely impediment to the advancement of educational technology is teacher training" (Bruder, 1989). Hixson and Jones (1990) noted that preservice training for teachers and administrators offered the most long-term impact on the nation's schools. Jensen (1992) surveyed 416 secondary teachers in Hawaii, Utah, and Oregon. His findings support the need for preservice teacher education in instructional media. His recommendations include:

"State Teaching Certification Requirements should be written to require evidence that secondary education teachers have both general instructional media competencies as well as specific skills that are significant to their teaching discipline."

The 1989 Electronic Learning technology survey (Bruder, 1989), found that 23 states and the District of Columbia required students enrolled in teacher education programs to take computer courses for certification. The credit requirements, however, varied from 1 hour to 50 hours. Only seven states required potential teachers to take a course on how to integrate instructional technology and/or instructional media into the classroom. Eleven other states required courses in specific content areas only, such as business education, science, and industrial technology.

Electronic Learning's survey of states in 1988 (Bruder, 1988) points to a perception that instructional technology and computer technology were one in the same. Many educators equate a computer science endorsement with a strong background in instructional technology, as evidenced by computer coordinators as directors of

technology at district and state levels. The promotion of technology involves much more than computer competency. Sheingold (1992) contends that time, human support, "and leaders that invite change and mean it and promote systemic change" are requirements for integrating technology into teaching.

Research Questions

This study addresses four areas related to instructional technology. It seeks to determine the competencies related to educational technology required of all individuals seeking a general teaching license or certification. Second and third, it seeks to determine the competencies for computer science teaching endorsements and technology specialist certification. Lastly, the study compares the computer science and technology specialist competencies.

The questions I am seeking to answer are:

1. What competencies, if any, in instructional technology are currently required for teacher certification at the elementary, middle school, and secondary levels in the United States?
2. Has there been an increase in requirements in the area of instructional technology, for teacher licensure/certification over the past 5 years?
3. What competencies related to instructional technology are required for a teaching endorsement in computer science?
4. What competencies related to instructional technology are required for a certificate or endorsement as an instructional technology specialist?
5. Do the requirements for a computer science endorsement or instructional specialist better qualify the holder for a leadership role in instructional technology?

Methods

Compilation of a standard set of competencies for instructional technology was essential to the comparison of programs. The state of North Carolina published a set of computer competencies for educators in

1992 (North Carolina State Department of Education, 1992). These competencies served as the basis for the competencies used in the survey for this study. The survey is divided into three categories: a) instructional technology competencies required of all educators at the elementary, middle school, and secondary levels; b) instructional technology competencies required for endorsement in computer science, and; c) instructional technology competencies required for a technology specialist certification. Appendix A contains the state survey in its entirety.

Despite the usual low return rates on mail surveys, a mail survey was the chosen method for obtaining the study data. To obtain information from across the nation, the Department of Education or Teacher Certification Office in each state and the District of Columbia received surveys. For comparison of state to university requirements, those universities having educational degree programs in the northwestern United States received surveys.

The response rate to surveys is a vital portion of any educational study. Recommended return rates for survey research vary from 60% to 90% dependent on the bias of the respondents (Jones, 1995). The survey was constructed to reduce the variation of responses by listing specific competencies rather than having each respondent provide their own competencies. The sample for this study included the entire population of state departments and educational institutions identified to further reduce sampling bias. Respondents had the opportunity to provide written documentation supporting their requirements.

This initial survey, sent to state departments of education, requested information on the competencies required by the state. Thirty-seven responses were received from the first mailing. A second mailing, two months after the first, garnered an additional nine

responses. A later third mailing added one additional respondent for a total of 46 surveys (90%) returned from the states and District of Columbia.

A similar survey was sent to the 32 colleges and universities listing educational programs in the northwestern United States (Idaho, Montana, Oregon, Washington, and Wyoming). This second survey requested the schools of education evaluate their teacher education programs for the same competencies as listed in the state survey. The initial survey received only 11 responses. A second mailing increased the responses to 19 and a third mailing did not receive any additional responses. Of the 32 colleges and universities offering teacher education programs 19 institutions (59%) returned the survey.

The 90% return rate from the State Departments of Education is above the recommended return rate for a mail survey. Analysis of the response time for the survey did not show any bias toward a lack of recommendations in the early or late responses. The high response, combined with the almost even split of responses to the three basic questions, allows a high degree of confidence in the conclusions drawn on this data set. The university return rate of 37% is well outside the recommended rates. In addition, the amount of variation found within this data set is high. The response time for the university surveys does show some bias. Private institutions and institutions with strong programs were generally the first to answer the survey. These three factors reduce the reliability of the data and the validity of the generalizations made from the data.

Analysis of the general competency data utilized four categories: a) basic operation of equipment; b) evaluation and classroom application of technology materials; c) use of special hardware or software, and; d) electronic research and information access. The analysis of the

computer science and technology specialist competencies utilized groupings that include: a) hardware knowledge; b) programming and operating systems; c) teaching and learning methodology, and; d) training for the trainer.

Results

Part I. General Certification/Licensing

The first part of the survey requested each agency or institution to indicate the existence of a set of general competencies required for all individuals seeking teacher certification or licensing. Table 1 summarizes the results of this portion of the survey. A state by state breakdown of the data appears in Appendix C, Table C1.

Table 1. General Certification/Licensing

	Number Responding ¹	Number having Requirements	Number not having Requirements
States	47	22	24
Universities	19	18	1

¹Alaska returned the survey but with no response to the questions.

Forty-seven of the 51 states responded with 22 states reporting a set of requirements was in place. A number of responses indicated movement toward adoption of standards. Some states had prepared standards but not adopted them due to budget and political difficulties. Appendix B lists comments written by the states, or excerpts from documentation sent by the states, concerning the adoption of competencies or standards.

Nineteen of the 32 universities responded to the survey; all but one indicated that a set of required competencies were in place. Of the five northwestern states represented, Washington and Wyoming were the only states with published standards. The University of Wyoming did not

return a survey to compare with the state standards. All responding schools from Washington exceeded the standards set by the state.

Survey respondents categorized the competencies into levels for elementary, middle school, and secondary school teachers. Except for competency number 1 (basic computer knowledge) in Maine and competency number 18 (familiarity with major application software) in Kentucky, all states that listed competencies require the same competencies for all levels of instruction (Figure 1). The universities surveyed place greater requirements on the elementary and middle school programs than the secondary programs (Figure 2).

The general competencies are grouped into four broad categories for further comparisons. These include:

Basic Operation of equipment (Competencies 1-4).

This category includes the general knowledge of computer hardware and software, audio and video players and recorders, and broadcast video. This group is the most often cited group from the states. Responses ranged from 19 of 22 states (86%) requiring competency 1, computer knowledge, to 11 of 22 (50%) requiring knowledge in the use of broadcast video. Ten states listed requirements for all four competencies of this category.

A similar pattern exists in the university requirements. While university requirements generally meet or exceeded the state requirements, there is not a consistency, even within a state. Only one of the 18 responding institutions (6%) required all four of the competencies in this category at all levels. A second required three with the fourth optional. Similar to the states, computer competency is a requirement of most institutions, 18 of 18 (100%) at the elementary level, 17 of 18 (94%) at middle school level, and 15 of 18 (83%) at the secondary level. The greatest discrepancy between state and university

programs involved knowledge of the use of broadcast video. Eleven of the 22 states listing requirements (52%) indicated a requirement for broadcast video, but only three of the 18 universities (17%) listed this competency, primarily at elementary and middle school levels.

Evaluation and classroom application of technology materials (Competencies 5-11, 16-18).

This category includes competencies in the evaluation of hardware and software materials and the determination of the appropriate use of these materials in the classroom. Of the 22 responding states, only 12 (54%) require five or more of these competencies. In contrast, the surveyed universities indicate that this is an area of high importance to their programs. Fifteen of the 18 respondents (83%) listed six or more of these competencies as required within their programs

Special hardware (Competencies 12-13).

The ability of the teacher to use specialized input and output devices, devices for large group instruction or special needs students, did not appear as an important aspect for the states. Five of the 22 responding states (23%) indicated the need for these competencies whereas 13 of the 18 (72%) of the universities indicated that at least one of these competencies is required.

Electronic research and information access (Competencies 14-15).

The use of computerized library services is somewhat important to the states with 7 of the 22 respondents (32%) indicating the need for this competency. In contrast only 4 of these states (18%) felt the teacher need show competency in the evaluation and selection of research materials such as CD-ROM and telecommunications resources. No state indicated a requirement directly relating to the Internet or similar on-line materials.

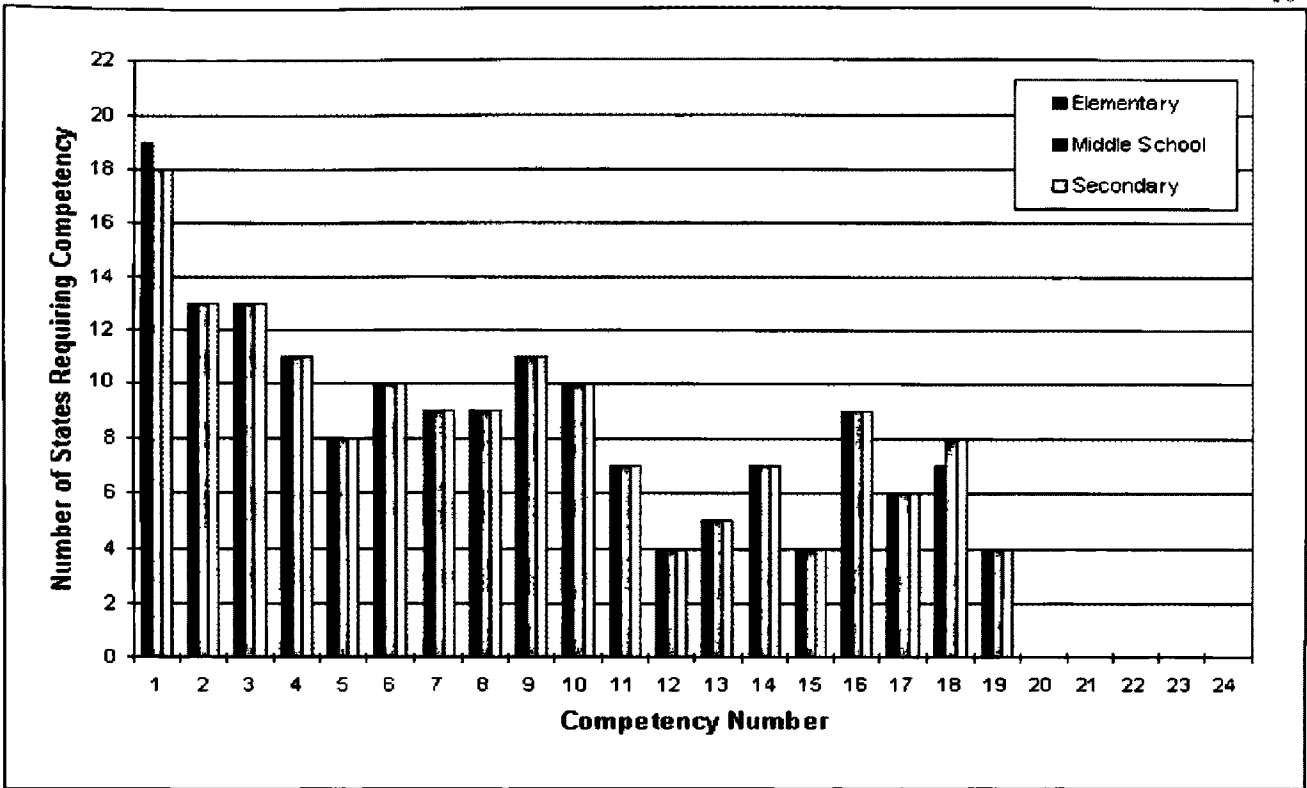


Figure 1. State instructional technology competencies for all teachers.

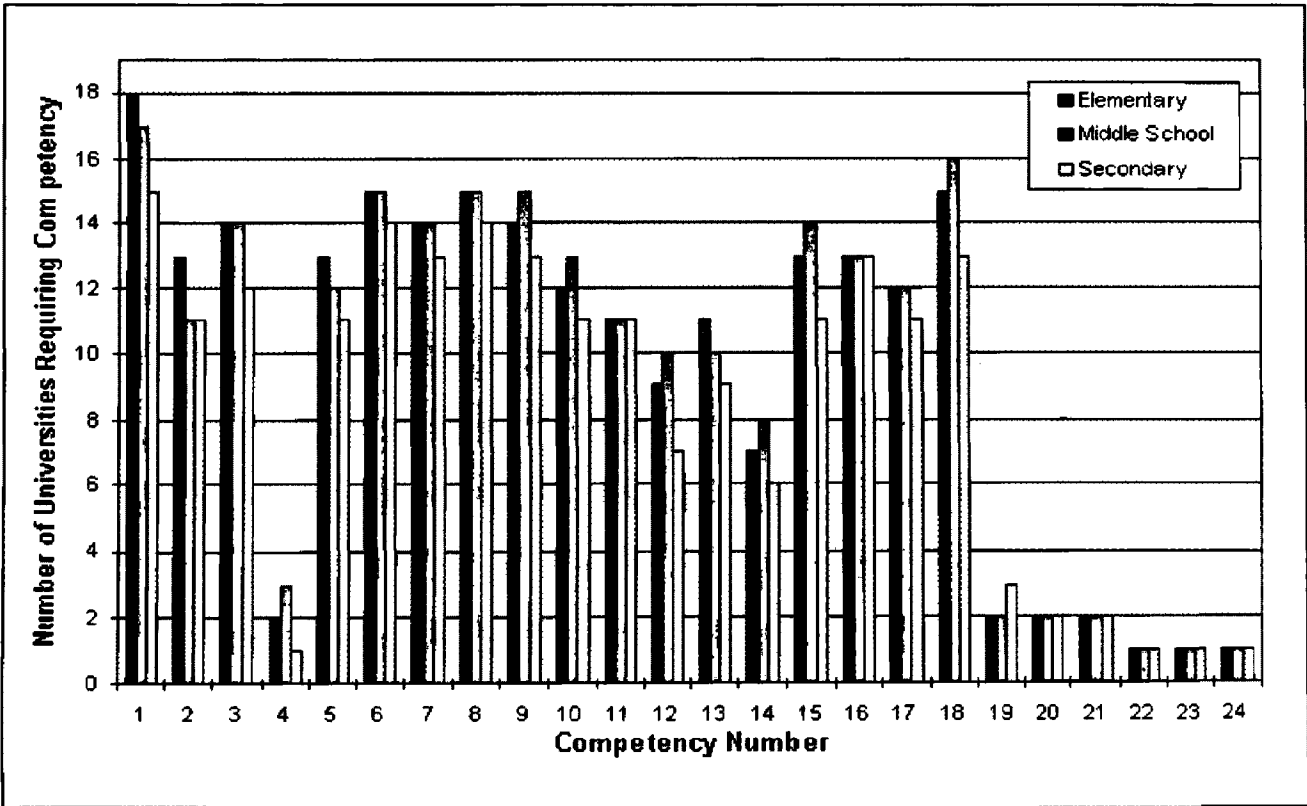


Figure 2. University instructional technology competencies for all teachers.

Eight of the 18 universities (44%) include the need for use of computerized library services. The evaluation and selection of research materials command a much higher priority, 14 of 18 (77%) universities indicating this as a required competency. Two universities specifically noted the need for competency in the use of the Internet.

Part II. Computer Science Endorsement/Program

The second portion of the survey requested information on the existence of a teaching endorsement in computer science and the availability of a university program aimed at earning such an endorsement.

Twenty-five of the 46 responding states indicated they have a computer science endorsement for teachers. Of these 25 states only 14 indicated a published set of competencies was in place for the endorsement. In three of the responding states, any certified or licensed teacher in the state is capable of teaching computer science related courses. Seven states indicate the existence of computer literacy, media skills, or technology education licensing in place of computer science.

Nine of 19 responding universities indicated the existence of a computer science program directly related to teaching. The states of Idaho and Oregon do not have an endorsement for computer science. All universities from these two states also indicated no programs for this endorsement. The remaining states did indicate the existence of a computer science endorsement. Nine of the eleven universities in these states indicate a specific program exists to satisfy the state requirements. Table 2 summarizes the computer science endorsement portion of the survey

Table 2. Computer Science Education Program

	Number ¹ Responding	Number offering certificate/program	Number not offering certificate/program
States	47	25	21
Universities	19	9	10

¹Alaska returned the survey but did not answer any questions.

Of the 25 states indicating the existence of a computer science teaching endorsement, 14 listed competencies required for this area. The majority of these 14 states require strong backgrounds in computer hardware, programming languages, and operating systems. Universities indicate similar requirements although there are disagreements as to the specific competencies. Both the states and universities indicate a strong need for the incorporation of an understanding of computer technology into the classroom (Appendix C, Tables C4 and C5). Figure 4 compares state competency requirements to the northwestern regional university requirements.

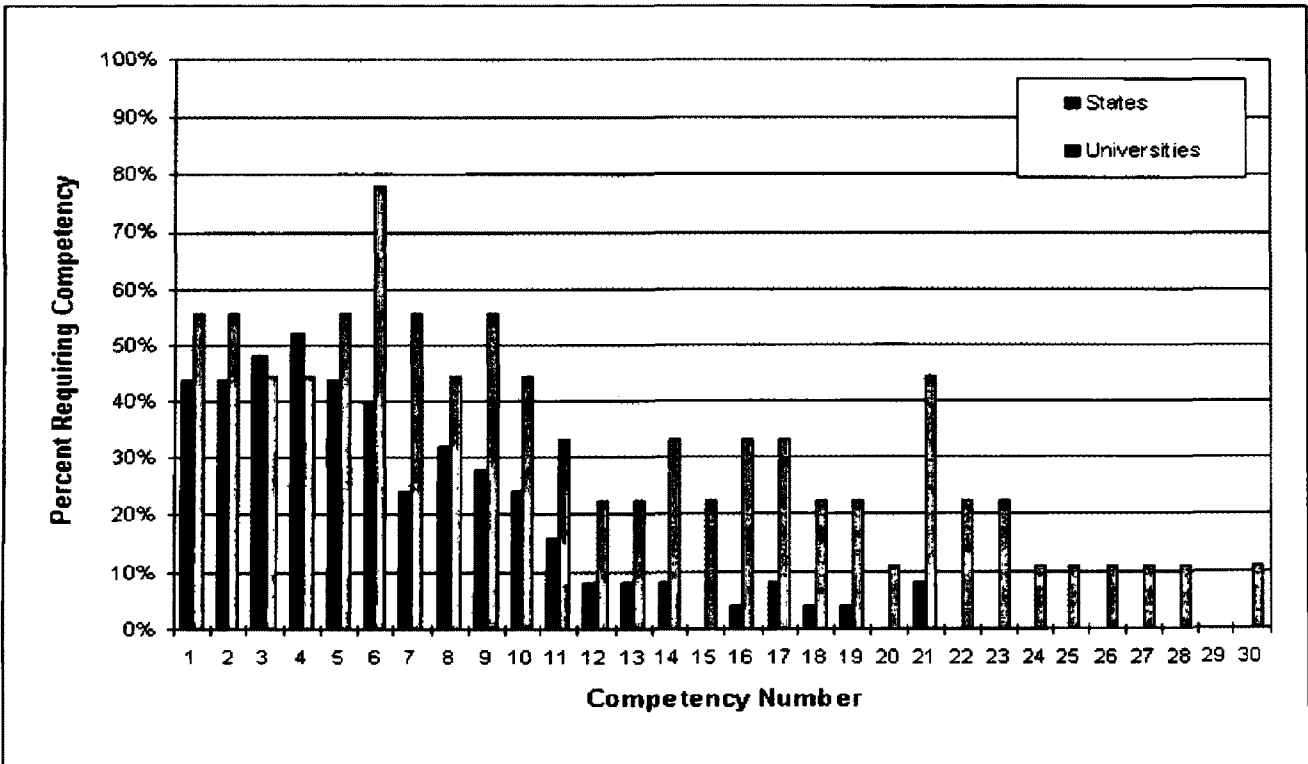


Figure 3. Computer science competencies of states and universities.

The competencies for Computer Science and Instructional Technology are combined into five categories.

Computer Hardware (Competencies 1-2).

All states and universities indicating competencies agree on the need for an individual to have basic understanding of hardware and operation of a computer system. Eleven of the 25 states (44%) indicated a required competency in the area of hardware knowledge. Six of the nine universities (77%) offering computer science teaching programs listed competencies in the area of hardware as a requirement.

Programming and Operating Systems (Competencies 3-6).

The need for a computer science teacher to have knowledge of at least one programming language (competency 4) was almost universal for the states (13 of 14 states listing competencies). The universities, however, split at 57% (3 of 7). Tempering the lack of specific programming skills was the requirement of knowledge of computer operations, data structure, and control structure (competency 6). In the area of programming skills, the universities seem to have taken a somewhat liberal approach to satisfying the state requirements.

Teaching and Learning Methods (Competencies 7-11).

Seven of the 25 states (28%) offering computer science endorsements included three or more of the five competencies in the methods' area (competencies 7-11). Four of the nine universities (44%) required three or more of these competencies. A fourth university did add competencies to the original list that included practicums and mentor programs within the computer science program.

Planning and Implementation of Instructional Technology (Competencies 12-19).

These competencies involve knowledge in the development, implementation and evaluation of educational technology plans for the school district. Only two of the 25 states (8%) indicated a requirement in this area. Of the nine university programs, two (23%) required more than one of these competencies.

Training (Competencies 20-21)

The preparation of a computer science teacher to also be a facilitator for staff development, competencies 20 and 21, is not a requirement for most states or university programs. Only two states (8%) indicated that a computer science teacher should be able to provide information and training but none felt the teacher should work on staff development programs. Similarly, four of the nine universities (44%) programs require competency in training but only one required knowledge in staff development programs.

Part III. Technology Specialist Endorsement/Program

The third portion of the survey sought information on the existence of state licensed or certified technology specialists for education. Of the 47 states responding, eight indicated the existence of such a license and only four of those indicated any specific competencies required for obtaining such a license. Table 3 summarizes the technology specialist data. Tables C6 and C7, Appendix C present the full set of data. Figure 4 compares the technology specialist requirements of the states and universities.

Table 3. Technology Specialist

	Number ¹ Responding	Number offering certification	Number not offering certification
States	47	10	36
Universities	19	4	15

¹Alaska returned the survey but did not answer any questions.

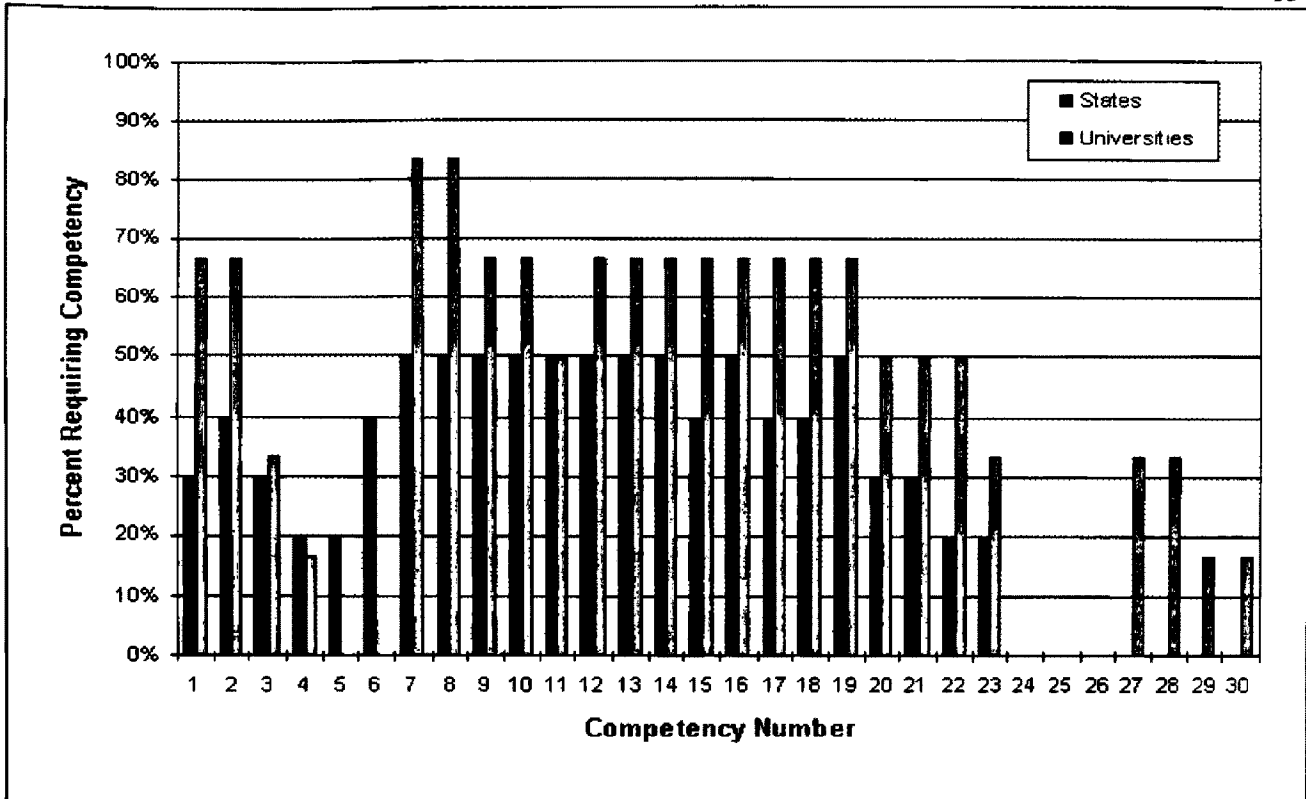


Figure 4. Technology specialist requirements for states and universities.

Of the universities surveyed, five indicated the existence of a technology specialist program for education. All of these were in states that did not issue a license or certificate for this specialist.

Those states and universities that did indicate competencies agree that the individual seeking this specialist license or degree should be well versed in the areas involved with planning and integrating technologies into the curriculum. Using the same 5 groupings for competencies as were used in Part Two, some very distinct differences appear between the states and the universities concerning a specialist's qualifications.

Hardware (Competencies 1-2).

Four of the 10 states offering specialist certification list at least one of the hardware competencies as being required. Of the states

that listed competencies, however, all indicated required competencies in this area. California, Louisiana, South Dakota, Utah, and Wyoming listed certification areas but did not list specific competencies. At the university level the competency requirements in this area increase to five of six (83%), with hardware competencies required for all programs where any competencies were listed. The University of Washington indicated a program but did not list specific competencies.

Programming languages and operating systems (Competencies 3-6).

Four of the 10 states (40%) indicate that a technology specialist should be proficient in a computer programming language or operating system. This proportion is similar to the universities where only two of the six (33%) require a proficiency in a programming language.

Teaching and Learning Methodology (Competencies 7-11)

Both the states and universities agree on needed competencies in this area. Five of the ten states (50%) listed requirements in this area. Four of the six university programs (67%) require at least four of these five requirements. All states and three of the four universities that listed competencies included all competencies within this area. The fourth university included two of the five. The university respondents listed a total of eight additional competencies (numbers 24-30) which related to this area and were not included in the original survey or listed by any of the states.

Planning and Implementation of Instructional Technology (Competencies 12-19).

Again the states and universities agree on the need for technology specialists being competent in method of developing and facilitating technology planning. Similar to the teaching and learning methods competencies, five of the 10 states (50%) and four of the six university

programs (67%) indicate requirements in this area. All states that listed requirements included six or more of the competencies in this area.

Training (Competencies 20-21).

The states and universities are split on the need for a technology specialist to be competent in the development and facilitation of training programs. Three of the ten states (30%) and three of the six universities (50%) indicate the need for developing and monitoring staff development. Three states (30%) and three universities (50%) indicate a needed competency in providing training for new hardware and software.

Part IV. Comparison of Computer Science and Technology Specialist

Programs

Identified competencies for the computer science programs, and subsequent endorsements, stress the importance of computer operating systems and programming techniques (competencies 3 to 6). They do not show the need for a background in the various types of educational technology nor in the overall areas of curriculum and educational leadership (competencies 7 to 11). The technology specialist competencies required by the states vary as to the importance of a computer systems background, but do stress the inclusion of curriculum and educational leadership. Figure 5 compares the requirements of the states for computer science and technology specialists.

The university programs are similar. Computer science programs stress the hardware knowledge and programming skills (competencies 1 to 6). Technology specialist programs do not. Competencies in teaching methods (competencies 7 to 11) are stressed slightly more in the computer science programs, but are important in both. Technology specialist programs require more planning skills than the computer

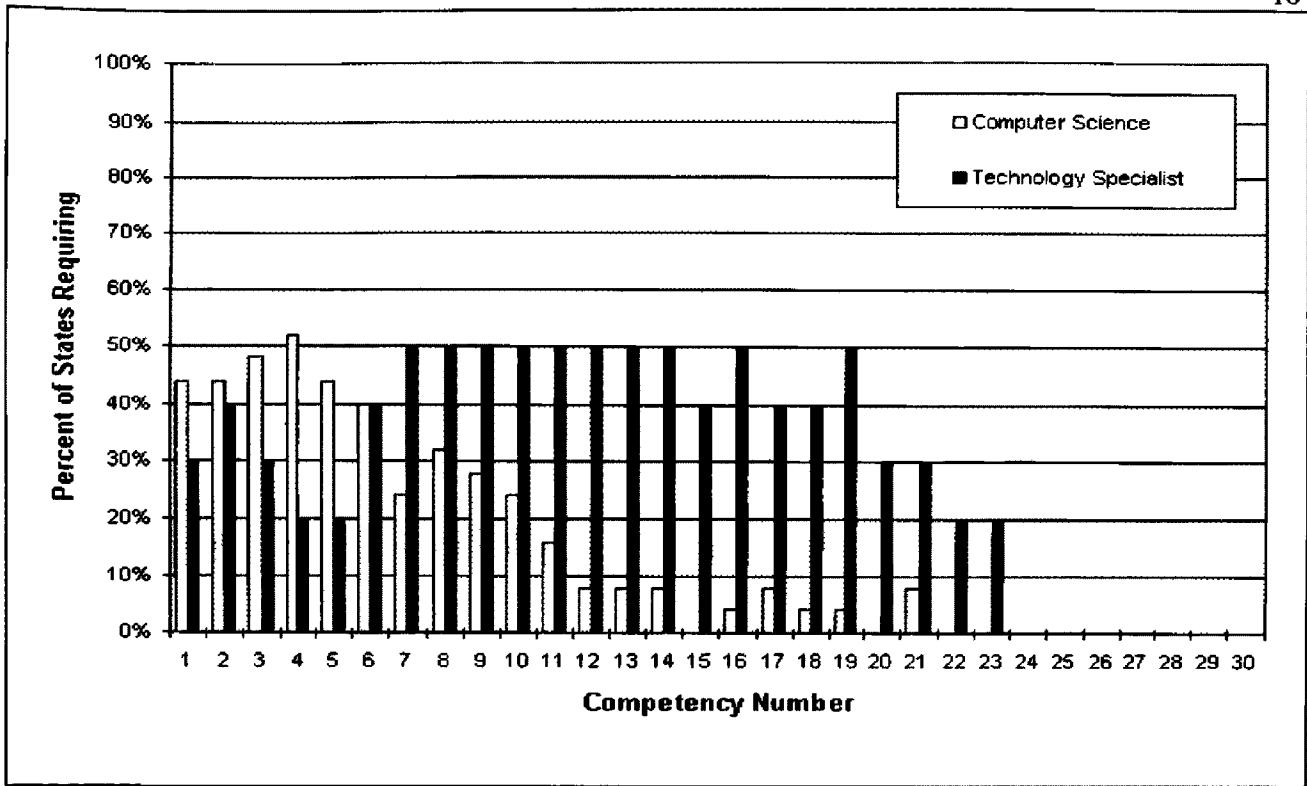


Figure 5. Requirements of states for computer science and technology specialist licensing

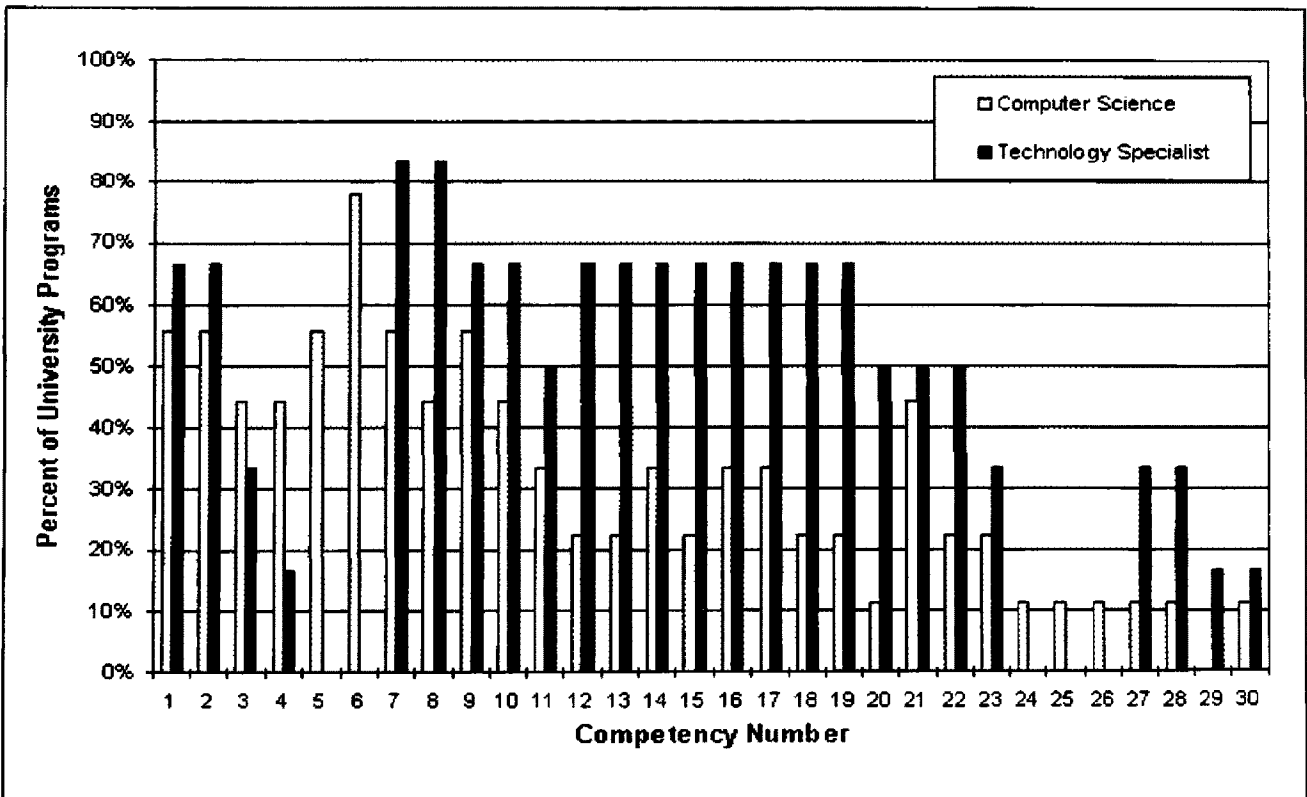


Figure 6. Requirements of university programs for computer science and technology specialists.

science programs (competencies 12 to 19). Figure 6 compares the requirements of the university programs.

Discussion

Part I General Competencies

Question 1. What competencies, if any, in instructional technology are currently required for teacher certification at the elementary, middle school, and secondary levels in the United States?

The most important aspect of the survey relating to the general competencies of new teacher licensees is the lack of specific requirements. The lack of requirements, combined with the opinion that an individual qualified to teach is also qualified to evaluate, purchase, and use various technology materials is one of the major sources for criticism of instructional technology today. There are, unfortunately, a large number of poorly written and produced software titles available to the educational community. Much of this software is overpriced and of questionable educational value. When an educational critic looks at the amount of money spent on poor quality material, and the lack of educational benefit from such materials, it is easy for them to justify their arguments against spending more money on technology that is not working.

Apparently the universities are taking the lead in requiring their graduates to be competent in areas concerning educational technologies. The requirements of the universities surveyed, although not entirely comprehensive, show vast improvement over the minimal state requirements. The monetary investment many schools have made in hardware and software requires a teaching staff well trained in the effective use of that equipment. When state requirements are minimal or lacking, the schools must supply the needed training of the beginning teachers. This overburdens already tight budgets. The universities

have taken steps in the right direction. It is up to the universities and public schools to pressure the states to increase standards in the areas of instructional technology thereby assuring a more knowledgeable and competent teacher applicant.

The collection and analysis of this data, have lead me to some conclusions on the state of the educational system in relation to instructional technology. The survey data clearly indicates that the state departments of education are not yet ready to put in place comprehensive standards in the area of instructional technology. Some states have taken the lead and have a comprehensive set of competencies (Colorado, North Carolina, and Tennessee), while others have what should be considered an incomplete set. A number of the states did indicate that they did not publish competencies due to current political situations. Financial constraints hampered other states in their movement toward establishing competencies.

Another reason for the lack of consistency lies in the definition of instructional technology. The entire field of information technologies is moving so rapidly it is hard to define the needs of teachers and students as we approach the 21st century. Any attempt to write a specific competency for a given area of technology may be outdated by the time the competency is printed and put into effect. Competencies must be structured to include the process and concept involved in the use of a specific piece of technology equipment, not the specifics of operation.

Any set of written competencies must include items covering four important areas: a) an understanding of how technology works and how it can be incorporated into the teacher's daily work; b) the ability to evaluate and select appropriate technology for the classroom; c) knowledge of the ways in which technology can assist in the education of

special needs students; and d) methods of research and information retrieval in this electronic age. Any competencies written should also apply to renewal as well as new teacher licensing to ensure that practicing teachers are up-to-date on the use of instructional technology.

If the states are unwilling or unable to establish a definite set of standards, the universities and colleges that prepare and retrain teachers should set standards to ensure competent teachers. The survey results show that the universities have taken this leadership role in the Northwest. This places a double burden on the universities in that they must not only update their programs but must update their equipment and faculty as well. The methods employed by the universities responding to the survey varied from offerings of specific classes designed to meet the criteria specified to the inclusion of materials within the existing methods courses. Of these methods, the preferred is the inclusion of instructional technology into the existing curriculum. For the institution this reduces the number of new courses required, but increased the need for training of the faculty. For the future teacher this allows for learning by example and by doing. Since many teachers revert to the methods they are most familiar with, the exposure to technology while preparing for the classroom will carry over into their classrooms.

The location least able to directly implement a set of competencies for teacher preparation is perhaps the most powerful in terms of influencing the implementation. At the elementary and secondary school levels the school systems can, through hiring procedures, influence the programs of the universities and hopefully gain influence on the states to upgrade overall standards. If school districts recruit and hire individuals with specific backgrounds, or

from states and universities that have strong programs in place, the long-term effect will not only strengthen the districts' educational programs, but will send a clear message to the universities that do not meet the criteria. If a university is unable to place teachers, and recruit new students, due to a poor program, the university must upgrade the graduation requirements to remain competitive.

Question 2. Has there been an increase in requirements in the area of instructional technology, for teacher licensure/certification over the past 5 years?

The 1989 Electronic Learning survey (Bruder, 1989) lists the number of states with various technology requirements. In the area of basic skills, 23 states plus DC (45%) reported requiring all or some students in teaching degree programs take computer courses. The survey data from the 1989 reports 19 of 45 states (43%) specifying computer skills. Seven states (14%) required all students to take a course on the integration of technology and/or media into the classroom in 1989 (Bruder, 1989).

The results of this survey indicate that 22 of 47 responding states (47%) now require competencies in the area of educational technology. Two states reported having requirements but did not indicate specific competencies. This indicated an increase of only 2% over the past 6 years. Survey results from the area of evaluation and classroom applications show from seven to eleven (16% to 25%) of the states requiring competencies that compare to the integration of technology or media of Bruder (1989).

These comparisons suggest a static environment in terms of increasing requirements in the preparation of teachers. In spite of calls for increased requirements, (Jensen, 1992), this study shows little overall advancement in that direction. It is not possible to

directly compare specific requirements of the Bruder (1989) survey to this survey as Bruder includes only a summary of her findings.

Part II. Computer Science endorsement

Question 3. What competencies related to instructional technology are required for a teaching endorsement in computer science?

The data from the states indicate indecision on the need for specialized computer science teachers with just over half (24 of 45) of states now offering an endorsement in this area. Those states that have the endorsement stress hardware systems, operating systems, and programming aspects of computer science. The universities are approaching the endorsement from a slightly different direction stressing the use of computers in learning and life, more than the strict techniques of programming and computer control. This shift of emphasis may follow the shift of computers from the corporate 'glass-room' to the desktop of workers and the living rooms of the general public.

School curriculum must change to reflect the needs of the society. The advent of the computer and use have had an enormous impact on society. Students are now familiar with the computer and relatively few have the need or desire for pure programming skills. Students use the computer as a tool and must be taught the proper usage just as they are taught the proper usage of an automobile. The state and university requirements for computer science do reflect the proper position of the field, computer hardware and programming. Most computer applications are better taught in conjunction with other subject areas and need not be blended with programming.

Part III. Technology Specialist Certification

Question 4. What competencies related to instructional technology are required for a certificate or endorsement as an instructional technology specialist?

Perhaps the most disappointing portion of the study is the data, or lack thereof, on the recognition of an educational technology specialist. The increase in the availability and use of technology in the schools over the past 15 years has been phenomenal. The survey data does not show any corresponding shift toward assuring trained personnel to assist schools in the planning, acquisition, and implementation of that technology. With only nine of the 45 responding states (20%) indicating the existence of a certificate or license in the area of educational technology, the leaders in educational technology will continue to be teachers or administrators struggling to keep up with the burden of two jobs. Until the leadership is recognized and encouraged, the school systems of the United States will remain reactive to the technologies rather than become proactive.

It is in this area that the definition of what constitutes instructional technology must be clarified. Despite placing a definition of instructional technology in the survey letter, states responded with requirements for industrial technology or technology education (formerly Industrial Arts), and media specialists (library media). While it is true that instructional technology relates to these areas, as well as to computer science, the field must encompass much more than the requirements for any one of these single fields.

The universities surveyed show promise for the future as 4 of the 19 responding schools (21%) indicated having a program in educational technology leadership, all of these in states that do not certify a technology specialist. The identified programs also show promise in the competencies required. They identify the technology specialist as a

person with a blend of technical knowledge of hardware and software, with a strong background in educational theory, and with leadership training.

Question 5. Do the requirements for a computer science endorsement or instructional specialist better qualify the holder for a leadership role in instructional technology?

The small amount of data related to licensing for technology specialists (9 states), and accompanying programs leading to degrees in educational technology (5 universities) prohibits a definitive answer to this question. With the emerging technologies that are blending computers and other media into a single field, the need for a computer background remains important. With the computer becoming a tool utilized in all subject areas, the need for a background in curriculum development and pedagogy cannot be ignored. Until all states and universities require their education graduates to be competent in the utilization of technology, the technology specialist must be adept at developing and implementing a training program for inservice teachers. As restructuring of the schools continues, the planning for inclusion of technology in the classroom is a major component of the restructuring.

Currently, the competencies for technology specialists are closer to fitting the above requirements. Only two states and the District of Columbia have at least some requirements in all areas. Of the university computer science programs, three of the nine programs require competencies in all areas. Only one of the six technology specialist programs at the universities requires more than a single, minimal computer competency. The foundations are in place. It appears that it will be up to the institutions to build on that foundation to prepare truly well-versed technology specialists from either program.

Recommendations

Throughout this study four items have surfaced which need addressing as schools move toward the future. The comments received from survey respondents, copies of published regulations, and the informal notes, indicate a wide variety of ideas as to what constitutes instructional technology. It is true that any attempt to define technology is like shooting at a moving target and a specific definition today will change tomorrow. However, at some time in the near future, educators must prepare a clear definition of instructional technology including what it is and how it relates to the classroom. This definition must include the educational use of: a) computer, audio, and video software (computer disk, CD-ROM, laserdisc, and magnetic tape); b) telecommunications (telephone, television, and satellite communications), and; c) electronic storage and retrieval of information.

Second, I must concur with Jensen's 1992 recommendation. States must write minimal standards addressing knowledge of instructional technology for teacher licensing. In addition, these standards should apply for renewal of licenses. Most of the standards now in use reflect the lack of a definition of instructional technology. We can no longer have a competency that addresses "use of a computer in the classroom." A single "computer literacy" or "use of audio and video media" competency is no longer enough. The preferred method of meeting these standards is for universities to incorporate the use of instructional technology into all teacher education courses.

Standards must address the following areas: a) selection and appropriate use of computer, audio, and video software; b) selection and operation of appropriate hardware; c) selection and appropriate use of television programming; d) electronic information access and retrieval;

e) operation of equipment for large group presentations or special needs students; f) appropriate use of technology in daily life; and, g) the role of technology in society.

Third, states must develop a technology specialist certification. Holders of this certification must be capable of working with administrators and instructional staff in developing and implementing a technology plan for a school district. Standards for this certification should include: a) teaching experience; b) knowledge of instructional pedagogy; c) knowledge of curriculum development at all levels, K-12; d) competency in the operation and basic troubleshooting of various technology hardware; e) an understanding of educational finance; f) training in long range planning, and; g) training in adult education.

Finally, universities must develop programs for technology specialists. The programs should be a part of the graduate degree programs for education. Much of the classwork is already available through educational leadership and curriculum and instruction courses. These courses can be augmented by courses in computer science, library media, and/or radio/television production.

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Appendix A

Teacher Competencies in Instructional Technologies

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Cooperating Organization: _____

Contact Person: _____

Telephone Number: _____

E-mail address: _____

If you would like to receive a copy of the project report upon completion please fill in your mailing address below.

Address: _____

Part I General Education Requirements

1. Are there requirements for instructional technology or computer competency in the bachelor degree program in education?

___ Yes Please answer question 2.

___ No Skip to part III.

2. Does the State Department of Education set these requirements as part of the certification/licensing requirements?

___ Yes, if available, please send a copy of any published document listing requirements for certification that would include those relating to instructional technology.

___ No, who does set the requirements?

Part II General Competencies for All Educators

Please indicate the level at which each of the following instructional technology competencies are required. (E1 - Elementary, MS - Middle School or Jr. High, HS - High School or Secondary)

(E1)	(MS)	(HS)	
___	___	___	1. General knowledge of computers, hardware, and software.
___	___	___	2. General knowledge of audio recorders, players.
___	___	___	3. General knowledge of video recorders, players, and laserdisc players.
___	___	___	4. General knowledge of the use of broadcast video (cable, satellite, and commercial television) in the classroom.
___	___	___	5. General knowledge of copyright laws regarding computer software and audio and video recordings.
___	___	___	6. The ability to identify current uses of technology in education and the home.
___	___	___	7. The ability to distinguish between the capabilities and limitations of instructional technology.
___	___	___	8. The ability to identify, evaluate, and select effective, appropriate courseware.
___	___	___	9. The ability to establish teaching strategies that integrate instructional technologies.
___	___	___	10. The ability to use computer assisted instruction software.
___	___	___	11. The ability to use computer managed instruction software.
___	___	___	12. A familiarity with special computer input devices such as graphics tablets, video capture, scanners, still cameras, MIDI devices, or voice recognition.
___	___	___	13. A familiarity with computer display and output devices such as color printers, music synthesizers, projection screens, large screen monitors, speech synthesizers.
___	___	___	14. The ability to use computerized library services programs.

(E1)	(MS)	(HS)	
_____	_____	_____	15. The ability to evaluate and select electronic research materials including CD-ROM and telecommunications resources.
_____	_____	_____	16. The ability to assist in the evaluation and selection of computer and audio/visual materials for classroom use.
_____	_____	_____	17. A knowledge of computer-based authoring and presentation software for classroom multimedia presentations.
_____	_____	_____	18. A familiarity with and an understanding of computer software including word processing, spreadsheets, and data bases.
_____	_____	_____	19. A familiarity with basic troubleshooting and general maintenance of equipment (computers, VCR's, televisions, etc.).
_____	_____	_____	20. Other (<u>Internet and electronic mail</u>)
_____	_____	_____	21. Other (<u>Instructional pedagogy- constructivist approach</u>)
_____	_____	_____	22. Other (<u>Working Practicum, elementary students with university mentors</u>)
_____	_____	_____	23. Other (<u>Electronic Publishing, Multimedia use and development</u>)
_____	_____	_____	24. Other (<u>Safety and crimes using computer</u>)

Part III Computer Science/Instructional Technology Specialist

___ Yes ___ No 1. Does your school have a specific educational program leading to certification or endorsement for computer science teaching?

If so, does the state department set requirements for this specialty?

___ Yes, please send a copy of the requirements if available.

___ No, who does set the requirements for this program?

___ Yes ___ No 2. Does your school have a specific program leading to certification or endorsement for an Instructional Technology Specialist?

If so, does the state department set requirements for this specialty?

___ Yes, please send a copy of the requirements if available.

___ No, who does set the requirements for this program?

Part IV Competencies for Computer Science Certification and/or Instructional Technology Specialist

If programs leading to certification or endorsement for Computer Science or Instructional Technology Specialist exist, please use the following list to indicate which competencies are required for the computer science and/or the instructional technology specialist degree programs.

**Computer Instructional
Science Technologist**

- | | | |
|-----|-----|--|
| ___ | ___ | 1. Identify hardware and software features, purposes, and proper care. |
| ___ | ___ | 2. Demonstrate the ability to set up and operate computers. |
| ___ | ___ | 3. Provide information on different programming languages suitable for elementary and secondary students. |
| ___ | ___ | 4. Demonstrate the ability to write in at least one educational programming language at a level sufficient to teach courses in that language and compare at least two programming languages. |

**Computer Instructional
Science Technologist**

- _____ 5. Demonstrate the ability to apply problem-solving techniques and to anticipate, identify, and correct programming errors.
- _____ 6. Understand computer operations by displaying knowledge of commonly used data and control structures, operating systems, file storage and access methods.
- _____ 7. Understand the broad area of computer technology as it relates to teaching and learning theory and practice.
- _____ 8. Identify appropriate use of the computer and computer programs in the K-12 curriculum.
- _____ 9. Provide information on contemporary issues and trends in computer technology.
- _____ 10. Demonstrate the ability to select and integrate appropriate hardware, software, and computer materials into classroom teaching methods.
- _____ 11. Identify review services and information sources for hardware and software prior to selection and integration into the curriculum.
- _____ 12. Provide leadership in selecting materials in accordance with the school's technology plan and existing curriculum.
- _____ 13. Provide leadership in identifying technology materials that need to be developed for use in the existing curriculum.
- _____ 14. Identify and provide information and training on hardware, peripherals, and related software appropriate for technology integration in the existing curriculum.
- _____ 15. Develop and modify annual and long-range goals for a comprehensive technology program as part of the instructional program.
- _____ 16. Provide leadership for using instructional technology in the K-12 instructional program.
- _____ 17. Implement procedures and direct activities for developing instructional technology programs, guidelines, and materials.
- _____ 18. Establish and implement procedures for the evaluation of the instructional technology program.

**Computer Instructional
Science Technologist**

- _____ 19. Provide leadership in evaluating and selecting instructional technology materials in accordance with the school's technology plan.
- _____ 20. Develop, implement, and monitor staff development activities needed to integrate instructional technology into the K-12 curriculum.
- _____ 21. Identify and provide information and training on hardware and related software appropriate for enhancing technology use.
- _____ 22. Provide leadership to organize and maintain an inventory of a school system's technology resources.
- _____ 23. Recognize the school's organizational patterns, instructional objectives, financial regulations, personnel policies, and building facility restrictions affecting the instructional technology program.
- _____ 24. Other (Software Design)
- _____ 25. Other (Practicum experiences in middle/high school)
- _____ 26. Other (Cognitive thinking skills development using computers)
- _____ 27. Other (Internet)
- _____ 28. Other (Multimedia use and development)
- _____ 29. Other (Electronic Publishing)
- _____ 29. Other (Subject matter methods courses)
- _____ 30. Other (Networking)

Appendix B

Comments from state Departments of Education

The following are comments and/or regulations submitted by the states.

Alabama

Under current Alabama regulations any professional teacher's certificate is considered proper certification to teach computer science/technology.

Alaska**Arizona**

Computer Science - 30 hours for major, 18 hours for minor

Arkansas

Computer Tech endorsement - bachelor's degree and teaching certificate.
Business Ed Computer Tech endorsement - certified in Business Ed, allows teaching programming and information systems.
Required course work - 9 hours computer applications and concepts including database management, graphics, spreadsheet applications and word processing; 3 hours programming; 3 hours electives

California**Colorado****Connecticut****Delaware**

Technology Education (formerly Industrial Arts) requirements sent.

District of Columbia

"... as a component of the professional educational requirements, applicants ... must present documentation outlining competencies in: 'the selection and use of materials, computers, media, technology, and other resources.'"

Florida

Computer Science - Plan One: undergraduate or graduate major in computer science including credit in computer applications and computer programming.

Plan Two: Bachelor's degree with 30 semester hours in computer science or computer science education including: Three semester hours in computer literacy; six semester hours in computer applications (word processing, data base applications, spreadsheet applications, telecommunications, graphics packages, computer as a control device) and; twelve semester hours in computer programming, to include six hours in Pascal and credit in data structures. (effective 1992).

Georgia

The Professional Standards Commission (PSC) is responsible of the certification of teachers and other education personnel and for determining standards for all educator preparation programs in Georgia. There are some broad based standards geared to instructional technology (literacy and applications) that institutions preparing education personnel must address. Colleges/Universities determine instructional technology content and competency levels. The PSC has general

expectations but no specific requirements. Any individual with a full-field professional teaching certificate is in-field to teach computer science.

Hawaii

Idaho

The present higher education offerings are technically and practically far more sophisticated for a major or minor than most teachers would pursue. Degree majors exist, but for outcomes other than classroom teaching. At this time Idaho has an endorsement (computer applications) but no standard for it. It is a "vanity" endorsement.

Illinois

Indiana

Computer endorsement (12 semester hours)
 Introduction to computer literacy
 Fundamentals of languages - BASIC/LOGO, Pascal
 Computer-based teaching methods - computer related and computer assisted instruction
 Relationship of computer to other disciplines
 The holder of this endorsement is eligible to teach a survey computer literacy course or serve as building level computer advisor.
 Professionalization requires completion of three semester hours of computer science at the upper division level and meeting the professionalization requirements.
 The computer endorsement is not required for teaching classes in computer literacy.

Iowa

At this time specific competencies are not addressed in state licensure requirements.
 Core requirements
 14.19 Completed course work or evidence of competency in:
 e. Audiovisual/media/computer technology.

Kansas

General technology requirements but not a specific list of requirements.
 General Standards
 91-1-80 Pre-service professional education
 (9) knowledge of evaluation techniques, research findings, teaching methods, laboratory techniques, materials, media, technology, and safety---.

Kentucky

Computer Science - Eighteen semester hours to include: college algebra, statistics, introduction to computer science and applications, and computer programming (9 semester hours).

Louisiana

Upper Elementary (Grades 5-8) - Universities which wish to require three hours of computer science of students should require a minimum of twelve semester hours in mathematics and a minimum of thirteen hours in science.
 Secondary - Three semester hours of computer science may substitute for three semester hours of science.

ADD-ON CERTIFICATION REQUIREMENTS

Computer Literacy - 9 semester hours including: computer literacy (3), computer science elective (3), and computer programming (3).
 Computer Science - 18 semester hours including: computer literacy (3), computer science elective (3), and computer programming (12).

Maine

Competencies for elementary and business education only.

Computer Technology Teacher endorsement (680)

Teach and/or coordinate computers in education K through 12

Minimum of 18 semester hours including three hours in at least four of the following areas: computer literacy, computer applications, evaluation of educational software, integration of computers into curriculum areas, computer hardware, computer in society, desktop publishing/graphic design, telecommunications, multimedia technologies, hypermedia technologies, networking, and computer programming.

Maryland**Massachusetts****Michigan**

The minimum requirement for the computer science endorsement is 20 semester hours for a minor and 30 semester hours for a major in computer science. This is an optional endorsement in the state of Michigan. Each university sets their own specific programs in computer science. Approval of each specific program is required by the state of Michigan.

Minnesota**Mississippi**

Certificate - Computer education: 24 semester hours programming courses; 18 semester hours computer applications

Endorsement - Computer applications: 3 hours computer literacy, 6 hours computer applications to include 3 hours programming, 3 hours applications or 6 hours computer apps.; and, 3 hours interactive instructional design.

Instructional Technology - certification area. "These masters, educational specialist, and doctorate degree programs should include the proper courses work to prepare an individual in the selected areas of multimedia, hypermedia, interactive media, emerging technologies, video and computer networking, planning for instructional technology, evaluation of technology effectiveness, desktop publishing, electronic presentation, facility design, technology laboratory management, distance learning, fiber optics, telecommunications, personnel management, resource management, and curriculum design and application at the three degree levels in addition to the standard professional, research, and general education requirements."

Missouri

Missouri does not offer certification in computer science. We are unable to assist in this matter.

Montana

Nebraska

Technology specialist - "We are still referring to this domain as 'Media Specialist'"

Requirements of colleges and universities for programs. Institution must provide:

"005.01F The latest communication technologies including, but not limited to, instructional television, instructional computing, film, videodisk, and other telecommunications technologies and in the appropriate uses of such technologies in the instructional process."

Nevada**New Hampshire**

New Hampshire had developed competencies for both computer science and computer technology 5 years ago but due to a moratorium by the State Board of Education nothing has been done and the competencies never implemented.

New Jersey

Teachers who hold standard instructional certificates in other areas may teach computer classes if they have and duty in computers including: (1) programming languages; (2) computer organization, and/or computer architecture; and, (3) data structures.

New Mexico**New York****North Carolina****North Dakota****Ohio**

Requirements are non-specific; Rather they require knowledge and skills required for classroom performance.

Coverage of some competencies up to each program and institution.

Oklahoma

Presently Oklahoma is not a competency-based certification system. Competency-based certification is mandated to be in effect 1-1-97.

Oregon**Pennsylvania****Rhode Island****South Carolina****South Dakota****Tennessee**

Data processing is an add-on endorsement to Basic Business/Accounting license.

The State Technology Office trains teachers in the use of technology as an inservice activity.

Texas**Utah**

Computer Literacy Endorsement
Computer Science teaching major or minor, or
A technology teaching methods course and 12 quarter hours providing
introductory competencies in technology areas
Computer Science Endorsement
Computer science teaching major or minor, or
Computer literacy requirements, plus 12 quarter hours computer science
courses to include structured programming and Data Structures, or
Demonstrate competency (minimum 2 years teaching experience).

Vermont**Virginia****Washington**

Detailed competencies are determined by each individual college.
Requirements [for computer science] are changing - probably in January
[1996] and will probably focus more on computer education.

West Virginia**Wisconsin****Wyoming**

Table C1. General Competency Requirements and Program Offerings by State

State	General Competencies			Computer Science			Technology Specialist		
	Y	N	NR	Y	N	NR	Y	N	NR
Alabama		X			X			X	
Alaska ¹			X			X			X
Arizona		X		X				X	
Arkansas		X		X				X	
California	X			X			X		
Colorado	X				X			X	
Connecticut		X			X			X	
Delaware		X			X			X	
District of Columbia	X			X			X		
Florida		X		X				X	
Georgia	X				X			X	
Hawaii		X			X			X	
Idaho		X			X			X	
Illinois		X			X			X	
Indiana		X		X				X	
Iowa	X				X			X	
Kansas	X			X				X	
Kentucky	X			X				X	
Louisiana		X		X			X		
Maine	X			X				X	
Maryland		X		X				X	
Massachusetts	-	-	-	-	-	-	-	-	-
Michigan		X		X				X	
Minnesota	X				X			X	
Mississippi		X		X			X		
Missouri		X			X			X	
Montana		X		X				X	
Nebraska	X			X				X	
Nevada	-	-	-	-	-	-	-	-	-
New Hampshire		X			X			X	
New Jersey		X			X			X	
New Mexico		X			X			X	
New York		X		X				X	
North Carolina	X				X		X		
North Dakota		X		X				X	
Ohio	X			X				X	
Oklahoma	X			X				X	
Oregon		X			X			X	
Pennsylvania	X				X		X		
Rhode Island		X			X			X	
South Carolina		X			X			X	
South Dakota	X			X			X		
Tennessee	X				X			X	
Texas	-	-	-	-	-	-	-	-	-
Utah	X			X			X		
Vermont	X			X				X	
Virginia	-	-	-	-	-	-	-	-	-
Washington	X			X				X	
West Virginia	X				X			X	
Wisconsin	X			X			X		
Wyoming	X			X			X		
Total	22	24	1	25	21	1	10	36	1
Percent of Total	43%	47%	2%	49%	41%	2%	20%	71%	2%

¹ Alaska returned the survey, but gave no response to any questions.

Table C2. General Competency Requirements and Program Offerings by University

University	General Competencies			Computer Science			Technology Specialist		
	Y	N	NR	Y	N	NR	Y	N	NR
Idaho									
Albertson College	X				X			X	
Boise State University	X				X			X	
Idaho State University	X				X			X	
Linfield College		X			X			X	
Montana									
Carroll College	X			X				X	
Montana State University	X			X			X		
MSU Billings	X			X			X		
MSU Northern			-			-			-
Rocky Mountain College	X				X			X	
University of Great Falls	X			X				X	
University of Montana			-			-			-
Western Montana College			-			-			-
Oregon									
Concordia College	X				X			X	
Pacific University	X				X			X	
University of Portland	X				X			X	
Western Baptist College			-			-			-
Western Oregon State College	X				X		X		
Washington									
Central Washington University	X			X				X	
Eastern Washington University			-			-			-
Gonzaga University	X				X			X	
Heritage College			-			-			-
NW College, Assemblies of God			-			-			-
Pacific Lutheran University	X			X				X	
Saint Martin's College	X			X			X		
Seattle Pacific University			-			-			-
The Evergreen State College			-			-			-
University of Washington			-			-			-
Walla Walla College			-			-			-
Washington State University	X			X				X	
Western Washington University	X			X				X	
Whitworth College			-			-			-
Wyoming									
University of Wyoming			-			-			-
Total	18	1	13	9	10	13	4	15	13
Percent of Total	56%	3%	41%	28%	31%	41%	13%	47%	41%

Table C3. General Competencies in Educational Technologies by State

StateName	Req	Basic Operation of Equipment				Evaluation/Classroom App						Competency Number					Other											
		1	2	3	4	5	6	7	8	9	10	11	Special		Research		16	17	18	19	20	21	22	23	24			
Alabama	N																											
Alaska	-																											
Arizona	N																											
Arkansas	N																											
California	Y	EMS					EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS				EMS	EMS	EMS	EMS							
Colorado	Y	EMS	EMS	EMS	EMS	EMS	EMS	EMS		EMS	EMS		EMS	EMS			EMS	EMS		EMS	EMS	EMS	EMS					
Connecticut	N																											
Delaware	N																											
District of Columbia	Y	EMS	EMS	EMS	EMS																							
Florida	N																											
Georgia	Y	EMS	EMS	EMS	EMS	EMS	EMS	ESM	EMS	EMS	EMS	EMS				EMS		EMS		EMS								
Hawaii	N																											
Idaho	N																											
Illinois	N																											
Indiana	N																											
Iowa	Y	EMS	EMS	EMS																								
Kansas	Y	EMS	EMS	EMS			EMS	EMS		EMS	EMS	EMS	EMS	EMS			EMS		EMS	EMS	EMS	MS						
Kentucky	Y	EMS				EMS		EMS																				
Louisiana	N																											
Maine	Y	E																										
Maryland	N																											
Massachusetts	-																											
Michigan	N																											
Minnesota	Y	EMS	EMS	EMS		EMS	EMS		EMS	EMS	EMS					EMS												
Mississippi	N																											
Missouri	N																											
Montana	N																											
Nebraska	Y	EMS			EMS					EMS											EMS							
Nevada	-																											
New Hampshire	N																											
New Jersey	N																											
New Mexico	N																											
New York	N																											
North Carolina	Y	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS		EMS	EMS		EMS	EMS	EMS	EMS						
North Dakota	N																											
Ohio	Y	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS																	
Oklahoma	Y																											
Oregon	N																											
Pennsylvania	Y	EMS																										
Rhode Island	N																											
South Carolina	N																											
South Dakota	Y	EMS	EMS	EMS	EMS																							
Tennessee	Y	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS		EMS	EMS		EMS	EMS	EMS	EMS						
Texas	-																											
Utah	Y																											
Vermont	Y						EMS		EMS																			
Virginia	-																											
Washington	Y	EMS	EMS	EMS	EMS																							
West Virginia	Y	EMS																										
Wisconsin	Y	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS				EMS	EMS		EMS	EMS	EMS							
Wyoming	Y	EMS	EMS	EMS	EMS					EMS	EMS	EMS	EMS								EMS							
Totals	22																											
Elementary		19	13	13	11	8	10	9	9	11	10	7	4	5	7	4	9	6	7	4	0	0	0	0	0	0	0	0
Middle School		18	13	13	11	8	10	9	9	11	10	7	4	5	7	4	9	6	8	4	0	0	0	0	0	0	0	0
Secondary		18	13	13	11	8	10	9	9	11	10	7	4	5	7	4	9	6	8	4	0	0	0	0	0	0	0	0

Y - state requirements exist N - No state requirements E - Elementary M - Middle School S - Secondary

Table C4. General Competencies in Instructional Technologies by University

State/University	Req	Competency Number																							
		Basic Operation of Equipment				Evaluation/Classroom App.						Special		Research		Other									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Idaho	N																								
Albertson College	Y	EMS		EMS		EMS	EMS	EMS	EMS	EMS	EMS		EMS	EMS	EMS	EMS									
Boise State University	Y	EMS		EMS		EMS	EMS	EMS	EMS	EMS	EMS		EMS	EMS			EMS	EMS	EMS	EMS					
Idaho State University	Y	EMS	EMS	EMS												EMS				EMS					
Linfield College	N																								
Montana	N																								
Carroll College	Y	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS			EMS	EMS	EMS					
Montana State Univrsity	Y	EMS	EMS	EMS		EMS	EMS	EMS	EMS	EMS	EMS		EMS	EMS			EMS	EMS	EMS						
MSU Billings	Y	EM			EM		EM	EM	EM				EM	EM			EM		EM	EM					
MSU Northern	-																								
Rocky Mountain College	Y	EMS	EMS	EMS		EMS	EMS	EMS	EMS	EMS	EMS	EMS		EMS	EMS	EMS	EMS	EMS	EMS						
University of Great Falls	Y	EMS	EMS	EMS		EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS
University of Montana	-																								
Western Montana College	-																								
Oregon	N																								
Concordia College	Y	EMS	E	E		EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS			EMS	EMS	EMS					
Pacific University	Y	EMS	EMS	EMS	Opt	EMS	EMS	EMS	EMS	EMS	EMS		Opt	EMS			EMS	EMS	EMS	Opt	EMS				
University of Portland	Y	EMS					EMS		EMS										EMS	EMS			EMS		
Western Baptist College	-																								
Western Oregon State College	Y	EMS	EMS	EMS		EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS			EMS		EMS	EMS	EMS				
Washington	Y	EMS	EMS	EMS	EMS																				
Central Washington University	Y	EMS	EMS	EMS		EMS	EMS	EMS	EMS							EMS	EMS			EMS		EMS			
Eastern Washington University	-																								
Gonzaga University	Y	E	E	M	M	E	S	S	S	M	M	S	M	E	M	M	S	S	M	S					
Heritage College	-																								
NW College, Assemblies of God	-																								
Pacific Lutheran University	Y	EMS	EMS	EMS			EMS	EMS	EMS	EMS	EMS	EMS	EMS	EMS			EMS		EMS	EMS	EMS				
Saint Martin's College	Y	EMS	EMS			EMS		EMS		EMS	EMS	EMS	EMS	EMS			EMS		EMS	EMS				EMS	
Seattle Pacific University	-																								
The Evergreen State College	-																								
University of Washington	-																								
Walla Walla College	-																								
Washington State University	Y	EM		EM		EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM	EM				
Western Washington University	Y	EMS	EMS	EMS		EMS	EMS	EMS	EMS	EMS	EMS	EMS		EMS		EMS		EMS		EMS	EMS			EMS	
Whitworth College	-																								
Wyoming	Y	EMS	EMS	EMS	EMS			EMS	EMS	EMS	EMS								EMS						
University of Wyoming	-																								
Totals																									
States	2																								
Elementary		2	2	2	2	0	0	0	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0
Middle School		2	2	2	2	0	0	0	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0
Secondary		2	2	2	2	0	0	0	1	1	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0
Unversities	18																								
Elementary		18	13	14	2	13	15	14	15	14	12	11	9	11	7	13	13	12	15	2	2	2	1	1	1
Middle School		17	11	14	3	12	15	14	15	15	13	11	10	10	8	14	13	12	16	2	2	2	1	1	1
Elementary		15	11	12	1	11	14	13	14	13	11	11	7	9	6	11	13	11	13	3	2	2	1	1	1

Table C5. Computer Science Endorsements and Competencies by States

StateName	Hardware		Programming				Teaching Methods					Competency Number							Training		Other										
	End.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Alabama	N																														
Alaska	-																														
Arizona	Y																														
Arkansas	Y																														
California	Y	Y	Y	Y		Y	Y	Y		Y	Y																				
Colorado	N																														
Connecticut	N																														
Delaware	N																														
District of Columbia	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	Y	Y	Y		Y									
Florida	Y	Y	Y		Y		Y																								
Georgia	N																														
Hawaii	N																														
Idaho	N																														
Illinois	N																														
Indiana	Y																														
Iowa	N																														
Kansas	Y	Y	Y	Y	Y	Y	Y			Y		Y		Y	Y			Y				Y									
Kentucky	Y																														
Louisiana	Y	Y	Y	Y	Y																										
Maine	Y	Y	Y		Y				Y	Y	Y		Y																		
Maryland	Y																														
Massachusetts	-																														
Michigan	Y																														
Minnesota	N																														
Mississippi	Y			Y	Y	Y	Y																								
Missouri	N																														
Montana	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																			
Nebraska	Y		Y	Y	Y	Y																									
Nevada	-																														
New Hampshire	N																														
New Jersey	N																														
New Mexico	N																														
New York	Y																														
North Carolina	N																														
North Dakota	Y																														
Ohio	Y																														
Oklahoma	Y			Y	Y	Y		Y	Y		Y																				
Oregon	N																														
Pennsylvania	N																														
Rhode Island	N																														
South Carolina	N																														
South Dakota	Y	Y		Y	Y	Y	Y	Y	Y	Y																					
Tennessee	N																														
Texas	-																														
Utah	Y																														
Vermont	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y																				
Virginia	-																														
Washington	Y	Y	Y	Y	Y	Y	Y		Y	Y																					
West Virginia	N																														
Wisconsin	Y	Y	Y	Y	Y	Y	Y																								
Wyoming	Y																														
Total Responding	25	11	11	12	13	11	10	6	8	7	6	4	2	2	2	0	1	2	1	1	0	2	0	0	0	0	0	0	0	0	0
Percent requiring		44%	44%	48%	52%	44%	40%	24%	32%	28%	24%	16%	8%	8%	8%	0%	4%	8%	4%	4%	0%	8%	0%	0%	0%	0%	0%	0%	0%	0%	0%

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Table C6. Computer Science Programs and Competencies by Universities

State/University	Req	Hardware		Programming				Teaching Methods					Competency Number							Other											
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Idaho	N																														
Albertson College	N																														
Boise State University	N																														
Idaho State University	N																														
Linfield College	N																														
Montana	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Carroll College	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Montana State University	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
MSU Billings	Y																														
MSU Northern	-																														
Rocky Mountain College	N																														
University of Great Falls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
University of Montana	-																														
Western Montana College	-																														
Oregon	N																														
Concordia College	-																														
Pacific University	N																														
University of Portland	N																														
Western Baptist College	-																														
Western Oregon State College	N																														
Washington	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Central Washington University	Y																														
Eastern Washington University	-																														
Gonzaga University	N																														
Heritage College	-																														
Nw College, Assemblies of God	-																														
Pacific Lutheran University	Y	Y	Y				Y	Y	Y	Y	Y			Y			Y														
Saint Martin's College	Y		Y				Y	Y																				Y	Y	Y	
Seattle Pacific University	-																														
The Evergreen State College	-																														
University of Washington	-																														
Walla Walla College	-																														
Washington State University	Y	Y					Y	Y			Y											Y									
Western Washington University	Y			Y	Y	Y	Y									Y						Y									
Whatworth College	-																														
Wyoming	Y																														
University of Wyoming																															
Totals																															
States	3	2	2	2	2	2	2	1	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Percent of States		67%	67%	67%	67%	67%	67%	33%	67%	67%	33%	33%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Universities	9	5	5	4	4	5	7	5	4	5	4	3	2	2	3	2	3	3	2	2	1	4	2	2	1	1	1	1	1	0	1
Percent of Universities		56%	56%	44%	44%	56%	78%	56%	44%	56%	44%	33%	22%	22%	33%	22%	33%	33%	22%	22%	11%	44%	22%	22%	11%	11%	11%	11%	0%	11%	

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Table C7. Technology Specialist Competencies, States

State	Prog	Hardware		Programming				Teaching Methods					Competency Number							Training		Other									
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Alabama	N																														
Alaska	.																														
Arizona	N																														
Arkansas	N																														
California	Y																														
Colorado	N																														
Connecticut	N																														
Delaware	N																														
District of Columbia	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Florida	N																														
Georgia	N																														
Hawaii	N																														
Idaho	N																														
Illinois	N																														
Indiana	N																														
Iowa	N																														
Kansas	N																														
Kentucky	N																														
Louisiana	Y																														
Maine	N																														
Maryland	N																														
Massachusetts	.																														
Michigan	N																														
Minnesota	N																														
Mississippi	Y					Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Missouri	N																														
Montana	N																														
Nebraska	N																														
Nevada	.																														
New Hampshire	N																														
New Jersey	N																														
New Mexico	N																														
New York	N																														
North Carolina	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
North Dakota	N																														
Ohio	N																														
Oklahoma	N																														
Oregon	N																														
Pennsylvania	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Rhode Island	N																														
South Carolina	N																														
South Dakota	Y																														
Tennessee	N																														
Texas	.																														
Utah	Y																														
Vermont	N																														
Virginia	.																														
Washington	N																														
West Virginia	Y																														
Wisconsin	Y	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	
Wyoming	Y																														
Total	10	3	4	3	2	2	4	5	5	5	5	5	5	5	4	5	4	4	4	5	3	3	2	2	0	0	0	0	0	0	
Percent of Total		30%	40%	30%	20%	20%	40%	50%	50%	50%	50%	50%	50%	50%	40%	50%	40%	40%	50%	30%	30%	20%	20%	0%	0%	0%	0%	0%	0%	0%	
Computer Science	25	11	11	12	13	11	10	6	8	7	6	4	2	2	2	0	1	2	1	1	0	2	0	0	0	0	0	0	0	0	
Tech Coordinator	10	3	4	3	2	2	4	5	5	5	5	5	5	5	5	4	5	4	4	5	3	3	2	2	0	0	0	0	0	0	

Table C8. Technology Specialist Programs and Competencies by Universities

State/University	Competency Number																																
	Hardware			Programming				Teaching Methods					Planning							Training			Other										
	Pro	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30		
Idaho	N																																
Albertson College	N																																
Boise State University	N																																
Idaho State University	N																																
Lunfield College	N																																
Montana	N																																
Carroll College																																	
Montana State University	Y	Y	Y	Y				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
MSU Billings	Y	Y						Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
MSU Northern	-																																
Rocky Mountain College	N																																
University of Great Falls	N																																
University of Montana	-																																
Western Montana College	-																																
Oregon	N																																
Concordia College	-																																
Pacific University	N																																
University of Portland	N																																
Western Baptist College	-																																
Western Oregon State College	Y	Y	Y					Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Washington	N																																
Central Washington University	N																																
Eastern Washington University	-																																
Gonzaga University	N																																
Heritage College	-																																
NW College Assembly of God	-																																
Pacific Lutheran University	N																																
Saint Martin's College	Y		Y					Y	Y																			Y	Y		Y		
Seattle Pacific University	-																																
The Evergreen State College	-																																
University of Washington	Y																																
Walla Walla College	-																																
Washington State University	N																																
Western Washington University	Y	Y	Y	Y	Y			Y	Y	Y	Y		Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y		
Whitworth College	-																																
Wyoming	Y																																
University of Wyoming	-																																
Totals																																	
States	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Percent of Total		0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Universities	6	4	4	2	1	0	0	5	5	4	4	3	4	4	4	4	4	4	4	4	3	3	3	2	0	0	0	2	2	1	1		
Percent of Universities		67%	67%	33%	17%	0%	0%	83%	83%	67%	67%	50%	67%	67%	67%	67%	67%	67%	67%	67%	50%	50%	50%	33%	0%	0%	0%	33%	33%	17%	17%		