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Preservice Technology Integration through Collaborative Action Communities

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Building on a successful field-based preservice program aimed at effective strategies for teaching diverse urban youth, the University of Houston is instituting an action research process to actively collaborate with Houston-area school districts to establish networked learning communities of university faculty, preservice teachers, and school-based educators to support the development of future teachers. The College has specific plans to restructure its required one semester, three-credit-hour technology course to a series of three, one-credit-hour technology sections tied directly to methods courses to allow students to develop appropriate content methods-based technology proficiencies. Field-based students will work with identified mentor teachers who use technology in real classrooms, and students will compile and maintain electronic portfolios throughout their preservice experience. Virtual field experiences of exemplary teaching will be brought to campus-based students and unique campus resources to field-based students in the form of traditional and online video collections. To ensure that all members of our learning community are effectively prepared for appropriate inclusion of technology in content methods courses, faculty and students will participate in a comprehensive support model of classroom instruction, workshops, and field-based experiences with the aid of a cadre of trained Technology Fellows.

Throughout the final decade of the Twentieth Century, educators involved with the preparation of new teachers have repeatedly recognized the need for a strong technology component for preservice programs and have experimented with a variety of learning models that integrated technology (e.g., Beichner, 1993; Carr, 1992; Falba, Strudler, Bean, Dixon, Markos, McKinney, & Zehm, 1999; Munday, Windham, & Stamper, 1991; Rodriguez, 1996; Smith, Houston, & Robin, 1994; Thompson, Schmidt, & Hadjiyianni, 1995; Willis, 1997). While pockets of success have indeed been celebrated, there is agreement that new teachers are generally not being prepared to effectively integrate technology in their future classrooms (Office of Technology Assessment, 1995; Strudler, Quinn, McKinney, & Jones, 1995; Willis & Mehlinger, 1994). In citing the inadequacies of the efforts of preservice programs, the literature appears to converge around the following points:

- It is no longer sufficient to send new teachers into the classroom prepared only with one disconnected technology-in-education course; introductory courses should instead be project-based and meaningful, followed by appropriate modeling and use in content methods courses and field experiences (Handler, 1993; Wetzel, 1993).
- True modeling of how objectives can be accomplished using technology for instruction is rare in preservice programs (Bosch & Cardinale, 1993; Office of Technology Assessment, 1995; White, 1994).
- Colleges of education faculty are in need of professional development opportunities to

learn how to effectively integrate relevant technology use into their curriculum strategies and content standards (Office of Technology Assessment, 1995; O'Bannon, Matthew, & Thomas, 1998; Parker, 1997; Sprague, Kopfman, & Dorsey, 1998; Zachariades & Roberts, 1995).

- Preservice teachers want to learn strategies for integrating technology tools into their teaching (Mowrer-Popiel, Pollard, & Pollard, 1992; Oliver, 1994), and expect to use computers in their teaching .
- (Marcinkiewicz & Wittman, 1995) but express their feelings of frustration at their lack of technology proficiency (Francis-Pelton & Pelton, 1996) and a lack of understanding of effective technology use in contemporary classrooms (Balli, Wright, & Foster, 1997).

As we move forward into the Twenty-first Century, we are poised for widespread, concerted action to prepare future teachers as complete professionals who are able to adeptly use and integrate into the curriculum ,all available learning tools. State and national organizations are leading the accountability push by implementing standards for the use of technology by teachers (Handler & Strudler, 1997; Hirumi & Grau, 1995; Northrup & Little, 1996; Thomas, 1994; Wiebe & Taylor, 1997). In 2000, the International Society for Technology in Education (ISTE) will release the National Educational Technology Standards for Teachers (NETS•T), a blueprint for the design of preservice technology programs developed through the extended collaboration of various stakeholders (Thomas, 2000). As this standards-based movement brings a clearer vision to the preparation of preservice teachers, teacher education programs across the country must finally acknowledge the long trend of research findings and recommendations to design appropriate learning environments that challenge long-standing curriculum structures. At the University of Houston, we are planning to implement such changes.

Need for Program Improvement

The University of Houston (UH) College of Education has a history of providing innovative teacher education programs, grounded in research and effective practice, for urban, at-risk populations. UH is located in the heart of Houston, the nation's fourth largest city, in the Third Ward, an inner city poverty area of Hispanic and African American cultures, which has been identified as a federal Empowerment Zone. In this setting, the College of Education works to strengthen the students in area schools as well as those in our program. Approximately 450 elementary and secondary teachers graduate from UH each year, with minority students constituting 37% of the College's undergraduate enrollment.

The University of Houston Pedagogy for Urban Multicultural Action (PUMA) Program

The UH teacher preparation program is predicated on a belief of learning throughout the career of a professional educator, beginning with effective preservice preparation and successful entry into the teaching profession. To that end, the PUMA program was designed to develop new teachers who can demonstrate current best practices, understand the needs of diverse youth within a constantly changing society, and reflect on their own learning and experience. Based at Professional Development Schools (PDS), PUMA provides authentic classroom settings in which preservice teachers can learn and practice effective teaching strategies, while working with university faculty and qualified School-Based Teacher Educators (SBTEs). The UH faculty teach subject-specific courses in 31 PDS locations across 8 school districts in the Houston metropolitan area.

The four-semester sequence of PUMA is offered in three phases: Pre-PUMA, Phase I PUMA, and Phase II PUMA. All prospective teachers in Texas, both elementary and secondary, are required to have a major in the arts and sciences, not in education. Following two years of university required courses in the Arts and Sciences, juniors begin the Pre-PUMA program, which includes courses in the theories and practices of effective classroom management, understanding the psychological needs of learners at all ages, and instructional technologies for the classroom. Phase I PUMA follows with a one-semester coordinated set of field-based courses that focus on the basic study of the history and philosophy of American education, the development of professional planning, instruction, and evaluation skills, and specific content methods courses. Phase I preservice teachers are placed in clusters at PDS schools to participate in methods courses and classroom placements on alternating days, permitting students to integrate theory directly with practice. Students who successfully complete Phase I are approved for admission into Phase II, a 14-week student teaching/internship placement, often in the original Phase I cluster schools, in which students demonstrate those sets of knowledge, skills, and attitudes reflective of a beginning professional.

Emerging Themes of Need

Although the PUMA program has received both local and national acclaim, several significant challenges remain related to improving the coherence of the entire PUMA program, some that can be addressed through the integration of technology in the most appropriate ways to meet the needs of a diverse student population. To begin to identify needs, we relied on long-standing collaborative relationships among the 32 school districts in the Houston area to invite key technology leaders to participate in a community-based consortium that would propose solutions to these challenges (Stringer, 1999). Analysis of baseline data collected through extensive surveys and focus group interviews from this consortium, along with preservice teachers and faculty, yielded a set of themes that helped us delineate the challenges this improvement initiative is designed to address.

Need 1: Access. The first challenge we face is identifying the best ways to create access to technology among our widely diverse urban student population. Although 73% of our students have home access to computers, only 3% own a portable computer that can be used in flexible groupings with other students and teachers for both campus and field-based coursework. Van Gorp (1998) suggests the ongoing difficulties with the accessibility of portable computers is an issue that will dissipate with increased student ownership of laptops.

Need 2: Coherence. Another challenge is a lack of coherence and the disconnection between the PrePuma courses and the rest of the PUMA program. Little across-course planning among the instructors gives the students the impression that these courses are separate entities—merely a set of academic hurdles, rather than a meaningful sequence of preparation. Furthermore, unlike the highly structured field experiences of PUMA Phases I and II, there is no field-based experience and sparse technology integration in Pre-PUMA. When queried, our students indicated a strong need for accessible networking for communication between campus-based and field-based experiences and resources.

Need 3: Educational technology.The third challenge that consortium members identified is that the current plan addresses educational technology with a single course taken typically during the Pre-PUMA phase of the program. This placement is not ideal for several reasons, including the

fact that such a "one shot," disconnected course does not allow students to see ways in which technology can be seamlessly integrated into content area strategies. When surveyed, UH preservice teachers perceived the importance of technology, but were unsure as to the benefit derived from the single course currently required. A majority reported, however, that they are rarely required to use technology in any other methods courses.

Need 4: Faculty training. The fourth challenge facing the college is a lack of faculty confidence and skill with technology. Although data from a faculty survey revealed 100% computer ownership for 5 years or more, actual instructional computer use in the classroom dropped dramatically. A majority of faculty expressed a desire to use more technology tools to improve their classroom teaching, however even those faculty members who are technologically proficient express concern about teaching technology strategies in addition to their already very full curriculum. Further, little effort has been made to collaborate with faculty in other colleges across campus that teach preservice teachers prior to acceptance into the PUMA program.

Design for Program Improvement

The initiative for program improvement emerged from the needs identified by the stakeholders. Those needs led to revised goals and objectives, which led to proposed actions, anticipated outcomes, and ultimately, multifaceted, interpretive, and participant-focused evaluation strategies. Figure 1 illustrates the vision for how the proposed goals fit within the overarching goal of continuous systemic improvement. The process we strive to build is based on *action research*, which is defined as a systematic process through which stakeholders work together to frame questions about teaching and learning, to problem-solve, to implement proposed solutions, and to document and evaluate the subsequent results of their actions (Lawler, 1985; Stringer, 1999). The specific model used spirals from the initial need through the stages of *Listen*, *Think*, and *Act* (Stringer, 1999), with the logical subsequent dissemination stage of *Share* to complete the sequence and feed the next spiral in the process. We *listen* by consulting stakeholders to assess what they see as collective needs; we *think* by setting goals and designing specific projects as a community; we *act* by implementing those plans; and we *share* by assessing progress toward goals and supplying that feedback to all stakeholders, in turn feeding the next listening phase. This process embodies the reflective decision-making among learning communities, which is integral to the PUMA program.

Our collaborative partnership can be described by three interlocking tiers of participation. At the core of the partnership is the vital relationship among the UH College of Education and the Houston-area school districts where the PUMA students are placed. They will additionally be the main participants in the action research process on which the program improvement plan is based. The next level of participation will include those who are not involved directly in the design process, but who nevertheless have a stake in the success of the program change efforts. For instance, interested faculty in other UH colleges will begin to bolster the goal of creating technology-infused learning environments for preservice teachers prior to PUMA admission. Additionally, we plan to disseminate results to other PUMA school districts who are unable to participate at this time, with the goal of inviting a majority of Houston-area districts to work with us in improving the education of our preservice teachers. It would be simpler to implement technology-related initiatives in isolation, without involving the stakeholders. We are optimistic that this commitment to stakeholders' regular participation in data-based decisions will contribute to success of the initiative, establishing improved communication between university and schools.

Goals According to Need

Below is a brief narrative description of each goal. Tables for each need outline the structure for design improvements to our program, including objectives, actions, outcomes, and outcome measures.

I.A. (Table 1) Networked learning communities will be established to provide collaborative and supportive environments in which preservice teachers can share and develop content, pedagogical, and technological expertise. Learning communities (Fullan, 1999) of preservice teachers, university faculty, and K-12 teachers will be established to support beginning teachers from initial coursework through induction teaching years. Students entering the PUMA program will be invited into these smaller, more nurturing subsets of the larger program, giving immediate support to new members and a virtual place to learn that is available from anyplace and at anytime. More experienced members can offer guidance and insight to new students, while newer students can constantly challenge more experienced members to reconsider previous conceptions.

Technology will play an invaluable role by connecting those at various distant locations and asynchronous occasions. Marcinkiewicz & Wittman (1995) found that among the first-year teachers they surveyed, almost half did not regularly use a computer. In response to this continued need for new teachers, the new ISTE NETS•T standards for the first time address performance profiles for first year teachers (ISTE, 2000). Accordingly, students in the UH program will ultimately be encouraged to remain in contact throughout their induction years, continuing peer and faculty support and providing students still in the program with connections to real teachers struggling with real technology issues.

I.B. (Table 1) All students will have access to current-model portable computer technology on a regular, immediate, and flexible basis. Preservice teachers will use computers both as students in university-based courses and as teachers in their field-based classrooms. We consider laptop computers to be the most effective way to encourage spontaneous learning anywhere at any time. Wireless hubs will be installed in classrooms through the College of Education building, and a mobile, wireless, laptop station will be purchased for use by PUMA faculty and Technology Fellows in any classroom in the building. Students will regularly experience the versatility of portable computers, thus creating an understanding of the need for portable computers in their learning and teaching. PUMA admissions guidelines for school year 2001-2002 will require the lease or ownership of a laptop computer; reasonably-priced laptops with accessible leasing and financing plans will be made available by business partners, and organizations such as the college alumni association will sponsor laptops for students in need. This plan not only solves the noted need-based problem with the laptop computers, but also invites alumni into the learning communities, potentially recruiting those who would not normally make financial contributions.

II.A. (Table 2) The College will offer a comprehensive, connected, and extended technology experience. To provide an environment in which future teachers can come to see the appropriate and exemplary use of technology in education, we will restructure our current three-credit hour required technology in education course into three one-credit-hour sections to be taken over the three-semesters leading up to the student teaching experience. Campus-based students will use technology appropriately in methods courses, and will also attend a one-hour weekly lab to

reinforce content-related technology strategies, while field-based PUMA I and II students will work with identified technology-using master teachers and receive site-based workshops and electronic support.

II.B. (*Table 2*) *Students will have comprehensive and coordinated opportunities to develop standards-based technology proficiency*. Entering PUMA students will demonstrate basic technology proficiency through a performance-based pretest so instructional efforts during PUMA can focus on the use of technology in instruction. Recommendations for such general preparation for students is found in the new ISTE NETS standards (ISTE, 2000), and we have found, as have others (Kirby & Schick, 1998), that students are now entering preservice programs with some experience with basic word processing and communication technologies. Those who are lacking the required skills will have ample opportunities to develop basic skills prior to PUMA admission through a series of topic-specific workshops (Balli, Wright, & Foster, 1997), recommended courses, and other support. Throughout PUMA, students will use various technologies to reinforce basic skills, personal and professional productivity, and effective content instruction.

II.C. (Table 2) Students will compile and maintain electronic portfolios throughout their preservice experience. While traditional grades will still be required by the university, an electronic performance-based portfolio system will be established to allow students a venue to reflect on and demonstrate growth, to develop a working knowledge of pedagogy, (Carroll, Potthoff, & Huber, 1996), and to hone a professional voice (McKinney, 1998). Portfolios have been shown to be a flexible assessment format capable of addressing criteria not a part of traditional assessments, such as continuous student reflection, individual assessment of growth and change, iterative evaluation of learning goals, and the contextual examination of created products in relation to complex teaching processes (Barton & Collins, 1993; Guillaume & Yopp, 1995; Levin, 1996; Snyder, Lippincott, & Bower, 1998; Wade & Yarbrough, 1996). Not only will portfolios give students an authentic example of assessment that they might use in their own teaching, but students will graduate with a tangible record of their experiences and a better understanding of their own abilities. Students might also include representative examples of work produced by the students they teach (Hoelscher, 1997). Students will receive instruction on technical procedures, style guidelines, and ethnographic strategies for selecting representative examples their own work.

III.A. (Table 3) Technology will be used to provide virtual field experiences to campus-based students. Video capabilities will be used to situate campus-based methods instruction in real classroom contexts. A collection of virtual field experiences using a variety of traditional and emerging video technologies will be developed, implemented, and evaluated. Methods and IT faculty will identify exceptional teaching and technology integration examples in collaboration with SBTEs. IT graduate students and staff will collaborate to plan, record, prepare, and compile high-quality video scenarios for use in on campus-based classes and in online training.

III.B. (Table 3) Technology will be used to bring unique campus resources to field-based students. While preservice teachers participating in the field-based PUMA programs benefit greatly from being immersed in authentic classroom settings, there are instances when the widely distant PDS locations prove problematic. It is difficult, for example, for certain expert speakers to regularly travel to all field sites. Certain unique courses will be taught to students in the field by campus-based experts through technologies such as video, online streaming video, videoconferencing, and web-based communication. IT graduate students and staff will

collaborate with faculty experts to plan, record, and prepare the presentations.

IV.A. (Table 4) Faculty and students will participate in new models of teaching and learning for the purpose of developing technology proficiency. Faculty will be assisted in developing skill and confidence in appropriate uses of technology for their content areas through intensive workshops during intersessions, summer, and weekends. Handler and Strudler (1997) suggest a collaborative process in which content methods faculty work with instructional technology faculty to align content strategies and resources with technology standards using a matrix technique. We feel such a collaborative alignment process not only capitalizes on our *f*aculty's full range of expertise, but helps to establish our collective meaning of technology integration for everyone involved with teacher preparation at the UH.

Of prime importance to the success of this program is the one-on-one collaboration that PUMA faculty will receive from Technology Fellows, Instructional Technology graduate students specially trained in such skills as content-area technology integration, mentoring, and adult learning theory. Similar to student-faculty mentoring plans proposed by others (Sprague, et al., 1998; Zachariades & Roberts, 1995), Technology Fellows will collaborate with and support PUMA faculty members in content areas to identify technology strategies that can be used to teach and demonstrate content-related concepts, to assist with set up and operation of necessary technology, and to generally help faculty gain confidence in their own personal technology skills. In addition, Technology Fellows will be accessible contacts to students in campus-based methods courses, during weekly computer lab workshops (Khan, 1997), and electronically via e-mail. After the first year, the Technology Fellows will commute to PDS sites with the PUMA students to maintain consistent student contacts, ensure properly functioning technology, and facilitate university-school relationships onsite. Completing our learning community concept, such relationships will make a school-based learning environment feasible and at the same time give our IT graduate students valuable experience in authentic teaching environments.

Table 5 illustrates the anticipated timeline for this program improvement.

Continuous Assessment of Program Success

These program change efforts were designed to increase the technological readiness of future teachers through an action research-based process. To monitor and continually adjust our efforts, we have developed an evaluation plan to address both process and product outcomes according to our inclusive approach.

After establishing baseline data from preservice teachers, university faculty, and SBTEs questionnaires and focus groups, we will continue working to identify more in-depth, qualitative assessment strategies to reassess the need and the strength of our research process. To ensure that the program is progressing toward the goals, we will: (a) ensure that national and state standards concerning content, pedagogy, and technology integration are met (e.g., Texas Essential Knowledge and Skills - TEKS, and the International Society for Technology in Education); (b) demonstrate that program curriculum supports the standards; and (c) base student assessment on the standards, through state assessment instruments (EXCET test) and local assessments, such as collaboratively developed rubrics. The process itself will be repeatedly assessed so that it accurately represents stakeholder needs, interests, and strengths.

We consider this unique teacher preparation approach ideal for the longitudinal study of the development of pedagogical skill and technology proficiency of new teachers. The rich context

will support numerous research projects, yielding data from a wide range of procedures and instruments. The Share phase of our design (Figure 1) is not only vital for keeping stakeholders informed of progress throughout the program, but for providing the impetus to communicate with other educators, policy makers, and researchers involved in the education of future teachers.

Conclusion

The purposeful creation of collaborative, authentic, and content-focused learning environments where future teachers are empowered to develop content, pedagogy, and technology strategies concurrently, is a critical factor in the design of preservice teacher education programs. Based on the UH's history of innovation and leadership in teacher education, as well as on the close working relations established with relevant stakeholders committed to improved education of urban, low-income, at-risk children and youth, we are optimistic that these program improvements have tremendous potential for long-range, systemic reform.

References

Balli, S.J., Wright, M.D., & Foster, P.N. (1997). Preservice teachers' field experiences with technology. *Educational Technology, 37*(5), 40-46.

Barton, J., & Collins, A. (1993). Portfolios in teacher education. *Journal of Teacher Education, 44*(3), 200-210.

Beichner, R.J. (1993). Technology competencies for new teachers: Issues and suggestions. *Journal of Computing in Teacher Education; 9*(3), 17-20.

Bosch, K.A., & Cardinale, L. (1993). Preservice teachers' perceptions of computer use during a field experience. *Journal of Computing in Teacher Education, 10*(1), 23-27.

Carr, L.L. (1992). Integrating technology into preservice education: Determining the necessary resources. *Journal of Computing in Teacher Education, 9*(1), 20-24.

Carroll, J., Potthoff, D., & Huber, T. (1996). Learnings from three years of portfolio use in teacher education. *Journal of Teacher Education, 47*(4), 253-262.

Falba, C.J., Strudler, N., Bean, T.W., Dixon, J.K., Markos, P.A., McKinney, M., & Zehm, S.J. (1999). Choreographing change one step at a time: Reflections on integrating technology into teacher education courses. *Action in Teacher Education, 21*(1), 61-76.

Francis-Pelton, L., & Pelton, T. W. (1996). Building attitudes: How a technology course affects preservice teachers' attitudes about technology.[Online]: http://www.math.byu.edu/~lfrancis/tim's-page/attitudesite.html

Fullan, M. (1999). *Change forces: The sequel*. London: Falmer Press.

Guillaume, A. M., & Yopp, H. K. (1995). Professional portfolios for student teachers. *Teacher Education Quarterly, 22*(1), 93-101.

Handler, M. (1993). Preparing new teachers to use computer technology: Perceptions and suggestions for teacher educators. *Computers in Education, 20*(2), 147-156.

Handler, M.G., & Strudler, N. (1997). The ISTE Foundation Standards: Issues of

Implementation. *Journal of Computing in Teacher Education, 13*(2), 16-23.

Hirumi, A., & Grau, I. (1995). A review of computer-related state standards, textbooks, and journal articles: Implications for preservice teacher education and professional development. *Journal of Computing in Teacher Education, 12*(4), 6-17.

Hoelscher, K. (1997). The road ahead: Preservice educators' ideas for using technology in K-6 classrooms. *Computers in the Schools, 13*(1/2), 69-75.

ISTE. (2000, March). International Society for Technology in Education (ISTE) National Educational Technology Standards (NETS) and performance indicators.[Online]: http://cnets.iste.org/

Khan, J. (1997). Technology-rich teacher education: Meeting the NCATE challenge. *Journal of Computing in Teacher Education, 13*(2), 24-29.

Kirby, E., & Schick, J. (1998, April_. Developing instructional technology curricula for preservice teachers: A longitudinal assessment of entry skills. Paper presented at the American Educational Research Association, San Diego, CA.

Lawler, T. (1985). *Doing research that is useful for theory and practice*. San Francisco: Jossey Bass.

Levin, B. (1996). Using portfolios to fulfill ISTE/NCATE technology requirements for preservice teacher candidates. *Journal of Computing in Teacher Education, 12*(3), 13-20.

Marcinkiewicz, H., & Wittman, T. (1995). From preservice to practice: A longitudinal study of teachers and computer use. *Journal of Computing in Teacher Education, 11*(2), 12-17.

McKinney, M. (1998). Preservice teachers' electronic portfolios: Integrating technology, self-assessment, and reflection. *Teacher Education Quarterly, 25*(1), 85-103.

Mowrer-Popiel, E., Pollard, C., & Pollard, R. (1992). An analysis of the perceptions of preservice teachers toward technology and its use in the classroom. *Journal of Instructional Psychology, 21*(2), 131-138.

Munday, R., Windham, R., & Stamper, J. (1991). Technology for learning: Are teachers being prepared? *Educational Technology, 31*(3), 29-32.

Northrup, P.T., & Little, W. (1996). Establishing instructional technology benchmarks for teacher preparation programs. *Journal of Teacher Education, 47*(3), 213-222.

O'Bannon, B., Matthew, K.I., & Thomas, L. (1998). Faculty development: Key to the integration of technology in teacher preparation. *Journal of Computing in Teacher Education, 14*(4), 7-11.

Office of Technology Assessment (1995). *Teachers and technology: Making the connection*. Washington, D.C.: U.S. Government Printing Office.

Oliver, R. (1994). Factors influencing beginning teachers' uptake of computers. *Journal of Technology and Teacher Education, 2*(1), 71-89.

Parker, D.R. (1997). Increasing faculty use of technology in teaching and teacher education.

Journal of Technology and Teacher Education, 5(2-3), 105-15.

Persky, S.E. (1990). What contributes to teacher development in technology? *Educational Technology, 30*(4), 34-38.

Rodriguez, S. (1996). Preparing preservice teachers to use technology: Issues and strategies. *TechTrends, 41*(4), 18-22.

Smith, R.A., Houston, W.R., & Robin, B.R. (1994). Preparing preservice teachers to use technology in the classroom. *The Computing Teacher, 22*(4), 57-59

Snyder, J., Lippincott, A., & Bower, D. (1998). The inherent tensions in the multiple uses of portfolios in teacher education. *Teacher Education Quarterly, 25*(1), 45-60.

Sprague, D., Kopfman, K., & Dorsey, S.L. (1998). Faculty development in the integration of technology in teacher education courses. *Journal of Computing in Teacher Education, 14*(2), 24-28.

Stringer, E. (1999). *Action research: A handbook for practitioners. (2nd Ed*.). Thousand Oaks, CA: Sage.

Strudler, N., Quinn, L.F., McKinney, M., & Jones, W.P. (1995). From coursework to the real world: First year teachers and technology. In D. A. Willis, B. Robin, & J. Willis (Eds.), *Technology and teacher education annual, 1995*. Charlottseville, VA: AACE.

Thomas, L. (1994). NCATE releases new unit accreditation guidelines: Standards for technology are included. *Journal of Computing in Teacher Education, 11*(1), 5-7.

Thomas, L. (2000, March). NETS project update. *ISTE Update, 12*(6), 1, 5.

Thompson, A., Schmidt, D., & Hadjiyianni, E. (1995). A three year program to infuse technology throughout a teacher education program. *Journal of Technology and Teacher Education, 3*(1), 13-24.

Van Gorp, M.J. (1998). Computer-mediated communication in preservice teacher education: Surveying research, identifying problems, and considering needs. *Journal of Computing in Teacher Education, 14*(2), 8-14.

Wade, R.C., & Yarbrough, D. B. (1996). Portfolios: A tool for reflective thinking in teacher education? *Teaching and Teacher Education, 12*, 63-79.

Wetzel, K. (1993). Teacher educators' uses of computers in teaching. *Journal of Technology and Teacher Education, 1*(4), 22-27.

White, C.S. (1994). Technology in restructured preservice education: School/university linkages. *Journal of Technology and Teacher Education, 2*(2), 119-128.

Wiebe, J.H., & Taylor, H.G. (1997). What should teachers know about technology? A revised look at the ISTE foundations. *Journal of Computer in Teacher Education, 13*(4), 5-9.

Willis, E.M. (1997). Technology: Integrated into, not added onto, the curriculum experiences in preservice teacher education. *Computers in the Schools, 13*(1-2), 141-53.

Willis, J., & Mehlinger, H. (1994). Information technology and teacher education. In J. Sikula & T. Buttery (Eds.). *Handbook on research in teacher education*. (Chapter 46). New York: McMillan.

Zachariades, I., & Roberts, S.K. (1995). A collaborative approach to helping teacher education faculty model technology integration in their courses: An informal case. *Journal of Technology and Teacher Education, 3*(4), 351-57.

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