IV. ESSENTIAL COMPONENTS TO SUPPORT ICTs IN TEACHER DEVELOPMENT

When a university, teacher education unit, state, region or country adopts or adapts a set of standards for determining how technology will be infused throughout their programmes, it is critical that faculty in the teacher education programmes be included in the planning effort. The faculty will plan for ICTs in teacher development considering their own conditions, culture, and context. During this collaborative planning phase, the teacher education unit and other university units providing courses for pre-service teachers (i.e. teacher candidates) should develop plans that not only address the four key components within the framework, but also the elements that support long-term implementation of the key components—leadership and vision, context and culture, planning and management of change, and lifelong learning. These elements are necessary for a supportive environment and a successful, self-sustaining implementation of technology infusion within the teacher education programme.

Experience has shown that a number of essential conditions must be met to successfully integrate ICTs into teacher education programmes. As educational entities have implemented ICTs in teacher education, researchers and evaluators have identified barriers that prevent or restrict successful technology infusion. Teacher educators express frustration by stating, "I am having problems implementing our plan for infusion of ICTs because..." Such statements are often completed by one or more conditions quite common among teacher education institutions around the world. ISTE has compiled a list of the most commonly cited conditions necessary to create learning environments conducive to powerful uses of technology. Table 4.1, Essential Conditions for Implementing NETS for Teachers, lists these crucial elements for addressing ICT needs in teacher education.
When planning for implementation of ICTs in teacher education, the planning team should consider each essential condition and note whether, and to what extent, it is present. The context, culture, and extent of collaboration among stakeholders will affect how adequately the conditions are met and determine what types of strategies might solicit support if the essential conditions are not currently present. Each of these conditions is examined in this section.

**Shared Vision**

Defined as the presence of proactive leadership and administrative support, shared vision means that the commitment to technology is systemic. From the administration to the grounds personnel, there is an understanding of, commitment to, and sense of advocacy for the implementation of technology. When the implementation of a technology initiative is problematic, a major reason often cited is a breakdown in the common understanding of the institution’s goals among those who hold the decision-making power. These situations can occur over something as simple as unlocking the door to a lab, or as complex as modifying existing operational budgets to provide allocations for technology funding. Facilitating the integration of technology may require a change in policy or rules, and the decision-makers have to be willing to look at the situation, forge compromises when necessary, and ensure communication among all parties. The collaborative environment necessary for creating a shared vision is also needed to sustain that vision.

**Access**

The fact that educators need access to current technologies, software, and telecommunications networks seems simple. However, this access must be consistent across all the environments that are part of the preparation of teachers. Most teacher education programmes involve several entities, including at least a college or university and one or more schools in the P-12 range. The access to funding and other resources may vary greatly among these partners, yet ideally, access should be adequate and consistent throughout the educational experience of students in the process of becoming teachers. Creative partnerships are often required to make this happen.

Additionally, there needs to be access to technology appropriate to the subject areas being studied, such as word processing programs and Internet access in English, or computer labs and microscopes for science labs. Access must be in
classrooms as well as lab settings, and provisions must be made for special populations. The technology should be accessible immediately when it is the best route to the information or tools needed by pre-service teachers, teachers, and students. Furthermore, university model classrooms are important for determining the way technology should be used in the P-12 environment. There should be an instructor station with a presentation system and 4-6 stations for pre-service teachers. The teacher candidates need to see and experience models that demonstrate the kind of access desired in the classroom.

In addition to ICT access in their coursework, pre-service teachers must have technology access in their student teaching environments and in their classrooms in the induction year and beyond. Otherwise, opportunities to use technology tools for teaching students or communication tools for mentoring or staying connected with parents will be limited.
Skilled Educators

The educators who work with teacher candidates must be skilled in the use of technology for learning. They must be able to apply technology in the presentation and administration of their coursework and facilitate the appropriate use of technology by their teacher candidates. From the first course taken by a freshman, through collaborative work at the school site, pre-service teachers should participate with and observe their mentors using technology effectively. The teacher educator should model and teach techniques for managing technology in the classroom and for communicating outside the classroom through electronic means.

Professional Development

Even in contexts in which professional development is extensive, it is important to provide consistent access to professional development as the technology constantly changes. Ongoing opportunities for professional development should be available to university and P-12 faculty and administrators who participate in the preparation of teachers. The venues and delivery mechanisms should take into consideration issues of time, location, distance, credit options, and so on. Professional development is not a one-time event; it should be focused on the needs of the faculty member, teacher, or administrator and sustained through coaching and periodic updates.

Technical Assistance

Educators need technical assistance to use and maintain technology. The focus of the faculty member, teacher, and pre-service teacher should be on teaching and learning, not on maintaining and repairing the technology beyond basic troubleshooting procedures. When the technology does not function well, a learning opportunity is lost and faculty frustration grows. Timely technical assistance is imperative for faculty and candidates to feel confident that they can use technology in their teaching and learning. There are many ways technical assistance can be obtained, including asking community members or student assistants to maintain a help desk. It is a critical factor for success in implementing ICTs.

Content Standards and Curriculum Resources

Educators must be knowledgeable in the content, standards, and teaching methodologies of their disciplines. Teacher candidates must learn to use tech-
nology in powerful, meaningful ways in the context of teaching content. Technology brings relevant resources from the real world to subject area content, provides tools for analyzing and synthesizing data, and conveys content through a variety of media and formats. Pre-service teachers should learn to use technology in ways that meet the content standards and the technology standards for students and teachers.

Student-Centred Teaching

Teaching in all settings should encompass student-centred approaches to learning. Technology should not be used only as a tool for demonstration, as an electronic overhead projector or blackboard; rather the use of technology by students should be an integral part of instruction. In student-centred approaches to learning, students become the source for problems investigated. Students and teacher candidates must have opportunities to identify problems, collect and analyze data, draw conclusions, and convey results using electronic tools to accomplish these tasks. Faculty should model the use of ICTs to demonstrate their usefulness and appropriateness for collaboration, acquisition of resources, analysis and synthesis, presentation, and publication.

Assessment

In addition to assessing teaching and student outcomes, institutions should continuously assess the effectiveness of technology for learning throughout the entire teacher preparation environment. The data obtained from this continuous assessment will:

- inform the learning strategies used,
- ensure that the vision for technology-use maintains the appropriate direction,
- pinpoint potential problems, and
- provide data for altering policies and instructional strategies or for acquiring resources.

Changes made over time due to technology innovation will exemplify informed decision-making.
The following chart provides guidelines for the essential conditions that should be in place for each phase in the teacher preparation process in order to support effective use of technology to improve learning, communications, and productivity.

<table>
<thead>
<tr>
<th>General Preparation</th>
<th>Professional Preparation</th>
<th>Student Teaching/Internship</th>
<th>First-Year Teaching</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Shared Vision</strong> – There is proactive leadership and administrative support from the entire system.</td>
<td>The professional education administration and faculty share a vision for technology use to support new modes of teaching and learning.</td>
<td>University personnel, teachers, and school administrators at the cooperating school site share a vision for technology use in the classroom.</td>
<td>Schools, districts, and universities share a vision for supporting new teachers in their use of technology in the classroom.</td>
</tr>
<tr>
<td>University leaders share a vision for technology use in all appropriate courses and content areas.</td>
<td>Access to current technologies, software, and telecommunications networks is provided for all students and faculty both inside and outside the classroom.</td>
<td>Access to current technologies, software, and telecommunications networks is provided for student teachers/interns and their master teachers/mentors/supervisors in the classroom and professional work areas.</td>
<td>Access to current technologies, software, and telecommunications networks is provided for new teachers for classroom and professional use, including access beyond the school day.</td>
</tr>
<tr>
<td><strong>Access</strong> – Educators have access to current technologies, software, and telecommunications networks.</td>
<td>Access to current technologies, software, and telecommunications networks is provided for teacher education faculty, classes, and field sites, including technology-enhanced classrooms that model environments for facilitating a variety of collaborative learning strategies.</td>
<td>Access to current technologies, software, and telecommunications networks is provided for student teachers/interns and their master teachers/mentors/supervisors in the classroom and professional work areas.</td>
<td>Access to current technologies, software, and telecommunications networks is provided for new teachers for classroom and professional use, including access beyond the school day.</td>
</tr>
<tr>
<td><strong>Skilled Educators</strong> – Educators are skilled in the use of technology for learning.</td>
<td>Teacher education faculty are skilled in using technology systems and software appropriate to their subject area specialty and model effective use as part of the coursework.</td>
<td>Master (cooperating/supervising) teachers and university supervisors model technology use that facilitates students’ meeting the ISTE National Educational Technology Standards for Students.</td>
<td>Peers and administrators are skilled users of technology for teaching and school management.</td>
</tr>
<tr>
<td>Faculty teaching general education and major courses are knowledgeable about and model appropriate use of technology in their disciplines.</td>
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<td></td>
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</table>

**Table 4.2. ISTE NETS Essential Conditions for Technology in Teacher Education**
<table>
<thead>
<tr>
<th><strong>General Preparation</strong></th>
<th><strong>Professional Preparation</strong></th>
<th><strong>Student Teaching/Internship</strong></th>
<th><strong>First-Year Teaching</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Professional Development</strong> – Educators have consistent access to professional development in support of technology use in teaching and learning.</td>
<td>University faculty and students are provided with opportunities for technology skill development and reward structures that recognize the application of technology in teaching, learning, and faculty collaboration.</td>
<td>Personnel in teacher education and field experience sites are provided with ongoing professional development.</td>
<td>Cooperating/master teachers and supervisors of student teachers/interns are readily provided with professional development in applications of technology in teaching.</td>
</tr>
<tr>
<td><strong>Technical Assistance</strong> – Educators have technical assistance for maintaining and using the technology.</td>
<td>Timely technical assistance is available for all faculty to ensure consistent, reliable functioning of technology resources.</td>
<td>Technical assistance for teacher education faculty and students is readily accessible and includes expertise in the use of technology resources for teaching and learning in PK-12 settings.</td>
<td>In field-experience settings, technical assistance is on-site to ensure reliability of technology resources.</td>
</tr>
<tr>
<td><strong>Content Standards and Curriculum Resources</strong> – Educators are knowledgeable in their subject matter and current in the content standards and teaching methodologies in their discipline.</td>
<td>Prospective teachers have knowledge in the subject area(s) they intend to teach.</td>
<td>Technology-based curriculum resources that address subject matter content standards and support teaching, learning, and productivity are available to teacher candidates.</td>
<td>Technology-based curriculum resources that are appropriate in meeting the content standards in teaching areas and grade ranges are available to teacher candidates at the student/intern site.</td>
</tr>
</tbody>
</table>
## General Preparation

### Student-Centered Teaching
- Teaching in all settings encompasses student-centred approaches to learning.
  - University faculty incorporate student-centred approaches to learning (e.g., active, cooperative, and project-based learning).
  - Teacher education faculty and professional teaching staff model student-centred approaches to instruction in education coursework and field experiences.
  - Opportunities to implement a variety of technology-enhanced, student-centred learning activities are provided for teacher candidates/interns.
  - Faculty routinely use student-centred approaches to learning to facilitate student use of technology.

### Assessment
- There is continuous assessment of the effectiveness of technology for learning.
  - University faculty and support staff assess the effectiveness of technology for learning to examine educational outcomes and inform procurement, policy, and curriculum decisions.
  - Teacher education faculty and professional teaching staff model the integration of teaching and assessment to measure the effectiveness of technology-supported teaching strategies.
  - Cooperating/master teachers work with student teachers/interns to assess the effectiveness of student learning and of technology in supporting that learning.
  - The district and school site support the classroom teacher in the assessment of learning outcomes for technology-supported activities to inform planning, teaching, and further assessment.

### Community Support
- The community and school partners provide expertise, support, and resources.
  - Prospective teachers experience technology use in real-world settings related to their general education and courses in their majors.
  - Teacher preparation programmes provide teacher candidates with opportunities to participate in field experiences at partner schools where technology integration is modelled.
  - Student teachers/interns teach in partner schools where technology integration is modelled and supported.
  - Schools provide beginning teachers with connections to the community and models of effective use of local and other resources.
Community Support

The visioning process includes the community and school partners who provide expertise, support, and resources for technology implementation. The community must see that technology is a valuable tool for prospective teachers and their students, and must be willing to support it in the political process from the boardroom to the state house.

Support Policies

Policies can either support or hinder the implementation of technology. As decision-makers develop new policies, they must consider how the policies affect acquisition of and access to technology. Some major barriers to the use of technology relate to faculty expectations about incentives and reward structures. The expectation for the use of technology must cut across all subject areas and
teacher preparation contexts so that faculty and teacher candidates are assured that their work will be valued.

Policies related to technical assistance should also support the use of technology rather than obstruct it. For example, although firewalls are essential in the university environment, there are ways to provide dial-up and remote access while maintaining the security of campus servers. Likewise, at the school level, there are ways to control students’ Internet access to unwanted images and information while maintaining an environment of exploration and inquiry. To develop environments equipped to support the infusion of ICTs in teacher education, essential conditions identified on Table 4.2 must be present in each phase of an aspiring teacher’s education in the university’s general education programmes, in the chosen subject specialization, in teacher education coursework, and at the school sites hosting student teachers and interns. Teachers and teacher educators cannot be expected to implement what they have learned about effective use of ICTs without the presence of essential conditions in their work environment. The following environments correspond to stages of development commonly experienced during university preparation:

- General Preparation—general university courses providing instruction in the foundational courses for all students and the specific coursework in the student’s major field of study
- Professional Preparation—formal coursework in professional education
- Student Teaching/Internship—supervised, extended field experience in the P-12 classroom
- First-Year Teaching—the initial year of P-12 classroom teaching

Recognition of the essential conditions necessary in all the environments that contribute to the preparation of teachers underscores the shared responsibility for preparing new teachers. The university, teacher education unit, and P-12 education must advocate resources that fulfil the essential conditions for each crucial stage of teacher development.

Table 4.2 addresses planning issues related to each of the essential conditions for each of the four environments that support the ICT preparation of teachers.
Benchmarks and Self-Assessment Tools for ICTs in Teacher Education

In planning the integration of ICTs into teacher education, it is important for teacher education institutions to understand the knowledge and skills necessary for teachers to effectively use ICTs in their instruction. They must also understand the institution's level of readiness to integrate technology into the teacher education curriculum. To accomplish these goals requires that the teacher education institution understand the benchmarks, standards, and guidelines for ICTs in teacher education. It is also important that they have access to tools that help them assess their level of readiness and progress in infusing ICTs into the teacher education programmes. Section VI provides a list of resources that may be helpful in assessing the extent to which the essential conditions are currently met and to monitor future progress in meeting those conditions.

REFERENCES


V.

ICT PROFESSIONAL DEVELOPMENT
FOR TEACHER EDUCATORS, ORGANIZATIONS, REGIONS AND COUNTRIES

The challenge confronting countries, regions and universities is to address the following basic principles for ICTs in teacher education (Society for Information Technology and Teacher Education, 2002):

- ICTs should be infused into the entire teacher education programme.
- Technology should be introduced in context.
- Students should experience innovative ICT-supported learning environments in their teacher education programme.

The most critical factor in the successful integration of ICTs into teacher education is the extent to which the teacher educators have the knowledge and skills for modelling the use of ICTs in their own teaching practices. To enable them to develop these skills requires a well-conceived and sustained programme of professional development. This section focuses on the professional development of teacher educators and the programmes for which they are responsible, such as pre-service programmes and certificates for practising teachers. The section discusses teacher educator professional development in various contexts of infusing technology into the educational system and process. The discussion is underpinned by new approaches to teaching and learning and by the recognition of the stages of professional and organizational development. Eight case studies from around the world illustrate a range of approaches and models that may be used. The section closes with a brief discussion of the importance of robust evaluations and the role of all stakeholders in the evaluation process.
BASIC STRATEGIES

Countries that have initiated efforts to infuse ICTs into teacher education have found four professional development strategies helpful in successful technology integration. First, professional development needs to focus on teaching and learning rather than on hardware and software. It should be designed by first considering what student teachers are expected to know and be able to do in a specific discipline, and then infusing ICTs into the learning process so that acquiring the knowledge and skills is more efficient.

Second, professional development is practically useless unless leaders and teacher educators are provided with access to technology resources and have the time and support—when needed—to apply the new knowledge and skills that they have learned. A just-in-time approach to professional development is a model that works well. In this approach, professional development is provided to teacher educators when they have a need or opportunity to use a specific technology tool or application to enhance learning. Third, professional development in the use of ICTs is not a one-time activity. To keep current with new developments means that professional development in ICTs must be an ongoing process.

A further strategy for professional development is to start in a small way. Start by providing professional development in the use of ICTs to a small group of teaching staff. Perhaps this group will have volunteered or demonstrated that they have basic ICT competencies for personal use, or have expressed personal interest in using ICTs in their teaching. Working with this small group allows the professional development staff to determine the specific interests and needs of the teacher educators and what works best in the professional development process. Based on this experience, professional development may be provided to other small groups of faculty, thus expanding and refining the professional development efforts. Figure 5.1 shows a group of student teachers working on group project in such a model.

The most important criterion for effective professional development is to tailor it to the learning needs and skill levels of individual teaching staff within a faculty. This suggests that, ideally, an institution should, based on availability of resources, provide a variety of options for professional development for the faculty. In structuring professional development options and resources, it is helpful to explore collaboration opportunities with partners outside the university.

The opportunities for ICTs to create new paradigms of teaching and learning will depend largely on leadership and a shared vision, and on appropriate and continuing professional development.
The planning and implementation of ICT-related professional development of teacher educators should be led by a planning group that includes representation and expertise from teacher educators, programme administrators, teachers, school administrators, technology experts, and business leaders. The diverse perspectives of the group should provide an understanding of the realities of the classroom, new views of the teaching-learning process, knowledge of the array of technologies that may be used to enhance learning, and community opinions. It is important for a planning group to negotiate a shared understanding of the role of ICTs in the agenda for educational renewal based on their individual cares and concerns (as described in Section VII on managing change through use of the CREATiER model). It is also helpful to have a larger advisory or liaison group that may facilitate collaborative professional development efforts and sharing of resources across related organizations, for example, between the university and the partner schools where students are placed for teaching practice.
NEW APPROACHES TO TEACHING, LEARNING, AND ASSESSMENT

An important aspect of professional development is not only enabling teacher educators to understand and use ICT tools in their teaching practices, but understanding how technology coupled with new approaches to teaching and learning, may enhance student learning. Many teacher educators recognize that approaches to education are changing and that new technology has the potential to improve education and student learning. They may also recognize the implications of increasing use of technology in society and employment, including employment directly related to their own disciplines and content areas. Less obvious are the implications for literacy and numeracy at the core of the educational process, and the need for teacher educators themselves to model good practice in their teaching so that their students can easily transfer these strategies into their own teaching practice. Teacher educators are experts in a domain, and it is important to respect this domain while helping them to revitalize and modernize their teaching with ICTs. The principles that this document espouses for the curriculum and professional development of teachers become even more relevant when applied to teacher educators. Similarly, the risk that established teacher educators must take to develop their practice needs to be recognized and mitigated as much as possible.

The most significant change required of individuals and organizations providing teacher education is to redefine student roles and responsibilities (as discussed in Section I). This is referred to as student-centred learning, and in the context of teacher education means that control of the teaching-learning process must move away from the teacher educator to the student of teaching. Both students and teachers have always had rights and responsibilities, but the redefinition of the learning environment requires a change in the balance of rights and responsibilities, with the student assuming more of both. ICTs demand this shift because technologies are constantly changing. Students need to develop the ability to think for themselves, continually learn as technologies change, and provide support to one another. This last element, peer teaching, is a natural product of ICTs because often the younger generations bring increasingly high levels of competence into the learning environment. This is a positive shift, and it should be noted that these strategies (learning from peer support and reciprocal mentoring between teacher and learner) are also appropriate for competencies that do not involve ICTs.
Teachers and teacher educators develop ICT competence in stages. Those who are fluent with technology may not appreciate how difficult it is for technology novices to appropriate ICTs into their professional practice. Teacher educators often find this task even more difficult than teachers do, because they typically have higher levels of content and pedagogical expertise that must be respected. Teacher educators, because they have to work in multiple contexts—both the home institution and the field where students are placed to observe and practice teaching—may also be more influenced by the absence of the essential conditions for ICTs in teacher education (described in Section IV).

Four stages are common, but they may be repeated with new forms of ICTs or applications of ICTs to new areas. The first stage for each individual is awareness, and the appropriate response at this stage is to provide information about a relevant application of ICTs and appropriate ways that it may be used in the individual’s current professional or personal concerns. Please note the learner-centred nature of this approach; the concerns are not those of the supporter (the ICT expert) or the organization, but of the individual teacher educator. Teacher educators then explore the use of the application. They need support to put this ICT application into practice in a timely manner and to reflect on its effectiveness. Only after teacher educators have gone through these stages are they able to adapt their practice to make better use of ICTs, and then move toward the final stage to become innovators and modellers of excellent practice for their students and colleagues. (These stages are described in the Concerns-Based Adoption Model, CBAM, and confirmed in ICT specific research, such as the Apple Classroom of Tomorrow described in Section VII, Managing Change.)

The advent of ICTs provides the opportunity to engage in this process from a new perspective and to model processes of learning for colleagues and students. It is acceptable for teacher educators to adopt only those aspects of ICTs that are relevant to their practice, but they must first be allowed to explore the range of possibilities, so that they and their students may become critically aware of, and competent in, diverse ICT applications. Of course, any teacher educators continually strive to be responsive to developments and innovations in education within and beyond their discipline.
CASE STUDIES

To understand the strategies of professional development it is important to understand how they are embedded in the broader context of the planning and implementation of ICTs in teacher education. The following section provides eight case studies. These illustrate an eclectic range of strategies. The first four case studies focus on strategies for individual teacher educators and their organizations. The second four include strategies for building capacity for ICT teacher education across regions and nations.

Each case study is analyzed by use of the framework for ICTs in teacher education illustrated in Figure 2.1. This holistic framework is used to understand the complex interaction of the professional development process. Teacher educators need to develop competence in the core themes of: pedagogy, collaboration and networking, technical competence, and social issues. This needs to be done within the local and global cultural contexts of: lifelong learning, leadership and vision, and planning and management of change.

Strategically Supported Workshops

A growing number of pre-service teacher education programmes in the USA have employed the ISTE technology standards, and ISTE describes the best of these programmes on the ISTE web site. One such programme was initiated at the University of Texas at Austin, where the teacher educators expert in ICTs have actively planned and promoted the professional development of their colleagues and facilitated the management of change. The culture is one in which all participants respect the leadership and vision provided by the dean and the college’s technology support centre. The current programme evolved from the experiences gained in working with the teacher education faculty. It underscores the importance of learning from the mistakes, as well as the successes, in implementing professional development. For example, a faculty development workshop was held to teach faculty to use a tool to incorporate web-based elements into their teaching. An initial training session was offered that provided the faculty with an extensive demonstration of the full range of capabilities of the tool. The faculty participants left the two-hour session with cognitive overload and little that they could immediately apply to their courses.

Based on this experience, another workshop was designed that focused on a few useful applications that faculty could incorporate into their instruction. The teacher educators were asked to bring class syllabi and selected course resources
to the workshop. The teacher educators learned how to post these materials online in WebCT and set up online class discussions. After the teacher educators had time to see how this worked in practice with their students, a second workshop was provided to help them consider appropriate ways to facilitate collaboration and networking, along with the social issues that might arise in using these methods. These redesigned workshops were highly successful and led to ongoing faculty development.

This effort was successful because this strategy permitted the teacher educators to gain new information about the software within a pedagogical approach that addressed their immediate concerns, and allowed them to pilot the approach and evaluate their efforts. A similar strategy works for other widely used software application tools, such as word processing and desktop publishing.

**Reciprocal Mentoring**

Professional development for ICTs in teacher education is ongoing, as denoted by the theme of lifelong learning in Figure 2.1. Successful models for professional development must reflect this dynamic nature by building capacity rather than teaching skills. Reciprocal mentoring is an example of a professional development model that builds capacity within an organization.

Iowa State University has an award-winning programme of teacher education and supports this excellence by providing professional development in ICTs for its teacher educators and the in-service teachers who work with students. Over a decade ago, the course Technology and Teacher Education was established to provide graduate students with an internship experience. Many of these students become teacher educators who are expert in ICTs. These students mentored teacher educators in ICT skills and, in return, the teacher educators mentored the students in their profession. The graduate students’ advisor, who strategically selected or negotiated the participation of teacher educators, facilitated and planned the interaction. Over the years, the balance moved from encouragement of reluctant teacher educators to participate, to the strategic choice of participants from a long list of volunteers. Similarly, the context and culture became increasingly akin to a sociable family that supports one another; an organization in which members learn from one another while collaborating and networking.

The mentoring course takes place in the fall semester. During weekly meetings, the graduate students learn about mentoring and a variety of approaches to infusing
technology into education. These meetings foster collaboration and networking among the graduate students, lend moral support, provide opportunities for the development of technical skills, and engage students with relevant literature. Each student also meets with his or her teacher educator mentee weekly and responds to their needs at an appropriate pace.

In the early stages of this process, many teacher educators develop confidence with ICTs very slowly, often starting with word processing of scholarly work or with the creation of slides using software. Technical competence is purposefully developed slowly, to keep pace with the emerging confidence and autonomy levels of the teacher educator. The graduate students' advisor insists that mentoring graduate students assist the teacher educator to engage with ICTs, rather than allow the teacher educator to delegate the ICT tasks to the student mentor. ICT applications used in instruction are favoured over those for research, so that the mentoring graduate student can support and experience the development of pedagogic competence. The mentor pairs are expected to engage in many rich conversations as they work together, covering diverse themes and competencies, including social issues with ICTs and discipline specific topics.

Toward the end of the semester, the teacher educators join the mentors' class for a celebration of their collaborative professional and course development. At this time the teacher educators are exposed to a wide range of ICT applications, cultures, and contexts, and reflect on the four themes and competencies. The graduate students' advisor also reflects on the programme's success in reaching department and university goals and gains new ideas for future planning. This model has been extremely successful, as measured by increased faculty competence in the use of technology and by the attitudes of graduate students and faculty. It has been adapted to various settings, including those in which undergraduate students are the mentors.

International Technology Transfer

Occasionally opportunities for collaborative projects are stimulated by requests for technology transfer proposals. This case study is of one such opportunity provided by the European Commission, which offered funding for faculty development to countries in Central and Eastern Europe (European Commission Telematics Programme, 2002). This case study illustrates the importance of considering all the elements presented in Figure 2.1 in designing and realizing ICT projects.
The MATEN (Multimedia Applications for Telematic Educational Networks) project provided technical and pedagogical support to countries in Central and Eastern Europe. It researched ways in which information and communication technologies affect instructional design in this region and the ways existing patterns of social interaction in education are shaping the evolution of software engineering (Multimedia Applications for Telematic Educational Networks, 2002).

The project provided funding for infrastructure to universities in Ukraine, Lithuania, and Russia, and provided support to encourage retention of faculty and teachers in countries in transition. Because of the project, they were able "to expand the Flexible Distance Learning Systems (FDLS) model to describe possible applications of different multimedia in curriculum and courseware design" (Multimedia Applications for Telematic Educational Networks, 2002). Two courses particularly relevant to this discussion are a course in ICTs for teachers in the former Soviet Union led by the Ukrainian Institute of Cybernetics in Kiev and a course at Kaunas University of Technology in Lithuania. The first stage of the course development took two years, followed by an additional contract to update and improve the courses with multimedia. This process set up the infrastructure and provided tailored ICT teacher education to the teacher educators who developed the first courses.

Rather than address the participants' stage of development, the project first took a more direct approach, with an assumption that content and technology could be simply linguistically translated for delivery. The participants, at an early stage in the professional development sequence, experienced more stress than success during these early days of the project. This demonstrated the need to carefully consider all elements of the framework in Figure 2.1 when inviting and judging proposals for ICT transfer into new educational contexts, in addition to considering the support for hardware, software, and related infrastructure.

The teacher educator participants had little experience of ICTs and were largely uninformed about recent pedagogical approaches, so their teaching tended to rely on textbooks and highly structured exercises. For this reason, a technology transfer course was created to enable the teacher educators to create a course suited to their own context and culture. A team developed the courses, and included teacher educators and ICT faculty from universities in these three countries as well as project staff.

This strategy permitted international experts to model appropriate pedagogic approaches, including collaboration and networking. The technology
transfer course was built upon an English university’s online ICT masters programme provided over the Internet for in-service teachers. This online learning environment was adapted over time in response to the needs of the target teacher educators. The teacher educators were helped to develop their own pedagogical skills, as they created content that placed ICTs into the context and culture of their region’s schools and universities. The teachers who completed high quality work received a certificate from the English university. This certificate motivated them and provided one form of quality assurance.

Although distance learning formed the core of this project, the on-site ICT faculty provided their teacher educator colleagues with training to develop technical competence, and handled the technical issues as they arose. This support was essential to the teacher educators as they moved through the stages of development. The local ICT faculty also created course materials for technical aspects, which were used by the teacher educators for their courses.

This project also illustrates the need to consider social issues when designing ICT professional development. There was difficulty in obtaining good access to ICTs for teacher educators due to their low status. This contributed to the stress they experienced as ICT novices and probably contributed to participant dropout. These and other social issues were sensitively handled by the project team as they arose. Other points identified in the framework under Social Issues did arise, including repeated attention to respect for copyright and intellectual property rights.

MATEN was a complex and ambitious project. Project staff provided vision and leadership and support for planning and the management of change. Dissemination activities carried out by the Ukrainian teacher educators spread the activities across the former Soviet Union and large numbers of teachers benefited from the course. These successes, although significant, could have been improved by making the process more transparent to those new to ICTs.

**MirandaNet: A Community of Practice**

Regional and international collaboration can provide ongoing mentoring and support for those who lead ICTs in teacher education for colleagues in their own schools and in other locations. One exemplary community is MirandaNet, which developed its first community in England to support teacher educators and teachers who lead ICT development (MirandaNet, 2002). This non-profit organization is more similar to a professional association than to a training agency or institution. It has collaborated with and received support from technology companies