Technology' Across the Curriculum: The Teacher as Change Agent

James B. Ellsworth

Abstract: Emerging technologies can enhance the learning process. To realize this potential, they must be effectively integrated throughout the curriculum. Past applications of emerging technologies often focused on the mechanics of their use - failing to ever attain the impacts on learning for which they were designed. This paper explores research on systemic change and the diffusion of innovations, from the standpoint of Teacher Education. A framework is proposed which may be used to prepare teachers to take an active role in implementing emerging technologies, not as a subject unto themselves, but as a vehicle for exploring and mastering content and as a metacognitive tool. Specific attention is also paid to using these technologies to integrate academic disciplines through authentic, relevant activities.

Resume: Les nouvelles technologies peuvent rehausser le processus d'apprentissage. Pour realiser ce potentiel, elle doivent etre integrees dans tous le curriculum. Par le passe, les applications des nouvelles technologies ont eu tendances a etre centrees sur la pratique de 1'usage de I'instrument meme - empechant ainsi de profiler des veritables avantages pedagogiques prevus pour ces technologies. Get article explore la recherche sur le changement systemique et la diffusion de 1'innovation du point de vue de la formation des enseignants. Un cadre conceptuel est propose pour preparer les enseignants a prendre un role actif dans P implantation des nouvelles technologies, non pas comme un sujet d'etude mais plutot comme un vehicule servant a Pexploration et la maitrise de contenus et comme un outil metacognitif. Une attention particuliere sera aussi portee a 1'utilisation de ces technologies pour integrer les disciplines academiques par des activites authentiques et pertinentes.

Early efforts aimed at harnessing the power of emerging technologies to the tasks of teaching and learning frequently produced disappointing results. Students often mastered only the mechanics of a specific set of applications, or perhaps explored a particular subject - like history or geography - with the aid of a technology-based tool. Initial predictions of a technology-empowered education renaissance once again gave way to study after study showing "no significant difference" (Russell, 1997).

How can this be? Most educators have *seen* examples of effective technology use, have *experienced* its effects on students' learning. Why, then, do these effects fail to materialize in so much research...or in so many classrooms? Equally important, what can Teacher Education programs do to influence this process for the better? The answer, perhaps, lies less in the nature of the technologies themselves

Canadian Journal of Educational Communication. Vol. 27, No. 1. Pages 31 - 44. ISSN-0710-4340

than in the concept of their use with which future teachers leave preservice education (Oliver, 1994; Wetzel, 1993), and in the role we expect - and prepare - teachers to play in implementing innovations in their teaching (Hall & Hord, 1987).

Defining the Issues

The current paper frames the challenge of preparing teachers for effective use of emerging technologies on these two dimensions: the implementation of technology across the curriculum and the role of the teacher as change agent. In this context, the phrase "emerging technologies" is used to represent the set of technological innovations, having implications for teaching and learning, which are just beginning to achieve widespread implementation in the classroom.

In the discussion that follows, "technology across the curriculum" refers to building technology competencies through the use of emerging technologies as *tools* for the mastery of other skills and knowledge, as opposed to teaching of technology as an independent subject. The term "change agent" here refers to anyone who seeks to actively facilitate the adoption or implementation of an innovation - in this case, emerging technologies - as opposed to merely accepting the innovation themselves. The next two sections use these dimensions to make a case for a new framework for educating preservice teachers in the use of emerging technologies.

Technology Infusion: Practicing What You Teach

Around the world, "ideal" use of technology in education has evolved from "technology in the lab," where technology experts focused attention on mastering the technology itself to "technology across the curriculum," where teachers take ownership of the technology as a tool for conveying their subject matter (Pelgrum, Janssen Reinen, & Plomp, 1993). Yet the "traditional" Teacher Education program has continued to treat emerging technologies as a separate subject, covered in one or more required courses (Collis, 1996). Perhaps not surprisingly, experience with such traditional programs suggests that students often emerge with only a shallow understanding of how they might incorporate emerging technologies into their own teaching (Oliver, 1994; Wetzel, 1993). At the same time, institutions that have tried the new ideal - full integration of such instruction - have found that technologically inexperienced students may be left behind, overwhelmed by the demands of trying to master the technology concurrently with foundations or methods content (Kenny, MacDonald, & Desjardins, in press).

This has arguably been the classic dilemma of integrating instruction in emerging technologies across the Teacher Education curriculum. Effective Teacher Education programs must "practice what they teach" by modeling the use of emerging technologies, infused throughout the curriculum, as tools to enhance the learning process. Yet these programs must concurrently be able to accommodate the full spectrum of "technology savvy" among their students. Rogers (1995) notes that "The adoption of an innovation usually follows a normal, bell-shaped curve when plotted overtime on a frequency basis" (p. 257). If the technologies in question are,

as defined earlier, "only beginning to achieve widespread implementation in the classroom," we can be confident that the adoption process has reached no farther than the early majority, leaving approximately 50% of prospective teachers with less-developed competencies in their use there (Rogers, p. 262).

This represents the first part of the challenge. Teacher Education must strike a balance between teaching emerging technologies by demonstrating their effective use in promoting mastery of *other subjects,* and ensuring that students in the late majority and beyond receive a baseline set of technology competencies before their lack of same would prevent them from mastering either the infused technology or the content it is used to teach.

Teacher-Driven Implementation: Educating Teachers as Change Agents

Assuming that a preservice Teacher Education program succeeds by this first measure, the next part of the challenge concerns *implementation* of what its students have learned. Hall and Hord (1987) suggest that many innovations are never really implemented as their developers originally conceived. Without an adequate understanding of the implementation process and its facilitation, teachers may react to resistance or other obstacles to change by attempting to bring an innovation into their classrooms with key components missing or seriously flawed. In such cases the innovation is never truly implemented, and much of its pedagogical benefit may be lost. Teachers with limited implementation competencies may also rigidly try to implement an innovation *exactly* as described, unwilling to modify components its developers might consider nonessential, even where such inflexibility may erode the support of key stakeholders.

Past wisdom dictated that such "reinvention" was simply inappropriate, but there may be cause to question this assumption (Rogers, 1995). After all, teachers are present in their classrooms on a day-to-day basis. They are in the best position, from a "data availability" standpoint, to assess and understand their students' needs. Ultimately, they are the ones with whom implementation of any potential solutions will rest. These facts would seem to argue for teachers playing a *leadership* role in implementing change in their classrooms - a role that might well include collecting feedback and using it to adapt innovations to those particular circumstances. This, in turn, requires the treatment of emerging technologies in preservice Teacher Education programs to be accompanied by some form of instruction in change facilitation.

Pulling it Together: Preparing Teachers to Lead Technology Infusion

At present, neither of these dimensions is often addressed by the preservice Teacher Education program. It is not uncommon for courses to advocate the view of technology as tool, rather than subject - but for emerging technologies to actually be *modeled* as across the curriculum is rare (Collis, 1996). Programs giving all

prospective teachers a solid grounding in change agentry are even more difficult to find.

The current paper proposes an integrated framework for accomplishing these goals, based on the tenets of systemic change theory and the stages of concern described in the Concerns-Based Adoption Model (Hall & Hord, 1987), This approach is intended to serve two main purposes in regard to emerging technologies. First, it aims to structure teachers' preparation in the infusion of these technologies throughout their own practice in accordance with recent research findings. Second, it concurrently offers future teachers a unique opportunity to *observe* what application of these principles might look like in the classroom.

Designing the Framework

Teachers, technology, and change agentry may well be naturally converging as education copes with present realities and future requirements. In 1990, Hughes suggested that a shortage of teachers in Canada could be ameliorated if teachers were prepared to make innovative use of emerging technologies to facilitate learning and motivation. Yet, as noted earlier, prospective teachers may enter their preservice training with any level of technological competence and confidence - so designing a "one size fits all" program to offer this preparation may seem problematic.

However, looked at another way, students undergoing such training may be viewed as a cross-section of the environment that awaits them in their first teaching assignments. As *they* first begin to teach, they will find some students (and colleagues) are more skilled with technology, and some are less. Consequently a Teacher Education curriculum that addresses this varied background developmentally - as teachers enhance their own competencies in integrating emerging technologies - *will also teach change agentry* by modeling such an approach, which graduates can ultimately use to infuse these technologies into the curricula of their own schools.

To the scholar of educational change, this description alone may call to mind the Concerns-Based Adoption Model (CBAM). First proposed by Hall, Wallace, and Dossett (1973), CBAM is the only major model of change that is both developmental *(i.e.,* built around a generally progressive series of stages) and focused expressly on teachers. If one considers the preparation of tomorrow's teachers to integrate emerging technologies in their instruction as, essentially, persuading them to *adopt* these technologies as tools for teaching and learning, the relevance of such a model becomes especially clear. Because CBAM focuses the change process on the perceived needs of the adopter, this approach has the added advantage of addressing a shortfall of many earlier diffusion efforts: "...change facilitators [basing] their interventions *(i.e.,* what they did) on their own needs and timelines rather than on their clients' needs and change progress" (Hall & Hord, p. 5).

Three diagnostic dimensions are available in CBAM: Stages of Concern, Levels of Use, and Innovation Configurations (Hall, 1978). Within the scope of this paper, it is the first of these, Stages of Concern (SoC), that will offer the most insight for

addressing emerging technologies in Teacher Education. The table illustrates CBAM's SoC dimension. At Stage 0 (Awareness), teachers may know the innovation exists, but express no interest in it. At Stage 1 (Informational), teachers begin to seek additional knowledge about the innovation. In Stage 2 (Personal), teachers are concerned with how the innovation will directly affect *them* as with the mechanical aspects of innovation use in their teaching. Only at Stage 4 (Consequence) do teachers first begin to focus on the impact of their innovation use on their students' learning. At Stage 5 (Collaboration), teachers' concerns begin to consider how they could *enhance* this impact by deliberately coordinating their innovation use with one another. Finally, at Stage 6 (Refocusing), teachers begin to consider the "next cycle" - what *new* innovation(s) might better address the need for which the current innovation was adopted (Hall & Rutherford, 1983).

Table 1: Stages of Concern

Stage 0	Awareness
Stage 1	Informational
Stage 2	Personal
Stage 3	Management
Stage 4	Consequence
Stage 5	Collaboration
Stage 6	Refocusing

Using these stages as a guide, then, the sections that follow set out a possible framework for modeling both appropriate technology use and change facilitation practice across the Teacher Education curriculum. An introductory technology course *is* recommended, to offer students with limited technology competencies the foundational skills and knowledge they will need to keep up with an infused curriculum. At the same time, this course is designed to offer equal benefit to students who arrive having already mastered these competencies, by allowing them to progress to the next stage: practicing their application in instructional settings.

The Introductory Course: Building Technology Competencies

Beginning at the beginning, students' first introduction to emerging technologies in the context of the Teacher Education program must recognize that some will be entering at SoC 0 (Awareness). Those at this stage may know that these technologies exist, and are sometimes used in teaching and learning. However, they have no experience with so much as the rudiments of their use in the classroom, may lack even basic skills like mouse and keyboard use, and do not consider technology to be personally relevant. Others will be at SoC 1 (Informational). They are aware of technology's importance in educational settings, and want to know more - but have

yet to make a decision about their own use (Hall & Rutherford, 1983). They too are inexperienced in classroom use of technology, although early information-gathering activities may have led them to have some exposure to basic technology skills and concepts. In the information-rich environment of Teacher Education, movement through these stages is likely to be rapid and relatively smooth.

Some, however, will enter the program at SoC 2 (Personal). These individuals have acquired enough information concerning emerging technologies to begin to question their ability to cope with their requirements, or to wonder about the personal consequences of failure to adequately master their use in the classroom. Those who have passed this stage and are at SoC 3 (Management) have passed an important hurdle, but will consider just *using* technology in the classroom to be highly demanding, and may wonder how they are expected to actually *teach* at the same time. Addressing the issues associated with these stages is considerably more complex.

Coping with this range of concerns and needs in a single course is certainly a challenge. Fortunately, a few strategies are available, and have experienced some success. A first step is finding out where your class stands. Hall, George, and Rutherford (1986) have developed and validated a questionnaire and associated manual for measuring Stages of Concern. Use of this instrument allows profiling of individual students, and design of appropriate interventions for addressing their varying needs.

As mentioned previously, some students will already be experiencing Management (SoC 3) concerns. They require practice, to refine and build confidence in their ability to manage emerging technologies in their classroom - and what better way to offer this than to recruit them as peer tutors for those at earlier stages? Students in these programs are, after all, learning to be teachers; assisting peers who have less technology background will prepare them to cope with the varying levels of experience they will encounter in their own classrooms (Kovalchick, 1997).

Helping peers who are experiencing the Stages of Concern that *they* recently passed through will also help them deal with the concerns they will subsequently encounter in the faculty lounges of their future schools, as they seek to enhance the climate for technology use among their fellow teachers. Finally, as other researchers note, the fact that students may be inexperienced in the use of emerging technologies *as teaching tools* does not necessarily preclude them surpassing even the professor in their *general* use. Employing students who may be experts at (for example) tracking their favorite rock group on the Web to help their classmates locate *educational* resources will free faculty to focus on the pedagogy that is the heart of the content they are teaching (Duffield, 1997).

Operationalizing these strategies in the classroom, of course, can be complex. One interesting approach to doing so has been explored by Brown and Henscheid (1997), who have developed the "PIG Continuum." The authors explain that "PIG stands for Presentational, Interactive, and Generative uses of technology, meaning that students can watch multimedia presentations (P), interact with simulations

and/or each other (I), or make or generate their own presentations (G)" (Brown & Henscheid, p. 17). In the context of the framework being described here, the peer tutors (students whose concerns primarily relate to SoC 3, Management) discussed above would most likely welcome the Generative opportunities, getting practice using technology to create and deliver the presentations being watched by their counterparts at SoC 0 (Awareness) and 1 (Informational) - who would be grateful for the information gained from observing such Presentational uses. Meanwhile, students experiencing Personal (SoC 2) concerns would have the opportunity to discuss them with one another - and with classmates who have recently resolved those concerns - during Interactive use, to observe classmates developing their competencies by observing Presentational use, and ultimately to try it themselves in Generative use. In fact, the authors note (p. 17) that PIG *is* a continuum because overlaps are also possible - meaning that a particular group of students could successively view a multimedia presentation, interact to discuss their personal concerns with each other and a peer tutor, then collaboratively generate their own presentation for the class.

The PIG Continuum also combines well with the use of technology portfolios suggested by Kovalchick (1997). Such portfolios could be developed through a series of Presentational-Interactive-Generative "rotations" (each focused on a particular teaching/learning technology) and would provide a useful and authentic assessment tool as well as the opportunity for metacognition and reflective practice she describes (pp. 32-33).

Beyond the Basics: Getting Comfortable With Classroom Use

Having completed such an introductory course, all students should now possess basic technological competencies at a level that will enable them to focus on the *application* of emerging technologies to teaching and learning in the integrated curriculum that follows. Nevertheless, even the most advanced students (those *entering the* introductory course already experiencing Management concerns) will have only limited experience applying these technologies to teaching in brief, isolated exercises. Those who entered the program at an earlier stage of concern will require even more additional practice beyond the introductory course. To satisfactorily resolve the remaining "mechanics of use" concerns all students will be experiencing at the end of the introductory course, the program must follow it up with activities to ground its lessons in the "bigger picture" of the classroom.

Within the "technology infusion" approach, excellent opportunities for accomplishing this can be found in courses teaching lesson planning or curriculum development. Students in each of these subjects can engage in exercises to actually *develop* a lesson that includes technology, or plan technology-enhanced projects to support particular portions of a curriculum they design. Such activities give students the chance to further refine their use of technology in their teaching, build confidence in their ability to successfully manage a technology-enhanced classroom,

and let them see how emerging technologies can work as a part of an actual teaching event or strategy.

In fact, formal models are beginning to emerge for doing just this. Among the most notable is the "iNtegrating Technology for inQuiry" model, or NTeQ (Morrison, Lowther, & DeMeulle, in press). Using NTeQ in lesson planning instruction provides an authentic context in which students can study, plan, and deliver instruction incorporating emerging technologies in educationally meaningful ways. This model is especially powerful in the Teacher Education context because it involves the teacher acting as facilitator of inquiry, rather than dispenser of knowledge, by *modeling* cognitive and physical processes. Thus, teacher educators who use NTeQ-planned lessons to teach students to design technology infused lessons are once again modeling processes their graduates will find useful in their own teaching practice.

Another interesting perspective is provided in a recent study by Oliver (1997) of 79 K.-12 Internet projects. Oliver's findings represent a possible taxonomy of Internet-enhanced activities within a project-based curriculum. While activities are included from every stage of a project life cycle, teachers should probably not be encouraged to plan entirely Internet-based projects. Oliver notes, in fact, that "...not all [activities] are present in every project" (p.33). This raises the possibility that his taxonomy might be most useful as an "a la carte" menu from which specific Internet-based activities can be selected *as part* of a project, where that medium facilitates a more powerful learning experience than would otherwise be available.

Assessing Impact: Forging the Link to Outcomes

Once students have satisfied their Management (SoC 3) concerns regarding their ability to successfully handle the time and procedural issues associated with technology use in the classroom, the next phase of instruction in the technology infused curriculum can focus on Consequence (SoC 4) concerns. These concerns are likely to express themselves as one of two questions: "How do I use technology to *improve* student learning," or "How do I tell if student learning *has improved."*

In the first category, the technology across the curriculum approach might suggest incorporating technology-based alternatives into educational methods classes. Where such classes may have traditionally expounded on the situations in which lectures, self-study, or group work might be most effective, they might now also cover the circumstances in which emerging technologies allow the teacher to do what could not previously be done, or to involve people who were never before reachable (Ellsworth, 1997). Such exposure will help equip tomorrow's teachers to make informed decisions about when to use technology and when a more traditional tool might be more effective - and to help *their* students construct their own rubrics for making these decisions in their everyday lives.

In the second category, an obvious home for such instruction within the technology-infused curriculum is in courses on evaluation and assessment. A second possibility is in classes dealing with applicable educational standards. Such

instruction might cover use of test construction software, spreadsheets, or statistical analysis packages. Perhaps the best way to involve technology in assessment across the curriculum, however, is to employ it *across the curriculum.* In a Teacher Education program where technology is a vital tool within every course, it carries with it the innate advantage of helping students create *and store* their products - the evidence of their learning.

This suggests a portfolio assessment strategy, or even "Graduation by Exhibition" - alternative techniques for measuring student achievement through critical evaluation of authentic products that are rapidly gaining a following in a variety of educational settings (Tiedemann, 1996). Such assessment is an especially crucial component under the technology infusion approach, as without a formal requirement for students to demonstrate their mastery prior to graduation, technology competencies spread across the curriculum may receive only cursory attention compared to the foundations and methods objectives for which students *are* held accountable.

An interesting combination of *both* categories is advocated by Kovalchick (1997), who advocates using "technology portfolios" as *an instructional strategy* in a reflective approach to Teacher Education. Her suggestion that portfolios - in addition to their more obvious use as an assessment mechanism - inherently facilitate positive learning outcomes is also supported by other research, which argues that the process of their *development* builds student motivation and ownership, and encourages reflective practice (Barton & Collins, 1993; Shackelford, 1996; Wade & Yarbrough, 1996).

Building Bridges: Interconnecting the Infused Curriculum

As teachers grow more adept at effective use of an innovation to promote learning, and more skilled at assessing the level of learning that has in fact occurred, CBAM research has found that they may begin considering how they could *intentionally coordinate* their use with other teachers to amplify these effects (Hall & Rutherford, 1983). Such Collaboration (SoC 5) concerns go beyond simply being aware that another teacher is covering a particular subject, and incorporating that into one's own course. Thus, Teacher Education faculty who want to *encourage* this collaboration must provide their students with skills and techniques to recruit other faculty members and engage them in productive, coordinated planning and teaching. Note that this does not have to involve team teaching, *per se,* although that is of course an option. Collaborative efforts can be as simple as joint lesson or curriculum planning - to identify areas where each participating teacher can tie in with what others are doing - or as complex as entire learning systems designed to interconnect *all* instruction (Tiedemann, 1996).

Once again, *teaching* strategies for collaboration, within a technology infused Teacher Education curriculum, offers an opportunity for *modeling* these same strategies for students. Many teacher educators have found that coordinated planning helps to ensure that all intended technology competencies *are in fact taught* - despite

being distributed across several courses taught by multiple faculty members - and facilitates use of exercises covering related competencies to reinforce one another (Rodriguez, 1996). It is also worth noting that such coordination, in addition to identifying opportunities *for faculty* collaboration, may also identify possible areas for *students* in different classes to collaborate in group projects requiring the competencies being learned in multiple courses - modeling the sort of cross-disciplinary cooperation they will encounter throughout their working lives.

Learning to Evolve: Creating an Adaptive Educational System

Recognizing the fact that change, in "real world" settings, is never complete, CBAM's final Stage of Concern, Refocusing (SoC 6), deals with "next steps." Once teachers are effectively using a given innovation to enhance learning, and coordinating their individual uses to further increase its impact, they are likely to begin considering what other, *new* innovations might help them improve their students' learning *more* (Hall & Rutherford, 1983).

When one considers the preparation of tomorrow's teachers in the area of emerging technologies, providing them with skills and techniques to facilitate refocusing must not be neglected. Many of today's teachers (and teacher educators) can remember when overhead and filmstrip projectors - and perhaps programmed texts - were "state-of-the-art technologies." Today, after perhaps attempting to discard these tools as "outdated," educational technologists are fast realizing that the addition *of new* tools does not necessarily allow (much less *require)* them to discard any *oldtooh* (Betz & Mitchell, 1996). Discussion of this problem, and of potential strategies for alleviating it, is growing more common in the Teacher Education literature (Smaldino & Muffoletto, 1997). With the tools at one's disposal multiplying, it will soon no longer be possible to provide future teachers with sufficient exposure to *all* of them to be useful. Instead, what is likely to be more productive is a *process* approach that emphasizes reflective practice, critical thinking, and media selection strategies. Such preparation will enable new teachers to examine *any* new technology as it emerges, to identify its most salient characteristics, strengths, and weaknesses, and to decide how best to incorporate it into their own teaching practice (if at all).

Tying It All Together: "Zooming Out" to the Big Picture

In describing the Elaboration Theory of Instruction, Reigeluth and Stein (1983) use the analogy of a zoom lens to illustrate the importance of providing a peek at the context within which a given block of instruction is situated as an organizer before proceeding with that instruction - and of returning to that "big picture" again once the instruction is complete. This was an important foreshadowing of Reigeluth's later involvement in the Systemic Change movement (Reigeluth & Garfinkle, 1994), as it recognizes the interrelationships between each level of instruction and its various components in a learning *system.* In essence, the entire notion of technology across

the curriculum is inherently systemic, as it seeks to place technology instruction and practice conceptually adjacent to the types of teaching and learning activities they most effectively support.

Consequently, as students conclude their preservice Teacher Education, it is important to review with them the technology preparation they have received, to highlight relationships between techniques and strategies that they may not have been able to perceive while immersed in them. Continuing with an integrated approach, such a review might fit well in a curriculum course, where a technology-infused curriculum could serve as a case study: Alternatively, it might be placed in the capstone course discussed in the next subsection, reviewing the Teacher Education curriculum and preparing students for the practice teaching experience.

Curricula supporting the former approach already exist, in the case of primary and middle school settings. At the primary level, Project CHILD (Computers Helping Instruction and Learning Development) is an outstanding example that has already produced significant positive results (Butzin, 1997). At the middle school level, another initiative called Project TEAMS (Technology Enhancing Achievement in Middle School) shows similar promise. The TEAMS curriculum contains four nine-week thematic units with themes selected for relevance to middle school students (transitions, caring, identities, and conflict resolution). Each unit incorporates several "rotations" in which the subject areas of science, mathematics, social studies, and language arts are related to the theme currently being studied. Technology is integrated into every rotation as a tool to facilitate particular learning activities (Reiser & Butzin, 1998).

Use of case studies showing application of the technology infusion principles students have learned during their Teacher Education program will help to anchor those lessons in a context that is personally relevant to each student. This approach would be even more effective if a similar technology infused curriculum was available at the high school level; students could then be shown the general concepts of technology integration as a class, then grouped by the level that they were preparing to teach for case study based activities, and perhaps brought back together for a synthesis and comparison of findings at the end.

The Capstone Course: Reinforcing Technology Leadership

The preceding sections have focused on developing prospective teachers' abilities to make appropriate and effective use of emerging technologies. The current paper also declared another objective as it began: developing those teachers' abilities to act as *leaders for change* in their schools, to work with their future colleagues to facilitate equally effective application of these technologies as tools for teaching and learning throughout the entire curriculum.

A major focus underlying this paper throughout the preceding sections as well has been the use of the Teacher Education curriculum *itself as* an opportunity to *model* principles of change facilitation, grounded in the Concerns-Based Adoption Model's "Stages of Concern," for that curriculum's students. At this point, when

(hopefully) these students have successfully experienced most of these stages, and learned techniques for facilitating progression through them, it may also be useful to provide specific instruction in change leadership, perhaps as part of a capstone foundations course. As the program draws to a close, such instruction could use the students' *own experiences* during their studies to illustrate the efficacy of the CBAM-based approach. In this fashion, the Teacher Education program can make a final contribution toward preparing its graduates to take an active role in helping their schools make appropriate use of emerging technologies as tools for teaching and learning.

Supporting Critical Reflection in Adoption

The preceding discussion has focused on preparing future teachers to infuse emerging technologies into their teaching, and across the curriculum - in essence, *to adopt* - and in fact to lead this process: *to facilitate implementation.* It has given only limited attention to the antecedent question of whether an innovation *should* be implemented - a vital and oft-neglected issue noted by Rogers (1995) and by several critical theorists (Habermas, 1969; Wajcman, 1991).

It should be noted from the outset that posing such a framework in "pro-innovation" terms is not intended to suggest that teachers should be trained to implement any proffered technology uncritically. On the contrary, it seems reasonable that *seeing* emerging technologies modeled in effective classroom use throughout their preservice preparation would facilitate teachers' critical evaluation of *future* technologies by offering an experiential basis for evaluating their contribution to teaching and learning; such reflection is to be strongly encouraged.

References

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

Betz, M. & Mitchell, J. (1996). Ed Tech in Teacher Education: Curricular Space Required. *Journal of Technology and Teacher Education, 4(3/4),* 181 -195.

Brown, G., & Henscheid, J. (1997). The Toe Dip or the Big Plunge: Providing Teachers Effective Strategies for Using Technology. *TechTrends, 42(4),* 17-21.

Butzin, S. (1997). Whatever Happened to Project CHILD? *Learning and Leading with Technology, 24(6),* 24-27.

Collis, B. (1996). Technology in Teacher Education. In T. Plomp and D. Ely (Eds.), *International Encyclopedia of Educational Technology* (2nd ed.) (pp. 534-538). Oxford: Elsevier Science Ltd.,.

Duffield, J. (1997). Trials, Tribulations, and Minor Successes: Integrating Technology into a Preservice Teacher Preparation Program. *TechTrends, 42(4),* 22-26.

Ellsworth, J. (1997). Curricular Integration of the World Wide Web. *TechTrends, 42(2),* 24-30.

Habermas, J. *(\969). Toward a Rational Society: Student Protest. Science and Politics.* Boston. MA: Beacon.

Hall, G. (1978, March). *Implications for Planned Dissemination, Implementation, and Evaluation Revealed in the SRI/NDN Evaluation and Levels of Use of the Innovation Studies.* Paper presented at the Annual Meeting of the American Educational Research Association, Toronto, Ontario, Canada.

Hall, G., George, A., & Rutherford, W. (1986). *Measuring Stages of Concern About the Innovation: A Manual for Use of the SoC Questionnaire.* Austin, TX: Southwest Educational Development Laboratory.

Hall, G. & Hord, S. (1987). *Change in Schools: Facilitating the Process.* Albany, NY: State University of New York Press.

Hall, G. & Rutherford, W. (1983/ *Client Concerns: A Guide to Facilitating Institutional Change.* Austin, TX: The University of Texas at Austin, Research and Development Center for Teacher Education.

Hall, G., Wallace, R., & Dossett, W. (1973). *A Developmental Conception of the Adoption Process Within Educational Institutions* (Report m 3006). Austin, TX: The University of Texas at Austin, Research and Development Center for Teacher Education.

Hughes, A. (1990). *Success for Every Child: The Teachers We Need for the 1990s and Beyond.* Syracuse, NY: Educational Resources Information Clearinghouse. (ERIC Document Reproduction Service No. ED 3 19 708).

Kenny, R., MacDonald, C., & Desjardins, F. (1998). The Integration of Information Technologies for Facilitating Learning: Redesigning the Teacher Education Curriculum at the University of Ottawa. *Canadian Journal of Educational Communication, 26(2),* 107-124.

Kovalchick, A. (1997). Technology Portfolios as Instructional Strategy: Designing a Reflexive Approach to Preservice Technology Training. *TechTrends, 42(4),* 31-36.

Morrison, G., Lowther, D., & DeMeuIle, L. (in press). *Integrating Computer Technology into the Classroom.* Englewood Cliffs, NJ: Merrill/Prentice Hall.

Oliver, K. (1997). Getting Online with K-12 Internet Projects. *TechTrends, 42(6),* 33-40.

Oliver, R. (1994). Information Technology Courses in Teacher Education: The Need for Integration. *Journal of Information Technology for Teacher Education, 3(2),* 135-146.

Pelgrum, W., Janssen Reinen, I, & Plomp, T. (1993). *Schools, Teachers, Students and Computers: a Cross-National Perspective.* TIie Hague: International Association for the Evaluation of Educational Achievement.

Reigeluth, C. & Garfinkle, R. (Eds.). (1994;. *Systemic Change in Education.* Englewood Cliffs, NJ: Educational Technology Publications.

Reigeluth, C. & Stein, F. (1983). The Elaboration Theory of Instruction. In C. Reigeluth (Ed.), *Instructional-Design Theories and Models: An Overview of Their Current Status* (pp. 335-381). Hillsdale, NJ: Lawrence Erlbaum Associates.

Reiser, R. & Butzin, S. (1998). Project TEAMS: Integrating Technology into Middle School Instruction. *TechTrends, 43(2),* 39-44.

Rodriguez, S. (1996). Preparing Preservice Teachers to Use Technology: Issues and Strategies. *TechTrends, 41(4),* 18-22.

Rogers, E. (1995). *Diffusion of Innovations,* Fourth Edition. New York: The Free Press.

Russell, T. (1997). *The "No Significant Difference" Phenomenon* (4th ed). Raleigh, NC: North Carolina State University. [On-line]. Available at http://tenb.mta.ca/phenoiTi/phenom.html

Shackelford, R. (1996). Student Portfolios: A Process/Product Learning and Assessment Strategy. *The Technology Teacher,* 55(8), 31-36.

Smaldino, S. & Muffoletto, R. (1997). The Education Media Experience in Teacher Education. *TechTrends, 42(4),* 37-40.

Tiedemann, D. (1996). New Florida School Celebrates Education and Technology: An Interview with Paul Kraft, Media Specialist for Celebration School. *TechTrends, 41(4),* 14-18.

Wade, R., & Yarbrough, D. (1996). Portfolios: A Tool for Reflective Thinking in Teacher Education? *Teaching & Teacher Education, 12(\),* 63-79.

Wajcman, J. (1991). *Feminism Confronts Technology.* University Park, PA: Pennsylvania State University Press.

Wetzel, K. (1993). Models for Achieving Computer Competencies in Preservice Education. *Journal of Computing in Teacher Education, 9(4),* 4-6.

Author

James Ellsworth is Communications Officer, Division for Systemic Change, the Association for Educational Communications and Technology.