APPROACHING CHANGE: SEARCHING FOR THE BEST POLICIES TO BRING COMPUTERS INTO OUR SCHOOLS

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INTRODUCTION

The implementation of computer technology in the schools has been identified as an important catalyst for educational change. How technology is introduced will have major implications for the success of projects. There are three approaches to this process: "transformationalism", "collaborationism" and "incrementalism".

Transformationalism

Transformationalism proposes that an overhaul of the education system is required before teacher development involving computers is possible (Becker, 1993; Lockard et al, 1994; Mann, 1994; Pelgrum & Plomp, 1993; Zorfass, 1993).

We must have the courage to abandon current structures of schooling, to eliminate 45-minute classes, to integrate curricula and to demand rigorous work from students....If educators can supply the imagination, reengineering can supply the means to develop and reach new visions of schooling (Berge, 1993, p. 176).

Since World War II, transformationalism has established a tradition of solving problems with innovation. The innovation management approach to improvement proposed that large sums of money be spent on new equipment and systems using the latest technology and requiring specialist involvement to give large-step changes in performance. Senior management and technical experts divide the organization's operations into departments; directing or dictating how processes or operations are to be performed. All planning and evaluation functions are directed from the top. Employees assigned to perform the work have no input into planning the work nor in evaluating the processes. Transformationalists tended to react to competing situations rather than proactively anticipate them. Typically, reactive organizations only take drastic steps after management is lost, rather than take prior steps to retain management that will put them into favourable situations. Moreover, organization employees and their representatives feel detached, uninformed and uninvolved in the performance and successes of the organization. Undoubtedly, this classical western approach to improvement has led to dramatic improvements, but typically has not been standardized and maintained.

Collaborationism
Collaborationism advocates that educational reform should be spearheaded by collaborative interactions over computer networks such as computer workgroups or computer conferences (Harrington, 1993; Flanders, 1991; Hunter, 1993; Mann & Weir, 1993). The main rationale for adopting a collaborationist policy is that educational resources are becoming more distributed.

Increasing numbers of educational reform or improvement projects are designed around the assumption that learning activities and environments can include and take advantage of interactions of learners and teachers with people, information and machines that are geographically and institutionally distributed (Hunter, 1993, p. 42).

One reasonable assumption about collaboration over computer networks like STEM−Net (Science, Technology Education and Mathematics Network) is that they change some of the ways in which we teach and learn from one another (Beals, 1992; Harris & Anderson, 1991; Newman, 1993). When interactions are planned collaborative learning can be made to occur (Eisenberg & Ely, 1993; Lowry et al, 1994; Mann, 1993; Traw, 1994).

Conferencing activities can be structured to give students opportunities to reflect on how what they know is influenced by what they hear, as well as what they see and read (Harrington, 1993, p. 15).

An erroneous assumption of these distributed collaborations, however, is that a computer network between learners or teachers improves achievement in curricular areas. Users of computer networks, like users of any other medium feel subjected to what is sometimes described as "a cohesion deficit from hyperspace wandering" (Duchastel, 1990, p. 230). Quality control, therefore, must become an important issue in collaboration over educational computer networks (Mann, 1992b, 1993; Mann & Weir, 1993).

**Incrementalism**

The preferred position advanced in this paper might be called "incrementalism". Incrementalism is consistent with the Japanese management practice of kaizen meaning "slow, never-ending improvement in all aspects of life" that focuses on quality control (Mann, 1992b). Continuous improvement differs from the classical Western approach to improvement principally in that it relies on an investment in people, not on equipment. Incrementalists propose that inservice courses in educational computing be provided to assist teachers in how to implement computers in the instructional process (Arzt, 1991; Kinnamen, 1994; Mann, 1992b; Simonson & Thompson, 1994). Preparing teachers to cope with and use computers in the classroom and laboratory is considered to be a complex task, continually buffeted by technological advances and constrained by resources (Ross, 1991). "Unless teachers become advocates of the change, the innovations are implemented pro-forma, if at all" (Becker, 1993, p. 145).

This approach is focused on teachers discovering opportunities, developing and disseminating findings to other educators; "It's messy but the only way to chart new territory" (Kinnamen, 1994, p. 70). Incremental changes can also be made to occur in other levels of the educational system. Policy makers in Newfoundland and Labrador, for example, have taken an incremental, bottom-up approach policy development to improve the chances of policy implementation. Phase 2-3 of the "Technology in Learning Environments" (T.I.L.E) document (Eaton, 1994), written by and for
educators of this province proposes substantive and cost-effective improvements in the policies and practices of educational computing in Newfoundland and Labrador.

POLICY-MAKING FACTORS

At most levels of the educational system, successful changes to educational computing with a minimum of discomfort requires policy-makers' attention to several factors, including:

1) Administrative Support
2) A Plan of Action
3) Articulation
4) Pedagogical Orientation
5) Program and Title Revisions
6) Partnerships

1) Administrative Support

The first factor affecting the successful adoption of educational computing is the support and leadership exhibited by the administration (Arzt, 1991; Lockard et al, 1994). Many educational computing facilities, however, are still planned and managed by noncomputing administrators. "It is only when faculty see chief administrators using technology do they feel the need to learn it themselves" (Kearsley and Lynch, 1992, p. 6). Kearsley and Lynch (1992) and Lockard et al (1994) have suggested the appointment of a computing leader. Some American universities have decided that their leaders should be Educational Computing specialists, including: the University of Michigan; SUNY; Slippery Rock University in Pennsylvania; and East Tennessee State University. Job titles, however, vary widely; from "Director of Learning Technology" to "Vice-President of Informational and Instructional Technology". Another possibility in education would be "Assistant Dean of Instructional Computing" (Mann, 1994).

2) A Plan of Action

A second factor affecting the successful adoption of educational computing is an incremental adjustment plan-of-action. This type of planning should reflect the current total quality management trend in business that advocates several small-steps' over the complete replacement' approach (Harvey & Green, 1993; van Vught, 1993). The probability of successful implementation increases when technology plans are tied to the goals of the school or faculty (Wiburg, 1994). Therefore, proposed changes for a faculty or school could also become a part of the larger vision for the School Board or university in rethinking its whole purpose, structure and function, the way Stanford has done. Carnegie Mellon, Stanford, the University of Michigan and MIT, for example, have set up internal study groups. Carnegie Mellon has implemented a major inquiry called "The AAAA Initiative" which is expected to produce recommendations in the next few months. The A's ask, "What makes it routinely possible for anyone, to send or receive anything electronically from or to anyplace at anytime?". Stanford expects changes that will "transform the content and the delivery of higher education [at the university]" (Jacobson, 1994). The STEM~Net at Memorial University serves isolated teachers scattered throughout Newfoundland and Labrador. STEM~Net is currently in its second year of three-year development. The hardware implementation and
software training is being introduced gradually throughout the provincial education system. In fact, this network is constantly under development, managing and maintaining the educational quality of select computer networking services (Mann & Weir, 1993). Such plans, however, usually require large-scale expenditures of money, effort and time.

Individuals can also affect the successful adoption of educational computing with their own incremental adjustment plans-of-action. For example, an incremental adjustment plan-of-action was implemented at Memorial University to permit working teachers to complete an undergraduate course in Multimedia authoring toward a Learning Resources Diploma. Their common concern was the driving distance to attend the scheduled classes and labs. In the Winter 1994 semester, these students agreed to accept the responsibility for their own instruction, maintain access to learning resources, ensure adequate technical support and participate by posting timely online messages using STEM–Net's email software. These "self-directed students" agreed to forgo step-by-step instructions, practice exercises and constant feedback on their performance, since the course materials have not been developed and pilot tested for such a purpose. Before enrolling in the course, these students obtained a STEM–Net account and ensured regular access to STEM–Net's Calvin computer from their school or home. They also agreed to secure regular access to a personal computer in their school or board with Windows and Toolbook software; cdrom and software; a video camera, and editing suite equipped with character and graphics generators.

Personalized Systems of Instruction of this kind can offer rewarding and satisfying experiences for students. Under these conditions, these undergraduate education students completed the same lab assignments and papers as their colleagues attending regular classes and labs. Self-directed students were told of the tendency to "let things go until it's too late"; a documented problem in the literature. Like their counterparts, self-directed students agreed to collaborate on group-directed projects with other self-directed students living within their area. They expected, however, that there may be little, if any, peer support and no one reminding them to submit assignments on time. Student achievement between these student groups was roughly equivalent. The content of online participation of the self-directed group was slightly higher than that of the in-class group who had both class and online participation, whereas the Multimedia products and final exam results for the self-directed group were slightly lower than that of the in-class group.

In this way, an incremental adjustment plan-of-action was implemented to serve more undergraduate education students without compromising the integrity of learning experiences for the in-class students. Policy makers should be aware, however, that the instructor's time conducting this kind of online Personalized System of Instruction required at least half again as many hours as the regular part of the course.

3) Articulation

A third factor affecting a successful adoption of computing is the determination of appropriate software and hardware to particular curricular computing areas, sometimes called "articulation" (Lockard et al, 1994). Specific software attributes and the teacher's role should be primary focii of the articulation. The attributes (e.g., sound annotation) in the software should be assessed in the light of the expectations for learning, as well as the expectations for use. One or more roles for the teacher and the prominent aspect of any suggested implementation strategy should also be evident.
Curricular software and manuals should be physically located and properly catalogued with other curricular materials for constant and easy access by inserviceing teachers (Mann, 1993). The placement of computers and curricular software in the Curriculum Materials Centre within the Faculty of Education at Memorial University has had the side effect of updating the curricular materials within the Centre. Course requirements are gradually reflecting more sophisticated uses of these resources.

4) Pedagogical Orientation

A fourth factor affecting a successful adoption of computing is a pedagogical orientation in specific aspects of curricular computing. This process includes the development of personal competence goals and a personal Repertoire for each school or university faculty member. This orientation replaces the traditional computer literacy' perspective of the mid-1980's which aimed to add computers to the curriculum as a special object of instruction.

General-Purpose Computing

General-purpose computing requirements should differ for graduate and undergraduate education students. At the graduate-level, a consultative, theoretical emphasis is considered to be appropriate, as suggested in the literature (Ragsdale, 1988; Willis, 1991).

**General-Purpose Computing: Graduate.** The role of graduate programs in education should not be to focus on the 'how to' questions of educational computer applications but rather to delve more deeply into the "why", "when" and other related questions. The hope is that potential in-service teachers will acquire a perspective on the latter issues through graduate courses, a perspective they can pass along to their fellow teachers. It is assumed that these graduate students (many on leave for precisely such an experience) will have already acquired the "how to" skills or will do so [on their own] or in non-credit course (Ragsdale, 1988; p. 232). Until 1991, the emphasis of the sole graduate-level educational computing course at Memorial University was on multimedia authoring. Multimedia authoring is presently offered as a special-purpose undergraduate computing skill, and as an elective called "Software Prototyping and Evaluation" to Computer Education graduate program. The revised graduate-level emphasis reflects the changing expectations of experienced Newfoundland teachers (Norris et al, 1992). The new "Computer Education" sub-specialization features two required courses: "Issues and Trends" and "Research".

**General-Purpose Computing: Undergraduate.** At the undergraduate level, there are two general-purpose computing requirements: 1) the development of personal competence goals, and; 2) the development of a personal repertoire. Personal competence goals require an established personal repertoire, not unlike a musician's.

Repertoire-Building

Repertoire-building for computing educators working in classrooms and labs, means:

- Creating and prioritizing computing requirements based on a critical competitors list of competing needs (e.g., language, disabilities)
Knowing the availability of workstations (e.g., one-on-wheels, few, lab-access)

Knowing that only specific, relatively unique features called "attributes" of courseware and information-free software can make a difference to teaching and learning. Moreover, hardly any attribute of mediated instruction affects learners in a uniform way. Strong interactions with a variety of individual differences among learners can be expected. Evaluations are more revealing when focused on the effects that a technology can be made to have than on the average typical effects of an attribute

Deciding on objective-types (e.g., skill, verbal information, cognitive strategy, social). Educators should know that learning outcomes will diverge as treatments become more open-ended, interactive and self-guided

Choosing patterns of time use (e.g., timed, task-defined, milestone, open)

Choosing the users-per-workstation (e.g., one, small groups, whole class)

Goal-Setting for Personal Competence

Once the personal Repertoire is established, then goal-setting for personal competence with computers is attainable. Personal competence means using a computer:

- As a tool for personal and professional productivity (e.g., a word processor)
- As a learning environment for higher-order thinking skills (e.g., a computer algebra system)
- As a palette for creative expression (e.g., desktop publishing)
- As a medium for communication (e.g., electronic mail)
- In cooperative learning (e.g., conferencing software)

Repertoire-building and goal-setting continues to be the emphasis of elective undergraduate courses such as "Curricular Uses of Computers" offered by the Faculty of Education at Memorial University of Newfoundland. Teachers learn to develop their computer competence with educational software as they work to attain these aims. Comprehensive research (Kulik & Kulik, 1991) shows that when these matters are considered, educational computing can be expected to improve teaching and learning.

A growing trend is to "have students program hypertext multimedia interactive presentations; this is one of the most valuable educational uses of technology there is" (Becker, 1993, p. 129). The consensus however is that there are more crucial concerns than developing one's own software (Geisert & Futrell, 1990; Lockard et al, 1994; Maddux et al, 1992). The main interest in most schools has been getting enough curricular and applications software for students and teachers to use.
A second concern was that few educators in their job situations have the time or the need to develop CAI software (Geisert & Futrell, 1990; Maddux, 1992). Task requirements and software interactions must be examined, special needs and software assessment standards, to mention a few (Lockard et al, 1994). An entire course or lab lesson can easily become devoured by courseware development activity. Anyone who has ever developed a piece of CAI software knows that such an activity is a major undertaking (Maddux, 1992).

Third, authoring software is often unavailable in most schools and school boards, so teachers do not have the authoring software required to develop their own programs. However, these negative comments about Multimedia authoring in education have not depleted its perceived value among some educators and researchers. Policy makers are advised, therefore, that Multimedia authoring should be implemented as a special-purpose computing activity, and in concert with general-purpose computing requirements.

**Special-Purpose Computing.** Special-purpose computing activities should also differ for graduate and undergraduate education students. Multimedia authoring, for example, has found a niche in most educational settings. Undergraduate diploma students in Learning Resources at Memorial University use fast computers, large hard drives and high resolution monitors and printers to learn Multimedia authoring skills and implementation strategies. This special-purpose activity replaces the former emphasis on slide-tape production.

At the graduate-level, special-purpose computing activities such as Multimedia authoring focus on the needs and interests of small groups such as vocational, second language or special needs students. An elective graduate-level course called "Software Prototyping and Evaluation" examines the three stages for developing and evaluating computer-supported intentional learning environments (i.e., the position paper, the revised design document and the completed package). Graduate students learn to scrutinize a range of methods and results of Multimedia authoring concerning researchers of educational Multimedia (Geis, 1993; Tripp & Roby, 1990; van den Berg & Watt, 1991). One developmental concern, for example, is that many programs are simply information environments for browsing and not "consciously designed as learning systems. Graphic organizer nodes, for example, don't show users how the bits and clusters of information are arranged" (Geis, 1993, p. 16). Program advisement should prevent cohesion deficit from hyperspace wandering (Duchastel, 1990). Designing lessons with learner control is also difficult, as noted in Alessi and Trollip (1991) and Burwell (1991). A common result is that learners state they were uninformed of important and constraining decisions made by instructional designers. Program structure and lesson design should, therefore, be based as much on recent computing research (Alessi & Trollip, 1991; Burwell, 1991; Locatis et al, 1990; Park, 1991; Way, 1992) as on the advice of local experts.

**5) Program and Title Revisions**

A fifth factor affecting the successful adoption of computing is program and title revisions to emphasize contemporary educational communications. Separate educational policies should be developed for general- and special-purpose educational computing activities at graduate and undergraduate levels. Policy makers are advised that organizations intending to embark on research
or development in Multimedia or cognitive science should be developed in concert with general-purpose computing requirements. Basic media titles such as "Educational Media" and "Educational Communications and Technology" should be replaced with computing titles such as "Educational Computing" or "Curricular Computing" to more closely reflect the needs of the school system and governmental policy.

General-purpose undergraduate media course titles such as "Educational Media" should be replaced with course titles suggesting high levels of human-computer interaction, such as like "Educational Multimedia Authoring", "Intermedia", "Educational Multimedia" or "Educational Multimedia". The title and description of the sole graduate-level computing course in the Faculty of Education at Memorial University has been changed from "Computers in Education" to "Issues and Trends in Educational Computing".

6) Partnerships

A final factor affecting the successful adoption of computing is collaborative partnerships with outside organizations. These alliances can help to reduce the inequity between educational and corporate values and attitudes (Mann, 1993). One example is a recent partnership between The Newfoundland Telephone Company and the Faculty of Education at Memorial University of Newfoundland in which computer education students were introduced to corporate technology (Mann, 1993). The six-week "Technology Orientation" to state-of-the-art technology took three forms: 1) the tour; 2) the work venue, and; the visit from Personnel. The student-teachers were unanimous in stating that their tour of the technical facilities and the subsequent presentation the company's human resource officer were good experiences and could only have a positive impact on young children. Several students stated that similar tours of the technical facilities and subsequent presentations from the company's human resource officer should be arranged for children at all grade-levels.

In this light, educators can do four things to collaborate with outside organizations (Mann, 1993). First, educators can encourage business leaders to influence educational policy. Second, educators can actively participate in the technological and strategic changes occurring within industry. Third, educators can lobby to support industrial initiatives within our own educational computing facilities. Fourth, educators can abandon discrete skills in favour of strategic objectives that promote team-based, critical thinking activity.

Summary

This paper has attempted to show that computing policy for education can take one of three approaches. Transformative policy often appears to be an exercise in planned obsolescence. Collaborationist policy involving computer networks often relies too heavily on untested distributed resources. Incremental policy is the best of the three approaches because of its reliance on knowledgeable people over software innovations. Incremental policy accounts for differences between general and special-purpose computing factors for graduate and undergraduate students. Incrementalism can be implemented by administrators or individuals with a commitment to respond to business and government concerns about computing policy for education.
References


Mann, B. L. (1994). Answers to five questions about educational media and technology. Paper presented to the School of Education, Boston University, Boston, MA. May 19.


