Complexities and Challenges of Integrating Technology Into the Curriculum

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Educational and Instructional Goals
K-12 education systems that make a commitment to introduce multimedia technology into schools and classrooms are likely to face the decision regarding whether to integrate formally technology into the curriculum. Although it is unlikely that this choice would be made at early stages of introducing technology into schools, there will likely come a point when policymakers and stakeholders agree that dissemination and use of the technology is sufficiently widespread within a system to justify its articulation in the curriculum, and perhaps in examinations, particularly if the system is intent on achieving academic goals that can be accomplished more effectively with the use of technology. Educational goals for which the use of technology is considered supportive include the following:

- Improve teaching and learning in content areas;
- Develop students’ skills considered to be essential in the modern working environment, including the ability to
  ♦ communicate using a variety of media and formats,
  ♦ access and exchange information in a variety of ways,
  ♦ compile, organize, analyze, and synthesize information,
  ♦ draw conclusions and make generalizations based on information gathered,
  ♦ know discipline content and be able to locate additional information as needed,
  ♦ be self-directed learners,
  ♦ collaborate and cooperate in team efforts,
  ♦ interact with others in ethical and appropriate ways;
- Increase motivation for teaching and learning;
- Change the social organization of classrooms to be more student centered;
- Enrich interaction among students, teachers and other schools;
- Stimulate creativity and collaboration.

Table 1 provides examples of such goals as articulated by six countries that have introduced computers and, in some cases the Internet, into their schools.

Research studies have found that some of these goals are indeed accomplished by integrating technology into teaching and learning. Riel (1992) found that students who participated in Internet-based learning networks showed increased motivation, a deeper understanding of concepts, and an increased willingness to tackle difficult questions. A review of over 100 studies found that use of computer and Internet technology in schools and classrooms

- improves students’ attitudes and confidence and is especially beneficial for ‘at risk’ students,
- provides instructional opportunities otherwise not available,
- increases student collaboration on projects,
- significantly improves student problem-solving skills,
- increases the preparation of students for most careers and vocations, and
- tends to shift teaching styles from traditional direct approaches to a more student-oriented approach.

To Integrate or not to Integrate
There are a number of reasons that education systems may decide not to integrate the use of technology into the curriculum, and especially not to hold teachers and students accountable for using technology in the teaching and learning process. The most significant reasons are limited and/or unequal access to computers and the Internet, and unprepared teachers. Few education systems at this point can guarantee that all students have adequate and equal access to computers and the Internet to accomplish stated goals; a status that requires considerable resources for hardware, software, connectivity, technical assistance and teacher development. However, the downside of not integrating technology formally into the curriculum is that the costly investment in technology will be underutilized and valuable resources will be wasted. Many teachers who have access to the technology will not use it, either because they don’t know how, are satisfied with their current approach to teaching, feel that using technology is too fraught with technical difficulties, or that they don’t have sufficient time to devote to the types of lessons best supported by technology. Moreover, Kerr (1996) argues that integrating technology into classroom practice requires “a radical shift in both teaching style and the teacher’s vision of what classroom life is all about. This new vision is one that changes the
Even teachers who are facile with technology and enthusiastic about using it confront another obstacle – overly packed curricula. For some time now teachers, educational researchers and others have been arguing that most curricula cover far too many topics at a superficial level, and seldom address topics in sufficient depth to promote deep-level understanding. Studies show that students learn isolated facts for a test and forget them soon after, a practice that runs counter to most systems’ stated goals for education. Teachers who sincerely want to adopt more child-centered, constructivist approaches bemoan their need to cover the overly full curriculum. “We don’t do what SIP [a long-term teacher development project in Kenya] wants because we need to cover the syllabus and we only have 35-minute periods. If they cut back on the amount of material covered in the curriculum, we would have more time to engage the children in thinking, but now we avoid asking questions that might require any extra time.”

In countries that have high-stakes examinations, the pressure to “cover the curriculum” is exacerbated, and anything that does not support students’ success on exams is likely to be neglected, including the use of technology.

Many of the more effective uses of computers and the Internet require larger blocks of time and integrate numerous topics, subjects and skills. They often engage students in more real-life types of projects than are typically found in textbooks and often involve students in collecting their own data, extracting information from the Internet, and interacting with a broader range of expertise than teachers and textbooks. Teachers will be reluctant to engage their students in such projects if they are not consistent with what is being measured on high-stakes examinations. Roschelle et al (2000) argue that, “Time spent preparing students to do well on numerical calculation tests, vocabulary, or English mechanics cannot be spent on learning about acceleration, the mathematics of change, or the structure of Shakespeare’s

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### Table 1: Goals for School-based Computer Use in Six Countries

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<th>COUNTRY</th>
<th>GOALS</th>
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| Barbados | • To provide better motivation for both teachers and students;  
           • To enable schools to provide better educational management;  
           • To assist students in mastering the requisite skills and competencies of a computerized world; and  
           • To enhance the teaching of subject matter of the various curricula offered. |
| Chile    | • To promote cooperative learning, higher-level thinking skills, data management, and communication skills. |
| Costa Rica | • To contribute to the improvement in the quality of education;  
             • To provide access to technology to children in rural and marginal urban areas;  
             • To stimulate creativity, cognitive skills and collaborative work;  
             • To rekindle teachers’ interests in teaching; and  
             • To provide students with new learning environments and opportunities. |
| Egypt    | • To improve the quality and relevance of education through improved access to information for teachers and students and work-related skills; and  
             • To provide a means of communication within the education system. |
| Jamaica  | • To integrate technologies into the curriculum;  
             • To foster literacy and numeracy acquisition through computer-assisted instruction in primary schools;  
             • To electronically network rural schools; and  
             • To expand software available to educators. |
| Turkey   | • To promote active involvement of students in individual and collaborative work;  
             • To enrich institutional activities through various kinds of multimedia instructional software and web-based materials;  
             • To enrich the interaction among students, teachers and other schools;  
             • To promote multidisciplinary and authentic tasks, covering more than one course and real-life applications; and  
             • To integrate IT skills into the existing curriculum. |
The ISTE standards are organized around the curriculum areas of English language arts, foreign language, mathematics, science, and social studies and include a set of sequenced learning activities arranged by grade level range, performance indicators, learning activities, references to national (US) standards, and information on related resources. Some abbreviated examples of the standards follow:

Chaos and Beyond, Mathematics, Grades 9-12

Purpose of the Lesson:
- Introduce students to nonlinear models and dynamic chaos
- Provide an example of mathematics that is possible only because of technology
- Introduce students to the ideas of self-similarity, recursion and fractals

Activities:
- Using a spreadsheet or graphing calculator, students plot and discuss simple linear population models where the change in population is represented by a simple birth and death rate. Investigate the idea of a stable population (and that most populations are not stable). Obtain population models from sites on the Internet (see Tools and Resources).
- Introduce students to the Verhulst population model. Plot and discuss it using a spreadsheet or graphing calculator. It is generally useful and not too time-consuming to plot the first 100 to 1,000 generations using a spreadsheet.
- The Verhulst model is closely related to the logistic equation. Students make graphs of the logistic equation using different control parameters and initial conditions.
- By changing the control parameter, $r$, and the initial population $x_0$, students investigate (A) stability of solutions, (B) bifurcations, and (C) chaos.
- For some values of the control parameter, such as 3.6, it appears that the population never settles down to one or a few alternating values. Such populations are known as chaotic, and students may wish to search for chaotic values of the control parameter. (ISTE, 2000, pp. 122-124)
Purpose of the lesson: Students collect current data to make generalizations and conjectures about the location of the earth’s tectonic plates while exploring the nature of the earth’s dynamic crust. The access to current data and instant maps in an environment of collaborative learning places students in a simulated scientific research setting.

Description: Students access current information on earthquakes that have recently taken place around the world. Data is collected over a period of time that, when graphed and mapped, will crudely show the boundaries between the earth’s tectonic plates. Students monitor earthquake and volcanic activity and produce generalizations about the changing nature of the earth.

(Selected) Activities: Students access the U.S. Geological Survey’s earthquake web site and look at recent activity in selected geographic areas. They plot the longitude and latitude of regionally selected earthquakes on a physiographic map available on the Internet. They map both active and inactive volcanoes around the world and assess the relationship between active volcanoes and locations of the tectonic plates. They check sites weekly for recent data and after a few weeks, plot a graph to show changes in the data. They collect additional data on earthquakes and volcanoes from other web sites, and develop a mini-lesson on the structure of a volcano, including the dynamics of how volcanoes erupt, using photos gathered from the Internet to increase comprehension. They prepare multimedia presentations of their studies for various geographic regions and link various regional presentations into a worldwide presentation and site. Students discuss the dynamic nature of the earth’s crust. (ISTE, 2000, pp. 156-157)

Conclusion

There are a number of particularly worthwhile educational, economic and societal goals that are more likely to be accomplished with the use of multimedia technology in the teaching and learning process. Such goals are unlikely to be achieved without ensuring a broad range of conditions that enhance the likelihood of technology use, including the integration of technology into the formal, articulated curriculum, and perhaps even into high-stakes examinations. However, establishing sanctions associated with high-stakes examinations cannot be justified until access to the resources required to achieve the goals is equitably distributed. On the other hand, many teachers are unlikely to devote the time and energy required to use technology if its use is not formalized in system statements of expected learning outcomes. Education policymakers and stakeholders that choose to pursue technology-related goals will have a fine line to walk between encouraging technology’s effective use in classrooms and ensuring that the conditions for equitable access are in place.

Endnotes