THE COMPUTER IN SCIENCE EDUCATION: ITS ROLE AS A TOOL TO EXTEND THE HUMAN MIND

The dramatic international events in the last few months show how quickly things can change and surprise even the experts. These changes, like most political changes, were brought about primarily by economic conditions. Fortunately, they were mediated politically from within by the people who were directly influenced by these conditions.

Historically, the U.S. educational system has also responded to change, but much more slowly than the changes occurring in today's world. But similar to dramatic changes in the world, effective changes in our educational system have been a response to economic conditions. The changes have also been mediated by the reciprocal relationship between the citizenry and its institutions. For example, the changes and needs brought about by industrialization in the 1830's and 40's gave rise to an educational system organized around the common school. These schools were intended to train people for industrial jobs and provide for a shared educational experience. In this same milieu, vocational education arose and the differentiation of the curriculum in the high schools occurred. Because the needs were not only perceived as real, but were real, lasting positive change in our educational system occurred.

During the years following World War II, our educational system again needed an overhaul. When Sputnik was launched by the Soviets in 1957, these concerns prompted one of the most massively-funded educational efforts for change in the history of the United States. Many of the changes focused on science education. The general feeling was that science education did not reflect the true nature of science, and the students did not seem to be able to use or apply their knowledge after leaving school.

Political pressure from these concerns generated the National Defense Education Act and a willingness by Congress to charge the National Science Foundation (NSF) with the responsibility of doing something about our "substandard" educational system. NSF felt that the best agents to investigate the matter were those who knew science best, the professional scientists. Thus the professional scientist began writing the curriculum for the secondary school. This became known as the "discipline centered" curriculum. The theme of teaching concepts and processes within the discipline was the central paradigm around which the texts were constructed. Content was important to the degree that it supported the structure of a discipline. Thus, for example, the different Biological Science Curriculum Study books (BSCS) varied in content, but maintained the central investigative methods of the discipline.

However, these innovations did not endure. Of the 40-odd attempts at science revision in this century, few, if any significant changes have occurred. Even in the reform movement's heyday, as many as two-thirds of the teachers were not teaching the science courses the way they were intended to be taught. Teachers returned to the pedagogical style that had served them in the past.
In the last few years, primarily because of the requirements of the information age, we again hear that the American educational system is in trouble. The Nation at Risk Report (1983), similar to the Committee of Ten report at the turn of the century, indicates a need to return to the "new basics." Cast in the light of Japan's economic might and the rapid changes occurring in the world, we see a pattern similar to the changes in education wrought during the industrial era, namely, how to develop and distribute human resources in the labor market given the exigencies of the time. But this time, unlike the perceived deficiencies in education during the Sputnik era, the economic changes are fundamental, and according to a Nobel Prize winning economist, Robert M. Solow, an absolute must. This is because the major driving force behind our economic growth is technology. Thus, changes in education, and specifically science education, might well be fundamental to our economic and political survival.

As a consequence, many prominent educators have advocated essential changes. Living and working in an information-rich world requires that people acquire a content (knowledge base) education consisting of facts and information about a subject. But more emphasis should be placed on teaching skills that address the needs of today's world, such as inquiry, critical thinking, decision-making, and information-processing abilities. Students need to acquire skills that increase cooperation and participation in a community where communication is a way of life.

Perhaps most important of all, students must be taught to be lifelong learners, because content knowledge in all disciplines will continue to increase at a rapid rate. Andrew R. Molnar of the National Science Foundation has stated "If we are to master information, we must expand human ability to learn and comprehend, and we must create new intellectual tools to extend human capacity to reason and to work smarter." This statement captures some of the essential requirements of science education and presents a fundamental challenge to the educational community.

One of the intellectual tools that can be used to meet this challenge is the computer. Because the computer continues to be of central importance in the private sector, the skills associated with its use in education as a whole are generally conceded to be important. Because the computer helps extend and free the human mind "to work smarter," its specific importance to science education cannot be underestimated. It is for this reason that science educators must recognize the vital role that computers can play in the classroom. And where do we have a better opportunity to demonstrate and model the major educational goals as outlined above than in the science classroom where the acquisition, manipulation, and display of data are so critical to the problem-solving and educational process?

Central to these ideas is the notion that these changes, like the lasting changes that have occurred in the past, are mediated by societal changes that apply irresistible pressure on the educational system from both within and without. Education reflects and adjusts to society's needs, and in its course returns and influences that society. This reciprocal relationship develops over time, but now we cannot afford to wait too long for fundamental changes to be made in science education because our national vitality might well rest upon such changes.
In the next few issues of the *Kansas Science Teacher*, I will examine specific uses of the computer in the science classroom. I will look at the use of databases for teaching data-gathering and problem-solving skills, spreadsheets for teaching inference skills, and the use of computer simulations as alternatives or complements to certain laboratory activities. Each of these major categories will be buttressed by highlighting specific pieces of software and by using examples that apply to the real science classroom.

Literature Cited and References


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