

STRUCTURAL FOUNDATIONS OF EDUCATIONAL SYSTEMS

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Summary

Educational systems everywhere are designed to prepare children for life and for work. Education is an essential component of the life-support system in any society, with economic and social progress being inextricably tied to the quality of the educational system. Beyond the scope of an educational system required for life-support systems, some educational systems are also concerned with the advancement of knowledge. The goals of education are accomplished in a variety of settings, and using a variety of instructional strategies. Classroom-centered instruction is the most common element of the formal educational system in most places, although distance education, workplace-

centered instruction, and independent learning are all important contributors. Instructional models, once strongly teacher-centered, are slowly giving way to student-centered models. The new instructional models make more, and better, use of new instructional technologies.

Advances in educational pedagogy are proceeding differently in various parts of the world. Pre-service and in-service teacher education programs change only slowly, and many countries are not able to devote much attention to any teacher training. Where public funds are seriously strained and international donations are sparse, difficult choices must be made in how to deliver educational experiences to children. The net result is that enormous gaps exist among the nations in the quality of education delivered to their children.

1. Introduction

Based on the archaeological record, the evidence is conclusive that the passing of knowledge and skills from one generation to the next long predates the appearance of *Homo sapiens* as a separate species. Even in the most primitive hunter-gatherer societies, survival of the species depended on children being taught to forage independently and to protect themselves. The transfer of accumulated knowledge and experience from one generation to the next qualifies the process as an educational system, however rudimentary.

As the social, economic, and technological structure of human society evolved, the task of transferring knowledge of the accumulated human experience to subsequent generations became more complex, requiring societies to develop effective ways to minimize the loss of knowledge with the passing of time. Occasionally during human existence, disease or war has decimated large percentages of a population, and a significant portion of the accumulated knowledge is invariably lost. Before the invention of writing, the sharing of knowledge from one generation to the next was particularly tenuous. One example illustrates the point. Soap is essential for personal hygiene, and epidemic diseases such as the Black Plague spread more rapidly during the Middle Ages because of poor hygiene. People of the time did not know how to make soap. On the other hand, the people of a thousand years earlier *had known* how to make soap. Somehow, that knowledge was lost in the transfer of knowledge and information across generations.

Today, significant knowledge is not as likely to disappear from the archaeological record with the passage of time. It is more likely to become buried in the mass of information that is accumulating at an exponential rate. Information must be processed and integrated into the human experience before it becomes knowledge. Even then, there is far too much knowledge for any one person to master more than a tiny fraction. For modern educational systems, the question that must be answered over and over again is: “What portion of humankind’s accumulated knowledge should be taught, and to whom, and by whom, and why?”

Despite the vast amount of knowledge that could be interpreted and made meaningful for successive generations, national educational systems frequently fall far short of the goal of delivering quality education to their students. This shortfall is true in the most developed nations, with large expenditures of funds for each student, as well as in the least developed nations, where formal educational systems scarcely exist.

2. Structure and Objectives of Educational Programs

UNESCO and World Bank objectives for global education programs are repeatedly stated as (1) education for peace, human rights, and democracy, and (2) education for development. These categories are intended to include all aspects of what could be classified as (1) the components of educational experience that are important preparation for living a socially responsible and happy life, and (2) the practical components of educational experience that provide the knowledge and skills for employment and economic progress. In this section, the education for development category is split into two parts. The rationale is that education to prepare an individual for the workforce is an essential component of the educational system for almost everyone, but education to enable contributions to the advancement of knowledge applies to only a few.

The educational systems of most countries distinguish primary education as the early education of children that focuses on development of basic skills for communication, numeracy, and socialization. Lower-secondary education is considered to be the initial post-primary years in which students are taught specific subjects by teachers who are subject-matter specialists. Completion of the lower-secondary-education course of study may, or may not, qualify a student to proceed to upper-secondary education. Where compulsory education exists, it often ends with the completion of lower-secondary education; many students go directly into the workforce upon completion of lower-secondary education. Upper-secondary education includes the education following the end of compulsory education and the beginning of tertiary education. Upper-secondary education is characterized by still more specialized courses that are typically covered in greater depth than in lower-secondary education. Students completing an upper-secondary education course of study may directly enter the labor force or they may matriculate to tertiary education in a college or university or to post-secondary vocational education. Ages of students at the beginning and ending of each of the principal education blocks vary over several years among countries; and distinctions are blurred in others. Students beginning primary education, for example, may be as young as five years in some countries and as old as seven years in others. In the most developed countries, pupils entering primary education are likely to have had one or two years of pre-primary schooling. Students ending their primary education may be as young as nine years in some countries and as old as fourteen years in others. Compulsory education may encompass as few as six years in some countries and as many as twelve years in others.

Post-secondary education is invariably less regulated than primary and secondary education, and this partially accounts for the fact that post-secondary educational systems are much more varied than primary or secondary systems. Institutions range from vocational or technical schools, where graduates are prepared for immediate entry

into the labor force, all the way to research universities or professional schools, where courses of study culminate in doctoral degrees.

2.1. Preparation for Life

Appropriate educational experiences to prepare an individual to live responsibly in an organized society are difficult to define. Certainly an understanding of world cultures, as well as one's own, is essential. By the same token, studies of history, government, ethics, language, and comparative religions broaden understanding and provide the basis for peaceful relations among peoples. The problem with education in the social sciences is that depiction and interpretations of world events and history are too easily skewed to make them consistent with national agendas. Blatant misinterpretations of events or political situations are easily revealed as such, and can be dealt with as propaganda. The more insidious problem is the myopic view of world events produced when education writers and speakers process information through their own cultural filters. An extremely important educational goal in the social sciences is to provide students with an awareness of their own cultural filters, and the ability to recognize the merits of alternative viewpoints.

2.2. Preparation for Work

Practical knowledge and skills that enable individuals to work productively in society vary enormously among nations. Highly industrialized nations depend heavily on such things as manufacturing, trade, banking and finance, education, the professions, service industries, and transportation. Individuals working at anything other than menial jobs in those nations must be prepared to a high level of specialization, typically requiring some post-secondary education. In the least developed nations, those same individuals might be unemployable because their skills were not appropriate to the economy. The great challenge for education planners in developing nations is to structure the educational system to meet current needs for workers as well as to anticipate the knowledge and skills that workers will need in the coming two or three decades as the nation's economy evolves. For example, as a nation moves from an agricultural economy to a manufacturing economy, the focus of some of the practical components of the educational system must shift from such things as crop science and animal husbandry to things like machinery operation and repair.

Many countries have established some system of vocational/technical education that may either be a part of the secondary school system or that is separately organized to deliver post-secondary education to adults. These schools may be operated as public institutions or as private businesses, but they share the characteristic of preparing students for immediate, although not guaranteed, employment following successful completion of a course of study. Generally, the curricula of these schools focus entirely on preparation to secure employment, and ignore the social science aspects of educational experiences unless those experiences directly affect employability.

2.3. Advancement of Knowledge

The quest for new knowledge is typically driven by a desire to understand nature, with

little thought to its practical consequences. In fact, practical applications of new knowledge often trail discoveries by decades, even centuries. The human condition can only be improved as knowledge is applied to improving such things as medicine, agriculture, technology, cognitive sciences, and political systems. Without the continuous generation of new knowledge, development of practical applications would soon cease.

The responsibility for advancing knowledge has been primarily taken up by research universities in the most developed nations. These universities consider the advancement of knowledge to be essential components of the educational system, and they prepare students to participate in discovery through an apprenticeship system. In science and engineering fields, university research can be quite expensive, primarily because of the costs associated with purchasing and maintaining large machines to probe the secrets of nature. Most less-developed nations cannot afford to support university research as part of their educational systems, nor do they need to. This component of the educational system becomes important only after the core educational system is functioning well.

Some successful corporations and government agencies support research laboratories that advance knowledge, but students are usually not associated with these programs. Also, the research is almost always targeted to areas of interest to the sponsor. Knowledge is advanced in pursuit of pragmatic objectives rather than for its own sake. In this article, such targeted research programs are considered to be outside the educational system.

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Biographical Sketches

Dwaine Eubanks is the Director of the American Chemical Society's (ACS) Division of Chemical Education Examinations Institute and Professor of Chemistry at Clemson University. Before coming to Clemson in 1992, he was a faculty member at Oklahoma State University. He was a visiting professor at the University of California at San Diego in 1990/91 and at York University in 1981. He was a research chemist at Du Pont's Savannah River Laboratory from 1963 until 1967. His professional contributions include numerous scientific presentations, journal articles, and the text *Chemistry in Civilization*. He presently is one of the lead authors in the new ACS curriculum project *General Chemistry*. He has extensive experience as a consultant to evaluate chemistry departments, and has been an active participant in local, regional, national, and international conferences dealing with chemistry education. He served as Chair of the Division of Chemical Education in 1985.

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