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Cooperation Between Business and Education to Meet the Challenge of a Changing Environment

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Articles in professional publications with titles like "Academe and Business Tighten Ties: Corporate Giving Nears 1.5 Billion" (Desruisseaux, 1985) and "Carnegie Report Calls Corporation a Major Part of the U.S. Educational System" (Scully, 1985), or "Partnerships: Schools Forging Relationships with Business Community" (Glass, 1984) are a sign of the times. The business/academia relationship continues to change and develop as the eighties roll along. Huddleston and Penwick (1983) indicated that in 1981 alone "more programs between education and industry were established than during the previous five years."

Referred to variously as "partnerships", "joint ventures", "collaborative efforts", "cooperation", and so on, these relationships are increasingly important to colleges and universities, to the businesses and industries with which the colleges and universities interact, and, to a relatively smaller degree, to public schools. We tend to talk about these relationships as if they were a new idea, which of course they are not. One of the earliest examples of such cooperation was in 1865, when Ezra Cornell and Andrew Dickson White joined business and scholarship together to found Cornell University (Schmotter, 1983). However, the relationships have now become generally symbiotic. Business and education must support each other in order to achieve the broad goals of our society. Warmbord, Persavich and L'Angelle (1981) reported on 219 exemplary programs, and many others have been reported in recent literature (Jasso, 1984; Sullivan, 1984; Worthy, 1985). Moreover, the experience is not a uniquely American one. Such cooperation is growing in Ireland (Kelly, 1985; O'Gorman, 1983), the Netherlands (Van Meygaard, 1985), and other parts of Europe (Michel, 1985). In this paper the major forms business and education partnerships currently take and the benefits of cooperation to the parties are presented. In addition, a review of factors that encourage or enhance business-education cooperation and some of the many barriers to such cooperation are explored.

Method
A structured review of a sample of recent literature on business/education cooperation was conducted. Forty-three articles and documents based on content relevance and accessibility were selected from the Education Index and the Business Periodicals Index, or from citations in the literature. One additional document, an Arthur Andersen & Co. (1984) report titled, "Joint Ventures Between Business and Higher Education: Human Resource Evaluation" was also included in the review. Each article or document was read, and verbatim statements were categorized as a (an):
- benefit,
- impact,
- facilitating factor,
- obstacle, or
- example of cooperation.
The verbatim statements were transcribed to a word processing file. Each statement was coded to enable sorting using the capabilities of the word processor. When a statement served two categories, it was entered twice and coded appropriately. Approximately 300 statements resulted from this process and were then sorted into the respective categories. Each category was analyzed into the subcategories that were summarized to form the basis for the results reported here.

Forms of Business-Education Cooperation
Four fundamental forms of cooperation were found. They were: faculty consulting, training program development and delivery, training program evaluation, and support of research.

Faculty Consulting
Hiring a faculty member as a consultant to address a specific need is one of the most frequently used forms of cooperation (Foote & Borsting, 1985). Through this vehicle a business is able to use the expertise of university faculty on an "as-needed" basis. Thus the business receives expert advice and the faculty member receives pay and valuable, non-university experience.

Training Program Development and Delivery
Employee training is a significant form of the cooperative relationship and may vary depending on its origins and intent.

Work-education programs are cooperative efforts designed to prepare students to join the work force before completing the schooling process. These programs include internships, visiting speakers and unpaid work experience for school credit (Zemke, 1983).

Adopt-a-school programs, in which a local company provides an elementary or secondary school with needed resources (e.g., aids, specialty teachers, equipment, incentive funds), are also a growing phenomenon. Started by the Atlantic Richfield Company in Los Angeles (Management Review, 1983) and spreading nationwide, the Adopt-a-school program has been effectively used in cities such as Akron, Chicago, and Boston.

Consortia, in which a group of companies jointly sponsor training programs for the general benefit of an industry, are also contributors to the business/education relationship. For example, Atlantic Richfield Company (ARCO), San Diego Gas and Electric Company, and Westinghouse Electric Corporation joined with the American Federation of Teachers, Joint Council on JOURNAL OF INSTRUCTIONAL DEVELOPMENT
Business and education must support each other in order to achieve the broad goals of society.

The Vanderbilt group has used private consultants to provide direct service to a business in conducting needs assessment and establishing evaluation criteria, and the university has supplied technical content and instructional staff and facilities for the training (Zemke, 1985). In a similar design, Arthur Andersen & Co., through its education consulting practice, worked with a large business machines manufacturer to plan, design, and evaluate a training program that subsequently received university accreditation.

In the preceding examples there was direct and immediate value for the efforts of both parties. Faculty receive pay for teaching, and businesses receive training and evaluation of the program. In some relationships, the quid pro quo may be less clear.

Support of Research

Cooperation in research to enhance technology transfer is a highly visible type of interaction between the academic and business communities. Businesses can draw upon the expertise of large, well-established research teams in universities by supporting research that might have commercial potential. The Stanford Center for Integrated Systems is one example of such research cooperation. It is a research facility in which academic and industrial scientists work side by side. It was created through support by the U.S. Department of Defense and 20 microelectronics firms (Langfitt & Ambrose, 1985). Another example of this type of support is the Microelectronics and Information Sciences Center at the University of Minnesota. Control Data Corporation has donated funds, facilities and processing expertise to allow the Center to conduct highly technical research (Schilling, 1983).

Support for research is also provided in direct contracts, state-subsidized programs, shared facilities or equipment, and in other ways. In order to ensure a significant and assured recurring payoff to such collaboration, the benefits to each party and the factors that facilitate cooperation must be clear.

Benefits of Cooperative Arrangements

Both parties must benefit from cooperation if it is to exist long term. The benefits recognized are fairly easily sorted into benefits to business and benefits to education.

Benefits to Business

The most commonly noted benefits to business resulting from cooperation are improved recruiting—based primarily on higher levels of entry skills resulting from training partnerships or on internships (Jasso, 1984; Michel, 1985)—and business gaining earlier access to technological improvements (Agres, 1983; O’Gorman, 1985). The quality of recruiting and the speed of technology transfer can be critical to a business in maintaining its competitive advantage.

Two other benefits that accrue to business are increased effectiveness of employees taught by expert instructors, and access to the research expertise within the universities (Langfitt & Ambrose, 1985; Darkenwald, 1985; Michel, 1985; O’Gorman, 1985).

Also noted as business benefits are improved morale (Jasso, 1984) and improved retention of personnel (Huddleston & Fenwick, 1983). These effects are assumed to arise from greater involvement in the community, as in adopts-school programs, and through the company attending to employee self-development needs by providing access to good training programs.

A final benefit noted for business is improved public relations (Jasso, 1984). The public relations benefit of direct contributions to schools or community projects is evident, but in today’s environment some of the social respon-
sibility for managing environmental change and skill/knowledge obsolescence falls to businesses. Those businesses that conspicuously contribute to the effort through cooperating with local educational entities will be more likely to be perceived as acting for the public good.

Benefits to Education
Two very prominent benefits emerged for education: (a) increased revenues, resources, and equipment. (Kelly, 1985; Langfitt & Ambrose, 1985; Schmotter, 1983), and (b) the provision of practical experience for teachers and students (Langfitt & Ambrose, 1985; O'Gorman, 1985; Robinson, 1985). Although increased revenues were seen by many as a benefit, at least one article presented it as a potential problem (Zemke, 1985). There is some sentiment that revenue replacement may redirect the mission of universities and that the current funding of projects is aimed not at improvement of curricula or schools, but to short-term objectives of the participating businesses. Other benefits for education were the enrichment of the educational process (Schilling, 1983), increasing enrollments through the captive business audience (Boyle, 1983; Burke, 1985; Zemke, 1985), and improving retention of faculty (Langfitt & Ambrose, 1985).

The benefits of cooperation to both business and education are strong and varied. They can lead to increased technological innovation and an improved flow of information and ideas in both directions. There are many factors that operate to promote the business-education interactions that yield these benefits.

Facilitating Factors
The factors that facilitate or encourage business-education cooperation fall into three categories: (a) attitudes and procedures, (b) environmental pressures, and (c) other incentives. Attitudes and Procedures
Successful cooperation depends upon commitment and the perception of mutual benefit by both parties. There must be a match between the business and the educational institution (Agres, 1983; Hansen, 1985). A strong industry or company will need strong scientific capacity in a university to benefit from a research partnership. Supporting structures (e.g., inexpensive office space, part-time appointments) may be provid-

Work-education programs are cooperative efforts designed to prepare students to tour the work force before completing the schooling process.

ed by a strong university to support fledgling businesses or entrepreneurs.

The pivotal element in successful cooperation is joint planning (Agres, 1983; Darkenwald, 1983; Hagen, 1983; Fink & Kosecoff, 1986; Jasso, 1984; Marketing News, 1981; Michel, 1985). Roles and responsibilities, outcomes processes, and time schedules must all be clearly defined and communicated. Through joint planning carried out at an appropriate level of detail, the parties may come to understand one another better and communication patterns will be established.

If the attitudes and procedures necessary to make cooperation work are not cultivated, widespread cooperation will not be achieved. Sometimes pressure from external factors can stimulate development of appropriate attitudes and procedures.

Other Incentives
Educational institutions have a pool of academic and research expertise that businesses can tap and businesses have money, equipment and other resources from which schools can benefit (Boyle, 1983; Kelly, 1985; O'Gorman, 1985; Pratzner, 1983; Robinson, 1985). Other incentives and facilitating factors that may make a difference are geographic proximity, local shortages of prepared personnel, and local student needs, government incentives, and person-to-person contacts (Fink & Kosecoff, 1986; Huddleston & Fenwick, 1983; Langfitt & Ambrose, 1985; Gorman, 1985; Van Meygaard, 1983; Whitworth, 1983). Finally, it is important that university reward systems be established so that teaching and research faculty are recognized for their contribution to cooperative ventures (Arthur Andersen & Co., 1984; Kelly, 1985). If the reward system does not serve as an incentive, it may function as a barrier. There are other barriers to cooperation as well.

Barriers to
Cooperative Arrangements

Baldwin and Green (1984) identified three major themes related to obstacles to cooperation: attitudes, which they described as perceptions held in each community of the other; administrative philosophy, which focused on the differing missions and accountabilities of business and education; and profes-

A second major factor that increases the push for cooperation is rapid change in technology and knowledge (Huddleston & Fenwick, 1983; Langfitt & Ambrose, 1985; Michel, 1985; Pratzner, 1983; Schmotter, 1983). Close links between businesses and universities means that the transfer of technology or knowledge takes place routinely and quickly. This can mean the difference to the business of having a competitive edge or of being second best. The support provided by business also helps the school break new ground and use new information more effectively for its own purposes.

Other significant environmental pressures are declining enrollments and public spending cuts (Fink & Kosecoff, 1986; Kelly, 1985; Schmotter, 1983; Zemke, 1985; Van Meygaard, 1985). While these environmental pressures encourage cooperation, there are also incentives or facilitating factors that are not as broad but still can have significant impact on cooperation.
sional work styles, which dealt with issues related to determining the scope and directions of research and rights to (or ownership of) results of sponsored research. These themes appear in the current literature (although they have been renamed here) as perceptions, missions, and academic rights and ownership. In addition, a fourth issue, political influences, was identified as a potent barrier.

Perceptions

Whether perceptions are accurate or not, they affect the level of trust and type of interaction that occurs in any partnership. Pink and Koscoff (1986) suggest that the educational decision-making process is sometimes slower than is conducive to interaction with business. The perception among many potential partners from business is that academicians do not appreciate the critical nature of timeliness. For a business the timeliness of information can make a significant difference in its value. If a consultant (or an employee) is a little late in delivery, decisions may be made without benefit of critical information. Perceived reliability is the issue. Business needs to be able to "... rely on the educational community to deliver the desired product on time" (Boyle, 1983, p. 16). Further, there is a significant barrier to cooperation represented by a business attitude of "skepticism about the interest and capacity of educational organizations to serve the needs of industry" (Dardenwald, 1983, p. 242). Also the stereotype of the theory-focused thinker unable to quite come to grips with short-term practical applications still holds valid for many businesses. On the other hand, the academic scientist often views the industrial counterpart as profit-oriented, interested in the short run, motivated by limited goals, and neither attuned to nor particularly interested in the development of knowledge, deep understanding, and insight for their own intrinsic value. Zemke (1985, p. 23), summarized the barrier well when he said, "Industrial trainers regard university educators as ivory-tower theoreticians. Spokesmen for educational associations seem to view profit-making training vendors as thieves."

Missions

The university's mission, to serve the public good through the search for knowledge and through teaching, is viewed by some to be antithetical to the mission of business which is to serve the interests of its stockholders (i.e., make a profit) by providing products or services to meet the needs and wants of buyers. The issue of most concern in relation to organizational missions is: By whom and on what basis is the research/teaching agenda established?

It has been observed that industry is reluctant to invest in R & D directed towards the development of fundamentally new technologies and that its orientation is toward applied rather than basic research. Given these conditions, it is feared that a university tied too closely to business for funding could be influenced to modify its fundamental mission. The concern is a broad one. If business is able, through funding, to dictate the research agenda, the effects could expand to (a) the tenure and promotion of professors who have the closest ties to business and who generate large funded projects, and (b) the management of student programs and support (leading to narrow topic assignments for both graduate research and courses). Finally, there is the concern that if, over time, the relationship between business and academia continues to increase, professors may neglect their teaching and administrative duties as a result of which their institutions and students will suffer (Kelly, 1985; Management Review, 1984).

Academic Rights and Ownership

Closely related to the issue of business gaining an undue influence over the research and teaching agenda of colleges and universities are the issues of academic freedom (Langatt & Ambrose, 1985; Management Review, 1984), ownership of intellectual property, proprietary information, and patents and royalties (Langatt & Ambrose, 1985; Schmoller, 1983). Coberly (1985) contends that information exchange through publishing is a fundamental responsibility of colleges, and that secret or proprietary work that limits students or faculty in the free exchange of information is detrimental. There is a need to establish legal rights to intellectual property (copyrights, computer programs, etc.) in the initial agreements with a research sponsor.

Politics

The political barriers to collaborative efforts occur on three levels. First, there is no national agenda for collaboration and no real leadership has emerged to shape and steer policy (Huddleston & Fenwick, 1983). Second, state executives and legislators make decisions about support or encouragement of programs based on political considerations and these decisions sometimes dilute the effects of concentrated effort or funding (Jaschik, 1986). Third, the politics within education encompass issues like contractual limits on assignment and scheduling (Jasso, 1984) and the use of tax monies to provide direct support to a business entity (Pratzer, 1983).

Ways Around the Barriers

Perceptions, if they are erroneous, will probably be changed only through significant interaction. As collaborative efforts increase in number and breadth, stereotypes and inaccurate perceptions may be replaced with understanding of the different philosophies under which each community operates.

The issue related to mission and academic rights and ownership are complex. On the one hand, businesses must protect their competitive advantages in order to succeed. On the other hand, the university must be true to its missions, protect academic freedom, promote basic research, and disseminate new knowledge and ideas. Colleges and universities and their business partners must, therefore, enter into agreements on an equal footing, and the agreements must be clearly spelled out to include rights and responsibilities of the parties. There needs to be genuine reciprocity.

The quality of recreating and the speed of technology transfer can be critical to a business in maintaining its competitive advantage.
and mutual benefits. One way around this barrier is to initiate third-party funding sources so that industry is not placed in the role of paying client (Arthur Andersen & Co., 1984). Another approach is through institutional policies. The University of Pennsylvania, for example, established guidelines that set the following expectations: (a) No sponsored projects are to be accepted if results cannot be publicly disseminated, (b) The university will patent all discoveries and grant all reasonable use to the public, and (c) university researchers will guard against conflicts of interest with the corporations with which they are associated (Management Review, 1984).

Finding resolutions to political barriers is not an easy task. There will always be the politics of the education community and local and state politics with which to deal. The issue of a national leadership, however, could be taken up by an organization or group of organizations coming together to try to develop a global plan for cooperation.

Conclusions

The decade of the eighties has become a pivotal period for the passage into the information age. Rapid technological advancement has made information potentially more accessible and certainly more important to the processes of business and inquiry. In addition, the move toward a global economy has heightened pressures on both business and education to better develop and use the human capital upon which both depend. Working better with human capital and taking advantage of technological advances often means working together for businesses and educational institutions.

The benefits from cooperation for both parties are strengthened positions and improved ability to react appropriately to the changing environment. The facilitating factors are many, but the barriers are potent. The challenge to the business and education communities is for each to maintain its unique mission within a recognized interdependence.

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Successful cooperation depends upon commitment and the perception of mutual benefit from both parties.
Building an Evaluation Research System for Joint Business and Higher Education Use: Critical Questions

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Introduction

In June of 1984, Arthur Andersen & Co. together with Northwestern University sponsored a conference to discuss the state of the art of evaluation relative to human resource development in business. Twenty-five universities were represented along with twenty-five corporations. While there was interest in many collaborative training efforts, one conclusion drawn was that there were too few joint evaluation efforts between business and higher education (Arthur Andersen & Co., 1984), and therefore, an absence of a shared data base to be used both by industry and higher education. As a result, methodological improvements for evaluating human resource development are delayed in both sectors. The conference report concluded with a number of recommendations for accelerating the exchange of methodology, information, and personnel in human resource evaluation between higher education and business.

In September of 1985, IC Industries Employee Benefits staff contracted with the Office for Health Promotion, Northern Illinois University (NIU), for program development as well as evaluation research services to augment its health care benefit programs funded by a Welfare Trust (the "Trust"). In this paper we will first delineate the eight conclusions reached by the joint business and university conference. This provides the framework for the case study description of a cooperative enterprise in practice.

The Conference on Joint Ventures Between Business and Higher Education: Human Resource Evaluation ended with eight conclusions. These conclusions reflected comments by David Mintzer, Vice President for Research and Dean of Science, Northwestern University; Gerold Miles, Director of Educational Programs, Center for Professional Education, Arthur Andersen and Co.; Alan Magazine, Executive Director, Business-Higher Education Forum; Ralph Tyler, Director Emeritus, Center for Advance Study in the Behavioral Sciences; and, William Wiggenden, Director of Training and Education, Motorola Corporation. The conclusions also reflected working group consensus from over fifty attendees. The conclusions are important because of the expertise of the participants. All are senior professionals committed to, and experienced in, the usefulness of industry/university cooperation. As you will see, they are reflective of real life project experience.

Conclusion 1: Business and higher education personnel are ready and willing to understand each other's needs in the area of human resource evaluation, and to enter into collaborative ventures when possible. Evaluation is a discipline that can directly affect training and other human resource development decisions. As such, it represents a sensible point at which to promote joint study efforts.

Conclusion 2: Effective evaluation is necessary to develop and implement sound human resource policy and programs. To meet human resource development needs, it is necessary to have a good understanding of the organization and its problems, opportunities, and business plans. Evaluation's purpose is to provide information to help ensure that the right people get the right kind of information and training at the right time, and in the right manner.

Conclusion 3: Evaluation is not being used to its fullest advantage in human resource development. In general, human resource managers need to expand their use of evaluation to improve program planning, development, delivery, and maintenance. Evaluation also provides a means for generating data for policy decisions relating to the workforce and to long-term planning within industry and higher education.

Conclusion 4: The incentive structure for cooperation between business and higher education must be clarified, strengthened, and diversified. University fiscal policies do not provide incentives for unit-to-unit collaboration between business and higher education, and make it more efficient and cost-effective for business to contract directly with individual faculty members. To make collaboration likely, it is critical that the benefits to each party be clarified, and that a structure for their negotiation be established.

Conclusion 5: Genuine collaborative efforts between business and higher education demand an understanding of alternative value systems. Business and higher education can learn from each other and learn together.

Conclusion 6: Many issues related to human resource development evaluation in private sector programs do not differ from those in public sector programs. The quality of evaluation in any setting is affected by the commitment to its use and the resources invested in its implementation.

Conclusion 7: Local conferences may be the most productive mechanism for establishing cooperative ventures between particular industries and universities. Meetings among institutions in close geographic location typically are more productive for generating sustained collaborative ventures.

Conclusion 8: Training and education in evaluation is important and can be
promoted in many ways. Use of faculty members in business and business people in universities is an option. Students also can serve internships in business settings as part of their academic training. Educational material highlighting sound evaluation practice would be helpful. These materials might take the form of collaborative case studies or evaluation materials for routine training.

The Cooperative Enterprise: A Case Study

Using a brief case study, we will describe efforts to build a joint evaluation capability and research base for shared use by a university and a major corporation. While it is not an unequivocal success story, it does demonstrate that, so far, project personnel have made incremental and deliberate gains in the art of collaboration. In part, steps forward have been stimulated and supported by lessons learned in joint conferences between business and higher education which was designed to explore human resource evaluation. The case itself is cyclical in nature, going from academic dialogue to field application to experiential data for client use and back to academic study.

The IC Industries Trust (mentioned in the introduction to this paper) was providing employees with new benefit packages, support resources for better use of medical resources, and on-site health promotion information and training. This three-part educational and resource support system, named LINK, was under development and partially in place at a number of company sites. LINK facilitators, though mostly untrained in the area of benefits or health promotion, were being selected to manage LINK programs within their companies. LINK was to be installed at the work sites of at least three of IC's six operating companies within the next calendar year. The initial request: Can you build a design to tell us whether LINK makes a difference in health claims, health habits, medical care behavior, and quality of life/work?

Posing the request in the form of questions implied that they did not know the answer. Correspondingly, it prompted university personnel to probe further, asking other and sometimes more difficult questions. Questions were aimed at clarifying the request and identifying the time and resources (personnel, money, and access) required to move forward in a reasonable manner. What seemed simple was extremely complex—developing and implementing a coherent research agenda and securing permission and access to data and employees.

Prioritizing Needs

Is what you want really what you need? In initial discussions, the first critical point was negotiating what an evaluation research capability should and could do for LINK. From our perspective, Trust staff were requesting summative outcome data from a program under development. There were a number of problems. The analysis of medical insurance claims data from each company site wouldn't be available for at least a year. LINK was in the formative stage and so staff were revising and often enlarging its mission and services on a monthly basis. There was little reason to anticipate outcomes of any kind if LINK programs were not installed and working at each site. At this point, there was no way to tell how operational they were. In short, summative data collection and outcomes assessment seemed premature.

From the Trust perspective, some key personnel thought we were rewriting their agenda. They wanted results (summative and high level) to report, and were not convinced installation and process evaluation was required. They thought the job they had outlined was clear and straightforward. We found the tasks neither as clear nor as straightforward as they did. Trust project staff wanted us to handle data collection but did not want to involve personnel at their sites in the process. Our dialogue ran into the occasional land mine. They did not speak our language, and we did not speak theirs. The formative/summative distinction, central to evaluation theory, was as involved to them as the corporation/company/site distinction was to us. The professionals in the business setting and the sensitive, profit-driven politics that connected them were the source of constant learning and innumerable design modifications on our part.

After six months, we had decided together to design a two-part evaluation research system. The first part, for immediate start-up, involved developing on-site evaluation support for each LINK program as it was installed. The strategy was to embed evaluation training and evaluation instruments into a one-day training session for new LINK facilitators. The training would help facilitators understand LINK, learn how to set program goals, monitor success, and report outcomes to the Trust. To help facilitators accomplish these objectives, several instruments were to be developed and pilot tested: an employee interest inventory, training course evaluation instruments, and an annual

 Businesses and higher education are ready to meet each other halfway in the area of human resource evaluation.
opinion consultants, and limitless site-specific data related to job performance, absenteeism, accidents, employee assistance programs and so forth.

Developing Training Materials
Who says when it’s quitting time? Once we had negotiated the parameters of the evaluation research system, there was a prematurity sense of unanimity. We had written policy that covered details regarding the production and ownership of materials we produced, we had a work plan, and we had mutually acceptable rewards. But as development of training materials for program evaluation began, another critical point arose. While we were the specialists in evaluating an object, they were the specialists in, and the creators of the object. Since LINK was still evolving, a great deal of discussion revolved around what was to be evaluated, why, and how. Important side issues were: the variance in what LINK programs might look like from site to site, the uneven skills of LINK facilitators, and developmental changes in the scope of LINK activities. Back and forth to the drawing board we went. Since each of us depended on information from the other to deliver materials, development was halting, interrupted, and iterative.

Ultimately, of course, it is the client who must cry halt. According to professional evaluation standards (Joint Committee, 1981), it is clients who determine deadlines and evaluation scope. In our case, the evaluation specialists urged the content specialists to raise their expectations for the training materials and the LINK facilitators. We suggested that without basic planning and evaluation, untrained facilitators stood little chance of managing a sound LINK program. And without a sound program, there was very little purpose in doing research on results. The Trust project staff pushed us to simplify, to accept that some conceptual issues could not yet be resolved, and to make evaluation as straightforward as possible. As we expanded our expectations for evaluation information from the field, we expanded university services to support facilitators. Week by week we reviewed until we both could live with necessary compromises.

Client/Evaluator Relationship
Whose ball park and whose home team? A collaborative posture suggests that one culture is not better than the other, nor should it be dominant over the other. This posture is challenged regularly by the funding structure. The prominent role of the funding client is exacerbated in the case of evaluation research services. Professional evaluation standards (Joint Committee, 1981) clearly define an aggressive role for evaluation clients. For example, clients determine critical questions, approve designs, and set reporting agendas. Other professional standards, such as those dealing with technical accuracy, help evaluators tell clients when compromise is no longer possible. University personnel wanted to develop an internal program evaluation system that met the Trust’s immediate needs to demonstrate that LINK was working at the corporate level, but also they were trying to design a system to deliver sound and useful information for company site facilitators. It was not always easy to dovetail both goals.

Slowly a new ball park was defined with Trust and university project staff. The Trust personnel learned pigeon evaluation as we learned to speak benefits. As both groups became bilingual, we began to become bicultural. The predominant values driving business and higher education are different. It continues to be important that we understand and respect each other’s values. For example, unless faculty contract with business on an individual basis, they work within university fiscal guidelines. In this unit-to-unit arrangement, the rewards available to them generally are released time, graduate assistants, access to top quality hardware, and research and publication and because typically, it is curiosity and scholarship, not consulting fees, that drive their decision to invest professional time.

If proprietary issues prevent access to researchable and publishable data, the incentive for higher education involvement decreases dramatically and is limited to financial gain. The construction of a data base that can serve business, but can also be used for research efforts in both sectors is the foundation for sustained joint ventures. Higher education has to remember, however, only if business is concerned with meeting the goals of the organization in a timely and efficient fashion. The construction of a research agenda or research base is not likely to be a priority, but it is a point of negotiation.

Presently, evaluation materials for LINK Facilitators have been prepared and will shortly be field tested. We anticipate at least one dissertation study will result from the field test. Additionally, a three-year quasi-experimental study on the effectiveness of newsletters on employee health behaviors is underway. There is the beginning of a carefully designed data base that can address specific research questions related to LINK and non-LINK employees, longitudinal changes in attitudes and behaviors, and short and long term effects of educational interventions on employees. The partnership has just begun, but we are both already wiser. Some dissonance still exists, and we expect that other points of disagreement may occur. However, we are learning to

Effective evaluation is necessary to develop and implement sound human resource policies and programs.

possibilities. In our case, research and publication potential are a prerequisite in order for faculty to make a long term commitment to a project. Why? Because they can make more money in direct consultation, because the kind of faculty we need to attract already have released time and graduate assistants, or could get them through a number of projects, accept tension as not only inevitable, but constructive. The result of the tugging is some stretching and flexibility that improves products and services.

Future Prospects
What lies ahead? We began with the Joint Ventures Conference to demonstrate that even before the project
with IC Industries, we both had the benefit of past studies and dialogues on collaboration. Our project did not create new issues in collaboration; it reaffirmed those about which there is already some information. So, we are attentive to past lessons. In 1985 the National Science Foundation NSF concluded a ten-year study to investigate how innovations with implications for both business and university are diffused. The evaluation focused on twenty centers where universities and industries collaborated on research agendas. One factor that stood out was that participation by industry personnel was limited to one or two relatively senior people; industry saw research efforts as significant, but did not structure its interactions to take advantage of the products of the collaborative effort (Eveland, 1985). From the Trust and NIU perspectives, forewarned is forearmed. The next critical juncture may be collaboration of Trust and university project staff in promoting diffusion of jointly produced evaluation products in company sites. That effort, if it comes, will provide even more facets to collaboration.

References
Controlling the Instructional Development Process

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Abstract. Process Control is a way for training managers in business and industry to plan, monitor, and communicate the instructional development process of training projects. This article describes two simple and useful tools that managers use to control the process of instructional development. The Process Control Planning Sheet is used by the training manager to plan the construction of courses. The Process Control Record is a charting tool that is used to monitor all training projects of a department. Process Control is a method training managers can use to increase the efficiency and effectiveness of the instructional development process.

Introduction
Systematic instructional development is used in the construction of training projects in business and industry. Training managers typically monitor the construction of a number of projects at one time. Because training projects can be at different stages in the instructional development process and can involve different resources and personnel, managers often have difficulty keeping track of all the projects under development. Controlling the process of instructional development in the private sector is particularly important because of the heavy emphasis on timing and quality. Traditional methods of project control like Gantt Charts (Gantt, 1961) or the Program Evaluation and Review Technique (PERT) (Moder & Phillips, 1964) focus on timing and efficiency.

Implicit in the systematic instructional design process is the assumption that by breaking down the instructional development process into logical steps and pursuing those steps, high quality instructional program will result (Bran son, 1981). Experience has shown that the implicit faith in systematic instructional development needs to be explicitly supported in the workplace because there are many threats to quality. The quality control method described here can be applied to any instructional development process in the private sector.

The purpose of controlling the development process for training projects is to ensure that all training projects are constructed in a timely manner and according to predetermined standards. Process control enables the courses to be monitored throughout all steps of instructional development. It also insures that work is periodically reviewed during the construction so that errors can be identified and corrected before they adversely affect later steps of the project.

The Training Technology System
Process control can be used for any instructional development system. It begins with the identification of all the phases and steps that are part of course construction. The Training Technology System (TTS) (Swanson & Sisson, 1985) is an instructional development process that has been designed specifically for business and industry training and is used in this article to illustrate the process control tools. The phases and steps of the TTS are identified in Figure 1. The TTS has three standard approval points, two in the analysis phase and one in the control phase. It is recommended that all projects be reviewed at these points in the construction process.

In addition, as with most systematic instructional development processes, the TTS has quality self-checks at the conclusion of each phase or step. From a managerial perspective, there are appropriate personnel to make quality decisions that are unique to the organization. These decisions go beyond any standard instructional development process.

Two forms, the Process Control Planning Sheet and the Process Control Record, are used by training managers to plan and monitor the construction of training projects. The Process Control Planning Sheet is an organizing tool that identifies the construction steps, personnel categories, and tasks. Figure 2 is a sample Process Control Planning Sheet for the TTS.

Training managers use the Process Control Planning Sheet to manage the construction of courses. Once filled in, the Process Control Planning Sheet is used to communicate the process by which courses are constructed. It is also the basis of the department's policy on how work is done and who does it. Personnel who are part of the development process can vary from organization to organization. For example, some organizations require that upper management approves the needs assessment. In other organizations, the training manager approves the needs assessment and communicates the results to upper management.

Another tool, the Process Control Record is used to monitor and report the construction process for all projects of a department. It is a charting tool for identifying training projects, training team members, and the phases and steps of the construction process. Figure 3 is a sample Process Control Record for a manufacturing training department that has six projects under construction using the TTS.

The first information to be entered in the Process Control Record is the names of the training projects and the names of the training staff who are leading and reviewing each project. Training team leaders use the phases portion of the record to indicate the TTS phases that
Figure 1. Training Technology System.

Figure 2. Process Control Planning Sheet for the TTS.
have been completed for their projects. By reviewing this part of the record, the manager oversees the training department's progress. The remainder of the chart is used to record the specific TTS steps that have been completed for each training project.

The training manager uses the Process Control Record to monitor the progress of a specific project by looking at the steps completed for that project. The manager also uses the Process Control Record to get a picture of the performance of the entire department. The marked phases blocks provide a histogram of the department's courses in their various stages of development. By reviewing this graphic illustration, the manager determines where in the construction process most of the courses are. The manufacturing training department example (Figure 3) shows that several courses are in the design stage and none are completed.

The Process Control Record can also be used for planning. Knowing the status of current projects allows the manager to plan easily for future projects. Also, projected completion dates can be recorded for each step of current projects. The projected dates act as time goals and guide the work flow. For example, a project with projected completion dates in the near future would need to be constructed at a different place than the same course with projected completion dates in the more distant future.

Summary

Instructional development process control provides an efficient means of monitoring, planning, and communicating the construction of training projects. It is important that the control of the instructional development process is not taken to extremes. Process control should not become a bureaucratic, paper-generating end unto itself. Rather, it should be a means for producing quality projects more efficiently. To be a useful tool, the process control system must be efficient and effective. It should include only the communications and approvals needed to ensure the identification and development of efficient and effective training.

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Instructional Systems Design: Five Views of the Field

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Abstract. Despite high enrollments in graduate programs, flourishing relationships with business and industry, and a general feeling that the field has much to offer, instructional systems design seems to confound the public. Some think of it as focused on technology and/or the production of materials; others think it mechanical and antihumanistic. Still others claim the field is stuck in a behavioral paradigm. Perceptions like these have been voiced for years. Where do they come from? Are they true? This paper presents five ways the field is viewed and suggests how instructional systems design professionals can avoid ambiguity in the future.

Introduction

Ambiguity seems to shroud the field of instructional systems design (ISD). Consider these facts: The number of academic programs in ISD in the United States has steadily grown to more than 200 (Miller, 1985). Graduates of these programs are in high demand in the job market (Morgan, 1986). Linkages with business and industry are strong and expanding (Carrier, 1986). Technology provides a steady stream of exciting tools for communication and instruction and ISD professionals are recognized as skilled in knowing how and when to use them.

Despite these indications of vitality and growth, an undertone of criticism depicts ISD as:
- concerned primarily with the use of hardware,
- concerned primarily with the production of materials,
- not really a field, but a simple step-by-step method that almost anybody can teach and anybody can learn in a short period of time,
- blind to any solutions other than training,
- a rigid, mechanistic, linear, and/or antihumanistic approach to educational planning,
- a synonym for behaviorism.

Most ISD professionals have heard these statements at some time in their careers. The question is, can they be dismissed as reflecting only an individual speaker’s bias, or do they in any way accurately reflect the field as a whole?

Academic fields can be stereotyped by people with a limited knowledge base. ISD, a blend of psychology, education, communications, management, systems theory, and social science, may be more open than most fields to “authoritative” comments from outsiders who, seeing one part of the picture, think they see it all. Still, it may be advantageous to examine the source of the criticism to be certain the profession itself does not add fuel to the fire.

Towards that end, five views of instructional systems design are presented in this paper. Each is held by some segment of the population as a true representation of the field; each of the previously mentioned criticisms can be traced to one or more of these views. By classifying what should and should not be considered an accurate representation of the field, the paper ultimately affirms what ISD stands for in theory and practice.

The Media View

People with the media view of instructional systems design see the field primarily as a process of media selection (Figure 1). They consider ISD professionals audiovisual specialists who know about the characteristics and effects of different kinds of media (as well as how to dry mount and laminate). ISD professionals are expected to be the first and loudest proponents of whatever new technology comes along and are valued for their technological expertise. Those holding this view are baffled by a designer who knows or cares little about the technical aspects of equipment operation; such a thing seems impossible given this perception of the field. The media view is particularly prevalent in higher education because ISD evolved from audiovisual education in many colleges and universities.

Comments. Of course, designers should be knowledgeable of all potentially valuable technologies. However, the basic premise of this view—that a dichotomy exists between the use of media/technology and the teaching/learning process—is a perennial plague on the field. Although Gerlach and Ely (1980), among others, have made a strong case against the media view, it lingers.

![Figure 1. Media view of instructional systems design.](image-url)
higher education, government agencies, or the private sector. Consultation between clients and designers is largely the transmission of client-generated objectives for the development of a treatment in the chosen medium (also very likely predetermined by the client). According to this view, the development of assessment strategies to document learning outcomes is rare, but when undertaken is usually the task of the client. In fact, there is only one activity where the client must depend on the expertise of the design staff: production.

Comments. It is inexcusable for designers to use or produce low quality materials (unreadable transparencies, shabbily edited videotapes, etc.). Learning theory as well as aesthetics dictate well-crafted and attractive materials. On the other hand, professionals in the field must guard against putting disproportionate emphasis on production standards if they represent themselves as instructional systems designers. Suppose, for example, an instructor contracts with a commercial television production studio for the creation of a simple videotape of a laboratory procedure and is told that, from planning to scripting to postproduction, the process will take six months. An emphasis on broadcast quality perfection might be expected from these professionals. If, however, the instructor contracts with the ISD center in his own institution, is given the same timeline, and finds the suggested treatment more "artistic" than he feels necessary, several things may happen: (a) He may decide the project is not worth the time commitment, or (b) He may eventually invest in portable videotaping equipment and create his own materials in the future. In any event, whether or not he feels a six month timeline excessive for a simple project, his view of ISD will resemble Figure 2.

The Narrow Systems View

This view (Figure 3) begins to look more like a real systems approach. Additional steps that call for refinement and sequencing of the subject matter prior to production seem to legitimize the process although the steps of needs assessment and formative evaluation are noticeably absent. It is no secret that real-world design work is sometimes a reactive approach to immediate or "tragedy" problems rather than a result of systematic analysis of organizational needs and priorities (Bernhard & DiPaolo, 1982). Likewise, formative evaluation may be short changed or ignored because of lack of time or resources (Dick, 1982) or because it is an unfamiliar or undervalued process.

The narrow systems view is common among those who consider instructional systems design a simple method that can be quickly taught "cookbook" style. It is the "in two weeks you too can be an instructional designer" view so prevalent in the Human Resource Development (HRD) seminar circuit. Writing behavioral objectives and test items and conducting task analyses are seen as the primary hurdles to overcome.

Comments. Academics and practitioners should argue strenuously against any representation of ISD that excludes needs assessment and formative evaluation. There are two reasons why students, newly employed designers, clients, and observers of the field must see these processes as essential parts of the whole and not add-ons. First, as Dick (1982) has stated, formative evaluation "has anchored the instructional design process in an empirical tradition" (p. 31). The same could be said for truly data-based needs assessment that establishes the criteria by which formative evaluation measures the success of a project. These processes provide accountability for an often difficult, time consuming, expensive process that may affect many individuals.

Second, a view of ISD without these processes triggers the criticism that the field has "training blinders" since it implies that all needs/goals are instructional ones. A well-designed needs assessment first identifies the true needs of an organization and then determines which needs require the development of training and which require nont raining alternatives. The accuracy of these data will then be determined during formative evaluation. Even if time and resources are limited, the questions raised by needs assessment and formative
evaluation must be addressed in any ISD project.

The Standard Systems View

The standard systems view (Figure 4) is named for its resemblance to what is widely considered a fair representation of instructional systems design. The major processes usually associated with ISD are included. Needs assessment is at the head, formative evaluation brings up the rear. Summative evaluation appears as a means of producing empirical product evaluation/marketing data. Figure 4 is a clear schematic of a complex, multi-step process that would serve well as a working design model. Note the distinction, however, between a model, which serves as a type of shorthand for designers familiar with its theoretical underpinnings, and a perception or view of the field. What conclusions would someone draw from Figure 4 assuming it to be representative of the totality of ISD?

First, consider merely the appearance of the graphic. It is linear. It looks rigid and mechanistic because of the step-by-step arrangement and the flowchart convention. As Chan (1984) points out, the lockstep sequence certainly does not appear "warm, humanistic, and artistic." He goes on to say that the jargon and maze of boxes and arrows associated with ISD lead many to believe that the field has "missed the mark, by failing to attend to global, holistic, and humanistic goals of education" (p. 8).

Figure 4 can also engender the belief that instructional systems design is a strictly behavioral approach to learning and instruction. The input-output structure and the emphasis on task analysis, objectives, and assessment of learning outcomes conjures up visions of machine-gradable (translation: low-level) training or, as Silberman (1970) puts it "the almost irresistible temptation to go after the things that can be measured" (p. 198).

Comments. Next to hardware, flowcharts like Figure 4 are the most visible accoutrements of the field. Designers may use models for organizational and communication devices, but others, unaware of the theoretical/research context from which they are derived and upon which they are dependent for enlightened and insightful implementation, often take them as graphic representations of the entire field. Hence, it is not uncommon to find that those who criticize ISD for being mechanical, antihumanistic, and/or behavioristic have a standard systems view of the field in mind.

Academics and practitioners must counter this view whenever possible by educating clients, students, and others about what is required to successfully implement the steps shown on Figure 4. For example, it must be consistently stressed that the best needs assessment, task analysis, test items, and media selection in the world may be meaningless unless a designer simultaneously attends to matters of diffusion. Likewise, ISD professionals must be aggressive about linking the practice of the steps on Figure 4 with relevant (and current) learning theory and research. Failure to make these connections consistently feeds directly into many criticisms of the field.

The Instructional Systems Design View

Figure 5 shows instructional systems design to be a synthesis of theory and research related to (a) how humans perceive and give meaning to the stimuli in their environments, (b) the nature of information and how it is composed and transmitted, (c) the concept of systems and the interrelationships among factors promoting or deterring efficient and effective accomplishment of the desired outcomes (Torkelson, 1977), and (d) the consulting and managerial skills necessary to meld points a through c into a coherent whole. The well known systems model functions as a series of gates that allow information to flow through at appropriate times. The gates facilitate systematic thinking in the midst of an often staggering number of variables designers attempt to control.

A single designer is usually not expected to have all of the knowledge and skills shown on Figure 5, although the smaller the design team, the more skills each person must have. However, whenever instruction is being designed, all five of the major categories (shown in capital letters on Figure 5) are called into play. For example, when it is time to write instructional sequences and design page or graphic layout, all designers—with or without a knowledge of learning theory and message design (Fleming & Levie, 1978)—will make decisions on these issues. Designers lacking familiarity with relevant research and theory substitute instincts and a good eye when making these decisions. Ideally, theory, research, instincts, and a good eye are at a designer’s disposal.

Similarly, a designer unfamiliar with
the research and strategies of diffusion will eventually be faced with the task of trying to assure successful adoption of whatever product or program has been produced. While luck, persuasiveness, and managerial mandate may aid the “diffusion-less” designer, the history of innovation would suggest these as highly unreliable techniques.

In short, the proper practice of ISD brings all the skills, knowledge, and attitudes shown on Figure 5 to bear on the problems of a particular system in an orderly and precise manner. Furthermore, there is (or should be) a symbiotic relationship between the major categories. Designers’ knowledge and skill in one area supports their work in other areas, as will be seen in the following description of the instructional systems design view.

Educational Theory and Research

General Educational Psychology

Designers should have an understanding of the principles of human physical, emotional, social, and mental growth and development. A knowledge of how socioeconomic status, IQ, sex differences, cognitive styles, creativity, and motivation may affect learning is also important. This background provides valuable insight into the characteristics of different target populations.

Specific Theories of Learning

A solid foundation in learning theory is undoubtedly the most essential element in the preparation of ISD professionals because it permeates all other dimensions shown on Figure 5. Designers must be familiar with the theory and research on learning and must be able to apply it to actual practice. For example, a designer working on an early childhood education project will find insight into children’s behavior and the value of a rich learning environment in the work of Piaget (1954). Ausubel (1968) and Rothkopf (1970) are valuable resources when producing tual materials. Designers familiar with social learning theory (Bandura, 1966) will not ignore environmental factors that significantly affect instructional programs, nor overlook the power of informal learning channels (e.g., observational learning). Bruner’s (1973) rich philosophical insight into discovery learning and problem solving, Keller’s (1983) work on motivation, Knowles’ (1984) emphasis on factors that facilitate adult learning, and the work of others contribute to a designer’s overall understanding of the learning process and skill in designing instructional strategies.

Cognitive science (Klatzky, 1980; Anderson, 1980; Cagnie, E., 1985; Wildman & Burton, 1981) is making a major contribution to our understanding of how humans perceive, process, store, and retrieve information. Schema theory, elaboration, metacognition, automaticity, expert/ novice studies, and transfer are only a few of the constructs studied by cognitive psychologists that have important implications for the
design of instruction.

Without a broad-based foundation in learning theory the practice of ISD becomes narrowly focused on means (the steps in the systems model) rather than on the rightful end (learning). Academics must provide students with a solid background in the relevant literature; practitioners must be sure on-the-job exigencies do not preclude the infusion of learning theory into design and production procedures.

Varieties of Human Capabilities

ISD professionals must be able to distinguish between psychomotor skills and intellectual skills; attitudes and cognitive strategies; and skills requiring memorization of information and those requiring the application of previously learned information to problem situations (Gagne, R., 1985). This knowledge enables them to take advantage of research on the particular conditions under which each type of human capability is most likely to be learned. Thus, a unit intended to formulate or change attitudes will use entirely different instructional strategies than one composed primarily of verbal information.

Knowledge of human capabilities also enables a designer to be certain that the objectives of an instructional unit truly reflect the needs of the system. Training journals complain that classroom instruction does not transfer to on-the-job competence (Broad, 1982). One explanation for this is that the objectives of classroom instruction often do not match the on-the-job requirements (e.g., a class presents and tests only verbal information when job requirements call for application of the information to novel situations). A thorough understanding of the attributes of each type of learning is insurance against such errors.

Finally, this knowledge guards against the trivialization or unnecessary simplification of instruction that occurs when (a) the objectives for a unit require only low-level learning, and/or (b) objectives are written only for skills that can be easily evaluated (e.g., by machine). ISD professionals must be alert to these issues. In relation to the former, they know that objectives can and should be written for higher intellectual skills: analysis, synthesis, problem solving, problem finding, etc. In relation to the latter they know that the problem is one of measurement (there are ways to measure achievement in problem solving, after all) and professional integrity (should a unit be designed that does not truly provide the skills required by the system?).

Task, Content, Learner Analysis

Task analysis has always been viewed as a critical and difficult step in the design of instruction. A traditional, behavioral orientation calls for breaking a goal into subgoals, thereby identifying essential prerequisites and mapping a logical sequence for presenting the content.

Cognitive science has broadened the concept of task analysis to include an analysis of the content itself. Such an analysis aims at determining the relationship between, and relative importance of, individual concepts within a body of content. One value of this relates to the presentation of material: What happens as readers try to progress through text material, for example, is that single ideas, concepts, rules, and other elements must be eventually integrated into some holistic structures organized around a few powerful ideas. The learner's task in this case is greatly facilitated when the content in question is well organized (Wildman, 1981, p. 17).

Another use for this information is to provide organizational and conceptual strategies such as advance organizers (Ausubel, 1968) or frames (Ambruster & Anderson, 1988) that learners can use to aid their own comprehension and retention of information.

A second cognitive perspective emphasizes the need to be aware of how students will process a particular body of content. Shulman (1986), for example, asserts that "pedagogical content knowledge also includes an understanding of what makes the learning of specific topics easy or hard" (p. 9). This idea considers how students' prior learn-

ISD is a blend of psychology, education, communications, management, systems theory, and social science.
Designers should have an understanding of the principles of human physical, emotional, social and mental growth and development. must also be studied. A designer's background in general educational psychology, learning theory, and the varieties of human capabilities provide excellent insight during this process. When all relevant data are collected, they are analyzed to determine whether there are any gaps between what is and what should be (Kaufman and English, 1979). It is here that a designer separates those needs for which training is the appropriate solution from those with motivational or environmental solutions. Hence costly instructional programs are undertaken only when the system analysis deems a project worthy, appropriate, practicable, and likely to succeed. Because of their analysis, consulting, and managerial skills, designers often are qualified to recommend noninstructional solutions (e.g., changes in office information flow or managerial styles) as well as instructional ones.

Diffusion

Havelock (1973) lists six steps (shown on Figure 5) necessary to bring about change in an organization. It should be noted that a well designed system analysis incorporates four of these steps: (a) a good relationship with the client is built and the designer's credibility established; (b) the problem(s) of the system are diagnosed; (c) all relevant resources are acquired; and (d) members of the system potentially effected by the innovation view the idea favorably because they (or at least key personnel) have been involved in the system analysis phase in some way. Once the solution for the project is chosen, the designer must see that the new instructional product or program can be maintained easily by the system. An understanding of the process of change, resistance to change, and categories of adopters (Rogers, 1983) prepares the designer to work sensitively and persuasively with different members of the role in making media selection decisions (Clark & Salomon, 1986) as do the resources and constraints of a particular system. Production specialists (graphic artist, video production personnel, computer programmers, photographers) are often engaged once design specifications have been formulated. However, designers must know the capabilities of all forms of media and technology (including the most recent advances in interactive video and telecommunications) so that they know when and how each can be used appropriately. Knowledge about production techniques also improves the designer's ability to communicate with technical specialists working on a project.

Evaluation

The last subcategory under educational theory and research deals with the evaluation of instructional products and programs. Knowledge of evaluation theory and techniques, both formative (Dick & Carey, 1985) and summative (Tuckman, 1979) is essential since on this rests the ability to assess the effectiveness of the entire ISD process. Designers will benefit from a knowledge of quantitative and qualitative (Cook & Reichardt, 1979) methodologies.

System Analysis

System analysis is divided into two subcategories in Figure 5: data collection, and data analysis. First, designers must know the goals, functions, resources, constraints, chain-of-command, and culture (Schein, 1965) of the organization in which they are working. Data must be gathered on the specific target populations within an organization to determine their general characteristics, motivation, sophistication as learners, and performance levels. (This information will be useful again during the task analysis phase.) Typical learning environments in the organization (formal, small group interaction, grapevine, on-the-job training, etc.) client group while working through the steps of diffusion.

Consulting/Interpersonal Relations

Bell and Nadler (1979) list the phases of a consultancy as entry, diagnosis, response, disengagement, and closure. These parallel the diffusion steps, yet emphasize the professional (and possibly contractual) relationship between the designer and the client. Writing contracts (Walter & Earle, 1981-82), determining the appropriate style of consultancy for a particular client, and knowing how to disengage from and conclude a consulting agreement (Davis, 1975) are among the consulting skills designers should possess. Interpersonal and small group interaction skills (Tubbs, 1978) prepare designers to work successfully with subject matter experts (Coldewey & Rasmussen, 1984), clients, and other designers. The ability to work with unfamiliar content (Bratton, 1981) is another essential skill for designers.

Project Management

Knirk and Gustafson (1986) list five stages of project management (shown on Figure 3): planning, organizing, staffing, budgeting, controlling, and communicating. Craig (1976) offers specific guidelines for many of these functions. In some cases, designers must also be able to write proposals for project funding. Cost-benefit analysis (Head & Buchanan, 1981), general writing skills (Booher, 1982), and platform skills (Schlegel, 1984) round out an array of organizational, managerial, and communication competencies for successful project management.

Summary

A summary of the instructional system design view serves as a rebuttal to much of the criticism of the field:

- The main emphasis of instructional systems design is not the use of hardware. Although very important, hardware is but one of the tools designers may use to address the problems of a given system.

- The main emphasis of instructional systems design is not production. Production styles and technical superiority are viewed as aids to instructional effectiveness and not ends in themselves.

- Designers do not assume that training is the solution to every problem. They use system analysis procedures to deter-
mine where training is justified and where it is not.

- ISD is more than a simple method. It is a field requiring a wide range of psychological, sociological, interpersonal, and managerial skills if it is to be skillfully and creatively practiced. This is not to say that classroom teachers and others cannot master and benefit from basic ISD procedures. However, professional instructional systems designers must be prepared to design for different system constraints, populations, content areas (often unfamiliar ones), and forms of media and technology.

- Instructional systems design is rigid, mechanistic, and linear only in its insistence on systematic planning. It does not, for example, allow for adequate, haphazard planning when the costs of production are so high and the stakes (individual and organizational development) even higher. Charges that ISD is antihumanistic are groundless. Designers with a background in educational psychology, learning theory, human capabilities, system analysis, and diffusion are fixed on the development of human potential and organizational health as primary goals.

- Although ISD clearly has roots in behavioral science, it is not in itself a learning theory—behavioral or otherwise. A designer may draw upon any number of psychological orientations depending on a given task and target population.

**Recommendations**

Although the preceding discussion has answered the common criticisms of the field, a concluding list of recommendations will be presented for consideration by ISD professionals.

1. The literature of the field sometimes promulgates distinctions between terms like instructional design and instructional development, instructional technology and educational technology—often with only the difference of a word or two. Not only are such fine discriminations confusing, but they tend to semantically chop the field into pieces. Should development really be thought of as in any way separate from design? The development of products and programs is inextricably intertwined with the instructional planning that draws upon learning and diffusion theory and system analysis data. Even if the staffing of ISD activities is differentiated, the process is a complex and unified one and should be consistently portrayed that way.

2. System analysis, consulting/interpersonal relations, diffusion, and project management skills are often presented as peripheral or even optional to ISD skills. This is unfortunate because the field is made to appear less than it is unless the mutually dependent interaction of these areas is emphasized. Admittedly, each category in Figure 5 has its own literature. Some diffusion literature, for example, even comes from sources outside education. Yet concern for diffusion is (or should be) prominent in a designer's mind long before an instructional goal is ever written.

3. There is a bewildering array of titles for academic programs in the field: educational technology, instructional technology, instructional systems, instructional design, instructional development, educational media, educational communications, instructional science, instructional psychology, training, etc. Observers must wonder if titles are synonyms or if each is pregnant with idiosyncratic meaning! Although the situation is unlikely to change, there may be a need to insist on some standards regarding the naming of academic programs. Imagine the development of a new masters program specializing only in the production of interactive video. Can such a program rightfully be entitled "instructional technology"? It seems reasonable that programs using the most common titles of the field (the first five on the list above)—even the ones that seem to emphasize the use of technology rather than design—have a correspon-

ing obligation to be sure their curriculum reflects the scope of the field and not a single specialization.

**Conclusion**

The purpose of this paper has been to delineate aspects of Instructional systems design that must be considered nonnegotiable items. Briggs (1977) defines ISD as:

A systematic approach to the planning and development of a means

Concern for diffusion is, or should be, prominent in a designer's mind long before an instructional goal is ever written.

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Variables Affecting the Legibility of Computer Generated Text

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Abstract. The effects of three text layout variables—justification, line length, and leading—are examined. Text presented on computer display terminals is read faster when the text is left justified, characters are small, and lines are long and separated by blank space. Although each of the variables affects the efficiency of reading text and may also have affective consequences, the overall effect of each on learning outcomes may be negligible.

Much has been written concerning the effects of printed text on comprehension and reading speed. Recently, however, as the price of paper has increased and the cost of computers has decreased, the use of the computer display terminal to display computer generated text has become more widespread (Merrill, 1982).

With the rapid growth of the computer in society, many have suggested that much of the present printed text will be presented on computer displays (Jonassen, 1982; Lancaster & Warner, 1985; Muter, Latremouille, Treurniet, & Beam, 1982). However, research suggests the readability of computer displayed text is often impaired. Computer displayed text is often read more slowly than the same text presented in print form. In some cases, studies have demonstrated that computer displayed text is read as much as 20%-40% slower than the same text in print form (Gould & Grischkowski, 1984; Kruk & Muter, 1984; Muter, Latremouille, Treurniet, & Beam, 1982; Wright & Likorish, 1983). However, little evidence exists to predict the effects of display differences on comprehension.

Nonetheless, since considerable amounts of text must be presented on computer displays, it is important to optimize reading efficiency of such text. One of the principal reasons for presenting text via the computer display is to capitalize on the interactive capabilities of the computer (Jonassen, 1982). However, not all material presented through the computer display requires these interactive capabilities. If reading speed of computer displayed text cannot match the reading speed of paper text (assuming similar levels of comprehension in each case) and the interactive nature of the computer is not utilized, it is doubtful that the computer display will rival paper as a medium for displaying large amounts of text. Consequently, it is essential that the optimum conditions of computer displayed text presentation are identified and employed.

The purposes of this paper are (a) to review the effects of these three text display variables—justification, line length, and leading—on reading speed and comprehension; (b) to analyze critically current literature in each area; and (c) to describe the implications of such findings for the design of computer based instruction.

Text Display Variables

In order to identify the optimum conditions for presenting computer displayed text, it is useful to first examine research derived from printed text (Spannau & Pariseau, 1985). The presentation of computer displayed text will likely incorporate some of the psychological principles derived from the investigations featuring printed text. However, due to the nature of the medium, differences are also likely to be found (Keil & Roach, 1986; Simpson, 1984). For example, with the computer display, fonts comprise discrete dots or pixels as opposed to continuous lines, and can be more difficult to decode. Consequently, care must be exercised in generalizing conclusions concerning printed text to computer displayed text.

Justification

One area of text layout that has received comparatively little attention is that of text justification. There are several methods for justifying text on a computer display. In this paper, the three methods illustrated in Figure 1 will be examined: fully justified, left justified, and center justified text.

Definitions. Full (or fill) justified text features lines of equal length. The spacing between the words is varied and words are sometimes broken at line endings to achieve this goal. Left justified (or right ragged) text features varied line lengths, uniform spacing between words and complete, unbroken words at line endings. Center justified (or balanced) text is balanced with respect to an imaginary vertical line, which extends down the center of the page (Harlcy, 1975).

Bork (1984) considers left justification of text to be essentially a method that evolved from printed text. He has argued that left justification is usually an undesirable practice when presenting computer text, noting that blank space is essentially free with the computer display and that text should be center justified in complete phrases.

Eye movement. In an investigation into the effect of text manipulation on paper, Keenan (1984) examined the effect of variable line length on reading speed. In the investigation, the relationship between the return sweep and line length variability was studied. The return sweep is the movement of the eye from the end of one line to the beginning of the next. Keenan concluded that line length variability disrupts eye movements. When margin position varies, return sweeps are often inaccurate resulting in undershoots or overshoots, and must be compensated for by the eye. The compensatory eye movement required to place the beginning of
the line in foveal vision (the region of the retina where vision is most acute) is called a corrective regression (Morrison & Inhoff, 1981; Rayner, 1978). The time length of a saccade, the eye movement required to bring new text into foveal vision (Rayner, 1978), necessary to perform a corrective regression is equal to the length of time taken over a normal saccade, roughly 30-125 milliseconds. Consequently, variable positioning of the margin will cause inaccurate return sweeps, which in turn result in increased reading time.

Reading speed. According to Leisman (cited in Keenan, 1984), fully justified text helps the reader to construct an internal map that performs the return sweep automatically. If true, variable line lengths of balanced text may hinder the development of the internal map and, consequently reduce reading speed. Even if this hypothesis is disproven, balanced text may still reduce reading speed. With balanced or centered text, variable line beginnings are common. In effect the fixation point for text varies from line-to-line, providing no consistent reference point. Thus the reader may be unable to perform return sweeps automatically. Under these circumstances reading speed will decrease due to the increased number of corrective regressions that must occur.

Hartley (1982) disputed the wisdom of balancing text around a central axis. He cautioned that when text is not left justified, reading difficulties for both young and old readers are more likely to occur. Inconsistent placement of the left margin serves only to confuse the reader unnecessarily. In a related study, center justification was found to make drug labels difficult to read, which in turn caused nurses to make errors in locating drugs (cited in Hartley, 1978). Once left justified, the labels were read more easily and nurses made fewer errors.

In a different study regarding reading speed and justification, Trolip and Sales (1986) found fully justified text presented on a computer display to have a detrimental effect on reading speed compared to left justified text. They determined the length of a fixation, the period when visual information is transmitted through the eyes (Rayner, 1978), to be a constant for the reader. The number of characters, whether letters or spaces, perceived during a fixation does not change. Consequently, fully justified text, into which spaces have been inserted to achieve full balance, causes more fixations in order to read.

This is an example of left justified text.

Note how all lines are returned to the identical left margin, but the right margin has a "ragged" appearance.

Left Justification

This is an example of center justification.

Each line is centered around the center of the monitor.

The effect is to create ragged looks at both the left and right margins.

Center Justification

Full, or fill, justification essentially blocks the text so that the left and right margins are always absolute. In effect, spaces are inserted as needed to assure that the block effect of fully justified text remains.

Full (Fill) Justification

Figure 1. Sample justification formats for computer displayed text
the same amount of text, and lowers reading speed. This idea is supported by several psychophysical experiments (Morrison, 1983; Morrison & Rayner, 1981), which suggest that the perceptual span is constant when moderate changes in the viewing distance are introduced. The perceptual span is the area close to the center of vision, in which visual details affect reading (McConkie, 1983). Perceptual span may be important in guiding readers’ eye movements and in helping the reader to integrate information from one fixation to another (Rayner, 1978).

A related implication of placing extra spaces between words is to vary the point to which the eye must move to find the next word. This will also reduce reading speed (Trollip & Sales, 1986). Variable placement of word beginnings may require the reader to make more decisions as to where a word starts. These extra decisions will probably result in increased reading time. The implication of this research is that justified text should be avoided for the presentation of text on a computer display.

**Indentation.** Another area of research related to justification is that of paragraph indentation. On printed text, indenting the first line of a paragraph significantly improves legibility (Tinker, 1963). Grabinger (1985) supported these findings for computer display text, noting subjects generally preferred paragraphs that were indented. However, although positive, the influence of paragraph indentation was modest. Through paragraph indentation, margin variability is increased but so is reading speed. However, this does not necessarily contradict findings regarding irregular margins. It is hypothesized that the periodic but systematic indentation of a new paragraph acts as an information organizer that helps to clarify lesson information, and thus to improve reading speed.

**Summary of justification theory and research.** Although most of the research cited focused on printed text, several findings appear relevant to computer displayed text. Left justified text, for example, may be preferred to either center or fully justified text, although the benefits may be inconsequential with regard to actual learning. Advocates of centered text consider the layout aesthetically pleasing, thus more motivating and easier to read than left justified text. It may be that such advantages outweigh the disadvantages of disrupted return sweeps.

**Line Length**

Another area of interest concerning text layout is optimum line length. Line length can be divided into two areas: Character density and the number of characters per line. These are illustrated in Figure 2.

**Character density.** Character density refers to the maximum number of

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*Figure 2. Samples of 40 and 80 character density and computer display usage.*
Windowing limits the amount of text that may be presented on the screen and makes the screen more pleasant to look at.

A related conclusion, suggested that larger characters subdue a greater viewing angle than smaller characters. That is, larger letters require a greater proportion of the total viewing angle to be used for the fixation. Consequently, readers have fewer characters in their perceptual span. Thus larger characters that reduce perceptual span may also reduce reading efficiency.

Number of characters per line. Some recent research into optimum characters per line for the computer display appears to contradict research for printed text. In his early work, Huie (1968) noted that shorter lines were generally preferred to longer lines for printed text. He claimed that the maximum line length should be roughly 9 cm—10 cm. Longer lines were alleged to cause inaccuracy on the return sweep: shorter lines allowed the reader to use peripheral vision to see what had passed as well as what was forthcoming.

Tinker (1963) reported that readers preferred moderate line lengths over both short and long lines. Long lines tend to result in frequent undershoots on return sweeps and complications in identification of the correct lines. Short lines, those containing fewer characters, tend to make inefficient use of peripheral vision and fail to stretch the perceptual span. Stretching the perceptual span results in a reduction in fixation duration and an increase in saccade length, which together cause an increase in reading speed. Optimum length lines stretch the perceptual span to its capacity.

Opinions vary greatly concerning the optimum number of characters per line of computer displayed text. One belief is that lines of text displayed on a computer display should be kept short. Bork (1984), for instance, stated that long lines are not needed in computer-based materials. He noted that readability research derived from printed text supported this position. Heines (1984) believed that line length was an important factor affecting text readability: The shorter the line on the computer display the easier it is to read. It was suggested that lines on the display should contain fewer words than when presented on paper.

Another perspective suggests that computer displayed text is read most efficiently when lines are long. Duchinecy and Koles (1983), for example, determined that lines ranging from 2/3 to full screen width were read equally well, and were read significantly faster than text presented at 40 characters per line. In this experiment, lines of length 52 characters and 78 characters were read much more efficiently than lines of 26 characters. Consistent with results from paper text, it might be expected that the 52 character line would have been read more efficiently than both the long and short lines. This suggests that in certain cases text display principles vary from print to computer display.

In another study, Grabinger (1985) found that longer lines (60 characters per line) were generally (but not strongly) preferred over shorter lines (40 characters per line). Although empirical evidence indicates that longer lines of text are read more efficiently than shorter lines, it is possible that shorter lines may have a greater affective influence on learning.

An alternative opinion concerning line length has been expressed by Frase and Schwartz (1979). They noted that optimum line length was of little practical or cognitive importance. Other variables, such as text segmentation (the implementation of line breaks according to natural language sequences), had far more influence on the readability of text. Segmentation helped to organize information for the reader thus improving the flow of information from short to long term memory. Improving the storage of information in long term memory results in more efficient recall and consequently
facilitates higher level cognitive activities. This position has also been advanced by Bork (1984).

**Summary of line length theory and research.** Clearly, additional research concerning line length is required before definitive conclusions can be drawn. It appears that text is read more efficiently when presented in a dense manner. However, precisely what constitutes optimum density is a matter of conjecture and must be determined empirically. In general, when given the opportunity to present text at 40 or 80 character density, denser text appears preferable.

The issue of the optimum number of characters per line of computer displayed text also remains unresolved. Recent research suggests that the research and theory of the number of characters per line for printed text does not generalize to computer displayed text. Research is required to extend the work of Duchnickey and Kolvers (1983) and Kolvers, Duchnickey and Ferguson (1981) to determine the importance of the number of characters per line for the computer display. If necessary, guidelines for determining the optimum number of characters per line need to be established. It must also be determined whether character density and characters per line operate interactively when text is presented on a computer display.

**Leading**

Leading is the insertion of space between lines. Leading is often referred to as single or double spacing of lines of text. Examples of leading, and the effects on legibility, are shown in Figure 3. Early research with printed text supported the notion that leading improves legibility, though often the improvement was not found to be significant (Trien, 1908).

The results of recent research, however, have revealed that leading has an important influence on the legibility of text. It may increase perceptual span by reducing the effects of lateral masking (Tinker, 1969). Lateral masking distractions are caused by characters in adjacent lines, thereby interfering with peripheral vision (Kruk & Muter, 1984; Van Nes, 1986). Peripheral vision is important since it may help to guide the readers' eye movements and integrate information from one fixation to another (Rayer, 1978).

With printed text, the insertion of blank space between lines decreases the amount of text per page and consequently increases the cost of book production. With a computer display, the insertion of blank lines of space adds nothing to production costs (Bork, 1984) and may improve reading speed (Sweeeters, 1985).

Studies related to the effects of leading on reading computer displayed text generally support the findings from printed text. Hartley (1979) stated that for printed text the optimum space between lines of text is obtained by inserting a line of space equal in height to the width used for word spacing.

Reading efficiency has also been shown to improve when text presented on a computer display is double spaced as opposed to single spaced (Hathaway, 1984; Kolvers, Duchnickey & Ferguson, 1981; Kruk & Muter, 1984). With single spacing, more fixations per line are required. Each fixation contains fewer words and, consequently, reading time is increased. Again, however, differences in reading speed were of little practical importance (Kolvers, Duchnickey & Ferguson, 1981).
Text is read more efficiently when presented in a dense manner. In general, present text at 40 or 80 character density.

Other research on computer displayed text suggests an interaction between leading and character height. Some authors have suggested that single spacing should be avoided on displays where leading is small in proportion to the height of the characters. Single spacing can increase lateral masking (Kruk & Muter, 1984).

The minimum ratio between line distance and line length has been defined precisely. Line distance is the distance between the lines that “connects the bottoms of short letters in two consecutive text lines” (Van Nes, 1986, p.100). Line length is the length of a line of text presented on the computer display. The minimum ratio of line distance to the number of characters per line should be .033 (cited in Van Nes, 1986). For example, if a text line measures 21.5 cm and the line distance is 0.8 cm the resulting ratio is an acceptable 0.037. With a lower value, characters can cause a masking effect that hinders word identification. This masking effect can be removed by either increasing the distance between lines or by decreasing the number of characters per line. Both have the effect of improving text legibility. Van Nes noted that a 20% reduction in the number of characters per line of single spaced text from 40 to 32 characters should increase legibility considerably.

Implications for the Design of Computer-Based Instruction (CBI)

1. If the options exist, left justification should be chosen over both center and fully justified text. Left justified text is read faster than both center and full justified text. However, the advantages of using left justified text may well be outweighed by other variables of text design.

2. When possible, text should be presented at a character density of 80 characters as opposed to 40 characters per line. Assuming comparable legibility, text is read more efficiently when presented in a dense manner. Research is needed to determine exactly what text density is read most efficiently. It must also be determined if character density interacts with reading ability to affect reading speed of computer displayed text.

3. Within practical limits, text should be designed to feature greater numbers of characters per line. Longer lines of text are generally read more efficiently from the computer display than shorter lines. However, there are undoubtedly limits, after which characters are no longer legible. These limits must be determined empirically. It must also be determined whether all readers prefer greater numbers of characters per line or whether for some, beginning readers for example, shorter lines of text are read more efficiently.

4. Loading of text should be increased as text density increases. As character length increases, the effects of lateral masking make text more difficult to read. Text presented at a character density of more than 40 characters per line should always be double spaced.

5. It may well be that the measurable effect of each of the variables on learning is minimal. However, the overall effect of reading text from a screen that is pleasant to look at may in itself have positive transfer to learning. Designers of computer based instruction are virtually unaffected by cost limitations when organizing text display. Consequently, the potential impact of different modes of presentation may be considered, without fear of increasing production cost, while possibly capturing the readers’ attention and helping to organize information. This may result in text that is both easier to read and better organized in long term memory.

Closing Comments

Although limited research has been conducted in computer displayed text design, additional research is needed. At present, designers are often hindered by the lack of research relevant to computer-based instruction. Designers of computer-based instruction are forced to either assume that research on printed text design will transfer to computer displays, or to rely heavily on intuitive beliefs. Identification of the principles of text design that are consistent with print research must be established. Where inconsistencies exist, the unique attributes of computer displays must be verified.

It is important that systematic efforts to identify relevant design variables are advanced. However, screen layout variables are frequently affected more by computer system limitations than by “ideal” display specifications. In many cases, learning outcomes may be only minimally affected by the manipulation of text display variables. Variables may affect the immediacy of text recognition, for example, but may have little impact on learning. The task for the instructional design profession is to identify relevant variables that influence the effectiveness and acceptability of computer displays.

Finally, it is worth noting that several other areas of text design likely to affect computer displayed text legibility exist. These include variable letter spacing (where the spacing between letters is allowed to vary according to the width
The task of the instructional designer is to identify relevant variables that influence the effectiveness and acceptability of computer displays.
Metacognition: Relevance to Instructional Design

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Abstract. Research in the field of cognitive psychology has led to evidence that proficient learners or performers have an awareness of their own cognition that manifests itself in strategic control of behavior. These findings are of particular significance to instructional designers because of their promising impact on instructional theories and models. Instruction can be enhanced through the incorporation of metacognitive aspects in the instruction and the resultant effects on the learner should be positive in terms of motivation and overall performance.

Introduction

In their review of the current literature pertaining to the steadily expanding field of instructional psychology, Gagne and Dick (1983) note the increased contributions emanating from research in the domain of cognitive psychology. Of particular significance to instructional design is the concept of metacognition because of its promising impact on instructional theories. Interest in this area has expanded from an initial focus on memory phenomena (Flavell, 1971) to widespread investigation in the field of reading research (Baker & Brown, 1984).

These new insights into the domain of cognitive functioning undoubtedly will affect the prescriptive nature of instructional theories, and designers should be aware of its relevance to their field. The purpose of this paper is to provide a definition of metacognition and to describe what the authors consider to be the effects of incorporating metacognitive aspects into instruction.

Metacognition Defined

In order to define this concept, the authors conducted an in-depth review, synthesis, and interpretation of the writings of Ann Brown, John Flavell, and Scott Paris (Brown, 1980; Baker & Brown, 1984; Flavell, 1979; Flavell & Wellman, 1977; Paris, Lipson, & Wixson, 1983). Generally speaking, the term metacognition is used to refer to a body of knowledge that reflects on knowledge itself. It involves an awareness of the mental processes and strategies required for the performance of any cognitive endeavor. This knowledge is manifested in the form of strategic control of the processes necessary for successful performance. Two interdependent phenomena involved in metacognition, knowledge and regulation, require full consideration here.

Knowledge About Cognition

As shown in the left portion of Figure 1, metacognitive knowledge refers to an individual’s awareness of his or her own cognitive resources in relation to the task. That is, the learner is aware of personal strengths and weaknesses as well as the requirements of the task or learning situation and has useful knowledge which enables him or her to predict how the two will interact for acceptable performance.

For metacognitive awareness, the learner needs three kinds of knowledge: declarative knowledge (knowing what), procedural knowledge (knowing how), as well as what Paris et al. (1983) refer to as conditional knowledge (knowing when and why). Figure 2 illustrates that declarative knowledge pertains to self and task characteristics as well as related strategies, while procedural and conditional knowledge relate to task-relevant strategies.

To illustrate how these types of knowledge function in a task or learning situation, consider the following example. Suppose that a proficient learner is faced with the task of reading an article about rodents, about which he must prepare a simple oral report. The learner demonstrates declarative knowledge of personal resources when he thinks, “I already know something about rodents.” and “I usually remember informational-type text easier than I do stories.” Declarative knowledge of task characteristics is evident when the learner thinks, “Reporting on the infor-

![Figure 1. The components of metacognition](image)
Regulation of Cognition

Regulation is the more observable aspect of metacognition and presupposes the existence of knowledge, since it is assumed that a strategic action is based on existing knowledge. Referring again to Figure 1, planning, monitoring, and revising comprise this regulatory component. Cognitive processes are orchestrated by the efficient, strategic learner so that optimum learning, understanding, or performance occurs. Planning refers to the cognitive processes that function to control information processing or task performance from the outset. Planning is goal related, requires task and self knowledge, and involves the initial selection of relevant strategies. Consider again the learner who must prepare an oral report on rodents. Planning is the underlying process when he acts upon the conditional and declarative knowledge and chooses to use outlining and summarizing as appropriate strategies for organizing and remembering the information.

Monitoring involves ongoing executive control of mental processes and is a crucial component of metacognition. Essentially, this regulatory function consists of checking and evaluating to determine whether the task matches preconceived notions about it, whether selected strategies are working, whether task performance is adequate, or whether comprehension is proceeding as it should. The student in our example may find that he is having difficulty understanding the information in the article about rodents.

When selected strategies or current operations are deemed inadequate or unsuccessful by the learner for some reason, a change in strategy must be made. This is where revision of skills, the student who realizes that he is having problems with the information about rodents may decide that the comprehension problem has arisen from the fact that the main ideas are not clearly stated and that the text is not well organized. He may then decide that before he can neatly summarize and outline the information, he will need to expend additional effort to extract the main ideas using comprehension strategies that require drawing inferences.

Skeptic's of the existence of a construct such as metacognition will say at this point that they doubt that anyone proceeds through such a regimen of conscious processing in an attempt to perform a task. This is true, in part, since much of this processing is carried out below the level of consciousness. The apparent disparity here can be explained by various researchers' descriptions of the relationship between cognitive processing and learner competence in a given task.

In his analysis of competent performance, Glasser (1976) describes the difference between a novice and an expert. In contrast to the slow, awkward, deliberate actions of a novice, an expert's performance is covert and, most importantly, automatic. That is, a competent performer responds to internalized strategies for thinking and problem solving that result in performance that is consistent, relatively fast, and precise. This is supported by research that suggests that when mental processes are used often, they become automated and more efficient (Gagne, 1983; LaBerge & Samuels, 1974; Shiffrin & Schneider, 1977), and are performed below the level of consciousness; indeed, they become inaccessible to conscious awareness, even for the purpose of verbally reporting on them (Ericsson & Simon, 1984). However, by using difficult, unorganized material in their study, Afferbach and Johnston (1986) were successful in
getting expert readers to de-automate and report on the processes they used in generating main ideas from text. The think-aloud protocols from this research served to illustrate that when the task becomes more difficult, even expert readers consciously plan, monitor, and revise as a means to successful performance.

Thus, as long as the demands of the task match the competence of the performer, or until some difficult or novel situation arises, an expert learner who possesses metacognitive skills proceeds in the "automatic pilot" mode described by Brown (1980), with most of the mental operations being controlled at the subconscious level.

With this definition in mind, the remainder of the paper will investigate how aspects of metacognition can be implemented for instruction and the consequent effects on the learner.

The competent performer responds to internalized strategies for thinking and problem solving that results in consistent performance.

Implications for Instruction

The Instruction

Too often in education or training, simple competence (i.e., the ability to perform) becomes the desired goal of skill instruction, reminiscent of the behavioristic influences that pervaded the field until the early 1970s (Bower & Hilgard, 1981). A skill is taught, practiced, and then evaluated. If performance is acceptable, the next skill is taught and so on. Generally, it is declarative and procedural knowledge that receive the most emphasis in instruction (Winograd & Hare, in press). Most educators and trainers would agree that simply equipping learners with a repertoire of skills is not sufficient to promote independence on the part of the learner, nor does it guarantee that the learner will see the relationship between lower-order tasks (i.e., discriminations) and the higher-order performance of cognitive strategies (Gagne, 1985). From an instructional viewpoint, skills must be taught not as ends in themselves, but rather as means to achieving ends in terms of overall performance.

While the research on metacognition as a construct is relatively recent and is confounded by problems with operational definitions and research methods, it appears to hold some promise for the improvement of instruction (Lohman, 1986). The authors suggest that incorporating metacognitive aspects into what Glaser (1976) describes as the conditions of learning will enhance instruction and result in competence of a higher level. Competence that involves strategic, self-controlled behavior and the ability to adapt to changing conditions. Transcending skilled behavior, strategic behavior is characterized by the notion of intentionality and purpose on the part of the learner, that is, the learner deliberately selects, controls, and monitors strategies to achieve in which skills are presented. For example, after gaining the attention of the learner, most suggested instructional strategies focus almost exclusively on the presentation of the what (declarative knowledge) and/or how (procedural knowledge) of the skill to be learned. These necessary types of knowledge are then enhanced through subsequent practice, feedback, and follow-up activities (Dick & Carey, 1985; Gagne & Briggs, 1999). Unfortunately, much of the conditional knowledge of when to use the skill and why it is significant is frequently left to the learner to acquire through incidental experience. Brown and Palincsar (1982) have shown that without instruction about the significance of the skill, effort by the learner to maintain and generalize the skill quickly diminishes.

It is suggested then, as outlined by Paris and his colleagues (1983), that to facilitate the learner’s ability to use a new skill properly, conditional knowledge must be included during initial learning of the skill. The learner should be informed of the importance of the skill (the why) during the initial focusing of attention. Rayner (1974) has suggested that this will increase the student’s motivation for using and maintaining a new skill because its significance for the student is immediately revealed. Likewise, as suggested by Baumann & Schmitt (1986), after the presentation of the what and/or how of the skill, students should also be informed and given examples of when the task is relevant or not relevant. Practice items requiring the student to identify when and why the skill is significant will reinforce the conditional as well as the declarative and procedural knowledge.

To illustrate this instructional format in a training situation, consider the following modification of a traditional method of instruction. In a recent training study involving teaching quality control techniques to assembly line workers (Keefe, 1986), no special consideration was given to relaying conditional knowledge. The modularized instructional materials were designed to teach the task in four steps prior to assessment of the assembly line workers’ performance. The steps were as follows:

Step 1: Declarative knowledge (what) was communicated as the workers were told that the materials were designed to teach them to read and interpret quality control charts used throughout their organization.

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Step 2: Procedural knowledge (how) was presented. After the workers were assisted in recalling specific math skills, the stimulus materials and information required to master the task were presented. Examples of the charts with various readings were given and the workers were shown how to record and interpret the data.

Step 3: Workers practiced using the charts and interpreting the results.

Step 4: Workers were given feedback.

In contrast, an instructional strategy modified to include the communication of conditional knowledge would alert the workers to the nature and importance of the quality control charts and would be as follows:

Step 1: Declarative knowledge would be presented (same as above).

Step 2: Conditional knowledge (why and when) would be added by instructing the workers about the importance of the skill and the appropriate time for its use. It would be explained that if the assembly line workers could read and interpret quality control charts during production, mistakes would be caught earlier and the product saved. This is because, traditionally, quality control measures are taken after a specific number of items have been produced.

Step 3: Procedural knowledge would be presented (same as above).

Step 4: Workers would practice using the charts as well as practice determining when and why to use them. This step would provide for rehearsal and reinforcement of both conditional and procedural knowledge.

Step 5: Workers would be given feedback (same as above).

It is true that some learners intuitively understand such things as the significance and utility of trained skills or strategies without explicit instruction. However, since metacognition is a developmental skill that does not automatically increase with age (Brown, 1980; Markman, 1977), it would seem that supplementing instruction with metacognitive aspects would prove beneficial to most learners.

Compelling evidence that such instruction results in a higher level of competence has been documented by a comparison of skills-training studies undertaken by Brown and Palacios (1982). They point out that students who received “blind training,” that is, instruction in only the performance of skills, achieved improved performance, but failed to use the skills subsequently on their own or to generalize them to similar situations (Belmont & Butterfield, 1979). In contrast, students who received “informed training,” that is, instruction that includes the rationale, significance, and utility of the trained activity, not only improved performance, but also demonstrated maintenance of the skill in appropriate situations (Kendall, Borkowski, & Cavanaugh, 1980; Kennedy & Miller, 1976; Paris, Newman, & McVey, 1981). Taking competence a step further, students who received “self-control training,” that is, additional, explicit instruction in task-specific executive skills such as planning and monitoring, exhibited increased outcomes in terms of independent production and awareness of appropriate skill use, strategy effectiveness, and self-regulation (Brown & Barclay, 1976; Brown, Campione, & Barclay, 1979).

The learning strategies curriculum that was developed and reported by Dansereau (1978) addressed the issue of providing the learner with the means by which to control intellectual processing. His work, however, focused on general strategies that presumably facilitate all learning and are encompassed in a self-contained curriculum. The present proposal pertains to knowledge and control at the task-specific level for all instruction, with the assumption that such information will transfer to broader, but similar areas. This is consistent with Gagne and Smith’s (1967) notion of training for vertical and lateral transfer; that is, instruction that includes information about the integration of subskills into higher level skills and the application of skills in appropriate situations (i.e., conditional knowledge). In addition, Gagne (1988) has noted the immense diversity of task-specific cognitive strategies, expressing doubt that general strategic thinking can be trained with more than moderate success.

The Learner

Instruction that provides conditional knowledge and self-regulatory components will no doubt have several positive effects on the learner in terms of overall performance. First, implicit within the concept of strategic learner behavior is the notion that motivation is the impetus for selected actions; that is, the relationship between skill and performance is described by Paris et al. (1985). Keller (1979) focused on the relationship between effort or motivation and one’s overall performance in his initial description of the motivational aspects of instructional design. He concluded that the degree to which effort is invested is heavily influenced by the skill’s perceived instrumental value for attaining a desired future goal. In other words, more effort is typically expended to acquire, maintain, and implement those skills that are perceived as being relevant and useful.

By supplying information about why and when a strategy or skill would be relevant to the learner, conditional knowledge provides an integral link between the skill and the motivation necessary for its implementation. Research that investigated differential effects of instruction with and without conditional knowledge (Duffy, Roehler, Meloth, Polin, Rackitt, Tracy & Vavrus, 1983) demonstrated that students who received conditional knowledge not only produced greater achievements than the control group, but additionally increased their efforts to use and maintain the newly learned strategies.

Second, as previously noted, research in several disciplines indicates that a major distinction between experts and novices in any content area is the difference in their use of self-controlled strategic behavior (Glarer, 1976). Experts tend to plan their alternatives before undertaking a specific action, as well as to monitor and revise their behaviors when appropriate. Each of these is an indication of experts’ incorporation of the metacognitive aspects within self-regulation. Likewise, students can learn to be strategic as they begin to use one or more of these self-regulatory components (Fish & Pervan, 1983; Paris et al., 1983). For example, Paris and Myers (1981) observed students in several fourth grade reading groups as they prepared to be tested on an assigned reading task. They noted that those finishing the test with the highest scores engaged in more strategic behaviors, such as taking notes, asking questions, and using the dictionary, than did those students with poorer overall performances. The researchers concluded that achievement was enhanced as students planned and monitored their learning and employed compensation strategies when necessary. In various other content areas, self-regulatory components have been used in areas ranging from controlling inappropriate behavior (Borstom & Quevillon, 1976) to improving math skills (Genshaft & Hirt, 1980).

Finally, combining the conditional
knowledge and the self-regulatory components, learners quickly gain confidence in their own abilities to use the skill appropriately and to achieve predictable outcomes. Learners increase their effort to acquire and maintain skills that produce outcomes that are attributable to their own behavior and not to luck or other external forces (deChamis, 1969; Weiner, 1974). As confidence with a skill and the outcome expectancies increase, the skill can then be used more strategically by the student to increase performance in a number of areas.

Conclusion

In conclusion, metacognition involves knowledge and regulation of cognitive processes resulting in strategic and adaptive behavior on the part of the learner. The authors advocated that the design of instruction, specifically the instructional strategies component, be extended to incorporate learning of conditional knowledge as well as self-regulatory components. There is evidence to support the notion that such instruction results in a higher level of competence. Such enhanced instruction should have positive effects on the teacher in terms of motivation and overall performance.

References


Adoption of new technologies in education can be greatly facilitated if their introduction is accompanied with a firm conceptual framework. But this is a rare occurrence. Too often conceptual frameworks for new technologies are offered after institutions have accepted or rejected them for reasons other than their theoretical and professional viability. Dennis Goofer’s The Education Utility is a successful attempt in providing the education community with a detailed explanation of an emerging technology. The book takes the reader through a “journey” in which the potential for a specific application of integrated information technology is explored. The exciting idea of schools and community organizations using an integrated information system as an education utility unfolds throughout the book in a convincing tone.

The journey continues with a tour of the infrastructure of the Utility, and a discussion of the public policy issues that such an enterprise needs to address. Other practical matters are explored too: how does the Utility fit into the existing educational system, how educators, parents, and students should be prepared to use it, what kinds of support services are required to make it viable, and what potential does it hold beyond the conventional school?

In the first chapter the author shares a dream with his readers. The vision is of a new era in American history in which divergent human resources and separate technologies are integrated into a coherent information system: the Education Utility. The purpose of the information system is to offer a vast array of instructional software and telecommunications capabilities to learners and educators. We are reminded that our time marks a technological watershed in American history beyond which the society, and the school, will be in need of more complex strategies and tools. New ways and means will be needed to deal with a variety of local, national and international problems for which we have not found adequate solutions yet. Novel approaches will be required to “revitalize” schools and communities so that they can face and resolve such outstanding problems. The Education Utility, it is asserted, can provide a wide spectrum of instructional information and services to teachers and learners, so that they can inject a new vitality into their community.

What type of equipment and telecommunications systems must schools have to be able to use the Education Utility? The second chapter of the book is devoted to a technical overview of the structure of the Utility and how computers, telecommunication systems, terminals and users would relate to each other. However, the information in this chapter is too general and does not answer specific technical questions. Are existing telephone lines adequate for using the Utility? Do schools need new microwave equipment? Can schools use existing computers? These and other similar technical questions remain unanswered. A more technical explanation would have been helpful to teachers and administrators to assess the feasibility of the Utility. It is of utmost importance that they become convinced that it is within their reach to participate in this major enterprise.

Public policy issues raised by implementation and use of an education Utility are addressed in chapter three. Will the Education Utility provide more educational opportunities for a multicultural society, or will it be selective in responding to the needs of certain segments only? Will it aggravate social inequity, or will it promote fairness? Will the Utility be dominated by central controls, or will it be responsive to local needs? Will data bases containing personal information be accessible to everyone, or can confidential information be protected? As the book deals with a potential technology rather than an actual one, it serves the reader well in raising these questions and providing guidelines for dealing with them when the system is put into use.

Chapters four, five and six delineate how the Utility can be assimilated into schools and how teachers and students can use its multiple capabilities. For example, teachers can:

* download shell programs which enables them to develop instructional strategies, define goals, and prepare instructional objectives and lesson plans.
* call up data bases with prepared instructional materials, as well as banks of tests with related instructional objectives
* set-up, or join a local, a regional, or a national teleconference on issues and topics of current interest
* share information with colleagues, across the country, if not across the world. One possible “scenario”, among many, is presented in the book to show how teachers can assist their students to use the Education Utility.

Preparing teachers, administrators, parents and learners to use the Utility is given its deserved attention in the book. The importance of training for the use of a new technology is not overlooked as is often the case in most transfer of technology projects. The notion that an appropriate hardware/software technology is potentially effective when teachers and students can use it properly is emphasized as a vital component of the concept of the Education Utility. Several strategies are suggested to facilitate the assimilation and adoption of the Education Utility. Establishing demonstration centers, conducting...
demonstration projects, setting up linkages with professional associations, and establishing a research and development academy are proposed to familiarize potential users to this new technology. The sections on developing integrated instructional strategies, and management systems for using the Education Utility are particularly instructive and constitute a strong segment of the book.

An impressive list of possible applications of the Education Utility in non-school settings is presented in chapter eight. A plethora of services made possible by the Utility is suggested that (a) facilitate and enhance present community affairs, or (b) make hitherto difficult or impossible tasks routine. For example, the Utility can be used to share information and services in several areas such as: health care, vocational and remedial education, community development, consumer services, and decision making on local, national, and international issues. These applications of the Utility go beyond its original conceptualization of providing certain services and information to teachers and students alone. This chapter stimulates a poignant question: Do schools provide the most appropriate setting for the introduction of integrated information technology into a community?

The author is fully aware of this important conceptual issue. In the concluding chapter he writes:

In my judgment, creating a highly visible support structure is one of the things that will assure that the Education Utility will be a technology that makes a difference in education. Conversely, I believe that absence of such a support system will condemn the Utility to mediocrity at best, and total rejection by the education community at worst (pp. 181).

However, the organizational structure for this support system in the local community is not very clear. This is an important conceptual issue that needs further clarification. Will schools provide such support services to other community organizations, or are they the recipients of such services? If schools are the recipients, is it possible to establish an independent unit to provide programmatic and technical support services to them, as well as to other community organizations? For example, could a local private company, similar to cable television company be established in each community? Such local support units could help schools to master the new technology, develop new programs, and interconnect with several other local organizations. It is the potential of the Education Utility to develop an information network capable of connecting schools to a variety of community organizations that makes it a unique and exciting technology. In fact, this holistic characteristic of the integrated information technology makes The Education Utility useful to a variety of readers.

The Education Utility is a useful book for:
- teachers, parents, and educational administrators who wish to use the new integrated information technology to induce into their schools and communities the vitality and versatility associated with such a technology
- community leaders involved in providing health-care services, career development services, adult education services, and other community development programs
- training directors in the private sector who need to know about new delivery systems which can bring training opportunities to the workplace
- researchers in the field of distance education who wish to: (a) study the Education Utility as a concept in distance learning, and (b) propose novel ways to use the capabilities of the system for developing new instructional strategies and services for different segments of the society

The Education Utility is a timely book because it provides a conceptual framework for using integrated information technology as educators and community leaders shape the information society in the 1980's and beyond. Bidding farewell to the industrial age and entering into the new information era will not be a simple process. Schools will be an important arena in which this momentous historical transformation will take place. Students need to be educated for a world in which the computer will be the means of production; ideas and information will be the commodities in demand; and the communication networks will be the highways for transferring these commodities. Educators in the coming years will face increasingly complicated decisions in relation to computers, telephone, office automation and communication systems in order to prepare students who must live in the Information Age. The Education Utility provides educators with a strategy for making appropriate decisions about these technologies and a resourceful framework for facing the challenges ahead. —Reviewed by Farhad Saba, Associate Professor, San Diego State University.
ERIC Reports on ID

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The development of computer-based instruction will be greatly facilitated by the use of an effective and efficient design model. Five components of such a model are: (a) the objective, (b) the content, (c) the questions, (d) the boundaries, and (e) the entry skills. A good objective describes either something observable that learners do, the conditions under which they do it, the standards for acceptable performance, or an observable product and the conditions under which they produce it. The content may take many forms—definition, description, generalization, principle, rules, and others. Learner processes will vary according to the content type, i.e. a rule-using task requires the learner to state the rule and then to apply it to a previously unencountered example of the class of problems for which the rule is intended. The questions enable the student to interact with the content and they test the student's mastery of the objective. Questions may be stated in interrogative (Who is green?) or imperative form (Write the sum of three numbers), and three kinds of feedback can be provided: knowledge of results (KR), knowledge of correct results (KCR), or KCR with advancement to next problem or question. The boundaries define the area the objective covers; one part of that area is the domain (stimulus or display), the other is the range (answers to the questions). Entry behaviors are stated for two reasons: to ensure that nothing is omitted and that there are no overlaps between old knowledge and new instruction, and to weed out students who lack prerequisite skills. Examples are provided for each of the five model components.—Microfiche copy only, 78 cents, plus shipping as ED 270 097.


This paper discusses various educational strategies for interactive videodisc design that were derived through scanning, synthesizing, and simplifying implications from a wide variety of learning theories. Four initial assumptions about videodisc technology are presented: (a) videodisc systems are more likely to be effective if learning theories inform their design, (b) application of videodisc systems should not be limited to lower levels of behavior or cognitive functioning, (c) the capabilities of interaction (control, feedback, pace) inherent in videodisc microcomputer technology can expand access and multiply the flexible use of visual materials, and (d) combinations of videodisc and microcomputer technology may give rise to additional instrumentation of learning theory research. Five unique features of the videodisc are also identified and briefly discussed. The major part of the paper focuses on three learning theories—behavioral, cognitive, and humanistic, and videodisc applications of each. It is suggested that education should continue to evaluate the implications, assets, limitations, and best instructional uses for the videodisc, and recognize that this medium can also provide instrumentation for research, particularly on higher order cognitive learning and critical reflectivity. A chart displaying the three learning modes, theoretical traditions, major learning theories, associated concepts, and potential videodisc utility is provided, as well as a list of references.—Microfiche 78 cents, paper copy $1.85 plus shipping as document ED 272 137.


This paper argues that research findings from the study of teaching could be useful in enhancing knowledge and tools for the design of both conventional and intelligent Instructional software. It also suggests that if the ways in which teachers effectively conduct instruction are different and in certain ways better than other media, and if teachers and computers share the critical capabilities of intelligent information processing, then two things might be predicted: (a) the study of instruction, if limited to instruction delivered by non-intelligent instruments, would not include research and theory regarding what to do with an intelligent instructional instrument, and (b) the study of teaching, being devoted to instruction delivered by intelligent entities, should include research and theory regarding what to do with an intelligent instructional instrument—the computer. A survey of research in the study of teaching uncovered the following names: David Berliner, N.L. Gage, Philip Hoftord, Christopher Clark, Robert Yinger, Barak Rosenshine, and Madeline Hunter. Topics and key ideas found to be repeated and emphasized as major areas of interest were teacher effectiveness, teacher thinking, and models of teaching. This survey however, did not reveal prescriptively-oriented theories and models of what effective teachers do and how they do it, nor were analyses found of the nature of interaction, questioning, and feedback. It is suggested that instructional

Although the quality of educational software is increasing dramatically, the need for good instructional software far surpasses the supply. There are at present relatively few authors with the array of knowledge and skills necessary to produce high quality interactive instruction. In the absence of trained authors, much of the available software has been produced by teams of experts who typically have little experience and knowledge. This paper explores the range of skills that may be desirable for creating effective instruction with the electronic media, examines the drawbacks of existing methods of authoring instructional material, and considers the kinds of curricula that would provide education and training in the requisite skills. A course of study is envisioned which would educate "master authors" in (1) subject matter expertise; (2) artistic and technological skills; (3) instructional design skills; and (4) information processing and learning theory. A 17-item bibliography and brief biographies of the authors are included.—Microfiche 78 cents, paper copy $1.85, plus shipping as document ED 272 136.

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While graduate programs in instructional design provide education in communications theory, media research, information systems, motivation theory, and behavioral and cognitive psychology, practice in the field often reflects a more pragmatic approach. In October 1985, Training Magazine surveyed thousands of training professionals responsible for instructional development in business and industry. Results indicated that, although half of respondents did employ some method of writing objectives and conducting evaluation, the percentages of affirmative answers to the following questions were: (a) write objectives in behavioral terms (60 percent), (b) assess entry level skills and knowledge (64 percent), (c) base media and method decisions on objectives (78 percent), (d) test programs as they are developed (65 percent), (e) evaluate the effectiveness of programs (68 percent), and (f) use feedback and test performance to revise (87 percent). Seventeen percent agreed with the statement "Our organization is too small to justify the processes and procedures implied by the above items." Results also indicate that 27 percent of respondents reported using computer-based training or instruction, and just under 12 percent reported hooking a computer to a video or videodisc player to deliver training. It is concluded that graduate educators have a responsibility to do more than respond to the field. They are encouraged to define it through more research and development and model it through the graduates they produce. A list of references is provided.—Microfiche 78 cents, paper copy $1.85, plus shipping as document ED 267 790.