Media and Learning: Are There Two Kinds of Truth?

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This article examines the assumptions and methods of conventional instructional media research to gauge its sufficiency as a basis for issuing the controversial finding that media do not influence learning and as an inquiry model for documenting media's educational effects generally. Examples of complex media effects are given and emerging media application paradigms are identified to support the argument that both a new conceptualization of the media and learning question and new approaches to its study are needed. An alternative values framework for guiding research on the effects of modern interactive technologies in complex learning environments is offered.

☐ "The opposite of a truth is falsehood, but the opposite of a profound truth is an equally profound truth."

Niels Bohr

The scientific "truth" of any research finding, E. G. Boring (1960) observed, "depends upon value judgments." Opposing value models are common in research disciplines. Boring attributed those in psychology to two groups that he called "Nothing-But" people—"reductionists . . . operationalists"—and "Something-More" people, who resist . . . "an ironclad reductionism [and] . . . rules that shackle . . . the scientific imagination" (p. 124). Salomon (1991) cited the divergent values and uses of *analytic* and *systemic* research in education. And Zukav (1980), drawing on "the poetic framework of Wu Li" to explain advanced physics, described the opposing principles that underpin Newtonian physics and quantum mechanics as their respective "dancing lessons" (p. 41).

Zukav's dance metaphor has more than poetic value; it is a useful reminder that research models are not carved in stone but, better said, choreographed. Prescribed movements reflect a particular scientific theory, which, as Boring (1960) observed, "is just the best opinion of what [some group holds] is a good idea to believe . . ." (p. 124). In any field, therefore, a research finding offered as a "profound truth" invites close inspection of the value system that governed the inquiry.

Traditional instructional media research employs a rigorous methodology that reflects Nothing-But and analytic values, and some aspects of Newtonian physics. It has issued one finding with the implied status of a profound truth: that media are "mere vehicles" that deliver content but do not influence learning (Clark, 1982, 1983). This inquiry does not attempt to *disprove* the mere-vehicles theory as

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stated; it grants that it is "true" in that its *dance/data/finding* path is technically valid (truth one), but argues that the traditional instructional research model's limitations render it incapable of providing an inclusive account of media's complex effects and, therefore, of discounting the thesis that more resourceful research might demonstrate that media do affect learning, that truth two is truth, too.

TRADITIONAL MEDIA RESEARCH EXAMINED

Since Clark (1982) declared the media and learning question a "dead issue" that is kept alive . . . "in the face of overwhelming evidence that the generic question [is] invalid" (p. 60), further examinations of the research data have not caused him to alter his position (Clark, 1991). Kozma (1991), however, in a direct response to Clark's (1983) challenge that a "novel theory" was needed to justify additional media studies, ascribed a more active role to the learner and argued convincingly that because the existing (pre-1982) research often failed to take into account media's "cognitively relevant characteristics," Clark's position "must be modified" (p. 205). A further examination of the manner in which the traditional model frames and investigates the media and learning question, however, strongly suggests that merely modifying that position is an incomplete agenda.

Truth One: A Covenant With Complexity

Researchers understandably focus on manageable problems. Schön (1987, p. 3), however, argues that they are "relatively unimportant" while important problems are "messy," and generally "defy technical solution." Thus researchers, in seeking technical solutions to difficult problems, are drawn to oversimplification. Traditional media research, judged by its techniques and values, is arguably indictable on this charge.

The traditional image of media-use. An instructional media research model invariably carries a blueprint of a teaching process and of media's role in that process. Traditional media research has been largely guided by an operative image which portrays media as simple tools used for routine stimulus presentation tasks, an image here called the *tools and tasks* paradigm. In this mode of use, media are typically seen as mere information carriers that serve as teaching aids for controlled-content delivery in a context in which learners assume relatively passive roles and the primary value is efficient content assimilation. This operational mindset pervades each level of conventional media research design—framing the central question, selecting an inference technique, and establishing basic operative values.

Framing the media and learning question. The notion of a "generic" media and learning question as an object of study obviously demands common perceptions of the two central concepts: *medium* and *achievement (learning).* But arguably no consensus definition of instructional medium exists and changing technology is making the problem increasingly difficult (Gayeski, 1992; Jaspers, 1991). A definition that embraces "the entire system of equipment, processes, people, and materials [used in] the presentation of information and direction of learner activity" (Bretz, 1969, p. xiii) may make an ungainly research construct, but it illustrates that wide opinion exists regarding what elements may be said to comprise the medium in a given context. Kozma's (1991) argument that the definition must include a medium's "cognitively relevant characteristics" underscores a fundamental point: Every media kit has its cognitive caboodle.

Regarding *learning,* Clark's (1982) allowance that media have uses related to their " . . . attitude and engagement possibilities," coupled with his claim that media offer no advantage "when student achievement is the issue," clearly places "attitude and engagement" outcomes, which many might rank as valid learning goals, outside the realm of achievement.

The nomenclature and definitions that Clark (1982) used to declare the media and learning question a "dead issue" thus seem to make that declaration little more than a broader version of

Mielke's (1968, p. 55) earlier, and timely, call to bury the "TV-versus-face-to-face body." But this framing of the media and learning question is clearly inadequate for the assessment of modern media systems and their complex effects. In fact, relatively early in the media research debate, Salomon (1978) observed that the growing evidence that only "managerial and economic" considerations were important seemed "to reflect more on the kinds of research questions asked than on the potentialities of media" (p. 37).

Deficits of conventional technique. Loftus (1991) calls hypothesis testing, the principal means used to assemble the "overwhelming evidence" that media do not influence learning, a "virtually barren technique," saying: "I find it difficult to imagine a less insightful means of transmitting from data to conclusions" (p. 103). Some may argue that Loftus undervalues hypothesis testing; clearly, it has its uses. But when further encumbered with the simplistic assumptions that traditional media studies typically embody, the resulting inference engine seems underpowered for the terrain it seeks to explore.

Operative values in media studies. The claim that "any necessary teaching method could be designed into a variety of media presentations" (Clark, 1991, p. 34) carries an assumption that is central to the mere-vehicles argument—that for any learning objective, the *necessary method* for teaching it to any learner population can be derived through technical means. This assumption not only discounts the "seemingly limitless variety" of traits found among learners (West, 1991, p. 78), it also supposes that the chosen *method*—a conceptual mosaic of teaching strategy, stimulus form, interaction and other specifications, plus the lesson content, can be realized in material form and packaged in various media formats *without variation,* thereby complying with the requisite *single-variable* canon.

This linear-programming image of the design process clearly does not fit the one now emerging in education and other fields; for example, as a dynamic "kind of making" that involves "transactions" with a problem's relevant variables (Schön, 1988, p. 181, 182), and as a "creative process . . . driven by the recognition of opportunities and . . . carried out in iterative cycles" (Rowland, 1993, p. 88). Moreover, it opens susceptibility to a distorting factor that was powerfully, and humorously, illustrated in a popular comic strip, *Crock.* When a member of the hapless "lost patrol" suggests using a mirror to signal the fort, the inept patrol leader responds: "That's a great idea, . . . but how do you write a message on a mirror?" When, in the interest of providing equal treatments, researchers do the tactical equivalent of writing on a mirror by, for example, creating a videodisc that "acts like videotape" or a computer-based lesson that "acts like a book" (Becker, 1991), the results cannot accurately reflect a medium's capabilities. Indeed, Mielke (1968) long ago expressed concern with research that seeks to bring different "modes of instruction down to a common denominator where 'other factors' [are] equalized." These "other factors," he warned, "are not an experimental nuisance [but] the very basis on which a rationale for televised [read: mediated] instruction must be made" (p. 56).

The assertion that a medium can have instructional uses while not promoting learning (Clark, 1982) points to another questionable assumption underpinning traditional media studies—that technology is a *nonproblematic agent* within a learning system. This premise reflects a general mere-vehicles doctrine that assumes a steady-state context in which technical devices and other system ingredients "cooperate" by holding to fixed, "assigned" roles. As with the view that weapons are not "ingredients of war" but only "give expression" to existing political ingredients within states (Lardner, 1982), the medium-as-mere-vehicle thesis necessarily holds that a medium can never *become* an active ingredient of a learner's cognitive dynamics or of a school's or discipline's curricular dynamics. This represents a perspective in which "the meaning of technology [is] nothing more complicated than an occasional, limited, and nonproblematic interaction" (Winner, 1986, p. 6); a presumption that is arguably unrealistic in complex sociotechnical settings.

Lastly, any technology-focused study, as Salomon (1991) confirms, involves a choice regarding the *level of understanding* of effects sought. Traditional media studies have typically concentrated on a medium's enhancement effects—communication efficiency or accuracy—while overlooking significant enabling and activating effects. This observation is not new, of course, but an example from another field provides an interesting insight into its potential consequences.

If nutrition scientists limited their focus to relating biological effects to food intake *by the serving* in the way that conventional media studies seek conclusions about learning from the relatively few stimulus "servings" they offer, the likely conclusion would be that "food does not cause cancer" (Smarter choices, 1992). But by studying how diet may promote the growth of cancerous cells and how obesity may act to "trigger" diabetes, medical researchers now better understand "the ways food can figure in . . . common diseases" (Smarter choices, 1992). In contrast, most conventional media research does little to reveal how students' *media diets* "figure" in learning, either by promoting, or inhibiting, the growth of learning proficiency, or by triggering increases in learning activity.

In sum, the many "layers of forced simplification" (West 1991, p. 226) found in the typical media study severely limit its ability to detect any but elementary, nonproblematic effects. Such research provides only what Winner (1986) terms a "strictly instrumental/functional" understanding of technology. At this level, the belief that media do not influence learning can be called truth; but, to paraphrase Boring, it is nothing but a Nothing-But form of truth. Preoccupation with achieving simple, instrumental understandings of media qualities may explain Hlynka's (1991) view that when it comes to considering research alternatives, "educational technology appears to have become stuck fast in a technological, means-end quagmire . . ." (p. 29).

MEDIA AND LEARNING: A COMPLEX PROBLEM

"Complexity," Heinz Pagels (1989) tells us, "covers a vast territory that lies between order and chaos" (p. 54). As a basic tenet of *ecological validity,* an inquiry model must meet the demands of the domain to which it is applied. Traditional media research reflects the assumption that measuring media effects is a straightforward process that lies in the realm of order. When viewed through a technology assessment lens (Spitzer & Kielt, 1977) instead of a tool-use filter, however, the true complexity of media's potential cognitive and curricular effects is better seen.

Technology's Effects and Their Study

That media and other technologies have profound *cultural* effects is indisputable. But while this realization may lend validity to the axiom that "The medium is the message" in the long view of history (Esslin, 1982, p. 4), it is not clear how it can or should apply to setting educational research strategy. Propitiously, both Kochen (1981) and Winner (1986) have provided illuminating insights into media effects with great educational relevance. Kochen listed three dynamics of communication technology: "amplification of . . . cognitive abilities, . . . control of an individual's affect, and new forms of communication and control in society" (p. 148). Winner's assertion that "technologies are not merely aids to human activity but also powerful forces acting to reshape that activity and its meaning" (p. 6) reinforces Kochen's three-level view of media effects. Although the available research on how mediating technologies can affect human cognition and reshape human activity and its meaning is limited, a few pertinent studies, and a growing record of professional experience, have raised important, and decidedly complex, issues for future inquiry.

The Technology-Cognition Connection

Neil Postman's (1986) assertion that a medium influences learning because of "the way it directs us to organize our minds and integrate our experience" (p. 18) and Alan Kay's (1991) claim that media "powerfully shape our ways of thinking" (p. 138) infer a strong medium-cognition connection.

In that vein, a computer maker's ad addressed what it called "the paradox of power." A powerful machine, it said "is more capable of bending to the will of humans, rather than having humans bend to its will." Ascribing a "will" to a computer is a metaphoric reach, at least for the present. But Winner's (1986, p. 55) reference to a machine's inherent "regime of instrumentality," and Vaughan's (1988) definition of a computer "environment" as "a set of rules, conditions and capabilities within which programs can be created and then run" (p. 28) both affirm that media have instrumental features that invariably will be more or less accommodating to a given user's learning style and instrumental proclivities. Kozma's (1991) discussion of the ways learners use the distinctive information presentation capabilities of various media well illustrates this *cognitive accommodation* factor.

A professional football player's observation that "mud rewards size at the expense of speed" reinforces the idea that any medium tends to reward certain human traits at the expense of others. For example, because learner populations contain both "visualizers and verbalizers"—those who "think in pictures" and those who "lack imagery" (Sommer, 1978, p. 1)—a highly visual medium will reward the first group at the expense of the latter. But if the testing procedure employed in a media, or aptitude-treatment-interaction, study is not able to detect these effects, the visual learners' achievement measures and the study's utility are compromised. West's (1991) hopeful anticipation that personal computers with extensive visualization capabilities may make it possible to measure "a vastly increased range of visual-spatial and other socially valued skills which have not previously lent themselves to conventional paper-and-pencil methods of assessment" (p. 41) speaks directly to this problem.

Evidence of a form of *cognitive amplification* effect appears in a conclusion drawn from a study that compared audio, video and computer teleconferencing methods in a simulated crisis exercise. Spangler (1977) reported that all three media were found to be "more sensitive to cultural factors" than was expected and, more significant, "that each medium creates its own kind of experts and that these experts can inhibit as well as encourage the exchange of knowledge" (p. 11).

One technical writing professor, alert to the interplay of medium and human performance, makes his students use tinkertoys in a product development exercise in order to eliminate the advantage that students in technical fields might enjoy. "Tinkertoys make all students equal," he explained, and allow students "to deal with substance rather than with technology" (Ideas for the Classroom, 1989, p. A19).

Anytime a medium acts to create its own kind of experts among users, or to make all students equal, it is no longer a mere vehicle; it has become an active agent within the system of which it is a part. Nowhere is this phenomenon better caught than in Alan Kay's simple question (quoted in Dede, 1992, p. 56): "What does a medium ask you to become in order to use it?"

The Technology-Curriculum Connection

That media affect the subject matter content they carry is widely believed but not well-documented. Moreover, observations about the interplay of medium and content are often negative. Critic Jonathan Yardley (1987a) has argued that television "is not equipped to handle complexities, conflicting arguments, [and] accumulated knowledge [because it] instinctively oversimplifies [and merely] educates by teaching children to do what television-viewing requires of them" (p. D2). Kay (1991, p. 141), too, warns that television is a medium "incapable of carrying important kinds of discourse."

Support for this surprising thesis exists in the academic world. Princeton University history professor Theodore Rabb (1987), describing the problems he encountered while creating a television series on the Renaissance, says that "no film producer can fully share the aims of a scholar, except in the case of preparing a specific, technical program for a limited audience.

"The differences begin at the most basic level: Academics deal in nuances, qualifications, and subtle distinctions, while film makers seek broad strokes, drama, and simple, vivid ideas." Thus, Rabb concludes, "the major problem is a fundamental division of purpose between scholarship and television" (p. B1).

Observations that a given medium is "incapable of carrying important . . . discourse" (Kay, 1991) or that a medium can have a purpose that is at odds with the demands of scholarship (Rabb, 1987) clearly reinforce the argument that "each medium distorts its messages with a particular bias" (Lias, 1982, p. 23).

Henry Ford's biographers have argued that he, perhaps more than anyone else, "made" the modern world because even though he did not invent the automobile, he "established the terms of its manufacture and distribution, and thus fixed its place in our lives" (Yardley, 1987b). Likewise, when a media system helps establish the terms of knowledge manufacture and distribution, it assumes a place in the learning lives of students and becomes an integral part of an educational system's curriculum apparatus. This may happen in direct fashion, or in the manner of a "Trojan Horse" (Salomon, 1991, p. 12).

A professional application that illustrates the Trojan Horse phenomenon is found in an interactive videodisc program developed at Dartmouth Medical School. The program explains the pros and cons of a particular type of surgery and thus gives patients a larger role in the decision-making process. The significance of this change is evident in the observation that "the interactive videodisc would thus replace the 'rational agency model' which assumes that only physicians know which treatment their patients would prefer and what its probable outcome will be" (Kangilaski, 1990). Thus the videodisc, while serving as an efficient information vehicle, is also reshaping an existing professional practice model.

That technical devices can affect direct curricular changes is evident in ongoing work in molecular genetics and biochemistry where new techniques have given rise to a form of *biotechnology* in which there is "a newfound and utter dependence upon . . . the . . . computer" for data analysis (Masys, 1989). "The promise of this new computer-intensive life science," Masys (1988) predicts, "is a coming era of molecular medicine, where the knowledge that guides individual diagnosis and therapy will include a molecular genetics and molecular biochemistry component" (p. 9). Thus, future medical programs will include learning tasks that are so computationally intensive that an absolute dependence upon computers for their execution is created. This clearly is a case of technology-driven curriculum transformation because the computer serves as an active agent in shaping a component of future diagnostic and therapy regimens and, therefore, of the future medical curriculum.

These varied examples of media capabilities lend support to Kantrow's (1980, p. 7) claim that technologies often exhibit a peculiar "inner dynamic." This dynamic, however, is no mysterious property residing deep in the "soul" of any machine; it is largely a function of the *opportunity utility* a technology provides. By imposing its particular instrumental regime on users, each technology helps create its own kind of experts. The new elements of expertise become, in Schön's (1988, p. 183) words, "a particular set of things to think with" in setting and solving problems. Thus a medium's communicative utility is stretched by the skillful application of the expertise which the medium's particular instrumental features nourished.

This dynamic is well-illustrated in political campaigning where expertise in using television, and reliance on that expertise by those who seek office, has instated an attitude that the ads are no longer just a way to present a campaign, they *are* the campaign. One student of the American electoral process has suggested that to counter this condition, political ads on television ought to be limited to "talking face" presentations. The point of this suggestion is obvious: cancel the medium's opportunity utility so that it may function as a mere vehicle, and nothing more. The idea may have merit in politics, but not in education and related research.

TOWARD A NEW MODEL FOR MEDIA RESEARCH

As the "ability to imbue technology with intelligence and style changes the rules of design" (Schrage, 1990, p. H3), conventional instructional research is less able to inform the design process. Indeed, "the lack of detailed instructional design models for training complex cognitive skills" is seen as "a serious omission in the area of instructional technology" (van Merriënboer, Jelsma, & Paas, 1992, p. 24). Moreover, as designers increasingly embrace constructivist approaches to creating interactive learning environments (e.g., The Cognition and Technology Group, 1991), conventional media research seems increasingly unlikely to fill in this void. Still, it need not be abandoned; only used in ways consistent with its limits. As Salomon (1991, p. 16) argues, using complementary models "serves better, fuller, and more satisfying understanding."

Salomon's (1991, p. 16) reference to acquiring "different levels of understanding" of complex phenomena strongly implies that a satisfying understanding of today's advanced media systems, and of the increasingly complex learning environments being built around them, cannot be expected of traditional quantitative or qualitative research. A full understanding of such environments, it must be noted, requires documenting not only their learning and logistical benefits, but also any dysfunctional effects, whether of a communicative, ergonomic, social, or motivational nature.

Emerging Media Application Modes

A useful first step in developing new perspectives on media research is to note new media application modes—and attendant research issues—as they appear. Tesler's (1991) elaboration of four paradigm shifts in computing since the 1960s provides an excellent descriptive model. Moreover, his succinct summary of technological changes in computing is matched in value by his description of changes in the computer's role—"from cloistered oracle to personal implement to active assistant" (p. 87)—and by his observation that each "new paradigm has molded the way users perceive their status in relation to the computer" (p. 93). Recent developments in media use have had similar effects which, to be understood, suggest changes in the focus of research.

Table 1 contrasts two presently emerging media-use paradigms with the conventional *tools and tasks* perspective.

The "desktop environment" (Relan, 1991) in which learners work independently with workstation-form media platforms well illustrates the *platforms and processes* focus. An interactive, computer-based, optical disc system, for example, is more than a mere tool because, to paraphrase Winner (1986), it requires users to "participate in [its] workings" and to "respect

TABLE 1 ☐ Three Media-Use Paradigms

	Tools and Tasks	*Platforms and Processes*	*Ecologies and Enterprises*
Media Role	Information Carrier	Workstation	Unified Information Management System
Facility	Classroom	Desktop	Network
Users	Instructors	Learners	Groups
Learner Status	Dependent	Independent	Collaborative
Context	Passive Environment	Responsive Environment	Shared Environment
Process	Assimilation	Interaction	"Intraaction"
Technology Focus	Tool Use	Cognitive Augmentation	Group Orchestration
Value	Instrumental Efficiency	Learner Proficiency	Team "Coficiency"

[its] authority." Users of such systems cannot ignore the technology and focus only on the content; a new level of instrumentality that may affect learning has been imposed on them. Consequently, the manner in which they perceive their relationship to the medium is invariably changed. But in this highly responsive environment, they gain increased control over their own learning activities and enjoy a more constructive role in learning.

This shift in the learner's role makes interaction, rather than passive assimilation, the key learning process; cognitive augmentation, rather than instrumentally-correct tool use, the central technology application focus; and learner proficiency, rather than communication efficiency, the premier system value.

Here the research emphasis shifts from measuring the medium's efficiency in delivering content to assessing its value in allowing students the freedom to apply their particular cognitive abilities and preferred learning processes in independent, problem-solving activities. How well different students adapt to and exploit this freedom—and there is wide variation (Jonassen, 1993)—is another important research issue.

Assessment of today's complex interactive systems is made difficult by certain inherent qualities. One is that, in the best programs, the system's instrumental features—random access, rapid branching, answer judging—are so intrinsically embedded in the overall design that distinctions between medium and method become artificial. A second complication arises from the advanced design that teaching programs often embody. One patient management simulation, for example, offers medical students several increasingly complex problems in one program and varies the amount and types of feedback according to the user's performance. Because students' experiences with such programs vary greatly, they cannot be said to constitute fixed treatments for research purposes, as more conventional media programs might be. Such sophisticated multimedia systems, Dede (1992) asserts, provide "leverage" that "stems from a synthesis of multiple attributes rather than any single characteristic . . ." (p. 54). Obviously, conventional methods geared to isolating single characteristics for study are of limited value here.

The *ecologies and enterprises* framework offers another complex operational focus for study. An *ecology*, in this sense, is a communication and knowledge distribution entity of such magnitude that it constitutes what Winner calls an "enduring framework" for educational, practical, social and, quite likely, political activity. The unified, institution-wide information system (the *new-nervous-system-for-the-campus* concept) exemplifies this framework. Such systems enable users to share work on a given enterprise or learning problem. The isolated human-computer interaction of the desktop environment becomes a dynamic form of intramural interaction, or *intraaction*, with the technology serving to orchestrate group activity and to promote cooperative proficiency—*coficiency*. Here, collaborative learning, group achievement and curriculum transformation are major research concerns.

This three-paradigm elaboration of mediated instruction is admittedly quite general, but two things are important to note. First, it is intended to make the point that implicit views that researchers hold about media's role in instruction and learners' relationship to mediating devices can strongly influence research design. Second, earlier paradigms are not completely wiped out by later ones. Certain aspects, efficient and engaging communication, for example, will always be valued. Desktop stations are not eliminated by networking; they are often linked in client/server relationships that alter their form and mode of use. Thus the listings in Table 1 represent what are perceived to be the seminal elements within each media application focus, and the major shifts in emphasis from one perspective to another.

An Alternative Values Base for Media Research

Educational technology has a noteworthy history of debate about the need for alternative research paradigms (Driscoll, 1984; Hannafin, 1986). Physics, however, appears to have had a

TABLE 2 □ Complementary Value Models for Media Research

Traditional Approach	*Emerging Approach*
Hypothesis testing	Technology assessment
Single-variable focus	Systemic focus
Fastidious design	Simple design
Highly controlled	Appropriate control
Data intensive	Selective data criteria
Brief duration	Extended duration
Strict entry rules	Broad entry rules
Small subject populations	Large populations
Measures "surrogate endpoints"	Measures major outcomes

considerable head start. Zukav (1980) marks the 1927 gathering of physicists in Brussels as the impetus for "the emergence of the new physics (quantum mechanics) as a consistent way of viewing the world," and as the virtual culmination of an "upheaval in physics following the discovery of the inadequacies of Newtonian physics . . ." (p. 37). What was new, and significant, about the new physics was that it was not simply a call for more rigorous methods; it proposed new assumptions about the nature of physical reality and altered expectations concerning what physicists could hope to determine and describe about reality. This carries an important message for educational technology, which appears to be in a similar period of upheaval with the adequacy of its traditional research and development models under question. Although diversity contributes to growth in any discipline, educational technology arguably suffers from the lack of a consistent way of viewing its world. Nothing-But people and radical constructivists would seem to have nothing to say to each other. And leading scholars disagree on the outcomes of media research, and even its value as an enterprise. Thus educational technology's "new physics" must make room for complementary models for media research and define their respective roles.

If one views a research paradigm as a technical engine mounted on a values chassis, then defining an alternative media research model logically begins with specifying the values foundation upon which its techniques will rest. Table 2 compares the major value features of the traditional approach to media research and a proposed alternative.

The traditional values set is most useful in studies that isolate variables and seek to establish one-to-one correspondence with anticipated effects. In contrast, the new values structure is intended to support studies dealing with *aggregations,* with examining the varied effects of complex learning environments in which multiple technological and design factors act in concert.

A technology assessment approach that measures multiple-level effects, assumes a systemic focus (after Salomon, 1991), and exhibits ecological validity accounts for several fundamental values. But it is not entirely sufficient. To arrive at a more nearly complete values base, one that points to specific design features, media researchers may profitably draw from an emerging trend in medical research where "fastidious studies" employing highly controlled methods often prove to be inconclusive (Brown, 1992), and where rapid proliferation of advanced (and costly) technologies is occurring while "knowledge of what truly makes patients well" remains "the missing element" (Cohn, 1993). A new form of experimentation, called "large, simple trials," is said to "ignore many customs of clinical research in order to get something notoriously elusive in medicine: definite answers" (Brown, 1992). The name—large, simple trials—is itself indicative of the central philosophy: pare down study designs, expand their scale and duration, and document a few major outcomes rather than numerous laboratory endpoints.

Why might simpler study designs be more effective in studying complex phenomena? The study of drugs' effects in medicine is highly instructive in this regard.

Despite decades of "costly and laborious experiments [that] produce a wealth of detail," the ultimate effect on mortality of many popular drugs remains unknown (Brown, 1992). Alternatives to the traditional clinical trial, which controls and measures many variables and typically requires participants to undergo many tests and procedures, are therefore being sought; thus the attraction of large, simple trials. In one such study now being conducted to test the effects of digoxin, doctors need not record large quantities of data but "must report only three major 'outcomes'—hospitalization, heart attack and death" (Brown, 1992). This makes it possible to enroll thousands of patients—under broad rules of entry—and to gather sufficient data to resolve the mortality issue.

Although education and medicine are vastly different, the similarity of the situations that obtain in the two fields is striking. Certainly, education also suffers from a general lack of definite answers to complex questions regarding technology's use. And the widespread use of objective tests in education can be equated to the recording of many laboratory readings in medical studies. Both data sets stand as surrogate measures of some larger condition that is of central concern. Consequently, studies that emulate large, simple trials may offer a promising approach to assessing technology's role in education.

Designing such studies obviously raises difficult questions. (Those dealing with logistics and cost are not discussed here.) Because education and training usually do not involve such dramatic markers as heart attack and death, major learning outcomes that serve as equivalent achievement milestones would need to be identified in individual disciplines. Lengthy prescriptions of the what-everybody-ought-to-know form appear to be of little help here. The concept of intellectual *landmarks* is one idea that seems more applicable. Greenspan and Salmon (1993), for example, argue that landmarks set by "what we expect children to achieve at certain ages" are better than test scores as measures of progress. In professional fields, ongoing efforts to define *novice* and *expert* performers could be expanded; a more replete continuum might range from novice to journeyman to expert to master.

But whatever the form in which major outcomes are specified, and whatever the shape new learning environments may take, research that seeks to gauge the value of these environments in achieving worthy intellectual outcomes must itself be grounded in sound values; values that guide, but do not shackle, the scientific imagination.

CONCLUSION

Education has been little changed by technology, even as its clients have been. But as computer professionals have shifted their focus from deciding which computer to buy to asking "what kind of computer environment does the organization want to live in?" (Schrage, 1990, p. H3), creative educators are recognizing that the question is no longer which stimulus delivery tools to buy but how to fashion technology-based knowledge environments in which students will want to learn. Such changes in perspective are defining new expectations for media research. It must not only provide standards to guide the design of instructional event sequences (its traditional role), but also support the building of a knowledge base to help individual disciplines to devise broad technology utilization strategies, and institutions to establish their fundamental technology implementation doctrine.

To fulfill these expectations, media research needs a new values foundation; one that embodies a new sensibility about technology and its effects on learning, the power to provide new levels of understanding of those effects, and a healthy regard for the profound and unexpected effects that technologies invariably produce. □

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