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A general issue covering varied aspects of educational technology

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Pedagogical Biases in Educational Technologies

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Capabilities and biases of learning technologies are examined in light of four widely accepted principles: deep content knowledge, dialogue, agency, and collaboration. Software that supports these principles must focus students' attention on ideas rather than topics or tasks and should foster high levels of *epistemic agency*, providing students with means to assume responsibility not only for their individual contributions to knowledge in the classroom but also for the overall progress of the class's knowledge-building efforts.

Technology intended to support learning is seldom neutral with respect to pedagogy. It usually makes some things easier to do than others and thus introduces a bias toward certain kinds of activity or certain ways of going about an activity. We are not here referring to explicitly instructional technologies—drill-and-practice software, computer-assisted instruction, intelligent tutoring systems. These usually embody a clear-cut pedagogy, in the best cases supported by an explicit rationale and program of research (e.g., Anderson, Corbett, Koedinger, & Pelletier, 1995). One need not speak of 'bias' in these cases; people know what they are getting. With the advent of the personal computer and the rise of the Internet, however, new kinds of technology began to appear that are not explicitly instructional but that are often proclaimed to have important educational value. Many of these are tools taken over or adapted from non-educational applications—word processors, presentation software, multimedia authoring tools, e-mail, conferencing software, Web search engines, and the like. Although these kinds of software are typically represented as supporting a "constructivist" approach to learning, it is often not clear whether this means anything more than that the software provides students with tools for doing things. That much is self-evident and implies nothing one way or another about pedagogical biases that might be embodied in the software.

Evidence that could be used to support claims of pedagogical bias is scarce, but what there is raises interesting suspicions. Here are four examples:

1. Although word processors have the potential to improve student writing by reducing mechanical burdens, investigators have found evidence of diminished planning and "an over-attendance to low level concerns, tidying up and fiddling at a local word or sentence level" (Haas, 1989, p. 96).
2. By reducing time pressure, asynchronous discussion—'threaded discourse'— ought to encourage reflection and more sustained analysis. Discussion threads, however, are notoriously short. Analyzing such discourse, Hewitt (1997) found that people tend to respond only to the most recent entries, seldom going back to pick up an older entry, and so a thread typically dies whenever the last addition to it fails to provoke responses, and overall there is less coherence than one would expect to find in an oral discussion.
3. The World Wide Web has been heralded as a vast information resource, enabling students to pursue inquiries independently and in greater depth than was possible when they had to rely on local print resources. Observing a middle-school class engaged in such inquiry, however, Moss (2000) judged that use of the Web encouraged the gathering of miscellaneous facts about a topic rather than pursuit of deeper understanding. This is what popular search engines are good at: delivering what we have called "knowledge *about*" rather than "knowledge *of*" a subject (Bereiter & Scardamalia, 2006).
4. Papert (1993) argued persuasively that children will learn more by building things than by investigating things that are already built. Operating on this premise, Yarnal and Kafai (1995) engaged students in creating educational computer games rather than in simply playing such games. The game building was part of a unit on oceans. The authors found, however, that the students (and their teacher) concentrated almost exclusively on the mechanics of game construction rather than on subject matter and that the games turned out to be factual quiz games—

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quite the opposite of what a constructivist approach to learning would favor.

All of these are indications of bias, not strict limitations. The technology did not prevent people from following a high cognitive path, but it apparently tempted them and made it easier for them to take a lower path. In many schools, including ones reputed to be "innovative," the favored technology consists mainly of "productivity" applications—word processors, spreadsheets, and presentation software primarily designed for business use and frequently bundled under the name "office" (Kozma, 2003). Surely, one might suppose, such technology is pedagogically neutral, free of bias. Spreadsheets have such a variety of uses that it is difficult to generalize, but word processing and presentation software have an obvious and intentional bias toward what in movies are called "production values": the esthetics and lavishness of presentation as distinct from the quality of content. In producing a document, some attention must of course be paid to its physical appearance. In the limited time frame of most student writing, however, this amounts to attention taken away from the higher-level concerns of writing (Scardamalia, Bereiter, & Goelman, 1982). With the current enthusiasm for multimedia in schools, attention to production values could easily overwhelm attention to content, as teachers have occasionally reported to us.

Can software be designed with a bias toward high-road rather than low-road cognitive paths? Anything that facilitates contact with and attention to meanings can be counted a step in the right direction. Bromme, Hesse, and Spada (2005) have drawn together contributions from a number of researchers working on ways to facilitate "the construction of 'meaning' when information is exchanged via computers" (p. 4). Figuring prominently in these efforts are tools for representing both conceptual content and process during collaborative knowledge work. To the extent that these introduce a high-road bias, it is through providing templates that encourage and in some cases force users to categorize what they are doing at a more abstract or metacognitive level. Automatic semantic analysis is possible through Latent Semantic Analysis (Landauer & Dumais, 1997), for instance, and Web 3.0 tools such as one that can generate nodes and links of a concept map from ordinary text (Cortex Intelligence, July 3, 2007). But turning these into tools usable by students is a substantial challenge. Summary Street (Kintsch, Caccamise, Franzke, Johnson, & Dooley, 2007) uses Latent Semantic Analysis to help students improve the content of their summaries. This works nicely if the material to be summarized is provided, but if students have to go out and find the content—as is common in much project-based learning—they are at the mercy of Web search engines, which generally work by narrowing topics rather than by synthesizing meanings. Locating answers to complex or uncommon questions generally requires substantial prior knowledge of the domain in which one is searching. The "Semantic Web" is expected to do something about this, but implementation applicable to education seems to be some distance off (Borland, 2007; Maddux, 2008).

Besides semantic content, software may also support higher levels of discourse form and process. There are, for instance, argument structuring tools, mostly based on Toulmin's (1958) model of logical argument structure; e.g., Belvedere (Paolucci, Suthers, & Weiner, 1996) and SenseMaker (Bell, 1997). The low-road approach to argument structure amounts to filling in blanks, producing something that will look like an argument but that may have no coherent point. With regard to process, there is software that amounts to a "paint-by-numbers" kit for writing, but it is also possible to design software that delivers prompts and hints without micromanaging the writing process (Rowley & Meyer, 2003; Zellermayer, Saloman, Globerson, & Givon, 1991). Blocking low-level processes is also a possibility, although one that has not been implemented in software as far as we know. In order to block low-level "tidying up and fiddling," for instance, font choices could be disabled until a late stage in the composing process (Goldfine, 2001). Any technology intended to promote a high-road path to content, structure, or process must walk a fine pedagogical line. The high road, we might say, is a very narrow path, with ever-present risk of micromanagement and dumbing-down on one side and insufficient support on the other.

A Principled Approach to Pedagogical Design of Software Learning Environments

Although formulations differ, there is a set of principles endorsed by a broad spectrum of educators and educational researchers that educational technology designers might all find easy to endorse. Some of the principles, such as "active learning," are so general that almost any interactive software would satisfy them. The following four principles, however, have some bite. They are not easily achieved in any case, and it is not so obvious how technology could help:

1. ***Depth of learning.*** This is an objective of practically every cognitively-oriented educational approach and is one of the main ideas informing Bransford, Brown, and Cocking's *How People Learn* (1999). Failures to achieve depth of learning are evident from the research on enduring misconceptions and from international assessments in science and mathematics. Although depth is difficult to define, in formal education contexts, it implies contact with

recognized deep principles of the disciplines (Bereiter, 2006; Brown & Campione, 1996). It also implies a progressive process, using the understandings gained from inquiry to formulate new problems and questions that could not have been formulated before (Bereiter & Scardamalia, 1993; Hakkarainen & Sintonen, 2002).

2. ***Discourse.*** We agree with Brown and Campione (1996) that discourse is central to knowledge advancement. It is, of course, the primary way of sharing knowledge and resolving differences, but its importance is more fundamental than that. One way of putting it is that first-hand experience, through experimentation, observation, and the like, as well as reading and browsing the Web, provide information, not knowledge. Converting such information into knowledge is a reflective process that is fundamentally dialogic. Dialogue with oneself is a possibility, but, especially in schools, interpersonal dialogue is the only practical way of processing information into knowledge. And not all forms of dialogue will do. Below, we turn our attention to dialogue particularly conducive to knowledge advancement.
3. ***Higher levels of agency.*** This implies something beyond students enjoying the right to choose or plan their own activities, enter into learning contracts, and other well-recognized forms of classroom democracy. It implies turning over to the students parts of the educational process that are normally reserved for the teacher, even in so-called learner-centered classrooms (Bereiter & Scardamalia, 1987; Scardamalia & Bereiter, 1991). This implies a high level of metacognitive engagement (Brown & Campione, 1996). Beyond that, what we have defined as *epistemic agency* entails students' taking responsibility for the advancement not only of their personal knowledge but that of the classroom community as a whole (Scardamalia, 2002).
4. ***Collaboration.*** Collaboration has become something of a mantra for Knowledge Age education. It appears everywhere in curriculum standards and guidelines and in the writings of business pundits. And of course it is institutionalized in "Computer Supported Collaborative Learning," an avant-garde community of technology developers and users. Perhaps the most notable shift in instructional psychology during the last quarter of the 20th century was the shift from focus on individual cognitive strategies to focus on community, culture, and collaboration. An older idea, cooperative learning, retained the individualistic focus as far as outcomes were concerned: it involved students working together to achieve individual learning objectives. Among Learning Scientists, collaboration is conceived of as extending beyond cooperative learning and also beyond collaboration in concrete tasks to collaboration in the pursuit of shared epistemic objectives: hence, "collaborative inquiry" (Suthers, Toth, & Weiner, 1997), "distributed expertise" (Brown, Ash, Rutherford, Nakagawa, Gordon, & Campione, 1993), and "collective cognitive responsibility for the advancement of knowledge" (Scardamalia, 2002).

Software can be found that undermines or at least fails to support these principles. Presentation software and "mind mapping" tools encourage reduction of a complex topic to phrases and labels. The default structure of PowerPoint slides is hierarchical decomposition into lists and sublists—not likely to be the best way to guide deep inquiry. The typical "mind map" is just a hierarchical list presented in a different format. It has been reported that a warning about the danger of insulation coming loose was contained in a slide presentation to NASA executives before the Challenger disaster, but it occurred far down in a list and was accordingly ignored. Software to guide inquiry projects can micromanage the process, reducing students' input to little more than filling in blanks. Creative knowledge work, which can move in unpredictable directions, has proved difficult to support with software. Collaborative writing software and wikis facilitate local revisions, additions, and deletions, but offer little encouragement for global rethinking and revision. But what would technology be like that supported the four principles? That is the question we pursue in the remainder of this article.

In the following sections we take up the principles in order, first providing a general discussion of their design implications and of the common technological approaches to them, then explaining how we addressed these principles in the design of Knowledge Forum® and its predecessor, CSILE (Computer Supported Intentional Learning Environment). The heart of CSILE/Knowledge Forum is a multimedia community knowledge base. In the form of notes, participants contribute theories, working models, plans, evidence, reference material, and so forth, to this shared space. The software provides knowledge-building supports both in the creation of notes and in the ways they can be displayed, linked, and made objects of further work. Revisions, elaborations, and reorganizations over time provide a record of group advances, like the accumulation of research advances in a scholarly discipline.

Depth of Learning: Representing and Working with the Big Ideas

Engagement with deep ideas as objects of inquiry is by no means easy to accomplish. Everyone thinks

about the world, but not everyone thinks about ideas about the world. The difference may be illustrated with one of the really big ideas, natural selection. When it enters into school discourse, it usually represents a belief about evolution. It vies with Lamarkism and creationism, frequently losing the contest in the minds of the students. This is thinking about the world—about the diversity of species, about biological adaptation, and about what actually happened in the distant past. But natural selection is an extraordinarily powerful idea in its own right, by no means limited to theorizing about the origin of species. It figures in explanations of drug-resistant germs and insecticide-resistant insects, the functioning of the immune system, knowledge evolution and diffusion, learning and creativity. A focus on the idea and on what it is good for, its strengths and limitations, would constitute quite a different curriculum element from the standard topical unit.

Focusing on ideas rather than generic topics also calls for a different kind of technology from the topical unit. Web search engines, encyclopedias, and book indexes are all suited to finding information on generic topics but are unhandy for tracking down explanations and underlying principles. Hierarchical decomposition into subtopics is the dominant structural concept throughout, and the "ontologies" that figure in Web 3.0 designs generally perpetuate this structure. A search engine for "thoughts" would need to go beyond finding documents that address the topics you are thinking about and find instances of thinking along the same or divergent or opposing lines. For such purposes, many people are reportedly finding the social networking supports of Web 2.0 more useful.

This suggests that if you are looking for complex information, it may be easier to find a person who has that information than to find it by searching documents. Within classrooms or other relatively small interacting groups, however, the problem is not so much idea search as idea fore-grounding and idea development over time. For these purposes, *dialogue* support becomes the key—as it has been since the time of Socrates.

Making ideas objects of inquiry means treating them as real things in the Popperian sense (Popper, 1972): that is, treating them as products of intentional activity which, though immaterial, enjoy existence in their own right, apart from the people who happen to believe or be thinking about them. "Conceptual artifacts" is the term we prefer to Popper's "objective knowledge" (Bereiter, 2002). What fundamentally sets conceptual artifacts apart from other artifacts is the logical relations that may obtain among them. One idea may imply, contradict, represent a special case or a generalization of another, and so on—literal relations that are to be found only figuratively among other kinds of artifacts.

Software intended for work with ideas should, accordingly, provide ways of representing and working with these logical relations. Concept nets are a popular way of representing part-whole relations, causal relations, implicative relations, and so on. Software is available that facilitates producing box-and-link diagrams, preserving the links as boxes are shifted around. A sizeable literature has grown up around the educational use of such diagrams. Certainly one important part of concept learning, especially in science, is learning how concepts are interrelated, and there is evidence that judicious work with concept nets can accomplish this (Jonassen, Reeves, Hong, Harvey, & Peers, 1997). However, there is more to ideas than their interrelationships. The philosopher Mario Bunge (1977–1979) said of theories that they can be variously treated as "ideal objects, systems of changeable meaning and truth value, growing bodies of knowledge, or prescriptions for doing things." Of particular importance in education is the explanatory role of concepts, theories, and the like. As Popper (1962) urged, the first thing you need to understand about a theory is the problem it is intended to solve. Concept nets do not convey what the whole network of concepts is for nor do they provide a very rich account of what any particular concept is for. And they are relatively useless for comparing one idea or theory with another. This is not to take away from the valuable role they do play, but it does suggest that many educators have been oversold—especially on so-called "mind maps" that link concepts without identifying the relationships.

In Knowledge Forum we provide open and versatile means for representing higher-level organizations of ideas. A "view" in Knowledge Forum provides a graphical background upon which individual notes can be arranged in any way. The background can be anything the designers (who are typically the students themselves) create: a scene, a set of categories, a narrative sequence—or, for that matter, a concept net. In particular, a view can represent graphically the big ideas that frame an inquiry. Views can be linked to other views and can be subsumed by still higher-level views. A particular note can appear in more than one view. Thus, multiple forms of representation are possible, providing different perspectives on the big ideas.

Knowledge-Building Discourse

Technology to support educative dialogue may be divided into two types: discussion software, for posting and responding to messages, and software designed to give some structure to discourse. The former is by far the most widely used, existing sometimes as a free-standing "forum" and sometimes as an add-on to a different kind of software, which may be a course delivery system, a game, a simulation, a document management system, or even an online newspaper column. The technology generally ranges from

primitive to extremely primitive. In extremely primitive versions, the messages appear one after another in chronological order and it is often a challenge to figure out what someone is talking about, because their message refers to an unidentified message some distance back in the queue. The merely primitive technology allows comments to be directly attached to the message being commented on, for comments on comments, and so on, to create a "thread," which usually appears on screen as an indented list. Anyone who has tried to carry on an intelligent discussion in such a medium will have been thwarted by the inability to link to notes in different threads or to make an entry that is superordinate to rather than subordinate to what is already there. Progress is inexorably downward in a branching hierarchy, which turns such vital operations as synthesis into a battle with the technology. What the technology does support very well is what it was originally designed to support: brief question-answer and opinion-response exchanges. Its unmodified transition from Web forums devoted to people's problems laying floor tile to educational forums devoted to students' problems understanding Newton's Third Law stands as a prime illustration of consumers' uncritical acceptance of whatever meets standards of usability.

Unlike the message-based systems we have been discussing, technology designed to assist reflective discourse generally has some theoretical basis. There is, however, an interesting divergence. One kind of application, referred to earlier, mainly supports argumentation. The other kind mainly supports explanation-oriented discourse. In recent years researchers working in the argumentation tradition have expanded the concept to include "collaborative argumentation" and "arguing to learn" (Andriessen, Baker, & Suthers, 2003). However, both in terms of analysis and in terms of technological supports, argumentation still carries an emphasis on confrontation and persuasion, whereas explanation-oriented discourse emphasizes working together toward a shared creative goal—to achieve some level of what Thagard (1989) has termed "explanatory coherence."

Both controversy and collaborative explanation are important in disciplined knowledge building, of course. As Woodruff and Meyer (1997) argued, however, they occur in different phases of knowledge development and can involve different communities. Argumentation tends to characterize interchanges between large communities (such as scientific societies) and occurs after theories or claims have been developed to the point that differences are clear; collaborative, explanation-oriented interchanges tend to characterize knowledge work within local groups, such as laboratory teams, and plays its main role in creating new knowledge rather than in deciding among competing ideas. On this analysis, the school situation is one in which collaborative, explanation-oriented discourse is much more appropriate than argumentation (cf. Coleman, 1998; Coleman, Brown, & Rivkin, 1997), although flexible movement between both forms of discourse is needed for knowledge advancement.

Knowledge Forum has been designed as a general-purpose collaborative knowledge-building environment with a special emphasis on discourse. One of the original intentions in design of its predecessor, CSILE, was to change the flow of discourse in the classroom so that it did not all pass through the teacher (Scardamalia, Bereiter, McLean, Swallow, & Woodruff, 1989). This has meant walking the narrow path referred to earlier, between providing too little structure and too much and enabling the teacher to exert positive influence without micromanaging the discourse. Thus, Knowledge Forum provides "scaffolds" (phrases indicating type of idea or contribution) but instead of requiring them to be used—and even requiring them to be used in a certain order—as other collaborative environments do, we made them optional, modifiable, but attractive as labor-saving devices (clicking on a scaffold pops it as highlighted text into the note being composed, thus saving on typing). Graphics, video notes, and other means of representing ideas can be brought into Knowledge Forum notes, thus expanding the discourse possibilities beyond those afforded by written text. Scaffolds are modifiable. Although a set of theory-building supports ("My theory…," "This theory does not explain…," "A better theory…," and so forth) has proved remarkably versatile in its applicability to different knowledge-building efforts, some teachers have used scaffolds designed to support argumentation (they lend themselves nicely to Toulmin's model) and such specialized tasks as medical diagnosis. Students, once they become immersed in knowledge building, will sometimes suggest scaffold revisions to reflect their growing epistemic agency.

Online discussions are often looked on as pale substitutes for face-to-face discourse, and it is surely true that they lack the vigor and multi-level character that gesture and vocal expression give to conversation. Rather than struggling to achieve closer emulation of face-to-face discourse, however, we have tried in Knowledge Forum to capitalize on the advantages that technology offers: the ability to focus on ideas rather than on the speaker, the ability to revise and undo, the ability to connect anything with anything and to overcome chronological sequence in doing so, the ability to create alternative organizations, the ability of one contribution to exist in different contexts, the ability to produce a synthesis of existing discourse elements, the ability to represent metadiscourse so that it is connected with but not muddled with the basic discourse (cf. Suthers, 2005). There is a great deal of

room here for invention, experimentation, and theorizing, which opens up once dialogue is viewed as an interaction among ideas and not solely or even primarily as an interaction among speakers.

Higher Levels of Agency: Kid-Level Knowledge Management

To consider "agency" as it relates to educational environments, we need to distinguish classrooms organized around activities from classrooms organized around ideas. There are, of course, other things classroom life can be organized around, but classrooms purported to take a constructivist approach can be fairly well covered by these two types of organization, with organization around activities being by far the most common. When classroom life is organized around activities, "agency" usually has a clear and easily specified meaning. It means the extent of autonomy students have in the choice, design, and management of activities. Where the activity is building things out of LegoLogo, for instance, one can find some classrooms in which the students have virtually no agency: cards accompanying the product specify step-by-step procedures for building various interesting devices, and the students slavishly follow those procedures. But there are other classrooms in which the students produce their own designs and manage collaborations themselves. (That both of these approaches should be called "constructivist" or "constructionist" seems to us to make a mockery of these terms.)

When classroom work is organized around ideas, "agency" takes on a different and less easily specifiable meaning. Relevant considerations are (a) the extent to which students' own ideas are given prominence, (b) the extent to which students take responsibility for improving their ideas and those of their peers, (c) the extent to which students are responsible for seeking out information (experimental, authoritative, etc.) needed to improve their ideas, (d) the extent to which students are responsible for connecting their work to the knowledge objectives set forth in official guidelines and standards, and (e) the extent to which organization and management of the whole idea-generating and idea-improvement process are in the hands of the students. Technology can support all these aspects of epistemic agency. Details can be found in Scardamalia (2002) and Scardamalia (2003). Here we will offer just one example: Knowledge Forum views, as described in an earlier section, require management. If a large number of notes are placed in a view, if their arrangement is left to individual whim, and if the graphical background is merely decorative rather than conceptually useful, the result can be distressing clutter. Several teachers have turned the management of each view over to a small committee of students. The teacher encourages them to attend not only to neatness and order but also to designing and managing the view so as to promote knowledge advancement. Students tend to take this role seriously; recorded discussions show them arguing about what to do with redundant notes and how to advance collective goals without trampling over individual sensitivities. This is authentic knowledge management, comparable to what goes on in the business world. It additionally encourages meta-discourse: reviewing ideas, "rising above" first efforts, and creating increasingly coherent conceptual frameworks for knowledge advances.

Supporting the Ethos of a Scholarly Community

Scholarly and scientific communities have evolved certain social forms that help to maintain the delicate balance between individual interests (tenure, recognition, etc.) and collective interests in advancing the state of knowledge. Educational technology tends to err in putting most of the emphasis on individual interests, perhaps reflecting a belief that youthful egos require exceptional nurturance. Supportive procedures range from miniature portraits adorning student contributions in a discussion forum to the full-scale creation of personal blogs or Web pages for every student, containing whatever the students care to display about themselves. Scholarly communities find more subtle ways to satisfy the ego-needs of members, ways that advance rather than deflect collective knowledge-advancement. Among these are citation and reference, humane peer review, and (to borrow a term from the business community) "incubation."

Citation and Reference

Scholars acknowledge and reference their sources, according to rigid formulas that vary from discipline to discipline. If they fail to do so, they too are liable to accusations of plagiarism. Referencing is tedious business, lightened by bibliographic software. In Knowledge Forum we have tried to lighten the burden even more, at least when it comes to citing information from other notes in the database. A note or a highlighted excerpt can be dragged into another note. There it appears in a distinctive font and a bibliographic reference is automatically generated. Future versions of Knowledge Forum are expected to extend this function to material copied from other sources, including the Web. The goal is to create a bias favorable to a reference-and-contribute approach to the use of authoritative sources, rather than the copy-delete approach that Brown and Day (1983) identified with immature writers.

Humane Peer Review

Peer review, as applied to publication, awarding of grants, and many other decision points in scholarly life,

is generally discussed in terms of quality control. Like democracy, it is recognized to have many faults but is judged to be better than the alternatives. Less generally recognized are the lengths scholarly communities go to maintain a sense of fairness, to ease the pain of rejection, and to use the peer review process constructively, as a form of mentorship. Quality control is highly dependent on the general state of development of the scholarly community, which raises question about the extent to which peer review among students will suffice. Furthermore, students will not have been schooled in the etiquette of peer review. We have worked in schools where sarcasm and put-downs were a normal part of both online and offline discourse.

Technology cannot, of course, make subject-matter experts out of novices or induce constructive criticism. Those are jobs for the whole educational program. In modest ways it can assist. In Knowledge Forum the main way this is done is through scaffolds and other devices that focus attention on ideas and minimize tendencies toward *ad hominem* judgment. Our own feeling is that in a healthy classroom there is little danger of personality and sociality getting lost; what's needed, rather, is a compensating bias toward treating ideas as having a life of their own. The desirable balance is illustrated in one extended discourse on growth, in which a student advanced a fanciful notion about cross-breeding plants and animals. The idea aroused considerable interest but was subjected to a devastating though polite critique by one class member. To this, the original author responded, "Geeeze Mike, I like all your comments, but it was just a theory!" (Bereiter, Scardamalia, Cassells, & Hewitt, 1997).

Incubation

To help new businesses get started, for-profit and not-for-profit institutions have been established that are called "incubators." Here the novice entrepreneur can take advantage of an existing well-equipped infrastructure, be shielded from many of the concerns that normally beset a business, and sometimes receive advice, training, and mentorship. Knowledge creation needs incubation in this sense, too, as well as in the more familiar sense of having time for ideas to mature before emerging from the shell.

In the sciences, publicly supported research laboratories almost always have an incubator function. Doing a post-doctorate in one of the laboratories has become almost an essential stepping-stone to a high-status academic position. But what would an incubator be like for earlier stages of educational development? An incubator for schools needs to be an environment in which ideas can develop with freedom from premature judgment but without being isolated from external sources of ideas and information. So again there is a question of balance. In classrooms using Knowledge Forum we have seen examples of imbalance in either direction. We have seen cases in which students' own ideas were allowed to proliferate without any effort to find out what the outside world knows and thinks. We have also seen instances in which early exposure to canonical knowledge squelches inquiry: "My theory was wrong. The correct explanation is...." The desirable balance depends on the subject matter and the knowledge students bring in with them. The design challenges are ones we have discussed elsewhere as "improvable ideas" and "constructive use of authoritative sources" (Scardamalia, 2002).

The ideal software environment will allow students to find their own shifting balance between too much outside information and too little, indulgence and criticism, mutual support and argument. Clearly an environment that micromanages and over-prescribes, the way many instructional environments do, does not encourage such self-organizing processes. Neither, however, do virtually structureless environments, such as blogs, which are gaining popularity for classroom use and which simply arrange contributions in chronological order. Our strategy in designing Knowledge Forum, as already suggested, is to make it possible for the students themselves to build structure as their need and capacity to envision it increase.

Conclusion

The design of educational technology ought to be seen as a part of instructional design rather than only as a source of tools for use in instruction. The Learning Sciences were founded on this belief, and many kinds of software have come out of research programs primarily concerned with educational rather than technological innovation. Nevertheless, most of the information and communication technology used in schools has its origins outside the Learning Sciences and tends to be assimilated to conventional practices rather than advancing the state of the art in education. In this article we examined capabilities and biases of learning technologies in light of four principles that have gained wide acceptance in the Learning Sciences: deep content knowledge, dialogue, agency, and collaboration. The following are some of the design characteristics that should create biases favorable to these principles in any online learning environment:

- In order to encourage the pursuit of **deep content knowledge**, provide means at any point in online work to move up to a more inclusive and integrative level of analysis, down to a more detailed level, or sideways to analogous ideas.
- In order to encourage **knowledge-building dialogue**, provide flexible supports that focus attention on ideational content rather than on utterance.

- In order to foster **higher levels of epistemic agency**, make it possible for students to function as "knowledge managers" or "knowledge enablers" (von Krogh, Ichijo, & Nonaka, 2000). That is, provide them with the means to assume responsibility not only for their individual contributions to knowledge in the classroom but for the overall progress of the class's knowledge-building efforts.
- In order to foster epistemically productive **collaboration** through online knowledge work, provide convenient and professional ways for students to cite and link to one another's work, thereby building a knowledge structure that represents the collective progress of the community rather than only the work of individual students or teams. □

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Enhancing Distance Learning for Today's Youth with Learner-Centered Principles

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Contributing Editor

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Providing a research-validated, evidence-based framework for designing effective distance learning experiences and environments is a current challenge to those interested in using this technology effectively with adolescents. This article offers the Learner-Centered Psychological Principles (LCPs) developed and disseminated by the American Psychological Association as a framework for developing design principles for distance learning for use in high schools. The argument is made and supported by research that today's youth are increasingly disengaged from traditional forms of instruction, and unless distance learning can offer an alternative paradigm that meets their learning needs, the potential of distance learning will not be realized. More importantly, this technology alone will not address the needs of today's youth to be prepared with 21st century skills for a global world. The authors describe how the LCPs can be used to define not only new design principles for distance learning but also a new educational paradigm.

Introduction

Purpose

The premise of this article is that the full potential of distance learning in all its forms and applications

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cannot be realized without attention to what is known about learning, motivation, development, and individual differences. This foundational knowledge base informs designers about the human learning capacities and learner needs that must be addressed in order for instruction in any form, including distance learning, to have its maximum effectiveness. As we develop the argument for this premise, we start by defining distance learning, examining its effectiveness, and exploring some research issues. We then describe the context of distance learning pertaining to today's youth and explore the knowledge base needed to realize the potential of distance learning as represented by the Learner-Centered Psychological Principles (APA, 1993, 1997). Finally, we describe an educational design for distance learning based on the research-validated Learner-Centered Psychological Principles (LCPs).

Rise of Distance Learning

There has been a sharp rise in distance learning in recent years. This tracks the rise in the Internet and increased online access in schools and private homes. Much of the emphasis in distance learning has been at the postsecondary levels as more colleges and universities have expanded their distance learning offerings (Spellings & Stroup, 2005). Many degree programs are completely available online now. As reported by Tallent-Runnels *et al*. (2006), 90% of postsecondary institutions were offering distance learning courses in 2000–2001. Nearly 20% of all higher education students were taking at least one online course in 2006. The growth rate for online enrollments is almost 10% annually—considerably higher than the 1.5% growth rate in the overall higher education population. As Allen and Seaman (2007) report, the number of postsecondary students taking an online course has grown sharply from 1.6 million students in 2002 to 3.5 million in 2006. Online enrollments which were 9.7% of total enrollments in 2002 grew to 19.8% of total enrollments in 2006. Whereas total postsecondary enrollment has grown by an average of 1.5% each year from 2002–2006, online enrollments have grown by an average of 21.9% annually during this time period.

There has also been an increase in distance learning courses at the K–12 level. The majority of school districts (63%) report having students enrolled in a distance learning course. School districts report expecting a 19% growth rate in students taking online courses. A recent report noted that 42 states now have significant online learning programs either supplemental or full-time and noted that over 40% of the states reported annual growth of over 25%, with half of these reporting growth of over 50% in the 2006–07 school year (Watson & Ryan, 2007). Over half the states have "virtual schools," more than twice the number of two years ago. Clearly, distance learning is an increasing option for today's high school, community college, and university students.

Distance Learning

Definition

Distance learning is often contrasted with face-to-face instruction in terms of whether the students and teacher are present in the same room (face-to-face instruction) or in different locations (distance learning). Definitions of distance learning typically share several common elements among those identified by Keegan (1988):

- physical separation of teacher and learner
- sponsored by an educational organization
- use of technical media to convey educational content
- provision of two-way communication
- possibility of occasional face-to-face meetings

In their definition of distance learning, Schlosser and Anderson (1997) stipulate that distance learning is a planned and systematic activity that includes presentation of teaching materials, supervision, and support of student learning. In their view, distance learning involves more than just separation of student and teacher. In many definitions of distance learning, specific reference is made to telecommunications that enable teachers and learners to interact over distance. For example, Garrison and Shale (1987) noted that the majority of communications between and among teachers and students is mediated through two-way communications media done continuously.

Role of Technology

Many recent definitions of distance learning include reference to use of information and communication technologies. There is a tendency to define distance learning as instruction delivered over the Internet, but the concept of distance learning is much broader and much older. Distinctions have been made between online education and distance education, with Larreamendy-Joerns and Leinhardt (2006) viewing online education as a special case of distance education. Distance education, on the other hand, is broadly defined to include various forms of study that are not under the continuous or immediate supervision of tutors but which benefit from the guidance of a tutorial experience. For purposes of this article, we consider distance learning to be formal instruction offered by an educational organization with the express purpose of teaching in which the teacher and students are separated by physical distance and interact through the use of some technology.

Effectiveness

There seems little question that distance learning has emerged as an important form of education at all levels. Tallent-Runnels *et al*. (2006) noted that in the

2001–2002 academic year 90% of public two-year institutions and 89% of public four-year institutions in the US offered distance learning courses. The National Center for Educational Statistics reported that in the 2002–2003 school year, 36% of public school districts offered courses using some form of distance learning. In a more recent survey of distance learning in rural high schools, Hannum *et al*. (2006) reported that 78% of rural schools used distance learning in the 2004–2005 academic year. Pethokoukis (2002) reported that enrollment in postsecondary online courses was increasing at 20% per year.

The increased reliance on distance learning to deliver courses to secondary and postsecondary students raises the question of the quality of distance learning. Several researchers have called for an examination of the quality of distance learning courses (Mariasingam & Hanna, 2006; Phipps & Merisotis, 1999) while others have compared the effectiveness of distance learning with traditional face-to-face courses (Bernard *et al.*, 2004; Joy & Garcia, 2000; McDonald, 2002; Russell, 2007). Perhaps the best evidence regarding the effectiveness of distance learning is found in several meta-analyses of the research on learning outcomes in distance learning.

In a large meta-analysis of the effects of distance learning at all levels, Bernard *et al*. (2004) report a small effect size of 0.0128 favoring distance learning in terms of learning achievement. They also found evidence that distance learning using asynchronous learning methods was superior in terms of learning outcomes to synchronous learning methods, although they indicated that K–12 students likely need the structure of synchronous learning. In another meta-analysis of the effects of distance learning on K–12 students, Cavanaugh *et al*. (2004) reviewed 116 effect sizes and reported an overall mean effect size of –0.028. They concluded that distance learning was as effective as traditional, face-to-face instruction for K–12 students, since the research noted only very small differences in the performance between students who participated in online programs and students who learned from traditional, face-to-face instruction.

Allen *et al*. (2004) reported an effect size of 0.048 in a meta-analysis of studies comparing distance learning with traditional instruction. This result is consistent with what Russell (2007) reported in his review of studies comparing forms of technology-based instruction with traditional face-to-face instruction and with the position taken by Clark (1994, 2003) that media alone do not produce learning gains. Likewise Hannum (2007) indicated that while computer and communications technologies offer many potential benefits for improving learning outcomes, he stated:

> *Only when we employ a systematic design process accompanied by superior pedagogy and lessons designed around empirically-validated learning principles will our use of computer technology in schools enhance learning outcomes.*

Research Issues

Although research supports the conclusion that students who learn through distance learning achieve equivalent learning outcomes to students in traditional face-to-face classes, distance learning students face barriers that limit their success (Muilenburg & Berge, 2005). One frequently mentioned barrier is the isolation many students in distance learning courses experience. Muilenburg and Berge (2005) found that distance learners reported lack of social interaction as their greatest barrier. Other barriers reported by students included administrator/instructor issues, lack of time and support, and motivation. It is not unusual to find high dropout rates in online courses. Roblyer (2006) indicated that dropout and failure rates for online courses can be as high as 60%–70%. While distance learning courses have been shown to be able to promote student achievement to roughly the same degree as traditional face-to-face courses, there is clearly room for improvement in distance learning courses in terms of supporting students so that they stay engaged, interact during the course, and do not drop out. Without such support, distance learning will fail to reach its potential.

When seeking to improve the quality of distance learning, we would do well to look beyond the technology itself, as the mere presence of technology has very small, often negligible, effects on learning outcomes. As many have noted, any learning gains resulting from technology-based instruction, including distance learning, will result from attention to the design of the learning environment, not the fact that technology was used (Clark, 1994; Hannum, 2007). Thus, real improvements in the effectiveness of technology-based instruction, such as distance learning, are unlikely without specific applications of well-documented research on what best supports learning for diverse learners, such as the incorporation of learner-centered principles and practices. Studies exploring such applications offer the promise of moving us beyond media comparisons to an understanding of the design principles that optimize student learning and motivation.

Context of Distance Learning

Youth of Today

Of importance in this discussion of the effectiveness of distance learning in high schools, then, is the issue of instructional quality and whether principles of effective teaching and learning are present in the distance learning environment. This requires a focus on

the context of the distance learning environment. Recent research confirms that the context must start with what we know about today's youth (e.g., Swanson, 2004). For many high school students, there is a lack of motivation toward academic activities, which Legault, Green-Demers, and Pelletier (2006) describe as amotivation (the absence of motivation). This class of behaviors can be attributed to low beliefs in one's ability to be successful, beliefs that the activity isn't worth the effort or energy required, the value students place on a task in terms of importance or relevance to the students, and features of the task that are perceived as boring or tedious. Given the prominence of this problem, Legualt *et al*. (2006) argue that academic attitudes and behaviors are strongly influenced by the social context of schools and particularly by the perceived support for autonomy, competence, and relatedness. In a series of studies, these authors looked at the different conditions that give rise to academic motivation. All four conditions were verified. The study also confirmed that if students believe they are neither smart nor capable of exerting effort, they are the most detached from school. Most important was teacher support of student competence by providing students with information and feedback about their academic abilities.

Youth are also becoming increasingly competent and knowledgeable about technology in all its various forms. Middle school students are flocking to the Web by the millions to build networks beyond classroom walls and to form communities around their passions and talents (Richardson, 2006; Wallis & Steptoe, 2006). They are displaying a range of creative and problem-solving skills in their use of technology tools. Clem and Simpson (2007) report that today's digital learners are different in many ways that require teachers and other educators working with these students to design new kinds of lessons that engage students with new technologies, including simulation-style games. Some of the important differences in digital learners include:

- they are proactive, autonomous learners who seek needed information from the environment to meet their own self-determined goals;
- they process information very quickly, deciding almost immediately whether or not something is relevant and useful;
- they relate first to graphics, then to text;
- they solve complex problems in collaborative learning groups;
- they are active participants in their own learning, doing first and asking questions later;
- they learn best through trial and error; and
- they are undeterred by failure and see it as a necessary learning experience that simply leads to a "restart."

We can see the power of creative capacity in students' responses to technology. Technology is clearly a tool of innovation that is underutilized and inequitably distributed in public schools. Most educators and many parents are aware of the gap between students' use and understanding of the latest digital technologies and how these technologies are used/not used in the schools. Prensky (2006) contends that schools are stuck in the 20th century, while students have rushed into the 21st century. Today's students were born into the digital age and are fluent in the digital language of computers, video games, and the Internet. Many even report learning to read from games rather than from teachers and school. Because students are empowered by technology in so many ways outside their schools, more than ever they need a meaningful voice in their own digital-age education (McCombs & Vakili, 2005).

Limitations of Distance Learning Courses

It is likely that the limitations of traditional education are exacerbated in distance learning courses that follow closely a traditional approach to instruction. When the familiar environment of the classroom and the physical presence of a teacher and classmates are absent, as they are in distance learning classes, some students struggle. Many students fail to complete distance learning courses, likely as a result of the lack of support from teachers and classmates. It is easier to fall behind in a distance learning course, especially when the pedagogy of the course involves little more than distributing online content to students who then complete individual assignments. Students working independently in distance learning courses may find themselves too far behind to catch up, so they drop the course. The research is clear that, regardless of context, the need for interpersonal relationships—both with teachers and peers—is crucial to optimum motivation and learning (Cornelius-White, 2007; Pianta, 1999; Wentzel, 2002).

The concept of education as transmission of content to students has been criticized as limiting the learning that takes place in traditional schools (Caine & Caine, 2006). This view of education as transmission of content to students is particularly ineffective in distance learning, because one-way transmission of content in distance learning courses reduces the possibility of engagement, interaction with peers and instructors, social construction of knowledge, feedback, and many other factors that produce learning (Marzano, 2005). While this teacher-centered view of instruction is a problem in traditional education and undoubtedly contributes to the familiar bell-shaped curve of learning outcomes, students experience even greater problems when interaction and collaboration are missing in distance learning courses.

Many distance learning courses suffer for reasons of weak or inappropriate pedagogy. Among these problems is a lack of sufficient and appropriate interactivity. It is not unusual to find a "modern" distance learning course using the latest technology to do little more than pass papers back and forth from teacher to student. That is, the teachers create a Website or use a content management system to post content for the student to read, view, or listen to. The student, in turn, goes through this content and then usually has to complete and send in send some assignment, perhaps a paper or a presentation, to the teacher to be graded. The technology may be thoroughly modern, but the underlying pedagogy is the simple correspondence instruction model of the World War II era. The only difference is that the Internet has replaced the Post Office as the vehicle for transmission. There is little interaction or engagement between teacher and learner, and even less engagement and interaction among students. The frequency of feedback to learners, and often the quality as well, was poor in the correspondence courses of the 1940s and 1950s. Our technologies today provide us with mechanisms to dramatically change this, yet our mindset and underlying pedagogical model keeps us from giving learners sufficient, timely feedback. In fact, the lack of feedback remains a major criticism of distance learning courses by students. We are now in an era when the availability of distance learning courses is high. The movement towards open educational resources promises to make even more content available to more learners, possibly altering the educational landscape (Breck, 2007). Still the importance of effective pedagogy remains a critical factor in the success of distance learning courses.

An element of effective pedagogy often missing in distance learning courses is support for learning (Bonk & Dennen, 1999; McCombs & Vakili, 2005). To be effective, students require more than just delivery of content, regardless of how well it is delivered. This concept of supporting learners is fundamental to the LCPs. Having someone physically present with the learner who knows the learner and fully understands the local context of the learning can be beneficial. Many distance learning courses ignore this human element. Undoubtedly this is why so many students drop out of distance learning courses and rate them poorly. They are expected to work in isolation without adequate support.

Achieving Success

Roblyer (2006) cited several success factors in her work. These success factors are:

- students are prepared for success by providing orientation programs to help them see what online learning will be like;
- teachers are prepared to effectively monitor and facilitate student work and discussions and to build a community of learners;
- course designs are flexible and interactive, giving students a variety of ways to show mastery of concepts and work in student-to-student interactive pairs or student-to-teacher interactions;
- teachers are monitored and supported to make sure they comply with program expectations and standards and provide a student-centered culture and have the opportunity to get together with peers to share best practices; and
- students are monitored and supported in a culture of collaboration that is tailored to individual student needs and focused on personal teacher-student interactions, also with a focus on student success.

The success factors identified by Roblyer point to the variety of influences on outcomes from online learning. In a study of factors related to success and satisfaction in an online learning course, Beffa-Negrini *et al.* (2002) found that several other factors are involved in online learning. These include learner satisfaction with the instructor and the quality of learner interactions with peers. Students through their behavior also exert some influence over the success of distance learning courses. Mandernach, Donnelli, and Dailey-Herbert (2006) examined predictors of success in online courses taught by 96 faculty members. They found that timely, active involvement in the course by students, effective student planning and time management, and student initiative or motivation were the three factors that best predicted student success in online courses. These and other findings, including the research-validated LCPs, indicate that factors other than academic preparation and study habits are important in fostering learning outcomes. We believe that attention to these factors specified by the LCPs can offset the dropout and failure problems associated with many distance learning experiences.

Learner-Centered Principles

Background

The Learner-Centered Psychological Principles (LCPs) follow from our understanding of learning and motivation as natural processes that occur when the conditions and context of learning are supportive of individual learner needs, capacities, experiences, and interests. The LCPs consist of 14 principles that are based on theory and research focused on human thinking, learning, motivation, and social processes and on personal and interpersonal relationships, beliefs, and perceptions that are affected by and/or supported by the educational system as a whole. The foundation of these research-validated LCPs provides a framework for designing distance learning environments and

Table 1. Learner-centered principles.

I. COGNITIVE AND METACOGNITIVE FACTORS

Principle 1: Nature of the learning process
The learning of complex subject matter is most effective when it is an intentional process of constructing meaning from information and experience.

Principle 2: Goals of the learning process
The successful learner, over time and with support and instructional guidance, can create meaningful, coherent representations of knowledge.

Principle 3: Construction of knowledge
The successful learner can link new information with existing knowledge in meaningful ways.

Principle 4: Strategic thinking
The successful learner can create and use a repertoire of thinking and reasoning strategies to achieve complex learning goals.

Principle 5: Thinking about thinking
Higher order strategies for selecting and monitoring mental operations facilitate creative and critical thinking.

Principle 6: Context of learning
Learning is influenced by environmental factors, including culture, technology, and instructional practices.

II. MOTIVATIONAL AND AFFECTIVE FACTORS

Principle 7: Motivational and emotional influences on learning
What and how much is learned are influenced by the learner's motivation. Motivation to learn, in turn, is influenced by the individual's emotional states, beliefs, interests and goals, and habits of thinking.

Principle 8: Intrinsic motivation to learn
The learner's creativity, higher order thinking, and natural curiosity all contribute to motivation to learn. Intrinsic motivation is stimulated by tasks of optimal novelty and difficulty, relevant to personal interests, and providing for personal choice and control.

Principle 9: Effects of motivation on effort
Acquisition of complex knowledge and skills requires extended learner effort and guided practice. Without learners' motivation to learn, the willingness to exert this effort is unlikely without coercion.

III. DEVELOPMENTAL AND SOCIAL FACTORS

Principle 10: Developmental influence on learning
As individuals develop, they encounter different opportunities and experience different constraints for learning. Learning is most effective when differential development within and across physical, intellectual, emotional, and social domains is taken into account.

Principle 11: Social influences on learning
Learning is influenced by social interactions, interpersonal relations, and communication with others.

IV. INDIVIDUAL DIFFERENCES FACTORS

Principle 12: Individual differences in learning
Learners have different strategies, approaches, and capabilities for learning that are a function of prior experience and heredity.

Principle 13: Learning and diversity
Learning is most effective when differences in learners' linguistic, cultural, and social backgrounds are taken into account.

Principle 14: Standards and assessment
Setting appropriately high and challenging standards and assessing the learner and learning progress—including diagnostic, process, and outcome assessment—are integral parts of the learning process.

practices that attend holistically and systemically to the needs of all learners. Along with others, such as Chou (2001), McLoughlin (2003), and McCombs and Vakili (2005), we believe that the best approach to improving the quality of distance learning lies in attending to these 14 LCPs.

Basis of the LCPs

The 14 LCPs were developed based on current theories of learning, including constructivism and social constructivism (APA, 1993, 1997). As such, they recognize that individual learners construct their own personally meaningful, goal-directed understanding of any content or experience to be learned. Each individual constructs meaning and understanding based on prior experiences, knowledge, and a host of other personal "filters." Although the social context and the knowledge imparted by others can have a major influence on what any one person learns and remembers, the information learned and its associated emotional context is uniquely a learner's own.

The research that is summarized in these principles derives from many fields, including psychology, education, sociology, and brain research. Research documentation can be found in Alexander & Murphy (1998); Kanfer & McCombs (2000); Lambert & McCombs (1998a, b); McCombs (2001, 2004); McCombs & Miller (2006); McCombs & Whisler (1997); and Perry and Weinstein (1999).

How the LCPs Address Learners and Learning

The 14 Learner-centered Principles are organized into four categories, or domains, as shown in Table 1, and define much of what is known about learning and learners as a result of research into both. Many of these principles are consistent with recent discoveries from psychology relating to positive youth development and prevention interventions (e.g., Blum, McNeely, & Rinehart, 2002; Catalano *et al.*, 2004; Libbey, 2004;

Seligman & Csikszentmihalyi, 2000).

Taken together, the four domains of the LCPs offer a holistic way of looking at how individual principles combine and interact to influence learners and learning. Research findings on which the LCPs are based confirm the four domains as follows (McCombs, 2004a; McCombs & Miller, 2006):

- *Cognitive and metacognitive*—what the intellectual capacities of learners are and how these capabilities facilitate the learning process.
- *Motivational and affective*—the roles played by motivation and emotions in learning.
- *Developmental and social*—the influence of various diverse aspects of learner development and the importance of interpersonal interactions in learning and change.
- *Individual differences*—how individual differences influence learning, how teachers, students, and administrators adapt to learning diversity, and how standards and assessment can best support individual differences in learners.

The LCPs apply to all learners, in and outside of school, young and old. Research underlying the LCPs confirms that learning is non-linear, recursive, continuous, complex, relational, and natural in humans. The evidence also shows that learning is enhanced in contexts where learners have supportive relationships, have a sense of ownership and control over the learning process, and can learn with and from each other in safe and trusting learning environments (McCombs, 2003, 2004b; McCombs & Whisler, 1997). Taken as a whole, the LCPs suggest a new framework or paradigm for distance learning.

Educational Design Based on Learner-Centered Principles

Background

When the 14 LCPs are applied to schools and classrooms, they address each of the four learning domains. The resulting learner-centered framework provides a systemic approach to content, context, assessment, and individual learner needs. In addition, basing educational practices on LCPs provides a means for transforming education. The role of teachers changes to that of co-learners and contributors to the social and interpersonal development of students. In partnership with their teachers, students become responsible for their own learning and participate equally in determining what, how, and when they learn. The learner-centered framework adds a constant reminder that the human element cannot be left out of even the most advanced educational systems, including technology-supported networked learning communities (cf. McCombs & Vakili, 2004).

Technology and Learner-Centered Principles

In spite of research supporting learner-centered practices, in much of the traditional K–20 educational system and reflected in responses of some schools to current high stakes accountability practices, learners can often feel isolated, and learning can often be characterized as simplistic and rote, with a focus on linear teaching of knowledge and skill standards. Distance learning, especially when it includes networked learning communities, shows great promise for changing this paradigm. Rapid changes in technological tools such as the Internet have now made it possible to support complex non-linear learning in ways that connect individual learners in meaningful dialogue, learning, and change across traditional boundaries of teachers, students, schools, classrooms, and individual communities. Online learning communities are fast becoming a reality that can transform thinking and practice beyond today's traditional models and boundaries of schools and educational systems.

In learner-centered distance learning environments, all people associated with the system are learners, whose status changes from novice to expert as tasks and goals change. The boundaries are limited only by imagination and need for access to expertise as learning needs and opportunities change in response to dynamic curriculum objectives. Content is digitally constructed and customized to meet individual learner needs, abilities, interests, goals, and other characteristics—including their dynamic and changing roles from novice to expert learners. Concepts such as "just-in-time learning" and "learning anytime, anywhere" describe the dynamic learning environment and online learning communities that revolve and evolve around inquiry-based learning tasks. With a shift in thinking about distance learning as transmission of content to thinking about it as engaging communities of learners, a different concept of learning emerges. The following characteristics are associated with distance learning that is more learner-centered:

- Practices integrate learning and motivational strategies to help students become self-directed learners.
- Instruction includes pre-assessments as well as ongoing assessments of students' interests, goals, background knowledge, and needs to better tailor practices to each individual and to better connect other learners in learning communities and/or communities of practice.
- Students are involved in co-creating instruction and all instructional experiences with their "teachers" and others in their learning communities.
- Practices address both community and individual personal needs.

- Curriculum is customized based on pre-assessment and ongoing assessment data.
- Curriculum is flexible and dynamic, with a minimum of structure, and that structure is based on student needs and/or developmental considerations.
- Concepts of "emergent" curricula allow individual learners and the community of learners to evolve and create curricula that includes dynamic and up-to-date information based on their needs.
- Curriculum goals are negotiated among all learners in the community.
- Curricula dynamically change with each new group of students, based on their needs, interests, goals, backgrounds, etc.
- Curricula accommodate teachers as learners and learners as teachers.
- Student-designed assessment and feedback loops are present at the individual and group levels; these are co-created with teachers, parents, and other stakeholders.
- Feedback is available for student review "on call" for self-evaluation of progress.
- Feedback is available for others to see when students are "ready" to submit work.
- Feedback provides ways for students to remediate and enrich their knowledge and skills in areas of choice as appropriate.
- Flexibility and adaptability are central design features.

In the context of distance learning, the learner-centered perspective contributes a balanced focus on the individual learner (the changing role of that learner from novice to expert, from learner to teacher), the learning process (the dynamic, self-directed, and often social nature of that process), and the learning context (the environment, climate, and community that supports the learner and the learning process). This balance is essential within the learner-centered framework.

Key Issues

The key issues in using distance learning to support learner-centered principles and practices are:

- building ways to meet learner needs for interpersonal relationships and connections;
- finding strategies that respond to individual differences and the diversity of learner needs, abilities, and interests;
- tailoring strategies to differing learner needs for personal control and choice; and
- assessing the efficacy of technology to meet diverse and emerging individual learner and learning community needs.

We believe that each of these issues may present a greater challenge in a distance learning environment as a result of the physical separation of learners from teachers.

Defining New Roles for Facilitators

Recognizing the importance of these issues to any form of learning, we believe the challenges they present can be best met in courses at the high school level when an adult serves as a facilitator who is physically present when students are participating in a distance learning course. Even though often distance learning courses taught online are asynchronous, many high schools actually schedule a daily class period for students who are taking distance learning courses so the students can do the work at that time for their distance learning courses. Asynchronous distance learning classes are favored by high schools, since there are inevitable scheduling conflicts in synchronous distance learning courses. Not only might schools be located in different time zones, they also might start their periods at different times. The first period might be 7:45 in one school, 8:00 in another, and 8:15 in yet another school. This would be difficult to accommodate in a synchronous course offered to these three schools. However if the schools participate in an asynchronous class, each schools could have students 'take' the class during the school day at any time they wished. During this period the students, who may be working on several different distance learning courses, meet in a room with a facilitator who oversees them and provides adult supervision for this period. For the most part, each student works independently on his or her course during this period. In a sense it is more like a study hall than like a regular class.

Since these are distance learning courses, the other students taking the same class may be scattered across the state or country and may complete their work, including communicating with the teacher and other students, at different times. What these distance learning courses provide is a way for high schools to offer courses they otherwise might not be able to offer. For example, a high school may not have a teacher qualified to teach a certain course, such as an advanced placement math, or a special science or English course. A school might not have a sufficient number of students who are interested in and ready for a certain course. Perhaps they only have five or six students who want to take an advanced foreign language or science course. Even if this school had a teacher qualified to offer this course, it would be prohibitively expensive to offer if for so few students. This is particularly an issue in rural high schools, which often have fewer students. In such situations where teachers are not available or the number of students for a particular course is low, distance learning can be a cost-effective way for high schools to offer a more comprehensive curriculum.

The person serving as facilitator may be a librarian, media specialist, assistant principal, coach, or other adult. It does not need to be a teacher, since the role of a facilitator is to support the learner and not to "teach" the content. The distance learning teacher does all the instructing. Often in these situations the facilitator does little more than ensure that the technology is working, the students are able to sign-on their courses, and the room is quiet and orderly. We believe that this approach represents a significant lost opportunity in distance learning courses. The facilitators are already employed and present in many high schools that offer distance learning courses. The additional time and expense of providing some training in using the LCPs is minimal. Even if distance learning courses had the very best of teachers, it would be difficult, if not impossible, for these teachers to implement fully the LCPs at a distance. We believe this requires having a facilitator at the local school in the room with the students to support their participation in the distance learning course. This support can take many forms, as is suggested by the LCPs. The facilitator can also serve as the eyes and ears of the distance learning teacher to provide him or her with much needed feedback about the students. The facilitator helps the learners engage with other learners online to forge stronger relationships and connections while creating online learning communities that support their academic progress.

Our experience is that even with limited training in use of the Learner-Centered Principles, the facilitators can be instrumental in implementing LCPs at the local level and thus improve the quality of the overall learning experience. Facilitators can help support and scaffold the learning of their students, while finding ways to adapt the course content to the individual differences and needs of their learners. The facilitator can work to find that delicate balance between freedom and control that is so vital to meaningful learning. This will help keep the learners from being overwhelmed by the requirements of a distance learning course while ensuring that they are not merely passive recipients of information transmitted over the Internet.

Facilitators can assist learners not only with any potential technical problem but also assist them in developing more sophisticated learning strategies and in enhancing their metacognitive awareness. The facilitator can also have an active role in alerting the teacher when problems are arising that the teacher may not be aware of due to his or her physical separation. When local facilitators have received some training and support in using the LCPs, we have found that their students are much less likely to drop out of the distance learning course, when compared to students who are in courses that the facilitators have not been trained in LCP use. In short, we believe that introducing the facilitators to the learner-centered principles will have positive effects over and beyond what is achieved by the distance learning teachers.

Summary

The learner-centered framework thus provides a foundation for transforming education and the role of distance learning. Many of those closely associated with the application and assessment of technology in education recognize that the current system must be transformed to accommodate the changing needs in our world, our technologies, and what students need to succeed and help shape the future (e.g., Levine, 2007; Stewart, 2007; Suarez-Orozco & Sattin, 2007). Technology can change the role of teachers to that of co-learners and contributors to the social and interpersonal development of students, counterbalancing the potential of computer technology to lead to personal and social isolation and alienation. Technology can further promote student connections to the community around them and to working in groups on real-world projects across time and space. Online delivery of education can then provide a means to centralize course development so that it achieves necessary economies of scale while linking intergenerational learners, teachers, and facilitators on a global scale. Rigorous research in all these areas is beginning to emerge (e.g., Duffy & Kirkley, 2004; Penuel & Riel, 2007) but more research needs to be done to systematically address the above issues and the critical features needed for effective distance learning. □

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Instructional Design as Design Problem Solving: An Iterative Process

David H. Jonassen
Contributing Editor

Design, including instructional design, is one of most complex and ill-structured kinds of problem solving. Historically, instructional design has been conceptualized as a linear set of phases (e.g., analysis, design, development, implementation, evaluation) that a designer progresses through. Silber (2007) has provided an alternative perspective on the instructional design process. He argues that instructional design, as it is practiced by experts, is moderately structured and heuristic, not procedural, comprised of thinking processes and guided by accepted principles. In this article, the author argues that design is ill-structured, and the primary thinking process that all designers (including experts and non-experts) employ is decision making that occurs in cycles. Decisions are driven less by accepted principles than they are by constraint satisfaction and beliefs, some of which are culturally accepted and others that are context specific. Unlike Silber, the author does not propose this process as a model of instructional design. Rather, he describes how design problems are typically solved and the implications of that process for designers and design education.

Introduction

Design is a ubiquitous professional activity. As Silber (2007) suggests, it is definitely a problem-solving process. In the fields of engineering, architecture, education and training, music, art, theater, writing, interior decorating, agriculture, computer science, marketing, and nearly every professional endeavor, many professionals design products, creations, processes, systems, activities, models, and a host of other outcomes. Most professionals are engaged in some form of design: writing software

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programs; designing a building; designing a new car or any of its 10,000 components, writing a concerto or musical score; writing a book, play, short story, article, poem; creating a marketing campaign for a new product; creating a new food product; designing a storefront display; decorating your home's interior or exterior; or decorating a cake. These and thousands of other jobs and tasks engage design problem solving.

Needless to say, these different kinds of design vary in process, assumptions, and methods. That is, there are different kinds of design problems. According to Brown and Chandrasekaran (1989), Class 1 design problems are open-ended, creative activities where the goals are ill-specified, and there is no effective design plans specifying the sequence of actions to take for producing a design model. Class 1 design problems are not routine, requiring a major invention or new product. They are very ill-structured. Class 2 problems use existing, well-developed design and decomposition plans (e.g., designing a new automobile). Class 3 designs are routine where design and decomposition plans are known as well as actions to deal with failures (e.g., writing a computer program).

Despite the long history of treating instructional design as Class 3 problems (Andrews & Goodson, 1980) that are most often summarized in the ADDIE (analysis-design-development-implementation-evaluation) model, I argue in this article that instructional design, as it is practiced, is a very open-ended and ill-structured Class 1 kind of problem. Given any learning problem for which an instructional design is required, there are an infinite number of possible instructional solutions, although only a subset of those solutions may be viable. Like most models of problem solving, ADDIE is an example of a phase mode model of problem solving, similar to the IDEAL Problem Solver (Bransford & Stein, 1984) that conceives of problem solving as a sequence of phases. Rather, I argue that design is most often accomplished in cycles of decisions.

Design problems, as presented, are among the most complex and ill-structured of all problems (Jonassen, 2000a). Given any learning problem, for example, there are potentially an infinite number of design solutions, which makes design problems ill-structured. Despite the apparent goal of finding an optimal solution within determined constraints, design problems usually have vaguely defined or unclear goals with many unstated constraints that must be discovered during the design process. Design problems have multiple solutions and multiple solution paths, despite the assumptions underlying ADDIE-based processes.

Perhaps the most vexing part of design problems is that they possess multiple criteria for evaluating solutions, and those criteria are often unknown and must also be discovered during the design process. Ultimately, the designer must please the client; however, the criteria for an acceptable design are usually unstated, which means that rather than optimizing a solution, designers most often seek to *satisfice* (Simon, 1955), a strategy that attempts to meet criteria for adequacy, rather than identifying an optimal solution. Design problems often require the designer to make judgments about the problem and defend them or express personal opinions or beliefs about the problem, so ill-structured problems are uniquely human interpersonal activities (Meacham & Emont, 1989).

Design Process

"Design is a quintessential cognitive task" (Goel & Pirolli, 1992, p. 395). The purpose of most designs is to construct an artifact that:

- Satisfies functional requirements.
- Meets implicit and explicit performance requirements.
- Satisfies implicit and explicit design criteria (style, simplicity, testability, maintainability, reusability, modularity, etc.).
- Satisfies restrictions or constraints on the design process itself (e.g., time, cost, tools available) (Mostow, 1985).

However, designing in different disciplines requires context-dependent cognitive skills, as I discuss next.

Domain Specificity of Design

Design problem solving is most often chronicled in the disciplines of engineering design, product design, architectural design, and instructional design. These activity systems are quite distinct, as are the nature of the design processes in which engineers, architects, and instructional designers engage. My goal in this article is to articulate what is common among these fields, that is, how are the design processes engaged by engineers, architects, and instructional designers similar?

Probably the key issue in design research is the domain-specificity of the process. Although Archer (1969, p. 76) argued that "the logical nature of the act of designing is largely independent of the character of the thing designed," many researchers argue that design is very dependent on the domain and context in which it occurs. Rowland (1993) argued that design is very much influenced by what it is that people design. In fact, many disciplines have articulated design processes that are specific to their domain. For example, product design (a major focus of design research), typically describes the product design process as:

1. Product definition
2. Market analysis
3. Prototype development
4. Product testing
5. Product introduction

Despite its ubiquity in teaching product design processes, this model of product design has been the focus of very little empirical research.

The largest body of research and writing on design comes from engineering design (e.g., Cross, 2000; Petroski, 1996; Vincenti, 1990). Within engineering domains, knowledge and reasoning also vary considerably.

Another domain where design processes have been researched is architectural design. The journal *Design Studies* is replete with qualitative studies of architectural design processes.

Design is also a fundamental process in the arts as well. Fine arts, graphic arts, music, and theater are filled with designers. How different are these processes? While design processes may appear similar, design problems are very domain- and context-specific. The domain knowledge, strategic decisions, and experiential understanding required to solve design problems is specific to the setting in which the design is being created.

Assumptions in Design Problem Solving

The following are assumptions that I make about the process of solving design problems. Instructional design is less about applying principles and heuristics (Silber, 2007) than it is about decision making. That is, design is an iterative process of decision making and model building. "The principal role of the designer…is to make decisions. Decisions help to bridge the gaps between idea and reality…, decisions serve as markers to identify the progression of the design from initiation to implementation to termination" (Marston & Mistree, 1997, p. 1). Clearly, decisions require thinking processes, as suggested by Silber, but decision making as a goal is far different than rule using. Many artists and architects refute this assumption, claiming that it is too reductive and ignores the roles of creativity and inspiration in design. Ultimately, however, even creative designers must make fundamental decisions about materials, functions, and a host of other design factors.

Most design decisions, especially instructional design decisions, are based on multiple constraints and constraint operations in the design space, not an agreed upon sets of rules and heuristics, as suggested by Silber (2007). Virtually all forms of analysis in instructional design are aimed at identifying and accommodating to various constraints. Design process consists totally of reasoning about constraints in order to determine parameter values (Brown & Chandrasekaran, 1989). Instructional designers use a variety of analysis methods, including needs assessment, task analysis, learner analysis, and contextual analysis to identify design constraints in the form of goals, objectives, contextual factors, and learner requirements that affect the design.

Gross (1986) introduced the idea of design as constraint exploration. Constraints are the formal and informal "rules, requirements, conventions, and principles that define the context of learning" (p. 10). Designing as a process of exploring and expressing constraints includes operations such as describing and structuring constraints and objectives, exploring fixes, resolving conflicts, and comparing alternatives (Gross, Ervin, Anderson, & Fleisher, 1988). Objectives are well established in the instructional design literature. Constraints in instructional design include:

- Technologies available/preferred/accessible
- Economic—funds and talent available
- Political/organizational mores and rules
- Environmental
- Learner characteristics
- Learning goals
- Physical context in which instruction delivered

Constraints are rarely, if ever, identified completely at the beginning of the design process, as implied by the ADDIE model. Rather, they emerge during each cycle in the design process. Designers make decisions based on the constraints as they emerge. What makes design an iterative process is simultaneous constraint satisfaction and constraint propagation. As constraints are identified and accommodated, new ones appear. As constraints are addressed during each cycle, the degrees of freedom decrease converging on a solution that satisfies the greatest number of constraints. Figure 1 conceives of the design process as a spiral of decisions. At the beginning of the design process, there are many degrees of freedom, that is, a relatively large number of options. As design decisions are made, those degrees of freedom are restricted by the decisions that have been made previously.

Design decisions are influenced not only by cognitive activity, but also by affective. As depicted in Figure 1, design decisions are influenced by beliefs that are often replete with personal, cultural, or organizational biases. Beliefs are conceptual frameworks that are amalgams of cognitive representations that are influenced by affective factors. Most artists and architects repeat signature designs that reflect their personal beliefs about form. Designs from different cultures appear quite different. For example, Finnish architecture is far more simple in its appearance than Portugese architecture. The cultures vary dramatically. Designs are also influenced by organizational norms. For example, software from Microsoft appears and functions similarly because of organizational beliefs. Biases are also epochal. Too often, instructional design decisions are most affected by unsubstantiated beliefs about the efficacy of the newest technology. For example, during the mid-1980s, interactive video solutions to learning problems were disproportionately chosen because that technology was the newest and most innovative. Early in the next decade, multimedia solutions were most commonly chosen. In the mid-1990s, Internet Websites became the standard solution. Nowadays, games have become the solution of choice. During each technology epoch, favored solutions to learning problems have been implemented in spite of constraints that may have contradicted them. Ask any instructional designer to justify all of the design decisions that were made, and the

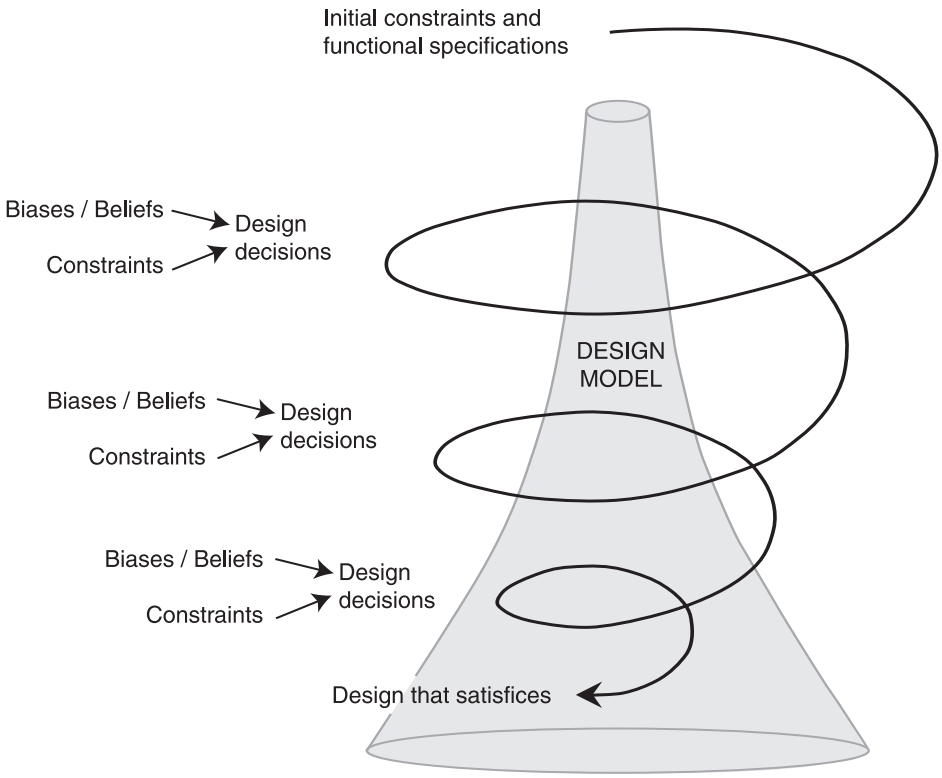

Figure 1. Iterative design model.

designer will not be able to provide empirical or rational justifications for many of the decisions.

Design is a process of model building. As design decisions are made, designers begin to construct an artifact or model that represents the proposed solution. Engineers and architects most often begin by creating a drawing. As decisions are made about the design, the design model expands as the decision-making contracts (see Figure 1). The initial drawing may be converted to a CAD drawing, a computational model, or a three-dimensional model. Instructional designers may begin by producing a storyboard and later converting that into a prototype of the learning environments. That is, as design decisions are made, degrees of freedom decrease (deceasing spiral in Figure 1) while the model becomes more elaborated. These models should reflect the functional requirements of the design as elaborated during the cycles of decisions.

The goal of design is satisficing, not optimization. Although designers talk about optimization, design solutions are seldom, if ever, the best solutions (Marston & Mistree, 1997). In reality, designers are usually unable to articulate what an optimal solution is.

Design Process

Many years of research and reflective instructional design experience has convinced me that instructional design is a cyclical process, rather than a sequence of phases. ADDIE and other phase models of instructional design imply that design is a relatively linear process, and that adaptations in designs occur only after implementation of a design that has been developed and implemented. Rather, beginning with the analysis phase, the design process iterates and changes with each cycle of design. Those design cycles are more micro-level than macro-level. I will illustrate my model of the instructional design process with a design problem that we are currently solving. Here is the context:

Recent reports show a need for roughly 90,000 new nuclear employees in the next 10 years. Loss of Radiation Protection personnel (RPs) at nuclear power plants will exceed 57% over the next five years, and over 1,000 replacement radiation protection workers will be needed. Radiation protection personnel serve in numerous facilities that regulate work with radioactive materials in nuclear power plants, radiopharmaceutical manufacturers, hospitals and research facilities, food irradiation facilities, and university research reactors. Their primary function is to protect other workers from radiation exposure, transport and monitor radioactive materials, and assess exposures to radiation workers. With the support of a Department of Labor grant, we have designed and are beginning to implement an Associates of Applied Science Degree in Nuclear Technology degree program to contribute toward meeting the energy industry's manpower needs for RPs and

to ensure that the demand for qualified, skilled workers is met throughout the U.S.

Design Cycles

Our design problem solving began identifying the tasks and analyzing the activity systems in which RPs perform. This was the first cycle of constraint analysis. We selected activity theory analysis because of the variety of contexts in which RPs work and the variegated effects of those contexts on the task. Rather than focusing on knowledge states, activity theory focuses on the activities in which people are engaged, the nature of the tools they use in those activities, the social and contextual relationships among the collaborators in those activities, the goals and intentions of those activities, and the objects or outcomes of those activities. We also tried to identify the socio-historic differences in the contexts in which RPs operate.

In addition to various rules, different radiation contexts also exhibit different cultures, based on the origins and experiences of the workers and the supervisory staff. For example, a great many workers in power plants come from the Navy nuclear program, so they bring a military perspective to their operations. Those socio-historical differences have significant impact on how jobs are perceived and conducted.

Finally, we attempted to identify any contradictions that were inherent in the systems, such as contradictions among regulations provided by different agencies, contradictions among the tasks that are performed, or contradictions among the roles that are assumed by different personnel (RPs, health physicists, operators, etc.). We believed that knowing how RPs work in different contexts is key to determining what they must know and how they must implement various methods. The first design decision was to organize the curriculum around work tasks rather than topics in nuclear physics, which was a much more difficult decision than it appears.

Based on our analysis, we identified a set of skills that RPs regularly perform, including performing airborne radioactivity surveys, performing surveys of material and equipment for unconditional release of radioactive sources, monitoring radiation fields, monitoring internal and external exposure of personnel to ionizing radiation, monitoring personnel for internal and external radioactive contamination, inventorying radioactive materials, performing radiological decontamination of areas and equipment, disposing of radioactive high-level and low-level waste materials, maintaining radioactive survey instruments, ensuring radiation detection instrument operability, calibrating radiation survey instruments, identifying and responding to abnormal and emergency radiological conditions, writing procedures to describe tasks, storing radioactive materials, preparing radioactive materials for transportation, providing radiological coverage of jobs and high-risk and low-risk activities (e.g., outages), and responding to emergencies. These became the instructional modules that students would work through.

During the next design cycle, we examined the methods most commonly used for nuclear training. The norm in the nuclear industry is topic-oriented curricula defined by learning objectives that emphasize recall of concepts. For example, we analyzed Department of Energy (DOE) and Institute of Nuclear Power Operations' (INPO) RP training objectives. Our analysis showed that, of all learning objectives, 60% focused on memorization, 18% on comprehension of ideas, 18% on application, 3% on analysis, and less then 1% on evaluation of knowledge. Our analysis of the kind of knowledge required by these objectives showed that 52% focused on factual knowledge, 21% on conceptual knowledge, 27% on procedural knowledge, and less than 1% on meta-cognitive knowledge. The culture of the industry emphasizes accountability that is operationalized by certification examinations that require learners to recall what they were taught. The second design decision was to orient the curriculum in terms of the thinking that RPs needed to do. In order to scaffold students' thinking processes, we developed a set of model questions that RPs should ask whenever they face a new radiation protection situation. Those questions are modeled for students in the Web-based environments in the form of an Ask System. The Ask System is found on the left side of the screen. It consists of questions that learners may ask about an authentic work task that is presented to the learners in the form of a story-based scenario.

In the third design cycle, we presented our design assumptions and decisions to members of the nuclear industry. The nuclear industry is probably the most highly regulated in the world, with extensive rules and guidelines provided by the Department of Energy, Nuclear Regulatory Commission, and numerous other task-specific agencies. Given the highly regulated nature of the industry, accountability is essential to these organizations, as well it should be. We decided that the courses had to appear to be structured in a relatively traditional way, so we constructed a six-course sequence, including Radiation Fundamentals (essential from an industry perspective), Radiological Monitoring, Radiation Dosimetry, Radioactive Materials Handling, Radiation Safety and Response, and a capstone course, Radiation Protection. While this structure was inconsistent with our beliefs, the decision was based on adoptability of the curriculum.

As we designed each course and presented our results to members of the nuclear power industry, additional constraints on our design were introduced. In one design cycle, we met with the teaching staff at the five different community colleges in which this curriculum is being implemented. Based on their beliefs and descriptions of students' skills and maturity, we had to add even more structure to the curriculum. Interestingly, each

new constraint that we addressed would often contradict constraints that were previously identified. These contradictions (according to activity theory) are common, but they make design decision making even more perplexing (Jonassen, 2000b).

Implications

What implications does this model have for preparing designers? The most important lesson is that successful design must address the constraints imposed by the context. Those constraints are addressed by a series of decisions. Teaching students a set of principles and heuristics, especially if done in the absence of context, will not help students learn to make decisions. ID models, including ADDIE, are based on principles that are applied uniformly in all contexts. That is why instructional design is so seldom successful. Whatever model of instructional design is used by designers, the design team should explicitly identify all of the decisions that are made in each cycle of the design process. For each design decision, designers should identify the constraints that are being addressed in the decision. Additionally, designers must articulate their rationale for the decision made by associating their choices with appropriate theories, empirical research, or previous experience. For each decision, designers should examine that decision in light of previous decisions in the design projects to ensure consistency in decision-making. If decisions contradict previous decisions, substantive reasons should be given. Finally, for each decision, designers should articulate personal and organizational beliefs and biases about design preferences. While this can be difficult, it can be supported by examining previous design for common characteristics. Although beliefs should not be completely ignored, they need to be compared with theory, research, or previous experience.

The next implication is to resist the temptation to jump to a final solution based on a little bit of analysis. Analysis is a process that pervades design, and it does not always occur in the front end. Rather, constraints emerge throughout the process and need to be addressed when they do emerge.

Summary

Instructional design, despite the numerous phase models that describe it, is most often a cyclical process of decision-making based upon constraint satisfaction that is modified by personal or corporate beliefs and biases. While analysis is essential to quality instructional design, constraints are rarely ever identified during the front-end analysis process. Rather, constraints are introduced at every step of the process. During each cycle, the designer makes decisions in order to satisfy new constraints that are introduced during that cycle. Those decisions are also affected by beliefs and biases that the designer or members of the design team hold regarding functionality and style of the design. This conception of design was illustrated by a large design project for training radiation protection technicians. □

Acknowledgment. My thinking about design has been significantly influenced by my conversations with Andy Gibbons, as well as some of his writing (e.g., Gibbons, 2003).

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Multi-User Virtual Environments for Education and Training? A Critical Review of *Second Life*

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Contributing Editor

Second Life is a popular example of an immersive, three-dimensional, virtual world. Inhabitants of *Second Life* often describe their experiences in-world as having great social presence. Certainly there is a good deal of potential for education and training to occur in multi-user virtual environments (MUVEs), if designed properly, especially when the goals involve role playing, simulation, and peer interaction. On the other hand, the author notes, the state-of-the-art of these virtual worlds is such that instructors should use caution, if for no other reason than the steep learning curve for students and teachers alike, in using MUVEs for education and training, when an easier to use alternative delivery system can be effective.

I get frustrated hearing people talk about how ***Second Life*** *isn't entertaining, or it's only useful for advertising to "freaks, furries, ageplay perverts and prank-loving adolescents."*

(Wagner, 2007)

Introduction

Networked, three-dimensional (3D), virtual worlds, such as *Second Life (SL)*, are quickly emerging as a favorite venue for social networking, collaboration, and even online learning. Is it all hype? Used for entertainment, professional, and educational purposes, millions of people live their fantasies and a "second life" in a metaverse where imagination is thought by some people to be the only limitation. In general, these worlds offer at least three things: (1) a 3D space or environment; (2) avatars that represent the individual user; and (3) interactive chat, either using text or voice or both (Dickey, 2005).

Approximately 200 colleges in the United States and a dozen other countries have a presence in *SL* (Kelton, 2007) and it is catching on in business as well, with companies such as Sun, Dell, British Petroleum, IBM, and Intel developing training in-world (Gronstedt, 2007). Since the inception of modern, multi-user virtual environments (MUVEs) less than a decade ago, why have people flocked to virtual worlds? There are 10 million residents (a uniquely named avatar with the right to log into SL) having signed on at least once to *SL* (*Second Life*, 2007), with 30,000 to 40,000 residents active at any one time. This article offers some thoughts on the advantages and barriers to learning and teaching in 3D, virtual worlds, and more specifically, in *Second Life*.

The Nature of *Second Life*

A user-created character, or avatar, is the user's in-world persona. One creates an identity to reflect an individual personality and interests (or several alternative avatars to capture several personalities and sets of interests that may be wanted). Creating such an identity is one of the important aspects that engage users, especially younger users, who find it similar to customizable social networking sites like *Facebook*.

Remember that everything found in *SL*'s landscape, including stores, businesses, houses, office buildings, campuses, island villas, night clubs, and jewelry, are all constructed by residents themselves—planners and artists who use great skills when designing and building (Cross, O'Driscoll, & Trondsen, 2007). Turn off the computer and the virtual world continues—it persists and endures.

Education is important in real life, so it ought to be supported and respected in-world as well. On the other hand, *SL* is probably more about *escaping* real life for most people than mimicking it. How realistic should a virtual world be? Dave Taylor (2007) asked, "…do people want to go through the same hassles in a virtual world that we do in the real world?" Still, in July, 2007, 26.74% of those active in *SL* were between 18 and 24 years of age, and 37.52% were between 25 and 34 years of age (Linden, 2007). With nearly 2/3 of the *SL* active users in the 18–34 age group, higher education should probably be interested.

Large, popular virtual worlds are immersive and quite engaging to most of the people involved in such environments. Through willing suspension of disbelief, immersion leads to the impression that one is participating in a realistic experience (Dede, 2005;

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Basics of *Second Life*

Second Life (SL) is a platform that extends the Internet into a 3D world. Philip Rosedale is the founder, master builder, and CEO of San Francisco-based Linden Lab. Launched in 2003, *SL* is a shared, virtual space, with users worldwide. Growing greatly in popularity, there are over 10 million *SL* residents at last official count, with 30,000 to 40,000 residents active in-world at any one time. A resident means that a person somewhere in the world has at least created an avatar and gone in-world. Of course, one user could, and often does, create more than one avatar.

Residents come together to interact, play, learn, conduct business, and communicate in a rich, authentic, immersive environment which is totally user owned and created. *SL* provides built-in scripting and building tools that allow residents to develop their own contexts, create customizable and individualized avatars, clothing, and pretty much any other objects or any experience that they can imagine (Kay & FitzGerald, 2007). The designers and builders also own the intellectual property for their creations.

An economy and currency (Linden Dollars or L$) is one thing that separates *SL* from other virtual worlds. L$ trade against US dollars through currency exchanges with the exchange rate fluctuating. This in-world economy allows residents to create goods and services, and buy and sell them to other residents. Premium members (paying customers) can also own land if they pay the Land Use Fee each month, in addition to the initial price of the land. There is an active second market in real estate in-world.

Several small and large businesses have a presence in *SL*. Large companies include: BP, IBM, Sun, MTV, BBC, Toyota, Dell, General Motors, Cisco, and Coca Cola. For multi-national retailers, direct sales to residents in-world is not the goal, since that doesn't make much sense except for a few products and services that residents buy, such as clothing usually handled by small, boutique enterprises. So, retailing in *SL* mainly takes on forms such as product placement, advertising, store layout design, and product testing. Additionally, *SL* could be used for market research, transporting, and feedback (SusiSpicoli, 2006).

Individual sign-up for *SL* is fairly straightforward and easy. Go to the *SL* homepage at *http://secondlife.com/* and find the "Sign Up Now" button. That will take you to a form to fill out and submit. There is a required orientation that takes place on Orientation Island, which covers navigation of your avatar, communication, and other aspects of the interface. The orientation must be completed before you can go to the mainland. SL requires a fairly powerful computer, and you should know that not all graphic cards are supported. Furthermore, to date there is not any technology to allow vision-impaired people to come in-world. So, before signing on, check the technical requirements at *https: secure-web2.secondlife.com/corporate/sysreqs.php* . If you don't, you may not be able to run the software effectively in-world.

In summary, *Second Life* simulates real life. It is a peer-to-peer, 3D, immersive, virtual world, where residents build relationships, design and build their own environment and objects, transact business, learn, and live. As is often the case in-world or in real life, you'll find most of *SL*'s hardships are in its possibilities. □

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MaryAnnCLT, 2007a). Virtual worlds can have elements of simulation and gaming (Ferdig, 2007), therefore if done well, they can be motivating to a lot of people. (*SL* is not a game, however, as it has no intrinsic goal-driven rules or intent to playing like a game does, but there are games within *SL*.)

Creating something using technology can be quite engaging. Add to this an economic infrastructure in *SL*, heretofore absent in virtual worlds, that can exchange real money to Linden Dollars and vice versa, which is often quite captivating to entrepreneurial interests (AlanInmc, 2006; Alvarez, 2006; Hof, 2006). Residents can buy and own land (with a paid account) and other objects they make, including the copyright, which permits them to sell their objects to other residents. It also allows *SL* to be used as a testing ground for business classes, albeit not without controversy (Au, 2006; *The Economist*, 2006). At this time, some people, dozens probably but not yet hundreds, earn full-time wages selling virtual clothing, jewelry, land, and various services in *Second Life* (*Current Events*, 2007).

Learning in *SL*

Virtual worlds are manifestations of the latest instructional technology tools, where a user's skin color, appearance, and beliefs do not matter very much. As importantly, persons with significant physical handicaps can often appear as capable, handsome, or beautiful as anyone else (Good, 2004). Conceptually, metaverses used for educational purposes are not new, dating back several millennia.

> From Plato's cave in *The Republic* (c. 360BC) to Ray Bradbury's gripping "The Veldt" (1951) to Vernor Vinge's *True Names* (1981) to Neal Stephenson's 1992 *Snow Crash* (where the term "metaverse" was reputedly coined), textual articulations of virtual worlds are numerous and varied, frequently expressing the desire to be free of a troublesome physical body that hinders unfettered, bodiless intelligence. (Willis, 2007)

Even the notion of virtual worlds is not new. A number of projects over the past decade, such as *The*

Sims, brought character-driven virtual environments out of the realms of fantasy, medicine, or the military into the more conventional educational and training environment (Kelton, 2007). While constructivist-, experiential-, exploratory-learning, gaming (Bartle, 2003, MaryAnnCLT, 2007b), social learning (Hayes, 2006), and role-playing (Bender, 2005) are used to explain much of the learning that takes place in SL (Dickey, 2005; LaChapelle, 2007), it suffers from the same barriers that teaching higher-order thinking involves in any environment—metaverse strategies, collaboration, and innovation by learners "does not target the core curriculum schools must spend most of their time focusing on" (Oishi, 2007). This is especially true for learners in high school.

Cultural Diversity

Certainly in-world is very *culturally diverse*, with people found from around the world, and avatars that expand culture to other levels (for instance, you may be seated in class next to a dragon or a furry). With such cultural diversity in an environment where anything is possible, the impossible sometimes happens. Discovery and exploration are encouraged. Experiential learning is encouraged. Persons may be exploring different genres, including gamers who are exploring shooting and destruction, or persons investigating altered identities, and various other alternative lifestyles that may seem quite strange, countercultural, or perverted to a particular student or instructor. It is important to remember that many people *live* in-world. While some are friendly, others are not; and while some avatars are predictable, others are unpredictable.

In such an immersive and flexible environment, a lot of time is needed to become oriented. The first place newbie residents (new members) go in *SL* is Orientation Island, where one must learn some basic skills before being allowed onto the "mainland" (Oishi, 2007). Still, it is safe to say that at least a dozen hours in-world is needed to feel at all comfortable for a newbie, and dozens of hours are needed by students and faculty members alike just to be able to navigate and communicate effectively.

Potential of Virtual Worlds for Education

While many higher education administrators and instructors are familiar with course management systems, fewer have experience with virtual worlds and may be resistant to them or doubt that they have any academic relevance (Graetz, 2006). Certainly, without a compelling reason to improve learning in ways that are not possible or easily done otherwise, it would be too much to ask each student and faculty member to spend such a large amount of time when it could be accomplished more efficiently some other way.

> On the other hand, there are imaginative possibilities in-world. Peter Yellowlees, a professor of psychiatry at the University of California, Davis, has been teaching about schizophrenia for 20 years, but says that he was never really able to explain to his students just how their patients suffer. So he went online…and entered *Second Life*…. Mr. Yellowlees created hallucinations. A resident might walk through a virtual hospital ward, and a picture on the wall would suddenly flash the word "shitface." The floor might fall away, leaving the person to walk on stepping stones above the clouds. An in-world television set would change from showing an actual speech by Bob Hawke, Australia's former prime minister, into Mr. Hawke shouting, "Go and kill yourself, you wretch!" A reflection in a mirror might have bleeding eyes and die. (*The Economist*, 2006)

Similarly, architects bring their students in-world where they can build things that would be too expensive or physically impossible to create in the real world (Lamb, 2006). In other words, simulations can be used as they have been for decades by professionals such as those in the military or surgeons, to practice in an environment that is less costly in terms of safety, money, and loss of life.

Not Utopia

One of the weakest aspects of *SL* is that after orientation, it is hard to know where to go or what to do. Once overcoming this, there are worthwhile areas to visit and more are being developed daily, even some educational sites. Yet it may take many dozens or hundreds of hours within the environment to gain the skills in scripting and the time for creating or building anything that is substantial, creative, or innovative.

A Darker Side

While the adult version of *SL* receives the most attention, there is a teens-only version, called *Teen Second Life* that requires residents to maintain a "PG" standard with "no strong vulgar language or expletives, no nudity or sexual content, and no depictions of sex or strong violence" (Oishi, 2007). Even in the adult version of *SL*, I think the media criticism of there being an overtly sexual nature in-world (Fass, 2007; Foster, 2007) is misguided or at least overblown unless one goes looking for such activity. Still, the issue deserves some thought, discussion, and reflection before encouraging students to go in-world. "The newbie is confronted with an array of cybersex areas, online casinos, and sleazy make-money-fast schemes" (Wagner, 2007).

Some people indicate a darker side to virtual worlds. Most of this falls in the categories of griefing, pranks, and spam. People engaged in these activities are usually those with too much time of their hands and too little brain power. It can go farther than this, however:

> *Second Life* relationships can be very intense. There are needy, vulnerable people online here who can be exploited easily, and there is no doubt that there is spillover from *SL* into their real lives as well. So, while coercion isn't the same as it is on the street, it can certainly happen here. Emotional abuse is just as effective as physical abuse, and there are people here who are experts at inflicting it. (Welles, 2007)

After 10 Hours In-World…

"How do I get there?" I asked. "You can tp, but it is easy just to fly, or you can walk down the beach." I thanked the young lady and she walked away. I was left thinking, I guess "tp" means teleport, but I don't know how. I had tried to fly only once before. Walking seemed simple enough.

It wasn't. Navigation is pretty hard at first in SL. In fact, *everything* is hard in *SL* the first time or two…or twelve.

Like almost everyone who signs on to *Second Life*, I spent hours creating and editing the appearance of my avatar. I really didn't have many preconceptions of what I should look like in *SL*, mainly because I didn't know what could be changed. It is safe to say that almost anything that can be imagined *can* be created. I simply ended up with a rather younger, thinner, taller, more muscular version of my rl (real life) self—in other words, not a very creative effort. But I did become attached to my in-world persona…er…me.

The shop-owner was completely in character. Dressed in renaissance clothing, she told me I could find he proper attire in the common area by looking for some crates so labeled. I found the area and the boxes, and selected the one that was labeled appropriately by gender. After figuring out how to take off my clothing, I then had to figure out how to get the new wardrobe on. Several times I ended up wearing the crate, rather than the clothing inside the crate. I thought of all those cartoons I watched as a kid with the man losing his money, usually gambling or in some other vice, and ended up wearing a barrel home. Sometimes and with some objects, you select "wear" to put them on your avatar, some things you have to uncrate first and then attach them to yourself, and some things…well…some things I haven't figured out how to wear. Nothing seems very intuitive in-world.

I am not a techie or programmer. I am not a gamer. If I had a background and familiarity with either or both of these skill sets, I could probably manage to get by in *SL* with a couple dozen hours of practice and play.

People told me…"once you search and find what interests you, a place or an event, just go to the tp button." "There is *no* teleport button," I retorted, as if it were their fault. After several hours of searching and being frustrated over the next couple days, I just gave up in exasperation.

Then my son came home from college and borrowed my laptop. I sat down after he was finished and *voilà*!—there was the teleport button at the bottom of the search box, just like everyone told me. Mark had changed the resolution on the screen, and solved the "problem."

And so it is with almost everything in *SL*.

Still even when I found some educational locations, they were essentially empty of content and people. I went to many and found myself isolated, frustrated, and disappointed—another couple of hours down the drain. □

The point here is that security on many levels is an issue and there is an "anything goes" mentality that is pervasive and in some ways encouraged in-world. How much of these behaviors is too much to submit students or employees to? Some critics find a seedy underbelly to virtual worlds and question whether they offer a safe learning environment for students (Bugeja, 2007; Grundy, 2007). As in real life, most of that which is harmful and hurtful in-world can be traced to deceit and dishonesty between people who seek to grow a relationship of some type with one another.

Work in Progress

In general, education is not known for innovation. (If you do not believe this, simply look at classrooms throughout the United States, which look pretty much as they did 125 years ago.)

> Surprisingly, though, the place where "anything is possible" bears a striking resemblance to the physical world where what is possible is determined by cultural, legal, temporal, and physical constraints, among others. *Second Life* visitors will find recognizable replicas of Yankee Stadium, Capitol Hill, and many college and university campuses, which often dutifully recreate classrooms and dorms, making virtual copies of their real-world counterparts. There are also virtual stores such as Sears, Circuit City, American Apparel, and Adidas. (Willis, 2007)

Before visionaries begin to use that emerging medium for something new and different, a new medium is often used first to replicate or improve that which already exists. For instance, much of what was first shot with motion picture cameras were plays, magic shows, and vaudeville performances (Dirks, 2007). So, it may simply be too early in the development of 3D virtual worlds to see what eventually will happen in this medium.

Conclusion

Generally, teachers and students in *SL* cannot accomplish anything that they could not accomplish in regular Websites. Plus, the 3D environment is much more difficult to use. The virtual world can be very frustrating when faced with the steep learning curve leading to effective navigation, communication, and collaboration (Foster, 2007). While there are no classes called off for inclement weather, there are a significant number of frustrating technical glitches, rendering issues, system sluggishness, and crashes (Evert, 2007).

It is entirely possible, perhaps probable, that as *SL* evolves and matures, the current drawbacks will become less pervasive and less important, or that the current version of *SL* is a stepping-stone to something else that will be less cumbersome. Regardless, until educators figure out what to do in 3D virtual environments that cannot be more easily done in real

life, such as what Yellowlees did with hallucinations, educators in these virtual metaverses are relying on novelty and social presence to carry the day. I doubt it is enough after the initial experimentation for either students or faculty. Still, it is too early to dismiss the potential, and worth seeking to understand education, teaching, and learning in emerging virtual worlds. □

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Learning and Knowledge Sharing Within Online Communities of Professionals

An Approach to the Evaluation of Virtual Community Environments

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Contributing Editor

This article discusses a possible approach to the evaluation of virtual community environments (VCE), intended as the integration of members, processes, and technologies characterizing a given community of professionals. In particular, as to the return on investment for VCE, the article supports the idea that tangible returns for the organization should not be considered as much as intangible ones, such as creativity, peer-to-peer learning, the ability to share knowledge, and the improvement in both organizational communication and problem-solving processes.

Introduction

Steve Denning (2000) underlines seven key issues in a Knowledge Management (KM) program:

- strategy of KM;
- organizing for KM;
- budget of KM;
- incentives for KM;
- professional communities of practice;
- technologies of KM;
- measurement of KM.

Given the aims of this article, particular attention will be paid to the fifth point, regarding professional communities of practice, specifically those based on the collaborative and intensive use of networked communication (Networked Communities of Professionals, NCP) (Trentin, 2001).

Although NCPs are usually considered entities arising spontaneously, this does not imply that organizations cannot make every effort to create favorable conditions for their birth and development, particularly when one wants to capitalize on their potentialities within the framework of a specific KM business program. This requires an organizational development that, on the one hand, allows NCPs to benefit from the attention given to them by the organization in which they are located, but, on the other hand, does not suffocate either their autonomy or operational and development dynamics.

A Key Problem: Evaluation of Effectiveness

Organizations intending to capitalize on the potentials of NCPs in favor of a company's specific KM program are willing to equip the communities with technological and economic resources. In view of this, though, in the medium/long term, they need to understand how much influence NCPs actually assert, in terms of effectiveness, on the KM program (Millen *et al.*, 2002).

This is a complex problem that cannot be tackled in the conventional way. The traditional approaches towards evaluation are actually not capable of appreciating creativity, peer-to-peer learning, the ability to share knowledge, etc., in other words, the factors which determine the creation of value within the community and the organization to which it belongs (Wenger *et al.*, 2002).

Hence, the organization, when setting out to evaluate the impact of an NCP on the company's KM program, must be prepared and willing to accept some compromises. For example, it should commit itself to non-traditional measures, or, in any case, not be based only on surveying tangible benefits. Besides, as Karl-Erik Sveiby (1997) remarks:

> *…If we measure the new with the tools of the old, we will not 'see' the new…Knowledge flows and intangible assets are essentially non-monetary. We need new proxies.*

Due to its level of complexity, the evaluation of an NCP's effectiveness continues to be an open issue also because it is subject to a large number of variables: specific business context, characteristics of the KM

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program to be developed, professional profiles of NCP members, networked technologies used to facilitate interactions within the professional communities, etc.

Therefore, it may be useful to understand which solutions have been adopted in the organizational experiences where the objective has been set up to address the specific problem.

For this reason, one of these experience will be used here as a case study to illustrate a possible approach to evaluating the effectiveness of the virtual environment built around a particular community: the community of professionals in Human Resources (HR) within the SanPaolo IMI banking group of Turin.

It should be clarified at once that the term Virtual Community Environment (VCE) is not intended here so much (or not only) as the technological environment used by the community to interact online, as rather (in a broader meaning) the integration of three elements considered the recipe of a KM program's success (Denning, 2000): community members, knowledge management/sharing processes, and technologies.

Research Background

For several years, the HR Division of the SanPaolo IMI Group of Turin has launched a series of programs aimed to develop the theme of professional communities intended as segments of a strategic company population for the development of internal know-how, the spread of culture and shared values, and the development of company business.

It is a case of initiatives tailored towards creating strong links between the organization's needs and the individuals' ability to determine and manage their own personal development autonomously, actively, and consciously.

GreenTeam-HR Community and Its Objectives

SanPaolo IMI Group began a specific KM program which, besides the use of 'conventional' KM systems, has decidedly focused on the driving force of already existing internal professional communities.

The HR professionals (around 500) were the first community involved in the program. It comprised people who, despite exercising the same profession, work in different company and geographic contexts, since they are located all over Italy. The development of this 'pilot' community, called *GreenTeam-HR*, has therefore had the aims to:

- enhance the efficiency of knowledge sharing and diffusion oriented toward endogenous company growth (Nonaka & Reinmölle, 1998);
- foster internal communication processes in relation to the specific demands of the professional role held;
- define and rationalize a coherent standard organizational model with which to address the KM theme throughout the Group;
- make information and documents accessible without intervening in the structure of pre-existing company information systems, but by placing a system alongside, capable of facilitating peer-to-peer knowledge sharing; and
- test the working models, methodologies, and technological solutions on a first pilot community (the HR community) that may also be transferred to the context of other communities in the very same Group.

Development of GreenTeam-HR

The community development was based on four key elements:

- *community-needs analysis* in order to develop the most suitable virtual environment favorable to company KM processes;
- *definition of the 'service model'* geared to the acquisition, development, systematization, and sharing of community knowledge (Berlin *et al.*, 1993);
- *'explicit' knowledge systematization and 'tacit' knowledge distillation*, that is, not only to focus on collecting and then structuring 'codified' and 'explicit' knowledge (Nonaka & Takeuchi, 1995), but also on sustaining the effort in consolidating, sharing, and developing 'implicit' or 'tacit' knowledge of the community; and
- *entrusting the running of the virtual environment to the same community*, playing on the strong involvement of its members in planning the model of use, development, and knowledge sharing.

GreenTeam-HR Portal

The reference network environment for the implementation of the project lies in the GreenTeam-HR Portal, which is a sub-section of the broader GreenVillage Portal designed for the company's internal communication throughout the SanPaolo IMI Group.

The portal, equipped to supply services for the community's knowledge sharing and development, is organized into both informative spaces (managed by an editorial staff) and networked interaction spaces (coordinated by facilitators).

The portal envisages three main interchange channels: *work, knowledge, make community* (see Figure 1).

The *work* channel provides a sort of 'toolkit' to carry out the typical occupational activities of the community. For this purpose, it has been structured into the following sections:

- Personnel Information System —contains the pro-

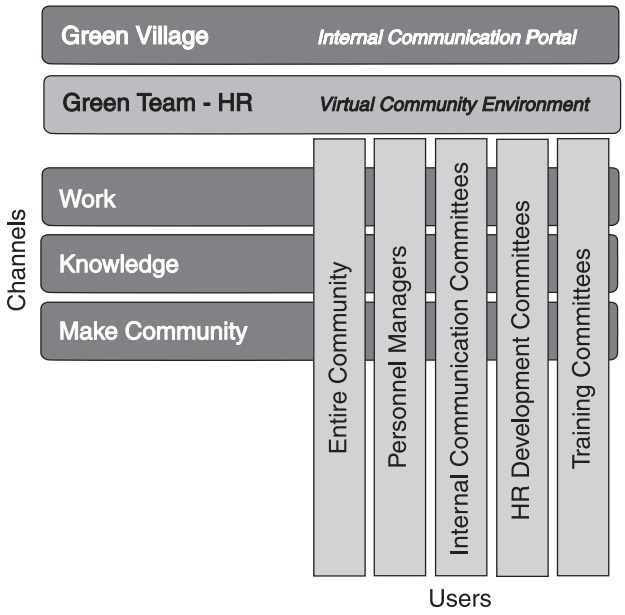

Figure 1. The logic structure of GreenTeam-HR (Battaglia & Salone, 2005).

cedures relating to the running and administration of HR; it is reserved for the professionals of the Department.

- Working Models—this area is set aside for collecting models and templates needed for the running of administrative activities by HR professionals.
- Job Posting—aims to meet supply and demand for qualified professional profiles within the Group. Once the demand for a particular profile on the Job Posting page is advertised, anyone interested can put themselves forward as candidate by directly contacting (via a direct link from the same Job Posting page) the heads of personnel who put in the request.
- Human Capital Value—is a sort of instrument panel to monitor key indicators used by the Human Capital Value system; this monitoring is oriented to estimate the contribution of HR and the processes linked to them, to business outcomes, and to create added value for the company.

The *knowledge* channel is the actual community repository, and it is therefore directed towards the collecting and cataloguing of explicit company knowledge to allow all members easy access.

Among the documents and data inside the system, it is possible to find laws, rules and circulars, events and training initiatives, business strategy and operation, guidelines, policies, HR methods and procedures, manuals, books, articles, surveys and benchmarks, conferences and seminars and events held in the HR community, links, case studies, etc.

Lastly, the *make community* channel aims to bring out personal knowledge rooted in the experience and actions of each individual, in the ideals, values, and emotions belonging to him/her. Since knowledge is an individual asset, it cannot be easily archived within the organization using traditional KM technologies, and so it may be difficult to communicate and share it. Therefore, the 'make community' channel sets out to help make knowledge explicit, by means some specific functions available to:

- circulate important news regarding community life through the weekly publication of a newsletter;
- update members about projects and initiatives involving HR personnel;
- present and/or rapidly find community members and their respective knowledge and skills by also using a transactive memory system (Jackson & Klobas, 2006);
- organize networked interactions in forums aimed at sharing innovative solutions adopted in their professional work and at collaborative problem-solving;
- conduct surveys by quickly consulting community members (even in anonymous way) on specific issues; and
- run blogs where actual online digital diaries are kept and may be accessed by all members, in order to report progress made by a workgroup or a sub-community.

As shown in Figure 1, the above three channels cross the entire HR community of professionals as well as its sub-community (personnel managers, internal communication committees, etc.). In relation to the thematic macro-areas identified by the three channels, the aim is to offer interaction spaces 'specialized' in the specific requirements of the single sub-communities.

Evaluation of Effectiveness of GreenTeam-HR

Once the GreenTeam-HR Portal had been implemented, its management structure set up, and a series of initiatives taken to launch it, then the monitoring methods and tools were determined to evaluate the effectiveness of what had been implemented.

Evaluation Method for VCE Effectiveness

The evaluation of the virtual environment effectiveness has been set out by taking into account two key aspects:

- frequency of VCE use by the potential users; and
- processes triggered within the VCE to access/request information, to discuss/analyze professional subjects with other members, and to provide new solutions and knowledge collaboratively.

Both of these two aspects should be taken into consideration, since individually they are unable to provide strong indications that the objectives, upon which the VCE was set up, are actually achieved.

In fact, high VCE attendance, alone, cannot be considered indicative of a smooth running of the professional community. The frequency of VCE use could primarily be aimed at accessing the community repository, or at reaching a wide audience to make requests. Here, the VCE may prove a useful resource for individual members, but not so for the community that is intended as an entity geared towards peer-to-peer collaboration.

The virtual space designed for the community can really become a breeding ground for new knowledge when networked collaborative learning processes are activated inside it, thereby favoring comparisons, search for solutions, and circulation of best practices. Although a collaborative process is not per se an adequate condition for the development of new personal knowledge, the mere fact that it takes place is, however, an important and necessary condition to claim that the NCP may potentially be a means for cognitive growth of its members.

Use of Survey Tools

A wide variety of tools may be employed in these cases to make the evaluation: interviewing participants, distributing questionnaires, organizing focus-groups, using observation protocols, storytelling, and analyzing cases which have involved both the whole community and individual members.

In the specific case of GreenTeam-HR, evaluation grids and questionnaires administered online were used and defined on the basis of a set of monitoring indicators grouped into five macro-categories, as reported in Table 1.

As one can observe, the first three categories refer to data found by analyzing both the traces (log files) produced automatically by the platform and the communicative/collaborative processes within the VCE.

With regard to the surveys relating to the remaining two categories (D and E), it was instead necessary to prepare questionnaires to distribute to each of the community members.

In view of the importance of the community members' opinions in order to evaluate the effectiveness of the VCE, we will now focus on what emerged from the data gathered by the questionnaire relating to point E in Table 1.

Data Emerging from Survey on Effectiveness of VCE

A year after the community was first set up, an evaluation of the VCE was carried out based on both the direct monitoring of activities on the GreenTeam-

Table 1. Monitoring indicators.

A	***Frequency of VCE use***	• typology, numerical consistence, and practice of the user; • access frequency to VCE by individual users; • number of exchanged messages in the different interaction areas.
B	***Typologies of VCE use***	• communication aims: access to documentary material, information requests, information forwarding, FAQ creation, self-help activities, etc.; • communication typology: one-to-one (requests to an expert, individual members, community manager, opinion leaders etc.), one-to-many (communications and/or requests to everyone), many-to-many (interaction in forum and/or workgroups).
C	***Collaborative processes activated in VCE***	• individual's degree of participation/contribution to interaction areas (forum and/or workgroups); • individual's quality of contributions to the interactions; • themes addressed in forums; • typologies of collaborative productions and their qualitative level.
D	***Support/ animation modality***	• support to the community by various key figures (number and quality of their contributions, their effectiveness, readiness to respond to direct questions or to manage critical situations, etc.); • stimulus, animation, and coordination of collaborative activities.
E	***Direct opinions of community members***	• approval regarding VCE's structuring and organization; • interest regarding the themes discussed and materials made available in community's repository; • professional usefulness of themes addressed; • penetration of use of VCE in working practice; • improvement in internal interpersonal communication; • speeding up problem-solving processes; • developments and improvements to be made to VCE.

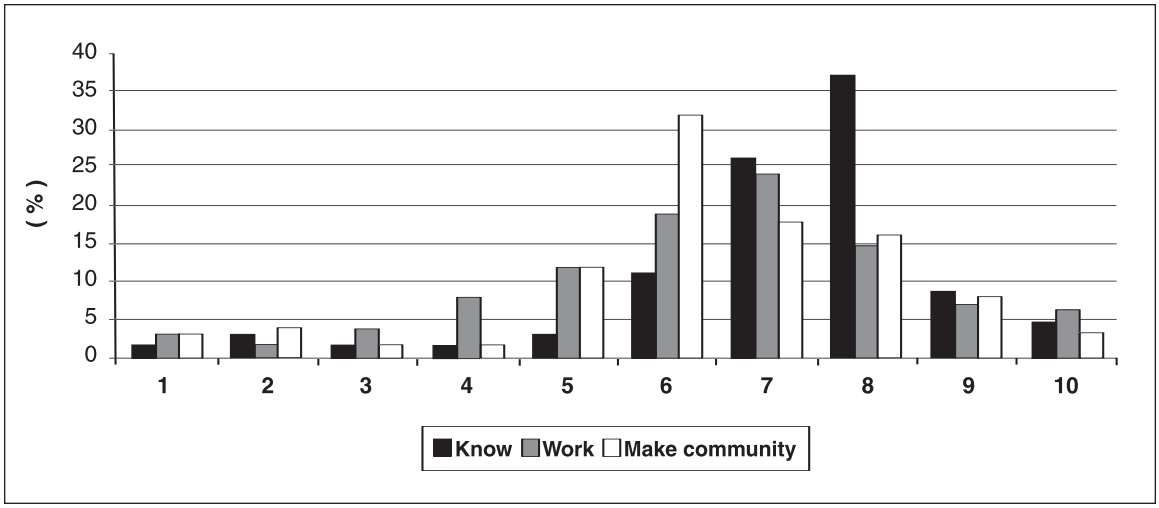

Figure 2. Evaluation of effectiveness of the channels in which GreenTeam-HR is structured.

HR portal and the administration of a questionnaire, that around 20% of members answered.

General Data on VCE Use

The findings have shown that 25% of community members access GreenTeam-HR once a day on average, while 26% claim they visit it just occasionally, and 22% several times a day. On the whole, about three-fourhs of those people who answered can be considered "regulars" in the use of the VCE.

As far as the most used functionality is concerned, it emerged that 84% access the VCE to consult community news, 43% to download documents, and 6% to contribute to the repository with their own material. Interpersonal communication is used by 11% of members to exchange information with their peers and by 5% to meet new people within the community. Only 8% use group messaging for theme discussions.

So, after the first year of activity, the trend still seems to be that of using the virtual space to access the repository and to find the right person to then establish personal interactions, largely via private messaging.

Effectiveness of VCE Structuring

Of the three main interaction channels in which GreenTeam-HR is structured, the 'knowledge' channel is what, as far as effectiveness is concerned, has obtained the highest evaluation (in a range of 1–10) (see Figure 2).

There is also a good evaluation of the 'make community' channel, the space devoted to social interaction, which plays a key role in enhancing trust among members of the community as well as the sense of actually belonging to it.

Interest in Themes Addressed

With regard to the themes proposed periodically on GreenTeam-HR, 68% of members declared finding them very interesting for their own professional practice, and 26% fairly interesting, whereas 6% find them hardly or the least bit interesting. This last fact may be related to the professional role of someone who answered and evidently considers the VCE as not being adequately equipped yet (for their specific needs) in terms of documents, information, and theme interaction spaces.

It should also be observed how, in view of a rather high percentage of those who consider the themes addressed in the forums stimulating and useful, 79% claimed to have never actively contributed to the discussion (a fact confirmed by analyzing the platform traces), even though they constantly read their colleagues' interactions.

This is not a positive factor, even though it was often found in the context of NCPs (Wenger *et al.*, 2002). Furthermore, GreenTeam-HR is a rather young community, which is still going through the initial stages that could be defined as 'cognitive,' mainly based on the active contribution of a small group of opinion leaders and senior members.

Professional Use of Themes Addressed

Regarding the usefulness of issues tackled in GreenTeam-HR, 55% answered that they have an immediate benefit of themes for their own professional practice. A smaller percentage (28%) considers them useful to refresh their knowledge on some important aspects of their profession, although there is the conviction of not being able to make direct use of them, at least in the short term. Instead, 11% regard the themes addressed as slightly useful for their everyday work, while 6% do not actually consider them important at all. Also in this case, just like the previous point (interest in themes addressed), this negative factor is related to the particular professional role of the people who answered.

Penetration of VCE Use in Working Practices

The interviewees were asked whether they believe GreenTeam-HR may become a working tool on the same level as other professional tools of daily use, and not just remain a complementary resource disconnected from the company portal.

Some 70% think that GreenTeam-HR should become an extra working tool and wish it were employed more in everyday working life. In this regard, it is interesting to note how 12% already consider it a working tool today, not just a communication, but also an operational tool. However, 14% were fairly skeptical about integrating it among the 'official' working tools. This not so much because they do not consider it useful, but rather out of the fear that a formal inclusion among company tools may result in it losing its peculiar characteristic as a tool for informal peer-to-peer communication and learning.

Improvement in Internal Communication

One of the elements which often weighs in favor of an investment on NCPs by the organization is their potential capability of improving internal interpersonal communication. This is not so much due to the technologies NCP use (often the same, at least as typology, as those used for formal company communication), as to the transversatility and optimization of communication flows favored by the dynamics of informal interaction among peers. In other words, what often convinces the top management is the opportunity to place the formal company communication channels (typically hierarchic) alongside the informal NCP communication channels (typically networked).

Regarding this possibility of integrating the two types of communication channels, 91% of those interviewed gave a favorable opinion, although with some reservations already mentioned in the previous point, that is, as long as GreenTeam-HR continues to keep its connotation of VCE completely informal.

Speeding Up Problem-Solving Processes

A further element which often arouses the interest of the organization in NCPs regards their potential to speed up the search for solutions to professional/company problems. In all, due to its characteristic of informality, communication among members of an NCP is not only faster but also amplified by the use of network technologies and therefore able to activate more effective individual and organizational problem-solving processes.

The GreenTeam-HR members were also asked to express their opinion about this. Compared to the previous point (improvement in communication), a certain skepticism was noticeable here. In other words, although 79% believe that the GreenTeam-HR is potentially useful to speed up the search for solutions and sharing of good practices, they are aware that such potentiality can be expressed only by acquiring a real community mentality. What can really make the difference is a cultural leap that heightens all the members' awareness of the need for active participation in community life. It is not limited to visiting the VCE merely whenever they require support to solve their own professional problems, but is extended to moments when they can provide and/or search collaboratively for solutions to other people's problems too.

Community Members' Suggestions on Ways to Improve VCEs

The final part of the questionnaire asked community members to propose any possible changes to be made to the current version of GreenTeam-HR in order to meet the wide range of professional demands more effectively. There was quite a variety of responses, and the most significant are reported as follows:

- enhance the visibility of the activities and results attained by the different sub-communities;
- extend the same experience to larger communities within the SanPaolo IMI Group;
- simplify the indexing and access to material collected in the VCE's repository;
- organize a specific and structured 'I search/I offer' space to optimize data/information exchange, thereby preventing requests and replies from becoming dispersed inside the discussion forums;
- organize a specific repository of solutions to problems addressed and successfully resolved so as to build a repertoire of repeatable experiences;
- provide e-learning courses; and
- improve the daily mapping of news published in the various areas of the VCE.

Conclusions

Following the experimentation, it may be affirmed that, although they can still be perfected, the questionnaires used for the online interviews turned out to be very useful for a qualitative evaluation of the effectiveness of the VCE. In fact, from the interviews, it emerged that, in view of a general appraisal on the usefulness of the portal and the activities inside it, a number of critical observations were made about the consolidation and further development of the community.

One of these regards the opportunity or not of allowing the VCE to become one of the 'official' working tools of the organization, with the consequent risk of losing its characteristic of being an informal peer-to-peer communication/learning environment.

A second critical aspect concerns the creation of necessary conditions so that the improvement of interpersonal interaction favored by the VCE actually

results in speeding up the processes of knowledge sharing and search for solutions to professional/company problems.

This has brought about some serious reflection on what, within the community, has been indicated as the 'return on investment' in the active participation in an NCP.

In other words, what type of return can one have in the face of a consistent investment of one's time in interacting and sharing knowledge, information, and materials with others?

There have been a wide variety of potential returns identified by the community members:

- acquisition of new information and knowledge from others and acting with others;
- availability of a large audience to turn to with requests;
- possibility to activate synergies in search for solutions to professional problems;
- possibility to make comparisons on specific topics and practices;
- stimulus to a deep reflection and systematization of their knowledge;
- autonomous acquisition of new knowledge favored by the process, as for previous point; and
- access to repository of selected materials pertinent to their professional work.

Until these potentialities are transformed into something tangible, each member has to find the right balance between the use of the VCE as a source of professional resources and the active, propositional participation in its dynamics and evolution.

This implies being prepared not only to collaborate when an explicit request is made by the group or by one of its members, but also to contribute spontaneously to the development of the community's shared knowledge whenever one comes upon materials, information, links, etc., considered of interest to colleagues. It distinctly emerges from the interviews how GreenTeam-HR still needs to take shape in such a way.

The monitoring and evaluation of what occurred during the first year of community life has clearly shown how, following the 'technological' phase (portal development) and internal 'marketing' phase (launch of the community), there is now the need for a greater channeling of forces towards an ever wider diffusion of the community-sharing culture. The purpose is to increasingly heighten and spread the awareness that involvement in knowledge sharing processes must not be considered an occasional occurrence but should be regarded as the norm, and the time devoted to socializing their knowledge with others yields a healthy return on investment, primarily for themselves and, consequently, for the whole community. □

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Raising the Bar for Instructional Outcomes: Toward Transformative Learning Experiences

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Contributing Editor

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Most instructional technologists understand that instruction aims to be effective, efficient, and appealing. These three quality indicators have proven useful in establishing desired outcomes. In this article the authors suggest an expanded set of indicators, with more attention to social impact, engagement, and the learner's experience. By broadening and deepening expectations, the authors hope to encourage more research on instruction, leading to powerful or transformative learning.

Instructional design (ID) as a domain of practice is about designing good instruction—in Reigeluth's (1983) terms, creating a program or product that is effective, efficient, and appealing. *Effective* instruction meets established learning goals and objectives; *efficient* instruction does so with minimal expenditure of resources, particularly time; and *appealing* instruction draws the sustained attention and positive response of learners. This simple framework of instructional outcomes, developed by M. David Merrill and colleagues in the 1970s (e.g., Reigeluth, Bunderson, & Merrill, 1978; Reigeluth & Merrill, 1979), has proven resilient and valuable for theorists and practitioners.

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Another example of a respected, simple outcomes framework is Kirkpatrick's four levels-of-impact model for training outcomes (1975, 1987). The basic notion is that outcomes can be assessed at varying levels, from immediate reaction to objective knowledge assessment to transfer and application in the job setting—and, finally, in business terms, to contribution to the bottom line through increased work productivity. Briefly comparing Reigeluth's three outcomes with Kirkpatrick's levels, we see Kirkpatrick's first level relating closely to the "appeal" construct, his middle levels suggesting the complexity of the effectiveness construct, and his final level of on-the-job impact relating somewhat to Reigeluth's notion of efficiency. Kirkpatrick's emphasis is more on job impact and less on detailing the nature of the learning.

In recent years, a critical review of educational practices complicates our notions of instructional outcomes. Our purpose in this article is to explore the limitations of traditional frameworks and to propose a more comprehensive framework for thinking about instructional outcomes. Our primary audience is the instructional designer—the person charged with designing a quality lesson, unit, course, or module. We hope other educators would also benefit from further reflection on outcomes of instruction.

Thinking clearly about outcomes is important to instructional-design practice for reasons inherent in the domain itself. A key precept of designing good instruction is staking out clear aims and then designing means for achieving those aims. Or expressed less linearly: Using articulated goals to guide design, we develop a coherent system of goals, learning activities, and assessments. As we improve our scrutiny of outcomes and sharpen terms, we should be able to better define the meaning of quality instruction and in turn achieve higher levels of credibility and rigor. Unfortunately, a lack of rigor can adversely affect how we are perceived as a profession. As David Merrill noted recently (Merrill & Wilson, 2007), everybody thinks they know what good instruction is, and everyone thinks they're an instructional designer—by virtue of their own experiences in innumerable classrooms and courses (cf. also Lortie, 1975). Before we can rise above this questioning of expertise, we need to sharpen our notions of intended outcomes for instruction.

Acknowledging the Complexity

Complicating the issue is the proliferation of mandated assessments and outcomes, and the myriad implicit outcomes expected of instructional settings. A typical instructional unit in a North American middle-school science classroom, to take an example, will have a number of fundamental goals and requirements attached to it, including:

- meeting the learning objective of the unit—typically expressed in behavioral terms of knowledge and skill acquisition;
- addressing key science standards as dictated by state and federal legislation;
- preparing students for mandated assessments in science and core outcomes of literacy and numeracy; and
- preparing students to succeed at the next curriculum level, which may use current outcomes as prerequisites.

But then consider the complex nature of classrooms, and additional goals emerge, such as:

- babysitting the kids—you can't dismiss the class just because today's learning objective was achieved;
- teaching middle-schoolers to be civilized and compliant learners within the school system;
- helping a mainstreamed special education student meet his or her IEP (individualized educational plan), diverging from the standard unit objectives;
- assisting an immigrant child to avoid total confusion and isolation, and to become integrated successfully into learning activities;
- finding a way to challenge the gifted student, who already knows more about the unit than you do; and
- strengthening a trusting relationship with a particular child in need.

Considering the longer term, even more goals should be borne in mind, such as:

- developing personal responsibility and study skills critical to success in high school, college, and adult life;
- infusing democratic values of respect for individuals, shared decision-making, and inclusion of diverse perspectives;
- guarding against the mindless perpetuation of privilege and class through school tracking, surface-level diagnostics, and unfair resource allocation; and
- helping students find the inherent passion and joy attached to scientific forms of reasoning and discovery—which in turn may lead to career choices.

This same exercise could be done at nearly any level or setting, with very similar results. For example, in a new-hire training event for sales professionals in a large corporate enterprise, the fundamental goals are to convey sufficient product knowledge and to develop marketing skills necessary to be successful on the job. But, at the same time, such an event is meant to acculturate new employees into the organization—to instill cultural values and pride that will motivate workers to perform in desired ways and at the desired level. Because the organization is likely to strive for workplace diversity, the training will be designed for people with widely varying social and educational backgrounds, helping them develop the skills and values needed to function as a team.

The point is, lessons and modules will inevitably focus on a few key outcomes, but the true needs and goals of instruction are nuanced and complex:

- Instruction has many goals or intended outcomes, some explicit and others implicit, but all are important to the functioning of the instructional system.
- Modern classrooms—particularly those adopting learner-centered teaching methods—accommodate multiple clusters of activity, including much self-directed and small-group activity that leads to varied learning outcomes.
- Learners themselves are hugely diverse and varied in their needs, in turn affecting the instructional outcomes that may be appropriate for them. Increasingly learners demand greater accommodation to their learning needs and preferences (see de Castell & Jenson, 2004).

Many readers, acknowledging the complexity of real-life instructional settings, are likely asking at this point: But how do we prioritize, how do we manage the complexity? How can we acknowledge all the nuances without being paralyzed by the complexity of the situation? These questions are key to any framework of instructional outcomes, and touch on core issues of how we evaluate instruction—what is good instruction, fundamentally?

Effectiveness—Good Enough?

Consider again the three classic descriptors of instruction: effective, efficient, and appealing. The construct of effectiveness considers *what* and *how much*—and *on what level*—the material was learned. Effective instruction "must be measured in relation to the goals and objectives of the instruction" (Reigeluth & Merrill, 1979, p. 21). Ultimately, effectiveness depends on the quality of those goals and objectives. But what if the goals are under-analyzed or poorly articulated—or incomplete, as they always are, at least to some extent? What if they are inadequate or even damaging in some way? Who evaluates the goals?

There should be a way to determine instructional quality independent of predetermined goals. We suggest a simple expansion of Reigeluth's framework by adding a fourth descriptor:

***Good** instruction—leads learners to valued ends (valued by society, the sponsoring institution, and the individual learner) while minimizing any negative impacts*

'Good' here is a synonym for *socially just and valuable*—instruction that, taken as a whole, has healthy consequences. Instruction as an intervention can thus be seen as a tool for accomplishing a valued end. All interventions—tools, technologies, programs, etc.—have both positive and negative impacts, some foreseen and some a surprise. These can be expressed as consequences, impacts, outcomes, or as costs and benefits. By focusing on good instruction, we are acknowledging:

- *The limits of analysis*. We can't analyze, capture, and predetermine all consequences of an intervention.
- *The multiplicity of goals*. Instruction always carries with it many unstated goals, some of which are considered only during delivery, if at all.
- *The diversity of learners*. In the end, instruction is largely about individual growth, requiring individual criteria for success.

We suggest that educators take a *pragmatic* approach to evaluation. Determining the worth of a thing should not be constrained by the stated goals of its initial design; rather, an evaluation should be open to all observed impacts—planned and emergent, positive and negative, short and long term.

But how do we know to look for unanticipated impacts when by definition we *aren't* looking for them? And what is the calculus for combining competing values and impacts, to determine if instruction is "good" or "bad"? Isn't that presumptuous, to even use normative, good/bad language to speak of something so ineffable and complex? We respond with the following points:

Some separation between stated goals and observed outcomes is healthy and desirable. Stated goals can have a powerful blinding effect, blocking from view consideration of other factors that can have potentially large impacts. Instruction should be judged not simply on achievement of stated goals, but on a somewhat independent scale of impacts. For this reason, Scriven (1972) promoted the idea of "goal-free" evaluation—intentionally blinding evaluators to official project goals in favor of observed impacts and outcomes.

Judging goodness is a holistic appraisal, requiring systemic thinking and qualitative understanding. An evaluation of instruction needs to be open to any and all forms of evidence or support, particularly of impacts and outcomes, but also of processes and mechanisms.

Evaluation of instructional outcomes should be an inclusive conversation. Ideally, all interested parties should have a voice and a place at the table as outcomes are prioritized and evaluated. This may include exceptional or marginalized learners; workers expected to apply skills and perform on the job; and clients or consumers of a company's products and services. At a minimum, these varied interests should be carefully considered when establishing criteria and demonstrating value.

Instruction needs to be evaluated in the context of larger societal and system needs. A course may s ucceed in conveying a fairly standard set of technical outcomes, but perpetuate inequities among certain learners, fail to meet other needed outcomes, or close students' minds to future learning experiences. A high-school AP calculus course may, for example, average high scores on the year-end exam. But if 90% of Hispanics in the school are denied access to the course, we have a problem. Or if 90% of the boys pass the exam with only 50% of the girls—another problem. And if the only way most students can succeed is by dropping extracurricular activities or quitting a needed job, we have to question the value of course success.

Real-world instructional design is not a rigid, step-by-step procedure that begins with fully defined goals and never deviates from predetermined models. Complex environments and learning needs need to be matched with flexible procedures for design. We also need reminders that design activity happens prior, during, and following delivery. Instructors are not just implementers of prior design decisions, but participate in the ongoing adjustments needed to meet the human needs of participants, and assure the quality of outcomes.

We appreciate designers' reluctance to adopt good/bad terminology. Use of the terms can be seen as a sign of arrogance or naïveté. We see a need, however, for more evaluation and reflection at a holistic, truly evaluative level. *Too often the goals of ID-developed courses lack ambition and perspective*. They may satisfy technical aims but fail in important social, political, or community ways. Often they work from an impoverished model of knowledge or expertise, leaving learners unprepared to fully integrate new practices into their lives. Or through subtle forms of coercion, they may not leave room for learners to make real choices and "own" the learning experience.

Like all professionals, instructional designers must establish normative standards of practice and create models and frameworks to guide that practice. We need to own up to this imperative, rather than hide behind technical frameworks whose net effect is to suggest that value judgments and decisions are beyond our reach. We need to squarely face the complex sociopolitical structures in which our designs exist.

Deeper Learning Impacts

In the preceding section, we expanded the notion of effectiveness by adding instructional *goodness* to account for outcomes that meet values-based considerations. In this section, we revisit *effectiveness* and *appeal*, and suggest paths to deeper learning impacts.

Increasingly, it seems, examples of outstanding instruction are hard to find. The rarity of high-quality instruction can be damaging, given the strong pressures to produce mediocre instructional products based on templates and preexisting content. If instructional designers are merely hired to quickly convert content from technical manuals by applying templates and rules, the reputation of the profession could be at stake. Articulating the features of truly outstanding instruction is a good step in combating this tendency toward mediocrity.

David Wong (Wong & Jenrisksen, no date) invokes the notion of the "living dead" in describing the impact of much public education in the United States—high-school students walking like zombies from class to class, not really "alive," but still walking. If instruction can foster such a frightening response, we may need to look for ways to resuscitate these students and redeem their poor lost souls!

Gordon Rowland (Rowland & DiVasto, 2001; Rowland, Hetherington, & Raasch, 2002; Rowland, Lederhouse, & Satterfield, 2004) and Brent Wilson (Wilson, Switzer, Parrish, & the IDEAL Research Lab, 2006) have worked with colleagues to articulate constructs of powerful or ***transformative*** learning experiences, resulting from deeply engaging instruction that learners consider pivotal or highly impacting in their lives. Wilson *et al*. (2006) define transformative learning experience using three indicators:

- *Lasting impression*. The learner holds in memory details about the learning experience.
- *Part of the person's self-narrative*. The learner references the learning experience within a narrative about themselves or their relation to a subject matter of importance to them.
- *Behavioral impact*. The learner can point to specific changes in their lives as a result of the learning experience.

This deeper form of learning impact moves far beyond *appeal*, and involves the person's whole identity and response, including affect, emotion, and will (cf. Reeves, 2006 and Wong, in press).

Consistent with this shift, David Merrill (in press) has recently revisited the notion of appeal and replaced it with *engagement*, leading to the *three e's* of effectiveness, efficiency, and engagement. Because engagement suggests a deeper and more complex relationship to a learning experience, we are happy to embrace this change and to revise our framework accordingly. While appeal suggests merely the ability to draw learners to the experience (a unidirectional force), engagement suggests a reciprocating relationship that changes the nature of the experience. Rather than just being sufficiently attracted to pay attention, learners invest creative effort and emotional commitment—and a willingness to risk in anticipation of valued outcomes.

More than most instruction, transformative learning is not under the full control of the designer, but rather requires a combination of careful guidance within crafted learning environments and learners who are ready and willing to become passionately engaged. Nonetheless, the goal of creating transformative learning experiences can be a worthwhile pursuit, even if not routinely attainable for all learners. Wilson and colleagues suggest a multidimensional approach involving the following three dimensions:

- *Cognitive design*. Designers apply principles of cognition to guide thinking processes toward desired learning outcomes. A cognitive design includes attention to learners' actions and behavior, cognitive load, social interactions, motivation, and their active efforts to construct meaningful understanding of the instructional materials.
- *Aesthetic design*. The designer thinks of instruction as an aesthetic medium in need of careful crafting and shaping, much like a work of art. The designer seeks a heightened immediate experience similar to one's encounter with a work of art—except that in the case of instruction, the explicit purpose is to help learners take on new knowledge, skills, and identities.
- *Mythic design*. Designers approach instruction as a mythic journey, encompassing high-risk exploration and struggle, followed by a resolution and return home with a new gift. The learner's progress is guided by a master who provides keys and knowledge at critical junctures. Designers use the language of rites, symbols, and narrative to convey a sense of deep experience. The journey necessarily takes on an element of risk and transgression, followed by reconciliation and service.

Our present knowledge base for design focuses heavily on the first kind of design, neglecting aesthetic and mythic aspects of the intended learning experience. To achieve anything more than what rule-based instruction will deliver, we need a change in thinking that acknowledges and encourages creative, holistic, and risk-taking forms of design (cf. Gustafson & Branch, 1997).

An example of deeply engaging learning with the potential to transform learners would be an undergraduate course, where learners work in teams to

respond to a real-life challenge. Joni Dunlap (2005) examined such a capstone course and found its impact on students to be profound as they transitioned from student to professional identity. Central to her design were aesthetic concerns such as:

- the creation of an *immersive context* (the real-life project with all its attending details);
- provision of a *consummation* to their coursework through a rich application of their learning;
- a focus on *holistic* learning activity that embodies content rather than merely providing new content;
- a willingness to allow learners the freedom to be protagonists in an adventure they themselves navigate; and
- the instructor's role as guide or supportive character in the unfolding narrative of the project, rather than just "teacher" (Parrish, in press).

Wilson *et al*. (2006) report a similar design of Scott Switzer's management course for instructional designers—which also had a significant impact on students entering a profession. Scott saw the structure of his course as beckoning learners to undertake a hero's journey into peril with the potential of eventual reward. He viewed his own role as similar to the "master guide" that accompanies the hero in many mythical journeys, offering wisdom and a degree of prescience, yet distanced from the material world to the degree that little substantial help can be provided to the hero (Campbell, 1949). The course was project-based like Dunlap's course described above, but in this case it was a bounded learning scenario that provided the safety of a fictional, yet richly detailed, challenge.

Such courses are more than repositories of effective cognitive teaching strategies—if carefully designed, they draw on aesthetic structures and mythic archetypes to craft an experience that affects the whole person, changing knowledge and skill levels, but also the way students think of themselves.

From an aesthetic perspective, these two capstone courses would be approached in a different way from traditional cognitive design. The learning experience would be closely considered at all stages from planning, delivery, and evaluation. To aid in making early design decisions, designers might develop a *design story,* empathetically visioning a set of imagined learners complete with bios and histories, and trace them through the whole experience. Instructors would seek continuing input concerning the quality of learners' ongoing experience and adjust course activities based on that ongoing conversation. In the case of adult learners, input into activities and designs would often be substantial. Student assessment would tend toward authentic projects and products, and observations of work. Formative evaluation of instruction would look for evidence of deep engagement and growing impact on learners.

A mythic design might seek to structure the capstone courses as final rites of passage required of inductees into a profession. Enriching this mythic journey would be a variety of symbols and gestures to highlight the meaning and significance of the work, e.g., team names, real clients for projects, audiences for presentations, prestigious judges of project work, and a concluding party for the successful inductees. Attention to this detail goes beyond a typical cognitive design, but can deepen and enrich the experience and encourage the transformation of learners' identities.

Russell Osguthorpe (2006) invited consideration of a neglected form of learning: the kind that *grows* rather than fades with memory or lack of use. In contrast with most forms of learning experience, this kind yields continuing dividends through a change in identity, schema, or fundamental practices. The initial inquiry of Rowland and Wilson is consistent with Osguthorpe's notion of expanding learning, as learners assume personal responsibility and commit to a self-directed plan of continuing study.

At this point our expanded scheme for instructional outcomes has added a fifth element:

- *Effective* instruction—meets the targeted goals of knowledge, skill, and attitude.
- *Efficient* instruction—does so in a cost-effective and timely way.
- *Engaging* instruction—challenges learners to respond through meaningful activity.
- *Good* instruction—leads learners to valued ends while minimizing any negative impacts.
- *Transformative* instruction—encourages deeply engaging experiences that can potentially transform identities and practices.

A graphic representation would look something like what we see in Figure 1.

Qualities of effective, efficient, and engaging instruction contribute to the often implicit but critically important quality of goodness. Achieving instruction that engages learners at a deeper level and leads to personal transformation happens less often, and is based on cumulative qualities in all areas.

Instructional designers who competently practice their craft and are well-versed in the literature may express hesitation about these added descriptors of instructional outcomes. But that is precisely the point—until we acknowledge and are willing to openly discuss instructional outcomes in a more ambitious way, we cannot hope to raise the standard of expectation regarding instructional quality. We need to take our own risky journey toward a broader conceptual base, and then articulate more completely what goes into

Figure 1. An expanding set of instructional outcomes.

good instruction, or transformational instruction. Commitment to truly outstanding quality then may have the potential to arouse the passion and commitment of a new generation of designers, committed to excellence in a way that their forebears only guessed at. □

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The AECT FutureMinds Initiative: Transforming America's School Systems

Charles M. Reigeluth
Contributing Editor

Francis M. Duffy

This article opens by discussing what paradigm change is and why it is needed. Then it describes the new AECT initiative, "FutureMinds: Transforming America's School Systems," beginning with its purpose (to help state departments of education to facilitate paradigm change in school districts), the fundamental ideas underlying the initiative (e.g., mindset change, invention process, broad stakeholder ownership, consensus-building process, and participatory leadership), and the strategy by which the FutureMinds Initiative operates.

Introduction

Educational reforms increased dramatically during the 1960s, in response largely to Sputnik. Educational reforms redoubled in urgency with the "Nation at Risk" report in the 1980s and again with "No Child Left Behind" in the 2000s. Educational reforms have variously focused on curriculum changes, consolidation, open classrooms, mastery learning, decentralization, shared decision-making, legislative mandates and controls, high expectations, integrated thematic instruction, professional development, technology integration, and standards with high-stakes accountability. Through all these waves of reforms, the educational system has remained resilient, and costs have increased dramatically, while student learning has remained disappointing. Why don't any reforms make a significant improvement in educational performance, and why hasn't spending more money been the answer?

During these decades, the United States has changed dramatically, as it has evolved from the Industrial Age to the Information Age. During this time educational needs have changed greatly, as have the family and societal situations with which the educational system must cope (Banathy, 1991; Bell, 1973; Reigeluth, 1994; Toffler, 1980). As systems thinkers know well, when a system's "environment" changes dramatically, the system must undergo paradigm change to survive (Ackoff, 1981; Banathy, 1996; Capra, 1982; Checkland, 1984; Senge, 2000). So what does "paradigm change" mean, and how could that play out in education?

One of the few things that educators, parents, and other stakeholders agree on is that students learn at different rates. Yet our current paradigm of education teaches a fixed amount of content in a fixed amount of time and in a fixed way. By holding time constant for all students, we force achievement to vary, and we use norm-based grading to measure that variance. When we take a close look at this paradigm, we see that it was not designed for learning! It was designed for sorting students (Reigeluth, 1994). And that met the needs of the Industrial Age, when (a) manual labor was the predominant form of labor, (b) we did not need to educate many people to high levels, (c) we could not afford to educate many to high levels, and (d) few would be content to work on the assembly lines if we educated them all to high levels.

Now that knowledge work has replaced manual labor as the predominant paradigm of work, and information technologies have made our world far more complex for everyone, we find that we need to educate far more students to far higher levels of education. In

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Paradigm Change in Public Education

This is the first in a four-part series of articles on paradigm change in public school districts. This first article describes the *FutureMinds Initiative*, a national initiative undertaken by the Association for Educational Communications and Technology to help state education agencies (SEAs) build the capacity to facilitate paradigm change in their school districts. The second article describes the *School System Transformation Protocol*, a detailed set of research-based guidelines to help the SEA facilitators guide their districts' paradigm change efforts. The third article describes fundamental features of the *learner-centered paradigm* of education, a paradigm that is designed for learning rather than sorting students, as the current factory model of schools does. The fourth article describes *learning management systems*, powerful tools that make the learner-centered paradigm more effective, efficient, and engaging.

short, we need a paradigm of education that is focused on learning rather than sorting. So, rather than holding time constant, which forces achievement to vary, we need a paradigm that holds achievement constant—at mastery of each standard—which means we must not force a student to move on before attaining the standard, and we must allow each student to move on to the next standard as soon as it is attained.

To have a paradigm that is learning-focused rather than sorting-focused, it must be attainment-based rather than time-based and customized rather than standardized ("one size fits all"). There must be fundamental changes in the rules, roles, and relationships that make up the current educational paradigm, and fundamental changes in the use of time, talent, and technology (Schlechty, 1990, 2005). For example, the learning-focused paradigm requires dramatic changes in the roles of teachers, students, administrators, parents, other community members, and even technology. Technology integration (integrating technology into what is already going on in classrooms) must be replaced by technology transformation (using technology to transform what goes on in classrooms) (Reigeluth & Joseph, 2002). Piecemeal reforms can never change the paradigm of education, and this is why they have continually failed to meet our educational needs in the Information Age.

Then, is paradigm change totally new? Actually, there has been one—and only one—time that the predominant paradigm of education changed in the U.S. During the Agrarian Age, the one-room schoolhouse was the predominant paradigm of education. During the Industrial Age, the current factory model of schools replaced it as the predominant paradigm, though of course some one-room schoolhouses remain in agrarian communities today. Now as the Industrial Age has given way to the Information Age in the U.S., we should expect to find that the industrial paradigm of education is inadequate to meet our new educational needs. We must transform, not reform, our public education systems (Banathy, 1991; Darling-Hammond, 1990; Duffy, 2003; Fullan, 1993; Reigeluth, 1994; Senge, 2000).

In fact, some educators have tried to change to the information-age paradigm of education. These efforts, like the Saturn School of Tomorrow in St. Paul, Minnesota (Bennett & King, 1991)—often called "model schools"—have usually overcome great odds to establish a learning-focused, attainment-based paradigm. But that paradigm was, of course, incompatible with the paradigm of its school district, which then exerted powerful forces to change it back. These failed school-based transformation efforts provide ample evidence that paradigm change requires changes on the district and even state level. This is far more complex and difficult than piecemeal reforms, but it offers the only effective way to dramatically improve educational performance—without increasing costs (Egol, 2003). The FutureMinds Initiative *(www.futureminds.us)*, sponsored by the Association for Educational Communications and Technology, was designed to meet these requirements.

Goals of the FutureMinds Initiative

The purpose of the FutureMinds Initiative is to provide unequivocal and substantial national-level leadership to assist State Education Agencies (SEAs) in building the internal capacity to help Local Education Agencies (LEAs) create and sustain transformational change in their schools from a time-based, standardized paradigm to an attainment-based, customized paradigm that will provide significant improvement in meeting students' educational needs and the needs of their communities.

Specifically, FutureMinds will furnish professional direction, guidance, and follow-up support to help SEAs (1) recognize the need for paradigm change, (2) decide to promote paradigm change in its LEAs, (3) develop support from key power groups in the state for district-wide paradigm change, (4) devote significant funding to support the transformation process, (5) develop the internal capacity to help LEAs engage in such change, (6) initiate efforts to foster such change, (7) develop and implement mechanisms to improve and sustain those efforts, and (8) disseminate information about those efforts.

FutureMinds advances and disseminates knowledge about how to best help SEAs accomplish these goals.

Fundamentals of the FutureMinds Initiative

There are ten fundamental principals upon which the FutureMinds Initiative is based:

1. Paradigm change. The FutureMinds Initiative is founded on the understanding that there is a need to change the paradigm of public education—that the factory model of schools is obsolete. For the paradigm of public education to change, three paradigm changes must occur in parallel within the system (Duffy, 2002, 2003):

- *Paradigm shift 1:* The primary work processes—teaching and learning—must be transformed to a paradigm that is customized to learners' individual needs and is focused on attainment of proficiencies (Reigeluth, 1994), and the supporting work processes must be transformed to best support the primary work processes. In addition, continuous improvement is needed as soon as the new paradigm is implemented. Duffy refers to this as *Path 1: transform the system's core and supporting work processes*.
- *Paradigm shift 2:* The school system's "social infrastructure" (e.g., organization culture, communication practices, job descriptions, reward systems, and so forth) must be transformed from a command-and-control organization design to a participatory organization design. Duffy refers to

this as *Path 2: transform the system's internal social infrastructure*.

- Paradigm shift 3: The relationship between the school system and its systemic environment must be transformed from an isolative and reactive stance by the school system to a collaborative and proactive stance. Duffy refers to this as *Path 3: transform the system's relationship with its external environment*.

These paradigm shifts require switching from a piecemeal approach for educational change to a systemic transformational approach.

2. The district as the unit of change. If paradigm change only happens in one part of a school district (e.g., one school), that part becomes incompatible with the rest of the system, which then exerts powerful forces to change it back. Therefore, paradigm change must view the whole school district as the unit of change.

3. Mindset change. A different paradigm of education requires an entirely different mental model or mindset about education by all those involved with the system (its stakeholders), or else they will resist the change and be unable to perform the new roles required by the new paradigm. Therefore, the paradigm change process must place top priority on helping all stakeholders to evolve their mindsets about education.

4. Invention process. The information-age paradigm of education is at the "Wright brothers" stage of development. Pieces of the new paradigm have been developed, but we still need to figure out how to put all the pieces together to work most effectively and efficiently. Furthermore, we expect aspects of the new paradigm to differ from one community to another. For both these reasons, it will not work to try to implement a "comprehensive school design" developed by outsiders of a community. Instead, the new paradigm must be invented or designed by the school district. Only after a variety of designs have proven effective will it be possible for the paradigm change process to become an adaptation process. Also, the invention process is a powerful tool for helping stakeholders to evolve their mindsets about education.

5. Broad stakeholder ownership. Because mindset change is so important to successful paradigm change, stakeholders must be involved in the paradigm change process, for it is only through participation that mindsets evolve. Furthermore, diverse perspectives enhance the creativity, and effectiveness of the invention process. But it is wise to go beyond involvement, to ownership of the change process, for that engenders true commitment and greatly reduces resistance to the new paradigm and enhances sustainability. Also, the broader the ownership, the better the results (though the more time it takes to design the new paradigm).

6. Consensus-building process. Stakeholders have different values about, and views of, what is important in education. Empowering stakeholders can generate discord and increase divisiveness unless a consensus-building process is used, along with a consensus-sustaining process.

7. Participatory leadership. Stakeholder ownership and the consensus-building style of decision making both require a different paradigm of leadership from the common supervisory or "command-and-control" paradigm. They require a paradigm that empowers all stakeholders to be leaders, supports them in their work, and provides professional development whenever needed.

8. Experienced outside facilitator. The journey of paradigm change is a treacherous one, and stakeholders typically have a long history of disagreements, factions, animosities, rivalries, and such. Therefore, it is essential to have a facilitator who is experienced in the systemic transformation process and has experience implementing the principles listed above. Furthermore, that facilitator must be someone viewed as neutral and impartial by all stakeholder groups. And that person must be available to facilitate all meetings in the school district until an internal capacity can be developed to assume increasing amounts of that role.

9. Time-intensive process. Mindset change takes time, and the more mindsets to be changed, the more time that is needed. This is because mindsets change primarily through exposure to new ideas and plentiful small-group discussion. Unless individuals' time can be bought or otherwise freed up, the transformation process will take many years and be less likely to succeed. This makes external funding crucial.

10. Capacity building. Empowerment of stakeholders requires building their capacity to lead the paradigm change process and to build participatory leadership skills. Such capacity includes Senge's (Senge, 1990) five disciplines of a learning organization (systems thinking, team building, personal mastery, vision, and mental models), as well as systems design, consensus-based decision making, continuous improvement, sustainability, and much more.

Strategy for the FutureMinds Initiative

We recognize that a school district must be the unit of change, not just an individual school. The history of educational reform is littered with useful school-level changes that were incompatible with the rest of the school district and consequently were gradually forced to revert back to the Industrial-Age paradigm. Transformation must occur on the district level and in all schools in the same feeder system* (all elementary and

*We recognize that some school systems are not organized using feeder systems. Also, we recognize that in some school districts the entire instructional program may be limited to the p–6, p–8, or 9–12 grades (e.g., in Connecticut they have school (cont.)

middle schools that feed into a single high school) for paradigm change to endure.

We further recognize that school districts need support for paradigm change to be successful. They need both expertise and money. These resources can both be provided by SEAs. Therefore, the FutureMinds strategy is to work with two SEAs that are at a high level of readiness for paradigm change, to build their capacity to support school districts in paradigm change. FutureMinds experts will train and coach SEA personnel who work with the districts and will provide strategic guidance for the paradigm change process, along with the instructional designs and technologies that are adopted. The strategic guidance is based on the School System Transformation (SST) Protocol, which has been under development by Charles Reigeluth and Francis Duffy for over 10 years and is being extensively field tested and improved in the Indianapolis Metropolitan School District of Decatur Township. We will also help the SEAs and school districts approach foundations for additional support as each project matures.

To accomplish this strategy, the following actions are envisioned:

1. Select two states (initially) that are at a high level of readiness for paradigm change.
2. Visit each state to build ownership in the initiative among all key leaders at the state level related to education.
   a. Reach consensus with the SEA, governor's office, state board of education, state teachers' association, and other key state leaders on the goals of the project.
3. Reach consensus with each SEA on:
   a. organizational changes to be made in the SEA for its unit to support district-wide paradigm change;
   b. initial expectations for the number of school districts to participate in each of the first five years of the project;
   c. the number, role, and qualifications of SEA employees to be devoted to the project in the first budget cycle, plus expectations for subsequent years;
   d. the activities to be done by the SEA and by AECT FutureMinds experts (including training of SEA employees to be district paradigm change facilitators, selection of school districts, and facilitation of the district-level transformation process), including timelines, for the first budget cycle, plus expectations for subsequent years;
   e. other state organizations that will be involved in the project (such as the state teachers associations, state administrators and school boards associations, state legislature, state chamber of commerce or business roundtable, accreditation agency, and so forth), along with their specific roles, including foundations that might supplement SEA funds to support school district transformation activities;
   f. the SEA budget to support each school district during the first budget cycle, plus expectations for subsequent years;
   g. the number, roles, and FTEs of AECT FutureMinds experts to be devoted to the project during the first budget cycle, plus expectations for subsequent years; and
   h. the budget for AECT FutureMinds' involvement in the project during the first budget cycle, plus expectations for subsequent years.
4. Carry out the project.
   a. Agreed-on organizational changes will be made to each SEA, with appropriate budget allocation to each state's FutureMinds Initiative.
   b. The agreed-on number of SEA employees and/or new hires will be trained at the AECT international headquarters.
   c. The SEA facilitators will select and begin working with the agreed-on number of school districts that are at the highest levels of readiness, using the SST Protocol with coaching from the AECT FutureMinds experts.

Conclusion

It has been well demonstrated that piecemeal reforms are not effective in meeting the educational challenges we face today in the Information Age. There is clear need for transformation to an information-age paradigm of education that is focused on learning by offering education that is attainment-based rather than time-based, and customized rather than standardized. This requires fundamentally different roles for students, teachers, administrators, parents, and other community members. It also requires a much more central role for educational technology. Such a fundamental paradigm change requires a very different approach to educational change—one founded in the district as the unit of change, mindset change, invention, broad stakeholder ownership, consensus building, participatory leadership, experienced outside facilitation, time for participation, and capacity building.

Based on these fundamental principles, the FutureMinds process entails experts training and coaching SEA personnel to facilitate district-wide paradigm change efforts using the SST protocol, which has a long history of development, improvement, and validation in the Indianapolis Metropolitan School

* (cont.) districts that are for the elementary grades only and in California they have high school districts). In such districts, change leaders would create clusters of schools, and each cluster would contain the entire instructional program for that district.

District of Decatur Township. The cost of guidance from the AECT FutureMinds Initiative is minuscule compared with the total expenditures states typically spend on school improvement, and it results in building capacity within a SEA to continue facilitating district transformation beyond the term of the AECT FutureMinds involvement. Can you imagine a better expenditure of public monies for education? □

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Q & A with Ed Tech Leaders

Interview with Allan Collins

Cynthia Kleyn Kennedy
Michael F. Shaughnessy

In this interview, ***Allan Collins*** shares his research and ideas about the field and his contributions to the field. He discusses situated learning, the issue of epistemic games, and situated learning environments. He hypothesizes about the future and discusses influences and mentors.

1. What are you currently writing or involved with?

I have just completed a book with Rich Halverson at the University of Wisconsin, which is tentatively

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Allan Collins *is Professor Emeritus of Education and Social Policy at Northwestern University. He is a member of the National Academy of Education, a fellow of the American Association for Artificial Intelligence, and served as a founding editor of the journal* ***Cognitive Science*** *and as first chair of the Cognitive Science Society. He has studied teaching and learning for over 30 years and written extensively on related topics. He is best known in psychology for his work on how people answer questions, in artificial intelligence for his work on reasoning and intelligent tutoring systems, and in education for his work on situated learning, design research, inquiry teaching, and cognitive apprenticeship. From 1991 to 1994 he was Co-Director of the US Department of Education's Center for Technology in Education. Recently he was chosen by French psychologists as one of 30 living scholars who have had the most impact on the field of psychology.*

entitled *The Second Educational Revolution: How Technology Is Transforming Education Again*. The book argues that the world of education is currently engaged in a massive transformation, as a result of the information revolution. We describe this transformation by comparing current events with the 19th century shift from an agricultural society to an industrial society that precipitated the transition from apprenticeship to universal schooling. The book will be published by Allyn Bacon Longman.

All around us people are learning with the aid of new technologies: children are playing complex video games, workers are taking online courses to get an advanced degree, students are taking courses at commercial learning centers to prepare for tests, adults are consulting Wikipedia, etc. New technologies create learning opportunities that challenge traditional schools and colleges. These new learning niches enable people of all ages to pursue learning on their own terms. People around the world are taking their education out of school into homes, libraries, Internet cafes, and workplaces, where they can decide what they want to learn, when they want to learn, and how they want to learn.

The emergence of alternative venues for learning threatens the identification of learning with school. The tension between new forms of learning and old forms of schooling will not be resolved with the victory of one or the other. Rather, we see the seeds of a new education system forming in the rapid growth of new learning alternatives, such as home schooling, learning centers, workplace learning, distance education, Internet cafes, educational television, computer-based learning environments, technical certification, and adult education. This does not mean that public schools are going to disappear, but their dominant role in education will diminish considerably.

The changes we see happening in education are neither all good nor all bad. We see many benefits to the kinds of education that technology affords, such as the ability of learners to pursue deeply topics of interest to them and to take responsibility for their own education. We also see many benefits in the successful history of traditional public schooling in America, which has provided extraordinary access to learning, status, and economic success for millions of students over the course of the past two centuries. But at the same time the roads to dystopia are also open. In particular, the new technologies can undermine both Thomas Jefferson's vision of educating citizens who can make sensible public policy decisions, and Horace Mann's vision of a society where everyone can succeed by obtaining a good education. Increasing the ability to personalize educational opportunities gives a natural advantage to those who can afford the services. Our fear is that citizenship and equity may be undermined by the fragmentation and customization afforded by the information revolution. We hope that by revealing the larger pattern of what is happening, we will make it possible for society to ward off the dangers and exploit the possibilities.

2. Can you describe the most recent research in which you have been engaged?

Now that I have finished the book with Rich Halverson, I am starting to work on a second book, with Barbara White at UC Berkeley, which I have tentatively entitled: *What You Need to Know to Survive in the 21st Century.* The book addresses the issue of curriculum without assuming that people will learn what they need in school. We plan to address how what you need to know has changed in recent years, the many arguments about curriculum over the ages, the principles that determine what is important to learn, and how to think mathematically, communicatively, financially, civically, scientifically, historically, globally, and strategically in a technology-rich world.

3. In your opinion, what do we need to do to more effectively integrate technology into education?

We need to think about education much more broadly than what goes on in schools. The rethinking that is necessary applies to many aspects of education and society. We are beginning to rethink the nature of learning, motivation, and what is important to learn. Further, the nature of careers is changing, and how people transition back and forth between learning and working. These changes demand a new kind of educational leadership and changing roles for government. New leaders will need to understand the affordances of the new technologies, and have a vision for education that will bring the new resources to everyone.

Eventually, when people and politicians become worried about what kids are learning or what adults don't know, their automatic reaction may not be "How can we improve the schools?" Instead they may ask, "How can we develop games to teach history?," "How can we make new technology resources available to more people?" or " What kinds of tools can support people to seek out information on their own?" These are all questions that push the envelope for improving education out of the schools, and into new venues. The link between schooling and learning forces our conversation into institutional responses—we don't yet know how to ask wider questions when we think about improving education.

4. What kind of training needs to be provided to undergraduate teachers in training? What has to be provided to graduate students who are already teaching?

The kinds of changes required in schools to teach thinking are enormous. To make such a radical change in teaching takes at least four elements: (1)

Visible models of adventurous teaching, (2) principles underlying the models, (3) guided practice, and (4) a reflective community. Technology can do much to support these four elements. It is important to provide video cases for teachers to study, with commentaries from different perspectives to help them understand the principles underlying the videos. By studying videos, we can begin to develop a theory and a language for describing teaching, just as science became possible when printing provided representations that could be studied and refined. If we form small groups of teachers who are willing to share videos of their own teaching, they can provide useful feedback to each other and help reflect on their practice (the "video club" model). It looks like the kind of technology-based professional development programs that can make a difference are slowly starting to develop.

5. Describe how "design research" has evolved since the early nineties when you and Ann Brown first came to be involved in "design experiments."

The design research approach has been taken up quite widely among researchers who are designing computer-based learning environments. The past decade has seen a burst of empirical work, theoretical treatises, and journal special issues devoted to the topic, including *Educational Technology*. There have been many recent attempts to develop a design-research methodology that is both theoretical and rigorous. As a recent National Research Council report states: "Design studies are iterative in that they involve tightly linked design-analysis-redesign cycles that move toward both learning and activity/artifact improvement. They are process focused in that they seek to trace both an individual's or group's or school system's learning by understanding successive patterns in the reasoning and thinking displayed and the impact of instructional artifacts on that reasoning and learning. They are interventionist in testing theory and instructional artifacts by designing and modifying real-world settings. They are collaborative in that they depend on the knowledge and co-work of practitioners. They are often multi-leveled in that they link classroom practices to events or structures in the school, district, and community. They are utility oriented with the intent of improving the effectiveness of instructional tools to support learning. And they are theory driven in the sense of testing and advancing theory through the design-analysis-redesign of instructional activities and artifacts."

6. How has technology impacted design research in terms of expediting processes and procedures?

Technology gives design researchers a way to embody their design ideas in computer-based learning environments. This provides more 'control' over the teaching and learning process. Hence it has been the technology-oriented researchers that have taken up the methodology of design research. As Carl Bereiter has argued, "Although there is innovation in education, it tends to be sporadic and discontinuous, with the result that innovative practices seldom win out against those with a long evolutionary history. Factors contributing to this condition include the difficulty of envisioning the human consequences of innovations and the predominance of research models that do not contribute to innovation. Design research is an emerging effort to bring what Whitehead called 'disciplined progress' into education, but it has not yet taken on a clear form or purpose. Design research is not defined by its methods but by the goals of those who pursue it. Design research is constituted within communities of practice that have certain characteristics of innovativeness, responsiveness to evidence, connectivity to basic science, and dedication to continual improvement."

7. How have your views on design research changed over the last five or ten years?

As my ideas about design research have evolved over the years, I have been trying to specify how to make design research more systematic and to emphasize the role of theory in the design-research process. In a 2004 article in the *Journal of the Learning Sciences*, we describe how to think about the methodology of design research in a more systematic way. In a companion article by Andrea diSessa and Paul Cobb, they address some of the theoretical issues relating to design research.

8. In design research, many variables cannot be controlled. What challenges do these variables present in terms of generalizability?

The role of design research is to provide an in-depth understanding of what is happening as a particular design is implemented in a learning environment in order to refine the design through multiple iterations. As Tharp and Gallimore argue, when a design is stable, the program should be evaluated with something like a randomized controlled study, in order to evaluate the design's effectiveness. Generalizability really depends on trying out the design in different contexts to determine where it is more effective and where it less effective. In Section 4 of our 2004 article in the *Journal of the Learning Sciences*, we discuss how a design-research approach might be applied to summative as well as formative research.

9. You were Co-Director of the Center for Technology in Education at the Bank Street College of Education. What do you see as your main accomplishments while at Bank Street?

Jan Hawkins and I held a series of meetings at different universities to discuss research based on design experiments, which helped to spread the idea of design research. John Frederiksen and I wrote a 1989 paper in *Educational Researcher* on "systemic validity" in educational assessment, which I discuss below. Finally, I wrote an article in *Phi Delta Kappan* in 1991 where I discussed technology's effects on education more broadly.

10. You are well known in education for your work on inquiry teaching. How would you define inquiry teaching, and how would it apply to instructional technology?

The kind of inquiry teaching I studied involved the teacher asking questions of students to force them to create their own theories about some phenomenon. It is often referred to as Socratic tutoring. I studied a wide variety of inquiry dialogues in order to determine how the teachers formulated their next question, based on the student's answer. In this way, I was able to construct a comprehensive theory of how Socratic tutors generate their questions. In the late 1970s, we built a prototype computer tutor based on these strategies that we called the Why system to teach about what causes rainfall or lack of rainfall in different parts of the world, but it was not so successful at understanding students' answers. More recently, Kurt VanLehn and Art Graesser have built a tutor they call Why2 to tutor physics, which builds on our earlier work.

11. What is cognitive apprenticeship? And why is this construct important?

Cognitive apprenticeship updated traditional apprenticeship to apply to subjects taught in school, such as reading, writing, and mathematics. The "cognitive" emphasizes that the focus is on cognitive skills, rather than physical ones. Traditional apprenticeship evolved to teach domains in which skills are visible. But students lack access to the cognitive processes of instructors as a basis for learning through observation. Cognitive apprenticeship is designed to bring these processes into the open, where students can observe and practice them.

There are two other major differences between cognitive apprenticeship and traditional apprenticeship. First, because traditional apprenticeship is set in the workplace, the tasks arise not from pedagogical concerns, but from the demands of the workplace. In cognitive apprenticeship, tasks are sequenced to reflect the changing demands of learning. Second, whereas traditional apprenticeship emphasizes teaching skills in the context of their use, cognitive apprenticeship emphasizes generalizing knowledge, so that it can be used in many different settings.

Throughout most of history, teaching and learning have been based on apprenticeship. Even in advanced societies, we learn through apprenticeship, such as our first language, critical skills in a new job, and doctoral training for scientists. When someone has the resources and a strong desire to learn, they often hire a coach to teach them by apprenticeship, because apprenticeship is a more effective way to learn. But for most kinds of learning, schooling has replaced apprenticeship. John Seely Brown and I have argued that computer-based learning environments have the capability to provide students with apprenticeship-like experiences, providing the attention and feedback that are associated with apprenticeship.

12. What are epistemic games and how does one go about learning about them?

Our work on epistemic forms and games attempted to characterize the structures and strategies that guide researchers in creating theories. There are recurring forms that are found among theories in science and history. A few of the different forms that occur are stage models, hierarchies, multifactor models, system-dynamics models, and axiom systems. Inquiry in different disciplines involves mastering how to carry out investigations of phenomena guided by one or more of these target structures. We refer to the target structures that guide scientific inquiry as "epistemic forms," and the set of rules and strategies that guide inquiry as "epistemic games."

Theories and models often involve epistemic forms, but they are particular instances; they are not the general forms that guide inquiry. Epistemic games are similar to analysis techniques except that they are more general. There are many analysis techniques in different sciences, and they are usually specific to the field and the kind of data analyzed. Epistemic games are used across many different fields and apply to many different kinds of data. One possible way to think about epistemic games is as the most general kind of analysis techniques or inquiry approaches.

If epistemic forms and games are as powerful as we suggest, it would make sense to teach them to students along with the facts, concepts, methods, and theories we now teach. But like any complex game, they cannot be learned in rote fashion. They can only be learned from trying to make sense of different phenomena. There are some attempts to teach basic forms like compare-and-contrast, cost-benefit analysis, and hierarchical analysis, but they are usually taught in a rather rigid fashion. Generally the relation of epistemic forms and games to the deeper aspects of inquiry are not understood, and the most powerful forms are only taught at the university level through tacit apprenticeships in the different sciences.

13. Tell us about situated learning and why it is important.

The situative perspective views knowledge as distributed among people and their environments, including the objects, artifacts, tools, books, and the communities of which they are a part. Analyses of activity focus on processes of interaction of individuals with other people and with physical and technological systems. Knowing in this perspective is both an attribute of groups that carry out cooperative activities and an attribute of individuals who participate in the groups. Learning by a group or individual involves becoming attuned to constraints and affordances of the material and social systems with which they interact. Discussions of motivation in this perspective often emphasize engagement of individuals with the functions and goals of the community, including interpersonal commitments and ways in which individuals' identities are enhanced or diminished by their participation.

When knowing is viewed as practices of communities and of the abilities of individuals to participate in those practices, then learning is the strengthening of those practices and participatory abilities. Systems in which individuals learn to participate in social practices are very common, and include apprenticeship and other forms of being initiated into the practices of a group. Lave and Wenger reviewed several studies of learning involving apprenticeship and concluded that a crucial factor in the success of such a system is that learners must be afforded legitimate peripheral participation, which involves access to the practices that they are expected to learn and genuine participation in the activities and concerns of the group. Lave and Wenger characterized learning of practices as processes of participation in which beginners are relatively peripheral in the activities of a community, and as they become more experienced and adept, their participation becomes more central. They emphasize how an apprentice's identity derives from becoming part of the community, as they become more central members in the community. For an environment of apprenticeship to be a productive environment of learning, learners need to have opportunities to observe and practice activities in order to progress toward more central participation.

The degree to which people play a central role and are respected by other members of a community determines their sense of identity. The central roles are those that most directly contribute to the collective activities and knowledge of the community. The motivation to become a more central participant in a community of practice can provide a powerful incentive for learning. Frank Smith argues that children will learn to read and write if the people they admire read and write. That is, they will want to join the "literacy club" and will work hard to become members. Learning to read is part of becoming the kind of person they want to become. Identity is central to deep learning.

14. Why is systemic validity in educational testing important in this age of No Child Left Behind?

John Frederiksen has argued that we need "systemically valid" tests, that is, tests that foster the learning of the knowledge and skills that the test is designed to measure. In order to achieve systemic validity, tests need to be: (1) direct, so that the test specifically measures the knowledge and skill students need to achieve, as opposed to measuring indicator variables for that knowledge and skill; (2) wide in scope, so that it covers all the knowledge and skill required; (3) reliable, so that all involved feel the scoring of the test is fair; and (4) transparent, so that all involved understand the criteria on which students are being judged. If learners are to improve their performance, the assessment must be transparent. When a high-stakes test is not direct or is narrow in scope, teachers and students will misdirect their preparation for the test. So, for example, if you use vocabulary as an indicator variable of college preparedness, students will memorize vocabulary to get into a good college even though a large vocabulary is unlikely to help them do better in college. Similarly, if you measure only reading and math ability, teachers and students will focus effort on these topics at the expense of other knowledge, skills, and dispositions, which might be more useful. Transparency is crucial to helping students direct their efforts toward improving their knowledge, skills, and dispositions.

The accountability movement, as exemplified by No Child Left Behind, is violating three of the four principles (all but reliability). This is clearly narrowing the curriculum to knowledge and skills that I feel are less useful for later life. I would argue that one's disposition to complete challenging projects, pursue knowledge that might be useful in later life, analyze complex situations, and develop effective learning strategies are much more important things to learn than what accountability tests are measuring.

15. Who has influenced or mentored you?

I have been influenced by many people, especially my many co-authors over the years, including Ross Quillian, John Seely Brown, Kate Bielaczyc, Barbara White, John Frederiksen, Jan Hawkins, Dedre Gentner, Andrew Ortony, Chip Bruce, Jim Greeno, Lauren Resnick, and Rich Halverson. Others who have had a large effect on my thinking include Ann Brown, Joe Campione, Marlene Scardamalia, Roger Schank, Louis Gomez, Xiaodong Lin, Alan Schoenfeld, Andy diSessa, and David Cohen. □

Educational Technology Classics

Theories and Models and Their Utility

Robert E. Silverman

There is growing interest in the relation between theories of learning and systematic views of teaching. This interest takes two forms. One form of interest is represented by the position that teaching is or should be an applied science and as such it must depend on a basic science and on theory or some set of systematic principles derived from the laboratory. A second form of interest is represented by the position that theories of teaching need not and probably should not depend on learning theory but can develop systematically without support from the learning laboratory.

I believe discussion of these positions and the issues they generate can benefit the development of educational technology, for any discussion would require a clarification of the arguments leading to each position and the presentation of information supporting each position. Such clarification and information should help to shed light on the variables operating in teaching.

My purpose here is to contribute to the discussion in two ways: first, by clarifying the distinction between theories of learning and theories of teaching, and, second, by recommending the use of models rather than theories at this stage in the development of educational technology.

It should be obvious to many observers that the interplay between educational practice and the scientific study of learning has not been particularly fruitful. Although attempts have been made to arrange a meeting of minds, and a number of investigators and practitioners have zealously tried to develop liaisons, these statesmanlike efforts have not been very productive. However, there are some signs of increasing interest in the classroom by investigators who work primarily in the laboratory, and some show of interest in the laboratory by a few practitioners. These signs may be indicators of an increasingly healthy relationship between the laboratory and the classroom, but it is probably too early to prognosticate. However, I will venture to predict that the prognosis for a more healthy relationship between laboratory and classroom can be improved if attempts are made to remove sources of misunderstanding and to develop better communication.

One real source of misunderstanding is in the area of theory and the role it may play in practice. Too often proponents as well as opponents of the psychology of learning fail to represent properly the place of theories of learning. There are no grounds for expecting psychological theories that have been developed in the laboratory to be directly applicable to the classroom. False expectations can lead to erroneous conclusions. The disenchantment of many practitioners of instruction with theories of learning is due in part to a misunderstanding of the role and place of theories of learning.

Theories of Learning and of Teaching

Theories of learning are concerned with the "how" of learning. The learning theorist seeks to organize the data of learning so as to develop generalizations that go beyond the data and in so doing bridge gaps in knowledge and stimulate further research involving the learning process. In constructing a theory, the theorist engages in three kinds of activity: (1) He makes systematic observations or he makes use of the systematic observations made by other investigators. (2) He invents (or borrows) constructs. The constructs are concepts that are used to represent relationships among things or events. (3) He derives hypotheses from the constructs and their relationships. The hypotheses are systematic guesses or deductions that can be tested directly or indirectly.

The study of learning is not the same as the study of teaching. I agree with Estes (1960) when he suggests that the relationship of the psychology of learning to education is or will be more like that to physiology to medicine than like that of medicine to the patient. Theories of learning do not (and should not) prescribe educational practices. However, they can provide a basis, in the form of models, for a technology of educational practice. Before such an interaction will be fruitful, a series of steps is required. These steps should include the development of a common set of terms and referents so that there is a

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This article consists of major excerpts from a 1967 article by **Robert E. Silverman**, who at that time was Chairman of the Department of Psychology at the University College of Arts and Science, New York University, Bronx, New York, and a Contributing Editor of this magazine. This continues the magazine's current series of selected articles published in the early years of its 48-year run.

common ground for communication. I shall argue below that models can provide this common ground.

Theories of teaching, using theory in the formal sense, do not exist in any number. There are, of course, a variety of positions and points of view regarding teaching, but these are for the most part merely informal frames of reference; they are not organized theories. While it may be argued that most teachers have some kind of theory of learning, I would set aside this argument in favor of the proposition that most teachers have a rationale for what they do as teachers, but few have a specific theory that guides their activities or helps them to decide upon a particular strategy or technique.

Theories and Models

In attempting to account for the dearth of theories of teaching, Gage (1963) suggests that many people feel that adequate theories of learning lessen the need for theories of teaching. Gage takes exception to this line of reasoning by pointing out that theories of teaching are needed to "…make explicit how teachers behave, why they behave as they do, and with what effects."

It is not sufficient for the teacher to infer from theories of learning; he needs a theory of teaching to enable him to make effective decisions as to what to do and when to do it. A theory of teaching should explain the relationships between the techniques and conditions of teaching and the behavior of learning. Such a theory should also deal with individual differences in learning.

A theory of teaching may derive its concepts and its methodological approach from a theory of learning. For example, a theory of teaching might use constructs such as need and habit, both derived from Hull (1943), or constructs such as valence and cognitive structure, both derived from the cognitive-field theory of Lewin (1942). In either case, for a theory of teaching, the constructs would attempt to relate the variables of teaching and their various outcomes in the form of learning.

In my opinion, the best way to proceed in developing a theory of teaching is to begin with what is known about learning in the laboratory and in the classroom by adopting a model derived from a theory of learning and/or from systematic approaches to the study of learning in the laboratory. In an earlier article in this magazine (April 15, 1966), I took the position that a sound educational technology requires a scientific basis. In that article, I referred to a model, specifically the stimulus-response model (S-R) of learning, as a kind of exemplar. At this point I shall extend the consideration of models in teaching and in the study of learning to models in general.

The relationship between the laboratory and the classroom may be improved by the use of models. By model I mean mode of representation. In this sense a model may be an analogy or it may be a replica. A model of a rocket ship is a replica and a model of the eye as a camera is an analogy.

There is a difference between a model and a theory in that one does not think of a model as actually existing. A model is merely an analogy, whereas a theory is a conceptual system that attempts to describe the interaction among real variables. A model tolerates exceptions, but a theory does not easily do so.

It is the property of being able to tolerate some exceptions that makes the use of models attractive in the early stages of educational technology. Models can be very useful and yet they demand less commitment to them than do theories. They can be discarded and replaced if shown not to be useful. The only criterion by which to judge a model is the criterion of usefulness. If a model helps us to understand complex events and to see new relationships, it is useful and is worth keeping.

Limits

The use of models is not without its dangers. Chapanis (1963), in his excellent discussion of models, points out limitations, the most crucial being the fact that models may invite overgeneralization, forgetting that the model is merely an analogy and referring to it as if it were the real thing. An example of this is calling the computer a brain and believing it has the properties of a brain.

Despite limitations, models can play a salutary role in the bridging of the gap between laboratory and classroom in that they can and, I believe, should be a means of translating laboratory principles and concepts into workable forms for application. At this stage in the development of educational technology, models are probably more useful than theories, more expendable, and much less demanding of emotional commitment. □

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Reader Comments

What Evidence Would Change Your Mind About the Learning Benefits of Serious Games?

A Reply to Parker, Becker, and Sawyer

Richard E. Clark

In a recent *Point of View* article (Clark, 2007), I argued that all well-designed empirical research evidence supported the view that games intended to teach do not yield more learning than much less expensive, alternative ways to teach the same knowledge. The article also argued that while there was very little evidence that games are a more motivating way to learn than other forms of instruction, the existing evidence cautions that increasing motivation may actually yield less learning than other alternative ways to teach and train. On a more positive note, I offered my view that the ideal role for "serious" games is to support continued practice in game environments that mimic the application setting for skills and knowledge being learned. This type of continued practice might have a powerful effect on the flexible automation of skills and their transfer to complex environments. My article also offered a number of suggestions for the design of future search and evaluation of serious games.

The Rejoinder: Parker, Becker, and Sawyer (2008) take me to task for "unfortunate errors and misapprehensions" in my article and offer "another side of the argument." They are concerned that I misrepresented the expense involved in producing the typical serious game and feel that my estimate was more typical of entertainment games and not those intended to teach. Yet they offer no evidence on costs beyond their own guess about game economics or that serious games are more cost-effective than other alternative instructional delivery vehicles. They criticize my use of Wikipedia to define "serious games" but offer no alternative definition. They agree with my conclusion that no peer-reviewed and published research evidence supports the learning benefits of games yet protest that evidence about the impact of games has been developed by commercial game manufacturers and has not been published in "academic journals." They dispute the published claim by O'Neil *et al.* (2005) that only 19 of over 4,000 published articles on serious games (as of 2005) reported empirical studies and that of the 19, none reported evidence for learning benefits when compared with non-game alternative ways to teach the same content. The evidence they cite to counter my claims and those of O'Neil and his colleagues come from unpublished doctoral dissertations, personal experience, and the evaluations of educational games by commercial and academic developers.

Inconvenient Evidence: It is most likely that the "other side of the argument" advanced by Parker, Becker, and Sawyer (2007) will resonate with many of the most committed interactive video game advocates. True-believers among us will only accept evidence when it supports their conclusions. It is tempting to avoid the results of well-designed empirical studies when they contradict an a *priori* belief. The argument that game technology continues to evolve is used to discredit inconvenient data reported in studies conducted in the past—even the very recent past. A similar approach to judging the data on medical treatments lead some people to ignore negative evidence that popular treatments for illnesses have no impact and avoid less popular or convenient treatments that can have significant benefits—sometimes at a lower cost. A side-effect of ignoring inconvenient but solid evidence is the gradual rejection of research as a way to help us analyze problems.

A Question for Readers: My question for the reader who takes the time to read both articles is whether it seems rational to trust the evidence collected by those who have a financial or professional development interest in promoting a product while rejecting evidence collected by more objective analysts and then subjected to peer review before publication.

A Shared View: I do share the optimism of Parker, Becker, and Sawyer that games could make a huge contribution to education, and I want to echo their call for interdisciplinary teams to conduct needed research and development. My concern is that games are too often developed and evaluated by people who have not mastered the very impressive body of research on instruction, learning, motivation, and the mixed method design of instructional studies. It is also possible that people who have mastered research design as well as instructional and learning psychology may not understand the unique benefits of serious interactive video games. Yet if we conduct collaborative research we must all be willing, at some point, to subject our research to peer review and accept results that do not support our prior expectations. Well-designed research often gives us the opportunity to try to understand and finally accept consistent counter-intuitive results and so be willing to change our beliefs and expectations. □

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Authors' Responses to Comments by Hackbarth

Responses from two authors and the Guest Editor of the special issue on *Opening Educational Resources*(November–December, 2007) to Reader Comments by Steven Hackbarth, March–April, 2008:

Making these comments specific to their article, *Towards a Global Learning Commons: ccLearn*, by Ahrash Bissell and James Boyle, **Ahrash Bissell** writes:

We agree with Dr. Hackbarth that any educational approach will demand rigor, clarity, and a hard-headed insistence on results. Like him we believe in precision and high scholarly standards. In that regard his use of scare-terms such as "anarchist" and "radical" is particularly disappointing and ill-serves the values he purports to represent. A deep belief in increasing the ambit of free access to educational materials is neither radical, though it once was seen that way, nor anarchist, though it is a project pursued by private actors as well as states. It represents a core value of the academy and of the Enlightenment, a value to which both of us subscribe.

A straight line runs from the creation of the circulating library and the introduction of free, publicly-provided education, to today's efforts to harness the power of the Internet to the same goals. Nor is it radical, anarchist or (as Dr. Hackbarth rather confusingly asserts) post-modernist to wish to involve students more actively in the educational process. Yes, rigor in both assessment and design will be necessary. Yes, the task is a difficult one and a healthy skepticism towards its efforts is productive. That is why it is particularly important that the OER movement neither be used as a Rorschach blot onto which readers can project their particular anxieties about modernity or post-modernity, nor presented as a panacea to ills it manifestly cannot fix.

When Professor Hal Abelson's MIT classes in computer programming are available, free, to educators and students around the world—who are free to translate them and adapt them without involving lawyers or paying fees—we believe the world is better for it. The process of building enterprises such as that is the one to which the OER community has devoted itself. That is what this issue, and our article, was about.

C. Sidney Burrus, author of the article *Connexions: An Open Educational Resource for the 21st Century*, has written these responses to a variety of Dr. Hackbarth's comments:

The special issue on OER gave a spectrum from visionary speculation to concrete, demonstrated success. The two most used Open Educational Resources are MIT's OCW and Rice's Connexions. Another successful system that is a special type of OER is Wikipedia, which Dr. Hackbarth himself uses. All of these are addressing exactly the issues that he values using the accumulated wisdom of traditional scholars and peer review by the individuals, societies, and professional groups. These techniques are having to be modified to handle the open medium, but MIT only allows legitimate faculty to put material into OCW, Connexions has a lens systems that allows experts to endorse only reviewed and vetted content, and Wikipedia uses the public as reviewers (which seems to work remarkably well, but it is yet to be proven).

While some of the "visions" may sound radical, virtually all of the implementation comes out of solid, traditional processes. Multi-authored books, anthologies, short monographs, encyclopedias, multi-volume series, etc., are very similar to the modules and collection in Connexions but use the slow, expensive, static, and difficult to deliver technology of print-on-paper rather than information from a disk on a screen.

Already, traditional scholarly and professional societies, commercial publishers, schools, and universities are experimenting with open access systems. The largest professional society in the world has initiated a pilot project with Connexions to publish educational and scholarly content in an open repository. A new peer review system is being formed that will use the same standards and methods but applied in a new way. Indeed, it should be able to do a more accurate and timely job of assessing the quality of submitted work.

After World War II, faculty at MIT published a series of books that basically defined the best of engineering education. Second and third tier schools of engineering all over the world used these books and were improved greatly (as were other first tier schools). MIT's OCW is doing the same thing with OER in modern times and it is being extraordinarily well received.

The OER community is providing tools and content so the "experts," traditional and non, can evaluate and use them in education. The third word in OER is "resources." It is the teacher, the educator, the curriculum builder that uses these new resources to do better teaching and cause better learning to take place. OCW and Connexions are providing resources, they are not doing the teaching. But, I agree with virtually all of the visionaries in the special issue and many others as well, these resources can support the same magnitude of improvement in education that the movable type printing press did. And, even if it is politically incorrect, I am not apologetic one bit about calling a "laggard" a laggard.

The following are comments by **Judy Breck**, Guest Editor of the special issue on *Opening Educational Resources*:

Opening up educational materials began as independent of the systems used to develop the materials. There are OER materials that were developed in traditional ways

(such as open courseware) and some that were developed in innovative ways (such as Connexions). It was assumed that the movement to open up materials did not by nature privilege one manner of content creation over another. What it did do was open up the possibility for new forms of educational content creation that had not previously been available, and for some (though clearly not Dr. Hackbarth) this has been a source of tremendous excitement. It has been natural to assume that these new possibilities would be complementary to rather than competing with traditional and existing systems.

But we have come far down a new road: A foundational change in global communication has put open educational resources at the core of learning and makes Dr. Hackbarth's negative comments about OER moot. Comprehensive and dynamic resources for learning are now interrelated by an open network paradigm, and these open resources have become the best kind of knowledge for learning. This is not a problem for education. It is very good news.

The embedding of what is known by humankind into an open network structure creates a new kind of opportunity for teachers to lead students to knowledge that is directly compelling to a learner. Teaching and learning at their best are the introduction to and engagement of knowledge itself within its cognitive context. The realization of this engagement is moving education into a global golden age.

Network-interfaced knowledge is compelling—attractive, interesting, obvious, contextual—because by being embedded in a network its cognitive relationships are mirrored. Algebra links to calculus while both link to trigonometry; and chemistry links to biology as well as physics, richly. Patterns of ideas emerge and can be followed and understood. Curiosity can be satisfied in context. The way the brain learns is, at the very least, echoed.

So, one asks: who has made this happen? The answer is one of the grand surprises of intellectual history: the network made it happen. Two simple elements form networks: nodes and links. Knowledge embedded into the Internet is (and can only be) interfaced to the learner by nodes and links. When a subject that humans think about is embedded into an unrestricted (open) network, the cognitive substance of that subject nestles into the nodes and links. Ecology distributes its topics in context among patterns of linked nodes that link in turn to geology, biology, and botany—and political subjects too. The network of history of the American Revolution contains sectors linked with British and French history and Native American sociology, and ship building, and the sugar trade, and beyond.

But what about the junk? How can the material and patterns in the network be trusted? The network has mechanisms for that as well. The single mechanism at the core of what is rapidly becoming the biggest enterprise on Earth—Google—is what makes open online knowledge elevate the best nodes and patterns.

The best stuff is used the most and its connections are made by the people who know the most about it. This network-inherent vetting of knowledge resources has occurred with minimal assistance from educators; imagine what we will do when we press forward to make it better!

The underlying network structure for future education is not bad news. It is a beautiful thing. We are only beginning to understand its elegance. We do know that network-platformed learning ingredients are more than the networking only of knowledge. Teachers and students are networked too, as are experts, librarians, and other providers and mentors for learning. From the richness of the chaos of interconnections emerges the order of learning. No one could have foreseen it, but we are watching it happen.

Dr. Hackbarth refers to my vision as "exotic," and indeed it is, from the root meaning of the word: *outside* and *from a foreign place*. Certainly, the hierarchical, standardized, grade-segmented routine of education resources as we have known them are a far cry from networking. Dr. Hackbarth concludes his comments by listing elements of the established educational methodology and insisting: "Within this context, not apart from it, OER may well transform the world for the better." Here he is wrong about what the context will be.

The context for future learning is the exotic new network fundamentality that has impelled the opening of educational resources. OER is a matter of flowing resources into networks where they can interact with other knowledge and experts, and with teachers and learners.

To observe the open networking of learning content, I invite you to visit learnodes.com *(http://www.learnodes.com/primer.html)* where I am spawning landing nodes for knowledge subjects and launching them into the open Internet as blog posts. The learnodes.com project is an open experiment in using techniques from the commercial sector for search engine optimization (SEO). Using SEO for OER is an example of harnessing network principles to bring education into the connecting world.

Commercial sectors have perfected processes such as Website usability, SEO, and various methods of digital knowledge management that can be used to power delivery of knowledge for learning. Understanding knowledge in its new network matrix and developing methods for teaching and learning in our newly connected world hold enormous promise for education. I urge that our discourse move forward onto this fascinating new network platform for learning. □

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Learning Trails

Traversing the European Ed Tech Scene

Kevin Walker

Science Fiction and Swedish Ships

Although it's generally pretty easy to get around Europe by plane or train, with most capitals within a couple hours' reach, not everyone can take the time to travel, and someone's got to foot the bill. And so after conferences in Lisbon and Palermo, Giuliana Dettori arranged for the third conference of the Kaleidoscope special interest group in Narrative Learning Environments to be held online.

The result was truly international, with participants from Australia and the US as well as Europe taking part in three streams, with brief papers written by "discussion starters" to kick things off. There was even a "virtual cafe" for informal chat, and where else could you find a conference that got underway on a Saturday night?

As Dettori, of the Institute for Educational Technology of the Italian National Research Council (ITD-CNR), defined it, "Narrative is characterized by having a temporal and causal dimension, without which we don't have narrative but some other form of expression, like description, argumentation, or report." From an anthropological perspective, people from every known culture can mentally organize information better when recounted to them as a story, and grand narratives sit at the heart of many cultures, as Mark Childs pointed out—the Ramayana in Thailand, the Kalevala in Finland, Robin Hood and King Arthur in the UK, where Childs researches narrative in multi-user virtual environments at the University of Warwick.

The benefits of narrative in learning are well known. It is useful in many subjects, including science and math, because it helps us explore the meaning of experiences. And it can transform seemingly abstract concepts that students experience in school into meaningful experiences more appropriately reflecting their real-life experiences. Ruth Aylett of Edinburgh's Heriot-Watt University said that in the first NLE event a few years ago in Lisbon.

"This is related with the concept of narrativity," said Dettori. "That is, the relation between a narrative and the internal representation of that narrative that is formed in the user's mind, and depends on how the user perceives the narrative elements...it is not by chance that a single narrative gives rise to many narrations, since obviously all of us are different."

The story itself, then, acts as a tool, said Demetris Lazarou of the University of Bristol. "I think that although we can argue that a story is a tool, can we also argue that it is also a transferable cultural tool that can be internalized and enable learners to re-use it in a situation that may seem similar to them?"

Once Upon a Time...

The term "Narrative Learning Environments" (NLEs), according to Dettori, came about in the 1990s, first in the field of Artificial Intelligence, to describe learning environments in which stories, created by the interaction between user and system, had a central role to facilitate learning. More recently, due to increasing interest in the educational potential of narrative, the term moved into other contexts and developed along with other kinds of tools and techniques. In all NLEs, stories are related to the task at hand, and play a central role. As Dettori points out, in some environments a story is used merely as an appealing background to problem solving, without a tight conceptual integration between the assigned tasks and the narrative fruition. "In this case, the back-story simply aims to provide a generic, extrinsic motivation to work in the environment, but it does not characterize those environments as NLEs."

Federico Peinado of the Complutense University of Madrid characterized three main "ingredients" of NLEs: their educational approach, their narrative approach, and technology used. In other words, it's not just the software alone but how it is used, added Lazarou.

Acting Out

There was a heavy emphasis on games, and debate as to whether they qualify as NLEs in Dettori's definition. This is Childs' domain; in fact when not playing the role of researcher, he can be found as Jedi Red Pesto in the *Star Wars* universe, or as blue-skinned punk Gann McGann in *Second Life*. Which is more real? In the virtual world, he pointed out, the absence of direct visual and audio contact, combined with interaction entirely online, enable users to adopt new identities. But he questioned the notion that an offline persona is more "real," suggesting that sometimes avatars can be considered truer reflections of a person than their offline selves. When the corporeal can no longer "corrupt" the truth about who you are, you might find (or construct) a "better" version of yourself that suits you more than your offline body. Therefore, he said, it makes more sense to think about in-character and out-of-character roles. Role playing is always for an audience, and in games the audience is the other players. As for the story, it is constructed by the participants in real time.

Valentina Lupi, of the University of Genoa, suggested therefore that theater is a better metaphor for educational games than cinema, since it means more involvement on the part of the audience. Even more so, added Childs, in improvisational theater.

But what happens in massively multiplayer games such as *World of Warcraft*, wondered Daniel Spikol of Växjö University in Sweden, in which a real-time narrative has

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many authors? Maybe such an environment, suggested Beatrice Demont of the University of Genoa, is only an evolution of the dolls that children play with, but "created in pixels and able to show a representation of your ideas and mind on a screen instead of a doll's house." Now you can play not only with your neighbors but the whole world.

If everyone is making their own stories however, doesn't this defeat the shared central narrative that Dettori so values? "The quests in *WoW*," answered Childs, "make it far more a NLE than *Second Life*, because it provides a structure in which a story can be enacted. In fact, with role-play games, the narrative is central to the experience. The looser the imposed structure, however, the more flexibility there is for people to create their own narrative."

Dettori was skeptical. "If we eliminate what is considered as the source of the educational value of narrative, than we cannot expect to harvest its fruits. This is why I wonder what kind of dialogue comes out in games like *WoW*; role-play games usually must be carefully prepared, in order to give rise to real narrative." She wondered whether the constraints on the possible behaviors of characters are sufficient to make a coherent whole from the actions of unrelated players. "I have some doubts about it, and for this reason I suggest that such games should rather be seen as tools, to which we must add some pedagogical planning...."

Giving Direction

Could such story structuring be automated? This has been Peinado's research question. If so, he wondered, what proportion of human/machine control is suitable? To what extent can educational guidelines be modeled in a narrative environment? In stark contrast to *WoW* for example, many early NLEs had a single "main character" so that the plot could be easily controlled and developed around him or her. Peinado suggested instead automating the role of a director. "A director should have broad knowledge about what is happening in the world, controlling (at least partially) all the characters without taking any of their particular perspectives."

Peinado developed KIIDS (*www.federicopeinado.com/projects/kiids*) to test some of these ideas. Though not technically an NLE under Dettori's definition, it produced interesting results. In the end, he concluded that only under very specific conditions, domains, and application goals could such automatic direction make sense. He didn't view this as a defeat but rather a challenge for computer scientists.

Wolfgang Heiden of the University of Rhein-Bonn in Germany has worked directly with computer scientists, but from a different angle. In an experimental lecture on Advanced Hypermedia, he used an NLE to enhance motivation, as well as to add "soft skills" to a hard topic. "The students were given an exposé of a science fiction story about virtual environments, simulation, and faked perception, on which they had to elaborate in various media. The exposé was explicitly designed to cover all aspects of VR [Virtual Reality] technology that were on the list of teaching topics for the course."

After background research, students presented the knowledge they had gained about different VR systems. Heiden filled any gaps with additional lectures, in order to make a consistent story. This was supplemented by visits and interviews at nearby research institutes. "Almost all students confirmed enhanced motivation by the task to produce material for a science fiction story. Some of them (those of the 'hacker type'), however, had difficulties with the creative part and preferred for themselves to work on the story display platform on a technical basis."

The Hard Stuff

Okay for science fiction, but what about hard science? This was Lazarou's interest, and he was determined that narratives were "not used merely as a nice background just for making the task appealing to the learners, but the narrative itself needs to be an integral part of the learning process and be directly interrelated with the learning activity rather than just 'sugaring the pill'." (That term comes from Ruth Aylett.) He therefore went a step further and assigned specific roles, such as detective or Formula 1 mechanic, for added engagement and empathy. He reported that "after students and teachers had experienced NLEs in science, they then tended to consider stand-alone simulations as de-contextualized environments with no real or personal meaning for students." He also found benefits for narratives in "socio-scientific" scenarios such as arguing for or against the building of a new zoo. Narrative therefore helps learners "become more critical and aware of the information they receive from others and the ways they could use it in constructing arguments and counter-arguments; promoting and supporting in this way dynamic social learning."

There was debate about the power of narrative to tackle learner misconceptions, for example, telling stories of famous mistakes in order to elicit students' own stories. Katalin Munkaksy, of Eötvös Loránd University in Hungary, thought so. "Story telling is the first step in better communication, in better understanding the process of classroom learning." In her research, PowerPoint narratives of informal examples supplemented math lessons, using familiar language, and helped six- to ten-year-olds—particularly low-achieving ones—as well as teachers, who revised their teaching strategies after the narratives helped them see the misconceptions. "In Hungary, mathematics lessons are mainly about clear logical problems," Munkaksy said, and the narratives acted as a bridge for younger learners.

Dettori believes that narrative is important in mathematics, "since mathematics entails increasing levels of abstraction, and the use of stories can help the learners better deal with abstraction." From grasping the concept of number to operations that build upon that abstraction, narratives create a context, helping the learner "see" the problem.

It's easy to see examples of this. "I know of some research that uses sensors of movement," recalled Francesca Morselli of the University of Genoa. Students walk or run in the courtyard, and a computer draws a graph of their movement to prompt understanding of concepts such as function and derivative by means of "telling the story hidden in the graph."

World of Craft, and War

This raises the question, can the real world be considered an NLE? Perhaps to the extent that, as Dettori says, narrative has a central role, relating directly to the

activity being undertaken. What about, as Spikol has created, a mobile game driven by narrative? Or what about the following:

"In Sweden a huge ship was built by the Swedish king around the 16th century," said Anna Kerfelt of Gothenburg University. "On its first trip, it sunk!! This is of course a trauma in the Swedish history, building boats that immediately sink. So what to do?" In this case, drag the boat out of the water and build a museum around it so visitors can learn from the story. "Visiting the museum is very interesting, but where do you find the kids?... gathered together around the computers where you yourself can be the (re)constructor, counting, estimating, and discussing how you can build a ship that does not sink."

"I wonder if the situation would be as successful if the kids at the computers were not able to view the massive physical object as well," asked Sherri Wasserman.

"It would not be exactly the same experience," answered Dettori, pointing out James Wertsch's observation that using artifacts to mediate action always changes it by adding both affordances and constraints (which are often useful as well). "Even though the object is not materially used as a working tool," Dettori said, "I think that its presence there mediates understanding."

Wasserman had good reason for asking, for she is part of a New York design team working on the World Trade Center memorial museum; she hasn't got a massive physical object, but its powerful absence. Can you think of a stronger narrative? Yet within that, she notes, are a myriad of multifaceted perspectives. "For us, media is the great enabler. Our hope, or at least within our designs, is that people will want to contribute—as we recognize that their personal history was a part of creating the greater understanding of the event, they'll want to create a record of their story in order to contribute to the greater history."

Here we are back at massively multiplayer environments—*World of Warcraft* indeed. Even the much-heralded Web 2.0 enables many voices, faces, and actions, but maybe it lacks the strong storyline that NLEs have. "Tools for creating coherence are missing from a lot of the social technologies," concluded Spikol. "I don't think tagging and folksomonies are intelligent enough to create good narrative all the time. We still need authors..." □

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Topics for Debate

Alexander J. Romiszowski

Distance Learning and Higher Education Export (Part 2)

Prologue

In Part 1 of this column (March–April issue), I discussed aspects of the phenomenon of cross-border higher education (HE) provision by means of online distance learning (ODL), and specifically analyzed the proposed approach of the Whitney International University System. I then compared these plans with the experience of the first five years of operation of a somewhat similar international ODL system in Australia. I also suggested that there were other potentially powerful international "players" waiting in the wings, and concluded by questioning whether the playing field on which all this is to occur is really as flat and level as some globalization theorists would have us believe.

In Part 1, I quoted several persons. It seemed both "politically correct" and potentially revealing to draw their attention to the column and ask for comments and reactions. I also invited some people I had not named, but who have studied and published on HE export and ODL. Four invitees made extensive contributions, which, in three out of four cases, included personal interviews in addition to exchanges of e-mails. In this column, I use these contributions as the basis for continuing this fascinating Topic for Debate.

The Whitney mission as seen from a Latin American perspective

Carlos Longo, who has recently taken on the direction of the Whitney International University System's initiatives in Latin America, sent me the following statement:

> "The Whitney Model has three pillars—High-end technology, which will allow our member universities to provide 24/7 Internet access and two-way satellite channels at very low-cost—Quality assurance, which will provide a comprehensive way to evaluate our methodology, delivery, and content—Finally, using a unique network of universities and

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remote learning centers, a large number of Latin American citizens, who for a variety of reasons my not be able to get a degree in a quality higher education institution, will be able to achieve this via a member university of the Whitney International University System."

In personal discussion, Carlos conceded that despite the fact that all the resources necessary to take this plan to reality are available and in place, there will be many challenges along the way: different national education policies and legislation; different cultures and educational expectations; different types of competition from other tertiary education providers. So, despite the high-level technology infrastructure that will be the standard, and also the scalable and multipliable business model (described in Part 1), it is expected that not only will the operational details be different across different world regions, but also within any region, such as Latin America, one can expect subtle differences to emerge that will reflect the political, cultural, and socio-economic differences between countries and sub-regions within countries.

HE export via ODL: Some viewpoints of independent commentators

Next, I asked John Tiffin and Lalita Rajasingham, the authors of the ground-breaking book *The Global Virtual* University (Routledge-Farmer, 2003) to comment on the previous column from their perspectives:

John Tiffin wrote:

"The tiger wakes indeed. I remember some years ago asking a workshop of American educationalists…how long it would be before the Asian tigers did to the education industry what they have done to the motor car industry. The question did not go down too well because at the time education was still held to be a public good rather than something that could be bought and sold. Such squeamishness has long passed. Tertiary teaching is becoming big business.…By the end of this century it (may) be the biggest business…it is already getting near to it in Australia."

In a follow-up telephone conversation, I asked "What about New Zealand?" John said that the growth of HE export via ODL had not contributed as much to the national goals as had been expected. On the other hand, "onshore" study by visiting students continues to grow on a par with what is happening in Australia: "On the course I am teaching right now, I have only one New Zealander—the rest are all Asian visitors."

This seems to question the first of the three pillars that Carlos Longo described—high-level technologies as an essential part of the solution. What the client wants is affordable access and quality, however achieved. John also expressed some caution as regards the second of the three pillars—quality assurance:

"The elephant in the room that no one wants to talk about is that the massive expansion in student numbers in Western (not Asian) universities over the last quarter of a century has been accompanied by an equally massive decline in the standards of the degrees they offer. Yes I know that university administrators will howl in outrage at such a statement and wave quality assurance measures at me… but there is nothing that can show me whether a degree from Harvard or Cambridge is any better or worse than a degree from Peshawar or Madras. Current comparisons of universities are made on the basis of the research publications and awards of staff, not on the competence of graduating students. We have no agreed global standards by which to clearly measure quality in tertiary education, and as long as the customers for tertiary institutions continue to grow, who wants serious quality control (as distinct from assurance)?"

Lalita Rajasingham focused on Carlos Longo's third pillar, by describing the rise of serious competition to Western and Northern global education initiatives from the nations of the East and South. She described the Indira Gandhi National Open University as the largest university in the world, with 1.4 million students enrolled, and stated that some 24% of the ten million Indians in higher education are learning at a distance, at the Indira Gandhi National Open University, at 12 other open universities, and in the many dual-mode institutions—also that this figure is to increase to 40% (but I note that South Africa already exceeds this).

She emphasized that China continues to gather momentum, and mentioned the formation during the short period 1999–2003 of "Web Institutes" in 68 universities, that work through a network of 2347 Learning Support Centers. She also mentioned Malaysia's UNITAR, which in 2003 had 8000 students enrolled at eight e-learning centers in Malaysia and one in Cambodia. This institution is of course just one of several—in Part 1, I described the work of the Open University Malaysia (OUM).

Outside of Asia, she highlighted the African Virtual University, which by 2004 had 31 learning centers at partner universities in 17 African countries and is to expand the network to 150 learning centers in 50 countries, the Global Virtual University of the United Nations University (GVU), and the COL-sponsored Virtual University of the Small States of the Commonwealth *(www.col.org)*.

A response from COL

Sir John Daniel, the CEO of the Commonwealth of Learning, responded to my e-mail on a cautionary note, stressing that the same challenges facing the Whitney initiative that emerged in my conversation with Carlos Longo would apply in any large-scale international ODL initiative, whether public or for-profit. He referred me to his latest published thoughts on the issue, from which I quote *(International Online Courses: Issues of Global Quality Assurance, Multi-Country Collaboration, and Open Educational Resources;www.col.org/colWeb/site/cache/offonce/pid/5127;jsessionid=A5487E583E9D1D39BAC7854F48DD8A03)*:

"If online courses are to have a transformative impact, then institutions must avoid the difficulties that have led to the failure of many e-learning initiatives…they must be set within a global framework of quality assurance and qualifications recognition that inspires confidence.…Quality assurance and qualification recognition is never easy. However, UNESCO has created a space for policy debate on these issues through its Global Forum on International Quality Assurance,

> Accreditation, and the Recognition of Qualifications.…the E?xcellence approach…offers a Europe-wide set of 33 benchmarks, independent of particular institutional or national systems, with… orientation on aspects of quality specific to e-learning in the areas of curriculum design, course design, course delivery, services (student support; staff support) and management (institutional strategies)."

It is good to read that issues of quality are being addressed at the international level. But I hear John Tiffin cry that this is quality assurance and not control, focused on the process and not enough on the product: "What the world needs is a global tertiary examination system that is independent of those who teach."

The USQ reality as it has progressed

It is appropriate that ***James Taylor***, from the University of Southern Queensland, closes this discussion with hard data. He e-mailed me the latest (2007) figures for the International students studying at a distance at USQ. Table 1 presents data for 2003 (quoted in Part 1) compared to the update for 2007.

The first point of note is almost no overall growth in the last four years, after the rapid growth from zero to nearly seven thousand over a similar period from 1999–2003—and this in spite of "spreading the net" to many more countries. The second point is the change that has occurred in the national composition of the student body. If we consider the categories "Pacific Islands" in 2003 and "Fiji" in 2007 as equivalent, we still have four new countries moving into the "Top 10," forcing four countries out and others down some places. More significant still are the big shifts in student numbers from the "big player" countries, notably Malaysia (60% decrease) and Singapore (66% decrease). Indeed the overall numbers have kept steady mainly because of the very large (765%) increase in enrollments from China.

In a telephone interview, James Taylor said that there were many regional, cultural, political, and other forces that may in part be responsible for slight swings in enrollment. However, the principal reason for the large downward swings in Malaysia and Singapore was the appearance in these countries of competitors offering similar ODL products and services. Some of these new competitors were also "offshore," but others were locally based national (private and public sector) ODL providers. Increased enrollments were registered in most countries where the pattern of competition had not materially changed during the period in question. The exception to this was China—the market demand being so high that the USQ market share grew despite significant in-country growth in ODL provision.

Epilogue

The USQ experience is an excellent lesson in the market realities of cross-border higher education export by means of ODL—an example of the typical effects of globalization: opportunities wrapped in problems. However, as I closed this column, I received another e-mail from James Taylor with several attachments containing further insights—not only into the latest developments at USQ in relation to international ODL, but also into the overall trends of higher education export, both "offshore" and "onshore." That was one other issue that I had planned to debate in this current column, but space will not allow. These contributions will have to wait for the next column, where we shall get *more scientific and systematic* about the design, implementation, management, and evaluation of HE export. □

Table 1. The last four years at USQ compared to the first four years.

USQ's International Students in 2003

Malaysia	2,327
Singapore	1,598
Hong Kong	565
South Africa	288
China	195
Germany	188
Pacific Islands	180
United Arab Emirates	114
Canada	98
Japan	93
Total, including 67 other countries:	**6,976**

USQ's International Students in 2007

China	1,686
Malaysia	919
India	729
Singapore	534
Nepal	479
Fiji	222
Taiwan	236
United Arab Emirates	173
South Africa	220
Indonesia	148
Total, including 93 other countries:	**7,077**

In order to post any comments on the views expressed in this column, or to add any further contributions from your own particular vantage points, join me at the following URL: ***http://www.tts-global.com/blog/*** *. I look forward to continuing the debate.*

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New Issues, New Answers

Marc Prensky

The Courage to Change: Guiding Teachers to the New Paradigm

In "Changing Paradigms" (July–August 2007; *http://www.marcprensky.com/writing/Prensky-ChangingParadigms-01-EdTech.pdf*), I discussed how successful pedagogy in the twenty-first century is experiencing a shift from what I call the "old" paradigm of "kids being taught by teachers," to a "new" paradigm of "kids learning on their own" or "kids teaching themselves" with their teachers' guidance.

Of course, the paradigm is not "new" in the sense of first appearing in the world—it has been long advocated by "progressive" educators, from Socrates to Dewey to the modern constructivists. One part of the paradigm, however, *is* completely new: the use of twenty-first century technology to support the learner-based pedagogy in ways that it never could be supported in the past (which is likely why it failed to catch on in mainstream education.) Today, this powerful combination of pedagogy and technology is leading our students to learn in twenty-first century ways.

Never Say Die. While many have adopted the new paradigm as their primary teaching philosophy, most have not. The old lecture-worksheet pedagogy is still dominant in most of the US and the world. In the words of the kids I interview, most of their teachers just "talk and talk and talk."

What's the Difference? The basic difference between the two paradigms is that in the "new" one, rather than the teacher telling the kids the information (often repeating in less-detailed form what is in the textbook), the teacher guides them via questions to find the information on their own, using computers, books, or whatever is available. The teacher then helps the students structure what they find and ensures that nothing important is left out. The new paradigm is really just another way of getting the students to learn the same material, but to learn it as researchers and meaning makers, rather than as passive note-takers. Same material, different method. Not such a huge switch for a teacher, you might think.

But if you think that, you'd be wrong. In the minds of the majority of our teachers, the switch *is* huge, and changing seems impossible. In order to see how we might help these teachers change, let us look at some of the reasons why.

One reason the switch is hard—particularly in this age of high-stakes testing—is that these teachers feel their duty is to "cover" all the material, which to them means that if all the material hasn't come out of their mouths at some point, they haven't done their job. This is based on the assumption—false as it turns out—that if they haven't actually *told* the kids about something, there is no way they could have learned it. We need to show these teachers that there are other ways to achieve learning that are better.

Many see the problem as an issue of control. One high school teacher told me that even though she watched her seniors design a "fabulous" senior project while running, jumping, and screaming around the room, she would never tolerate that level of chaos when she was actually teaching, *even if she knew the results would be better*. The ideal picture for these "old paradigm" teachers is their students all quietly taking notes during a lecture. But today's students prefer actively finding their own information, being connected to the world through technology, whenever possible, and working in groups, which, though often messier, often leads to better results.

It Comes Down to Fear. Those teachers still teaching in the old paradigm offer many additional reasons for not moving toward the new: (1) The kids won't do as well on the tests. (2) The technology often breaks down. (3) I don't know if I can, even though I know it's the right thing to do—(whispered to me in the hallway out of hearing from her colleagues). (4) I'm too old. (5) I need training. In the end, all these reasons come down to the same thing: *fear*. This shouldn't surprise us—all change is scary. And changing the thing you do every day, where you have the most experience (and you might feel you have the most to lose), is *really* scary. A great many of today's teachers are "scared to death." Although they often cite the technology as the source of the fear, I think the fear is less about technology and more about the need to teach differently.

What Can We Do to Help? So what can those of us who are already there do to help these willing but frightened teachers move to the new paradigm, which both the students and the successful schools tell us is the right way to go?

"Feel the fear and do it anyway" was what I encouraged teachers to do, until a friend pointed out that that doing that was, in fact, the definition of courage. So now I encourage those teachers who still "talk and talk and talk" to find, inside themselves, "the courage to change."

And I believe they can and will change (at least most of them). But to do so they will need help beyond mere slogans. This is where all of us who want to help our kids—teachers, technology specialists, administrators—come in. My guess is that teachers will be brought to the new paradigm by three things: (1) examples they can emulate, (2) colleagues and administrators who support them, and (3) successful trials. The burden of creating these largely falls on us, the believers.

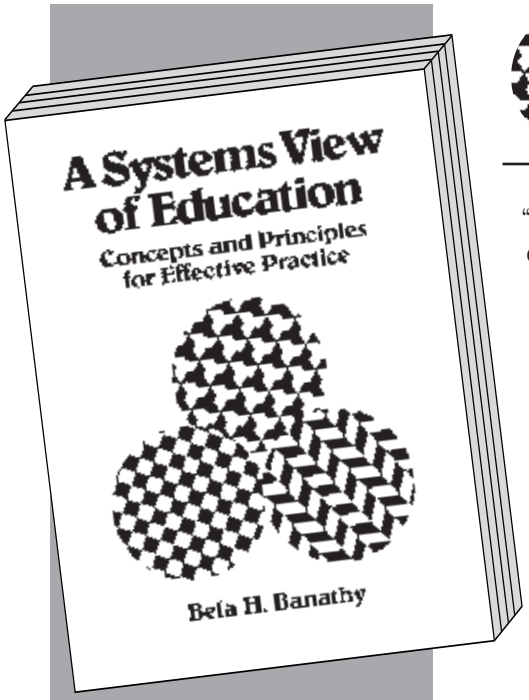
First, we need to be sure that there are plenty of examples, i.e., hundreds of videos on the Web, illustrating successful teaching in the new paradigm. A two- to three-minute video posted on YouTube or TeacherTube, with a teacher explaining, students endorsing, and a shot of the class in action, can do more than thousands of words to help a teacher "get" the change required. When there are statistics showing the classes' standardized test scores have increased (and often there are) add those in as well. Every teacher, specialist, or administrator who knows of a successful new paradigm teaching example ought to create and post at least one such video.

Second, those of us who are successful teaching in the new paradigm need to literally buddy-up with those who need to change, showing them the best examples, giving them advice and empathy, going to each others' classes and helping them prepare lessons. When administrators design inservice training, it should have the theme of changing the teaching paradigm as a prerequisite to introducing technology, and include a means of following up to ensure that change happens.

Third, we need to use our students as resources. We need to ask them how our lessons could be better, and encourage them to ask their teachers to try new ways. When lessons are successful, students need to give teachers positive feedback. Teachers and administrators trying to change can enlist their students as consultants. Students can help teachers find the good examples posted on the Web and make new ones.

In the language of business, our entire teacher corps is going through a major retooling, to the new student-centered learning paradigm. While the "old paradigm" teachers need the courage to change, the re-toolers need to be those of us who have already figured out how to do it—I'm not sure there is a better way. □

Marc Prensky *is an international speaker, writer, consultant, and game designer in critical areas of education and learning. Marc can be contacted at* ***marc@games2train. com*** .



A Systems View of Education

"Systemic" is a modern buzz word of high currency in both the public and private sectors. We are seeking "systemic" solutions to "systemic" problems. If we are ambitious, we combine "systemic" with "long term." This combination contrasts with short-term, piecemeal, disjointed efforts.

Recently, the notion of "systemic" has become a core concept in the search for educational reform. When we probe into the meaning of the term, often we get such answers as: "things are connected," "there is no single cause of the problem," "things are complex." Of course, these answers are all appropriate. But there is much more to the meaning of "systemic." "Systemic" enfolds large sets of system concepts that constitute system principles, which are common to all kinds of systems.

Systemic is manifested in multiple connotations, such as: the way we think (systems thinking); the way we understand phenomena (having a systems perspective) and characterize an entity (systems description); the way an entity behaves (systems behavior): the way we carry out disciplined inquiry (systems inquiry).

Having and acting upon a "systems view" embrace all the above. Having a systems view of education, for example, means that we can think about education as a system; we can design education so that it manifests systems behavior; and we can engage in educational inquiry by using systems approaches and methods.

The author has selected systems concepts and principles that are most relevant to education as a social system, and organized them into three complementary systems models: a systems-environment model, a functions/structure model, and a process/behavior model. This book is a learning resource for those who wish to understand basic systems concepts and principles; who wish to view and characterize education as a system; and who wish to learn the basics of systems practice.

Working with this book, and completing the personalized activities in it, requires first "reflective thinking"—willingness to give up, or at least suspend, old ways of viewing and thinking and to be open to new ways of seeing. Then it requires "creative thinking" and action, as one applies the systems view to the reconceptualization and redefinition of education, and to its redesign as a system that nurtures learning and aims at the full development of human potential.

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