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Knowledge Building

In what is coming to be called the "knowledge age," the health and wealth of societies depends increasingly on their capacity to innovate. People in general, not just a specialized elite, need to work creatively with knowledge. As Peter Drucker put it "Innovation must be part and parcel of the ordinary, the norm, if not routine." This presents a formidable new challenge: how to develop citizens who not only possess up-to-date knowledge but are able to participate in the creation of new knowledge as a normal part of their lives.

There are no proven methods of educating people to be producers of knowledge. Knowledge creators of the past have been too few and too exceptional in their talents to provide much basis for educational planning. In the absence of pedagogical theory, learning-by-doing and apprenticeship are the methods of choice; but this does not seem feasible if the "doing" in question is the making of original discoveries, inventions, and plans. Rather, we must think of a *developmental trajectory* leading from the natural inquisitiveness of the young child to the disciplined creativity of the mature knowledge producer. The challenge, then, will be to get students on to that trajectory. But what is the nature of this trajectory and of movement along it? There are three time-honored answers that provide partial solutions at best.

One approach emphasizes foundational knowledge: First master what is already known. In practice this means that knowledge creation does not enter the picture until graduate school or adult work, by which time the vast majority of people are unprepared for the challenge.

A second approach focuses on subskills: Master component skills such as critical thinking, scientific method, and collaboration; later, assemble these into competent original research, design, and so

forth. Again, the assembly—if it occurs at all—typically occurs only at advanced levels that are reached by only a few. Additionally, the core motivation—advancing the frontiers of knowledge—is missing, with the result that the component skills are pursued as ends in themselves, lacking in authentic purpose. Subskill approaches remain popular (now often under the banner of "twenty-first century skills") because they lend themselves to parsing the curriculum into specific objectives.

A third approach is associated with such labels as "learning communities," "project-based learning," and "guided discovery." Knowledge is socially constructed, and best supported through collaborations designed so that participants share knowledge and tackle projects that incorporate features of adult teamwork, real-world content, and use of varied information sources. This is the most widely supported approach at present, especially with regard to the use of information technology. The main drawback is that it too easily declines toward what is discussed below as shallow constructivism.

Knowledge building provides an alternative that more directly addresses the need to educate people for a world in which knowledge creation and innovation are pervasive. Knowledge building may be defined as the production and continual improvement of ideas of value to a community, through means that increase the likelihood that what the community accomplishes will be greater than the sum of individual contributions and part of broader cultural efforts. Knowledge building, thus, goes on throughout a knowledge society and is not limited to education. As applied to education, however, the approach means engaging learners in the full process of knowledge creation from an early age. This is in contrast to the three approaches identified above, which focus on kinds of learning and activities that are expected to lead eventually to knowledge building rather than engagement directly in it.

The basic premise of the knowledge building approach is that, although achievements may differ, the *process* of knowledge building is essentially the same across the trajectory running from early childhood to the most advanced levels of theorizing, invention, and design, and across the spectrum of knowledge creating organizations, within and beyond school. If learners are engaged in processes only suitable for school, then they are not engaged in knowledge building.

Learning and Knowledge Building: Important Distinctions

An Internet search turned up 32,000 web pages that use the term "knowledge building." A sampling of these suggests that business people use the term to connote knowledge creation, whereas in education it tends to be used as a synonym for learning. This obscures an important distinction. Learning is an internal, unobservable process that results in changes of belief, attitude, or skill. Knowledge building, by contrast, results in the creation or modification of public knowledge—knowledge that lives 'in the world' and is available to be worked on and used by other people. Of course creating public knowledge results in personal learning, but so does practically all human activity. Results to date suggest that the learning that accompanies knowledge building encompasses the foundational learning, subskills, and socio-cognitive dynamics pursued in other approaches, along with the additional benefit of movement along the trajectory to mature knowledge creation. Whether they are scientists working on an explanation of cell aging, engineers designing fuel-efficient vehicles, nurses planning improvements in patient care, or first-graders working on an explanation of leaves changing color in the fall, knowledge builders engage in similar processes with a similar goal. That goal is to advance the frontiers of knowledge as they perceive them. Of course, the frontiers as perceived by children will be different from those perceived by professionals, but professionals may also disagree

among themselves about where the frontier is and what constitutes an advance. Dealing with such issues is part of the work of any knowledge building group, and so students must learn to deal with these issues as well. Identifying the frontier should be part of their research, not something preordained. The knowledge building trajectory involves taking increasing responsibility for these and other high-level, long term aspects of knowledge work. This distinguishes knowledge building from collaborative learning activities. Keeping abreast of advancing knowledge is now recognized as essential for members of a knowledge society. Knowledge building goes beyond this to recognize the importance of creating new knowledge. The key distinction is between learning—the process through which the rapidly growing cultural capital of a society is distributed—and knowledge building—the deliberate effort to increase the cultural capital of society.

Shallow versus Deep Constructivism

"Constructivism" is a term whose vagueness beclouds important distinctions. Knowledge building is clearly a constructive process, but most of what goes on in the name of constructivism is not knowledge building. To clarify, it is helpful to distinguish between shallow and deep forms of constructivism. The shallowest forms engage students in tasks and activities in which ideas have no overt presence but are entirely implicit. Students describe the activities they are engaged in (e.g., planting seeds, measuring shadows) and show little awareness of the underlying principles that these tasks are to convey. In the deepest forms of constructivism, people are advancing the frontiers of knowledge in their community. This purpose guides and structures their activity: Overt practices such as identifying problems of understanding, establishing and refining goals based on progress, gathering information, theorizing, designing

experiments, answering questions and improving theories, building models, monitoring and evaluating progress, and reporting are all directed by the participants themselves toward knowledge building goals.

Most learner-centered, inquiry-based, learning community and other approaches labeled "constructivist" are distributed somewhere between these extremes of shallow and deep constructivism. Participants in this middle ground are engaged to a greater or lesser extent with ideas and they have greater or lesser amounts of responsibility for achieving goals, but the over-arching responsibility and means for advancing the frontiers of knowledge are either absent or remain in the hands of the teacher or project designer. The idea of 'guided discovery' suggests this middle ground. Middle-level constructivist approaches are best categorized as constructivist learning rather than knowledge building. Knowledge building calls for deep constructivism at all educational levels; it is the key to innovation.

Knowledge Building Environments

In knowledge building, ideas are treated as real things, as objects of inquiry and improvement in their own right. Knowledge building environments enable ideas to get out into the world and onto a path of continual improvement. This means not only preserving them but making them available to the whole community in a form that allows them to be discussed, interconnected, revised, and superseded.

Threaded discourse, which is the predominant Internet technology for idea exchange, has limited value for this purpose. Typically, ideas are lodged within conversational threads, contributions are unmodifiable, and there is no way of linking ideas in different threads or assimilating them into larger wholes. By contrast, CSILE/Knowledge Forum®, a technology designed specifically

to support knowledge building, has these required provisions and scaffolding supports for idea development, graphical means for viewing and reconstructing ideas from multiple perspectives, means of joining discourses across communities, and a variety of other functions that contribute to collaborative knowledge building. Contributions to a community knowledge base serve to create shared intellectual property, and give ideas a life beyond the transitory nature of conversation and its isolation from other discourses. Thus the environment supports sustained collaborative knowledge work, integral to the day-to-day workings of the community, as opposed to merely providing a discussion forum that serves as an add-on to regular work or study.

A shared workspace for knowledge building enables a self-organizing system of interactions among participants and their ideas and helps to eliminate the need for externally designed organizers of work. Advances within this communal space continually generate further advances, with problems reformulated at more complex levels that bring a wider range of knowledge into consideration. Thus there is a compounding effect, much like the compounding of capital through investment. Supporting such compounding and social responsibility for the collective work is the main challenge in the design of knowledge building environments.

In keeping with the belief that the process of knowledge building is fundamentally the same at beginning and advanced levels, and across sectors and cultures, Knowledge Forum is used from grade 1 to graduate school, and in a variety of knowledge-based organizations in countries around the world.

Social Aspects of Knowledge Building

Educational approaches of all kinds are subject to what is called the "Matthew effect": The rich get richer. The more you know the more you can learn. This is as close to a law of nature as learning research has come. It can be used to justify loading the elementary curriculum with large quantities of content. However, another potent principle is that knowledge needs to be of value to people in their current lives, not merely banked against future needs. This is part of the justification for activity and project-based methods where work is driven by students' own interests. In knowledge building this Deweyean principle is carried a step farther: Advances in understanding produce conceptual tools to achieve further advances in understanding. Thus there is a dynamism to knowledge building that can be a powerful motivator.

The Matthew effect foretells a widening gap between haves and have-nots in education, one that may already be manifesting itself in the widening income gap between the more and the less well-educated. No educational approach can be expected to solve the related equity problems, but knowledge building offers signal advantages. The knowledge building trajectory offers value all along its course, not just at its upper reaches. At all stages people are building authentic knowledge that is immediately useful to themselves and their community in making sense of their world. They are also developing skills and habits of mind conducive to lifelong learning. It is not assumed that everyone will come out equal in the end, but possibilities for continual advancement remain open for all.

From a social standpoint, the ability to connect discourses within and between communities opens new possibilities for barrier-crossing and mutual support. Successful knowledge building communities establish socio-cognitive norms and values that all participants are aware of and work toward. These include contributing to collective knowledge advances, constructive and

considerate criticism, and continual seeking of idea improvements. Grade 1 students, participants with low-literacy levels, and workers in knowledge-creating organizations can all adopt such norms, which then serve as a basis for cooperation across the developmental trajectory and among culturally diverse groups.

Knowledge building has been shown to yield advantages in literacy, in twenty-first century skills, in core content knowledge, in the ability to learn from text, and in other abilities. However, it is the fact that knowledge building involves students directly in creative and sustained work with ideas that makes it especially promising as the foundation for education in the knowledge age.

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