Can Schools Enter a Knowledge Society?

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A familiar question is how can schools prepare students for the 21st
century? But this question produces answers little different from
those that would have been produced at the dawn of the 20th century.
One answer is didactic instruction focused on traditional subject
matter. The other is what has variously been called progressive, child-
centered, open, or activity-centered education. Each has merit, but
neither prepares students for 21st-century knowledge work. The idea
of a knowledge building community presents a third alternative--an
alternative that encompasses the other two. In these communities
knowledge creation is built into the social fabric of the community,
and into the technologies that support knowledge work. Thus
progressive problem solving becomes as integral to schooling as it is
to knowledge-based professions and knowledge-creating
organizations.

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creation, knowledge building communities, knowledge society**

1 Introduction

Standing in the way of turning schools into knowledge building communities are two myths, one
of which supports didactic education and the other of which supports activity methods. The first
is the "foundations" myth--the myth that a substantial period of learning must occur before
students are ready to criticize or advance knowledge. According to this myth, only a select few
can ever become knowledge innovators, and then probably only in graduate school. The second is
the "concreteness" myth--the myth that young students are only at home with the familiar and
the manipulable. It is allowed that young students *have* ideas, but it is not granted that they can
happily *work with* ideas. Both of these myths assume that the teacher alone is in direct contact
with the world of ideas, metering these out to the students in one case or designing activities based
on them in the other case.

The knowledge building communities that I have worked with constitute living refutations of
these myths. Even the youngest of participants work creatively with ideas. The notion that ideas

are improvable--that one should go beyond the given information--is conveyed early, and refined through constant engagement in improving ideas. This experience makes it impossible to receive an idea without turning it over, contrasting it with personally held beliefs, thinking of analogies, contemplating conditions under which it will not hold true, imagining what a better idea might be, wondering how knowledgeable people arrived at this understanding in the first place, contemplating counter-positions, connecting related ideas.   In cultures that support a process of idea improvement, students learn to negotiate the worlds of received wisdom and new ideas for themselves, rather than depending on the teacher as an intermediary. The contrasting, more shallow processes for internalizing received ideas--memorization, use of mnemonics to aid recall, regurgitation of information, close paraphrase of ideas, are all less rewarding. Creative work with information is what converts it into ideas that are personally relevant, that are useful in a variety of contexts, that are understood so deeply that they are resistant to forgetting, and that help in understanding other ideas.

Knowledge creators and expert learners alike deal directly with ideas. In contrast, most school learning situations, whether of didactic or child-centered kinds, focus on something other than ideas —producing an essay, doing assigned exercises, carrying out a prescribed experiment, or undertaking a student-designed project. Whether it is the dullest of drill-and-kill classrooms or the liveliest of open classrooms, everything seems to be focused on tasks and activities. It is as if schools are designed to promote learning by any means, so long as it does not involve work with knowledge. The challenge is to bring knowledge into the center of students' (and teachers') attention.

For the classroom to shift from a focus on tasks and activities to a focus on knowledge is a radical shift, as all who attempt it discover. I have come to liken it to a Copernican Revolution, for it is much like moving the sun from the periphery to the center. The focus on tasks and activities is not simply a matter of tradition. On one hand, it is an adaptation to the management situation faced by a teacher who must keep thirty or so students productively occupied throughout the school day. For the Copernican Revolution to take hold, that management situation has to be altered—and since very little can be done about the many-to-one ratio, this means somehow radically altering the activity structure. But the focus on tasks and activities also seems to derive from the two myths I have cited. These myths have been so widely accepted that they constitute the conventional wisdom--a wisdom that adds up to a low opinion of students' intellectual capabilities. Changing that wisdom requires demonstrations that young students are capable of genuine engagement with ideas.

So, the design challenges, as we have approached them, are:

1. Provide 'a way in' to knowledge creation for all students. This requires that students acquire agency over their own minds. It is this *epistemic agency* that allows them to begin to create, examine, and improve ideas.

2. Engage students directly with *idea improvement* and with *problems of understanding*. This requires that students become constructivists themselves--understanding that knowledge is constructed and continually improved upon by people, and that this is something they can do.

3. Render the hidden aspects of knowledge creation transparent and foster these processes in day-to-day discourse *Knowledge-building technology* serves this purpose.

4. Provide social supports for knowledge creation. This is the role of *knowledge building communities*.

5. Sustain work at the cutting-edge of abilities and disciplines. This is fostered through a *Knowledge Society Network*.

These five challenges are discussed below, in the context of the central challenge, which is to bring ideas to the center of classroom work.

2 Epistemic Agency

Knowledge builders take charge of their own learning, taking responsibility for personal understanding and for the creation of knowledge artifacts. The starting point for epistemic agency is the ability to recognize a relation between what is in one's own mind (which may be a well-formed opinion or only a vague feeling) and something external (what others say, an established theory, etc.). Epistemic agency means working through that relationship between internal and external ideas to some resolution. Ideally, that resolution will consist of a revised idea, which then becomes the object of a further cycle of knowledge work. The great challenge for teachers is to turn this demanding work over to the learners, not to do all of the relating, negotiating, and reconciling for them.

Turning over responsibility for tasks and projects is relatively easy. So is devising individualized schemes with contracts specifying learning or work objectives. What is hard--and typically absent--is turning over the executive processes--those processes that seemingly depend on some higher, more knowledgeable and responsible agent in the learning process. Being able to assume responsibility for these executive processes begins with the ability to set forth personal theories and to refine these, and extends to the full set of executive processes listed below:

• set goals for learning and for project work
• identify tasks and problems that extend understanding beyond current limits
• monitor performance to determine when it is falling short of expectations
• define remedial steps when learning falls short
• elucidate connections between today's learning and yesterday's and between one person's work and anothers'
• clarify how ideas are relevant to a variety of real-world problems

Teachers and managers tend to keep these processes for themselves, even in the university and workplaces. What would their role be if they gave them away? In a knowledge-building community the role of the teacher or manager is to give this expertise away, by turning over higher-and-higher levels of responsibility for knowledge work. There is nothing beyond consideration for responsibilities to be transferred.

Only teachers who themselves have a high level of epistemic agency can accomplish this. The more responsibility they turn over to students, the more demanding the knowledge work they must engage in. This is because each participant is setting their course of development, and engaged in working at the limits of their understanding. This is different from going off in different directions and needing to be pulled back on course. Participants are drilling deeper into the belief systems and known information regarding a body of work, and then rising to new heights to view the landscape of their ideas. The teacher's knowledge does not circumscribe interactions. By serving as a model of expert learning, the teacher helps others gain insight into the executive processes by which learners take charge of their understanding.

Enabling students to elaborate theories, to evaluate new information in light of them, to engage in theory refinement and, more generally, to contribute products of mind to communities in which those products are continuously improved--this is what we term the 'improvable ideas' challenge.

3 Improvable Ideas

The history of scientific achievements teaches a lesson: ideas are improvable. Even when an idea is completely discredited, such as the Becher-Stahl-Priestley phlogiston theory, it still plays a role in stimulating the research that leads to the more advanced idea, in this case Lavoisier's oxidation theory. Oxidation theory was further advanced by Dalton's atomic theory. We still think of all of these theorists as geniuses, but people who hold pre-atomic beliefs are considered to hold naive conceptions while contemporary chemists pursue theories that continue to advance improved versions of last year's theories.

Epistemic agency enables idea refinement. Improving on existing knowledge, grasping and applying what is already known by others, and creating knowledge new to the world are all psychologically similar and intensive knowledge processes. The fact that someone already knows the answer to a question does not diminish the importance of asking the question; it only diminishes the importance of the achievement in answering it. And the fact that an answer can be provided by an authority does not diminish the need for others to be able to understand the answer. The dividing line between expert and inexpert knowledge workers is not in the process through which they work, it is in the level at which they are able to contribute.

Learning often occurs spontaneously and without awareness. Idea improvement, however, is a deliberate creative process. The first requirement for making it happen is epistemic agency. Students have to assume high-level executive responsibility for advancing their personal knowledge. The second requirement is that their personal beliefs and understandings must be made public. Explicitly formulating "my theory" makes possible a number of important actions that are not available for privately held or tacit knowledge. "My theory" may now be compared to other theories, tried out on relevant problems, subjected to criticism. Beyond the question of "Is it right or is it wrong?" are more constructive questions: "What do I need to find out in order to improve my theory?" "What is still vague or incomplete about my theory?" The third requirement is that they must situate their efforts at theory improvement within a larger context of knowledge work. "Mendel worked on Karen's question," claims a Grade Five student engaged with a team of students improving their ideas about the inheritance of parent characteristics. Students who continually improve their ideas like to view their intellectual work as a natural extension of the work of great minds. They appreciate the inputs that situate these ideas in the

context of key players in the field. The final requirement is a responsive community that cares about the problem that "my theory" addresses.Often this community is limited to the local classroom, where the ideas under consideration may be relatively limited in scope and the participants in the knowledge building enterprise more accepting of ideas than would be the case if they were evaluated by a more distant and severe critic. It is possible to be overly supportive or overly critical. Knowledge advancement thrives in cultures of constructive review--review through which dissenting positions are noted, contradictory data discussed, experiments conducted, and knowledge conflicts resolved by rising to a higher level. These issues are elaborated in the sections below titled Knowledge Building Communities, and the Knowledge Society Network.

Knowledge building technology and communities are built on the assumption that if the ideas of great minds have been improved continuously throughout history, that process is a good one to emulate. The most frequent objection we encounter relates to a concern about bringing misinformation out into the open. The concern is that when misconceptions appear (as they inevitably do when participants are advancing their own ideas) they will catch on and spread like wildfire. In 15 years we have seen no evidence that knowledge building communities hold tenaciously to misinformation, preferring weak ideas to better-developed ones. Once we replace a fear of misinformation with appreciation for continual improvement, we find that pride comes with demonstrations of advances in understanding. Idea improvement is something everyone can do to some degree, and students can get better at it through hearing others report how they went about it. For example, students report advances from their earliest understanding to more refined understanding, and in doing so provide an account of what they read and what made them see things differently. In a workplace context we might learn more about changes in procedures associated with higher productivity. The combination of a culture that prizes continual improvement, and reports of those advances, has proved more valuable than static accounts of ideas, whether those accounts are naive or mature.

4 Knowledge Building Technology

'Ideas to the center' is the knowledge-creation challenge, technology a vital part of the solution. Knowledge Forum®--a second-generation CSILE (Computer-Supported Intentional Learning Environment) product--was designed to render the underlying, hidden aspects of knowledge creation transparent to users, and to support the continual improvement of ideas. The technology itself has been refined continuously through more than 15 years of daily use, first in school contexts and more recently in hospital settings, businesses, cultural settings, and a variety of other contexts.

In traditional classroom discourse the teacher knows the answer to the questions she asks and she knows what ideas will be conveyed if classroom discussions are successful. She monitors discussions and provides corrections to their direction to ensure they remain on course. While the teacher works to keep the discourse on track, the students work to tell the teacher the things she is waiting to hear. This 'knowledge telling discourse' [1] [2] is by no means limited to schooling. It is familiar in workplace settings, including the modern e-learning world. Any time there is a course of study, with predefined benchmarks for success, and efforts to ensure that participants arrive at that endstate, there will be knowledge telling discourse. It is a time-honored and valuable

form of interchange that provides a check on whether to-be-learned material has in fact been learned. It is fundamentally judgmental--a test. It is not reflective. The average wait time for an answer after a teacher has posed a question in face-to-face interchanges has been clocked at a few seconds [3] the average time for Grade Five students to get started writing after being assigned a short essay topic was likewise very brief - just a few seconds. [4]. (By contrast, the time for reflection while writing ran as high as several hours in a class that had learned to take a knowledge-building approach.)

Discourse tuned to presenting the 'correct idea' is the antithesis of discourse that encourages epistemic agency and idea improvement. The process of improving on ideas is not a more sophisticated or elaborate version of knowledge telling discourse. It is a radically different process in which ideas start as inchoate entities and through rethinking, restating, reevaluation in light of feedback develop into more fully formed ideas. In order to support such discourse, and to bring ideas to the center of classroom life, traditional teaching-learning interactions need to be altered.

Knowledge Forum overcomes the dominant role of knowledge telling by providing a forum through which ideas are entered into a community for sustained work with them. Community members build and refine a jointly-owned, multimedia design space (technically a database) by entering their ideas and thereby making them explicit and setting them in a context where they are built on, cited, refined, summarized, published, and in other ways analyzed and improved. All members have access to the notes of all other members, and in this way individual contributions are raised to the level of significant knowledge resources. The process of review and synthesis demands and encourages the production of ideas valuable to others. Reflection, teamwork, and analysis of ideas from multiple perspectives leads to the production of better knowledge. Linkages with other communities--made possible through a system of virtual visitation--allow ideas to be reviewed by increasingly distant, and possibly more objective participants. Members of the local community determine the amount and type of external contact, interaction, and review that they want to engage in.

In more specific detail, Knowledge Forum users author *Notes* and *Views*. *Notes* are individual or co-authored entries that present a problem to be solved, a diagram for a new design, a theory and supportive evidence, a point needing clarification--any knowledge object of significance to the community. Any artifact of an organization (a manual, research report, map, spreadsheet, video) can be entered as a note. These notes are contributed to one or more *Views*. *Views* serve as collaborative design spaces. Co-located or distantly located participants meet there to advance their work jointly. That work might be any challenge that a team decided to tackle: a project that needs to be completed next week, a problem of understanding, the creation of a model to serve as prototype for something to be built, an overview of organizational goals for review and assessment, and so forth. The backdrop for their work (the view background) may be white space, a text, a graphic, or any organizational framework for notes that the community designs. Any objects brought into the Knowledge Forum database, including views themselves, can be treated as an object of inquiry and a candidate for improvement. The trace of entries over time, including the revision of notes and reconstruction of views, serves as an objectification of group advances, like the accumulating issues of a scholarly journal.

Advanced knowledge processes are supported as contributors use additional facilities (italics) to:

- '*build-on*' the work of others. Readers can build-on any note--just click the build-on icon that appears on each note and a new, automatically linked note, will appear. These linked notes can be rearranged to form a variety of visual organizations for ideas (a list, a hierarchy, a matrix , and so forth)

- *reference* others' work. Any section of a note can be copied into another note, resulting in automatic insertion of a quote, an icon that returns readers to the original, and compilation of a *bibliography* of cited material. Thus participants are encouraged to recognize the work of others and contribute to it rather than plagiarize.

- *scaffold* advanced knowledge processes. High-level knowledge processes such as theory refinement and constructive criticism are supported through scaffolds that encourage users to identify the knowledge processes that they are engaged in. Scaffolds are customizable, so users can fine-tune these to suit their needs.

- *co-author* notes. Note authors can allow specified others to write and edit a note, in which case the note is coauthored

- create *collections*. Through simple drag-and-drop facilities collections of notes can be created.

- *annotate* or comment on a note. Post-it like notes can be inserted within other notes.

- '*rise above*' a set of notes. Authors can synthesize ideas, create historical accounts, enhance organizational memory by creating special collections of notes. Rather than simply placing notes in spatial relation to one another (*collection*), it is possible to create a super note--a note that packages other notes and encourages the creation of a higher-order synthesis of them

- *publish* notes and views. Knowledge Forum supports a publication process similar to that of scholarly journals. Users produce notes and views of various kinds, frequently revise them, and can submit them for peer review. 'Published' notes and views appear in a different font and searches can be restricted to published notes on designated topics.

- *search* for ideas. Search facilities allow users to find and order notes in a note reader.

Notes can be contributed to one or more views and easily rearranged and embedded in graphical displays to represent different ways of conceptualizing the developing knowledge base. *Views-of-views* allow participants to create higher-order interpretive frameworks for this growing body of ideas.

Knowledge Forum operates on either a local area network or over the Internet. Communities set access privileges and permissions so that guests can join online activities. Participants may be co-located or distantly located, and they may structure their own, separate design space, or a common design space. If they work in separate databases, they can choose to provide others with full access, or limit access to the published views. A system of virtual visitations allows communities to visit one another. Selected views can be replicated from one design space into another to create new cross-community discourses. Participants (currently spread over 10

countries) can also gain access to each other's databases through a Web browser. A Palm KF version will soon be added, to allow synchronization of online and offline work.

Research tools work in the background of this workspace, recording processes automatically so that, if the community chooses, research into the operations of the community become integral to its operations.

We have found theory refinement in evidence even among Grade One users of Knowledge Forum [5]. This finding suggests that the technology has been successful in one of its main objectives, to provide 'a way in' for everyone, and thus to take the essential first step in enabling knowledge creation. The same technology and the same social structures are being used to provide 'a way in' to knowledge building for people in health care, graduate school, business, cultural organizations, and other workplace environments. This not only demonstrates the universality of the basic ideas, it opens the way for Knowledge Building Communities to form into a larger whole--a Knowledge Society.

5 Knowledge Building Communities

It is hard to maintain epistemic agency if personally held beliefs have no life outside one's own thoughts. The first challenge is getting ideas into a community's meme pool. 'Memes,' a term coined by Richard Dawkins [6] , play the role in cultural evolution that genes play in biological evolution. Dawkins argues that natural selection applies to anything that can replicate, not just DNA. Pinker [7] elaborates:

> Memes such as tunes, ideas, and stories spread from brain to brain and sometimes mutate in the transmission. New features of a meme that make its recipients more likely to retain and disseminate it, such as being catchy, seductive, funny, or irrefutable, will lead to the meme's becoming more common in the meme pool. A complex meme ...arises because some person knuckles down, racks his brain, musters his ingenuity, and composes or writes or paints or invents something. Granted, the fabricator is influenced by ideas in the air, and may polish draft after draft, but neither of these progressions is like natural selection. Just compare the input and the output-draft five and draft six, or an artist's inspiration and her oeuvre. They do not differ by a few random substitutions. The value added with each iteration comes from focusing brainpower on improving the product, not from retelling or recopying it hundreds of thousands of times in the hope that some of the malaprops or typos will be useful. (p.208-209)

Knowledge building communities provide a hospitable environment for ideas, plus a value-adding environment so that with each iteration the focusing of 'collective brainpower' improves those ideas. These communities represent the social innovations that corresponds to Knowledge Forum's technological innovations [8] . Priority is given to the production of ideas of value to others, not simply to demonstrations of personal achievement. Ideas that are insignificant, immature, out of touch with the community's canons will be ignored or dismissed. To avoid this fate one must successfully negotiate the world of differences between personal or new ideas and currently dominant ones. This requires a dialectic between personal ideas and ideas 'out there.' Knowledge building communities thrive on this dialectic. Different participants set out their

different beliefs, and members of the community approach incoming information from different vantage points. How well do the different theories account for all known information? Does one theory provide a better account than another? Working through this process brings participants into the very processes through which ideas have been debated and refined historically.

The defining characteristic of members of a knowledge building community is commitment to the collective goal of improving ideas. Advancement of knowledge is pursued jointly and strategically and with deliberate investment of resources. Participants aim to redefine problems at deeper or more inclusive levels as they proceed rather than to eliminate problems. Collective expertise is evident in links to views of different team members and in the production of higher-order conceptual frameworks. Analytic tools that work in the background allow yet another layer of reflection on community operations. The result is continual advancement of the community's knowledge and capabilities, similar to the process of expertise in cutting-edge research and development teams. [9] [10].

6 The Knowledge Society Network

The Knowledge Society Network (KSN) takes collaborative knowledge building to a new level--to a network-of-networks of knowledge building communities. The KSN provides a natural extension of the progressive refinement of ideas, knowledge sharing, and group interactions that define work within a community.

For many Internet users (including many educators) the power of local-community networks is unknown to them. All they know is connections to remote people and sites; they have trouble seeing the point to network connections among students who are all in the same room. In contrast, the Knowledge Society Network leverages off of this power to align human and digital resources in ways maximally conducive to knowledge advancement. Outside communities do not provide the special recognition that comes from sharing a common culture and mission. But they can provide distinctive forms of knowledge building support, such as a counter influence to narrowing perspectives [11]. One of the knowledge arts of a knowledge-building community is knowing when to expand horizons. Globally networked knowledge building communities give new meaning to work at the cutting edge, as they help sustain problem solving with the full complexity of problems represented in the world at large.

The KSN was initiated through support of the Canadian TeleLearning Network of Centres of Excellence, and now represents an international, virtual institute. Its participants represent cross-sector communities (schools, small businesses, universities, hospitals, research scientists). The digitally stored output of these online communities provides data for continually improving this work. The work of these communities is enriched and also made increasingly demanding by commitment to openness in knowledge building. Participants agree to allow their design space to serve as an object of inquiry for other members of the network. Communities are joined through partnerships and shared commitment to break down traditional organizational isolation and barriers. By making use of talents within and between communities, knowledge building is built into the dynamics by which participants communicate and pursue organizational goals. Processes of reflection, review, and publication encourage each community to create high-level syntheses of their work and share these with teams working on parallel problems elsewhere. For example,

elementary school social studies communities might work with high school social-study communities, and they in turn with social scientists in various community organizations. There is no predetermined alignment; communities may find their cutting edge in unanticipated places. The process common to everyone is knowledge advancement.

The KSN represents a design experiment--what Dewey termed an "end in view"[12]—some envisioned but as yet unrealized advancement in practice. The 'end in view' is a society that turns over the process of knowledge creation to all of its members [13] . Knowledge generated through this experiment is fed back into practice as further experimentation, thus resulting in a progressive research program. Our work to date suggests that it is better to think in terms of interleaved or nested communities, rather than one global community, and to support multiple and diverse forms of interaction. These include virtual visitations, the creation of progressively higher views of the community's work, opportunities for connectedness on the basis of shared problems of understanding rather than a priori segmentation on the basis of sector, age, or research community.

7 Conclusion

Advancing knowledge is a concept common in science, scholarly disciplines, and modern knowledge based-organizations. What is radical is the suggestion that this concept should be applied to schools, service organizations, and more generally, organizations not known for knowledge innovation. How can they be brought into the knowledge creation fold? As suggested above, this requires that we provide 'a way in' to knowledge creation for all and engage them directly with problems of knowledge. Knowledge building technologies provide the enabling environment; knowledge building communities provide the social support by engaging all members in the process of knowledge creation. In both local- and wide-area contexts, responsibility for the success of a group effort is distributed across all the members rather than being concentrated in the leader. This is the case in research groups and other groups directly concerned with knowledge production. We propose that this process provide the foundation for schooling. In this way progress emerges from the opportunities created by earlier progress--as it does in knowledge creating organizations.

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