Knowledge Building, Constructivism and Online Learning Environments:

The Work of Carl Bereiter and Marlene Scardamalia

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Introduction

At the turn of the twentieth century, John Dewey advocated for an education system that took into account the interests and experiences of individual students. In the hundred years since, we have seen the education pendulum swing back and forth between the ideals of student centered education that Dewey espoused and the teacher centered approach that is favoured by supporters of standardized testing and teaching accountability. As we begin the second decade of the twenty first century, the student-centered approach is at the forefront. Teaching strategies such as differentiated instruction, layered curriculum and multiple intelligences dominate teacher lexicon and the epistemology of constructivism has begun to permeate the teaching landscape. Adding to the shift towards student centered teaching and learning is the push to identify and develop so called twenty first century skills. These skills include working with technology, collaboration, creativity and problem solving and at times they run counter to the traditional skills cultivated in educational settings. As many popular videos like to point out, we are training students for jobs and careers that do not currently exist, and thus the current dilemma in education pits the need to build specific content knowledge vs. the need to develop skill-building capacity to properly prepare students for an uncertain future. The work of Carl Bereiter and Marlene Scardamalia at the Ontario Institute for Studies in Education at the University of Toronto, specifically their work with regards to knowledge building, provides an insight into the challenges in education today and gives educators a new lens through which they can confront these
challenges. This paper serves to discuss the concept of knowledge building and how the contributions of Bereiter and Scardamalia can be used to make sense of the challenges in education today. Secondly, it will discuss how the key components of knowledge building theory can be used to provide a framework for the development and implementation of online learning environments.

The Current State of Education

In his book, Education and Mind in the Knowledge Age, Bereiter (2002) identifies a metaphor that describes part of the rationale behind traditional education, the mind as a container. This metaphor describes the didactic approach in that the teacher possesses knowledge and it is their responsibility to pass that knowledge into the mind of the student. As education evolved towards the end of the 20\textsuperscript{th} century efforts were made “to shift from a didactic approach focused on the transmission of knowledge and skills to what is popularly called ‘active learning,’ where the focus is on students’ interest-driven activities that are generative of knowledge and competence” (Scardamalia & Bereiter, 2006, p. 116). One of the reasons for this shift is a societal focus on so called 21\textsuperscript{st} century skills; and this focus has influenced the design of current curriculum. This curriculum emphasizes “a set of personal qualities that must be cultivated if the education system is to produce people who can thrive in and contribute to the new order: imagination and creativity, ability to work in groups, communication skills, information-finding skills, problem solving abilities, technological literacy, and above all a continual readiness to learn” (Bereiter, 1997, p. 3). Although
Bereiter acknowledges the merits of these skills, he also posits that this ideology has given rise to the thought “that technology will revolutionize everything, that we don’t need schools anymore, and that there is no use mastering any body of knowledge because it will soon be obsolete” (Bereiter, 1997, p. 3). The idea of technology replacing knowledge is countered by Scardamalia (2003) who points to the example set by graduate schools to provide guidance for all levels of education; “Except at the graduate school level, education has little concern with creating knowledge that is new to the world. Yet there is a growing expectation that education at all levels should equip students for life in what Peter Drucker has termed the ‘Knowledge Society’” (p. 10). In a knowledge society or the ‘knowledge age’, human ability to innovate and create new knowledge is what allows the society to succeed and prosper (Scardamalia & Bereiter, 2003). In our current educational system there is a growing awareness of this need for innovation; “that there is more to learning science, mathematics, or history than mastering an organized body of content and a set of procedural skills” (Bereiter 1994, p. 22). Scardamalia and Bereiter (2006) describe this difference between mastery of content and the ability to manipulate knowledge using the phrases ‘knowledge of’ and ‘knowledge about’. They use knowledge about to illustrate traditional educational practice; the knowledge you could recall when asked about a subject, that is similar to the information given in textbooks, which students recreate in projects and assignments. Knowledge of a topic or activity implies an ability to participate. It contains both procedural knowledge (the how to) and content knowledge that would be derived through experience. They
summarize the difference between these two concepts in terms of education; “Knowledge about dominates traditional educational practice … Knowledge of, by contrast, suffers massive neglect” (Scardamalia & Bereiter, 2006, p. 105).

Bereiter (1997) proposes a significant shift in the culture of education where the concept of knowledge of plays a more significant role and where schools are used as workshops to generate knowledge; “Transforming schools into workshops for the production of knowledge mobilizes those skills and personal qualities valued by business futurists, putting them to work toward ends that are consistent with contemporary conceptions of learning and with the objectives of a modernized liberal education” (p. 2). The idea of a liberal education harkens back to the work of Dewey but in current education it is often referred to as constructivism. Schwartz and Fisher (2003) state, “Constructivism emphasizes that new knowledge is a personal creation that is socially mediated” (p. 23). This seems to fit within the framework of Bereiter’s proposal, however he has some reservations about how the philosophy of constructivism is put into practice in classrooms and how it fits within the ideology of knowledge building.

**Constructivism and the Production of Knowledge**

It is important to note that constructivism is a theory of learning, born out of extensive research into how humans acquire knowledge. It refutes the metaphor of the mind as a container and promotes the importance of pre-existing knowledge and experience. “One of the most important discoveries guiding learning sciences research is that learning always takes place against a
A backdrop of existing knowledge. Students do not enter the classroom as empty vessels waiting to be filled; they enter the classroom with half-formed ideas and misconceptions about how the world works” (Sawyer, 2008, p.6). Connecting this to the world of formal education, Russell (1999) posits, “isolated facts are of little interest to a learner unless they are connected to or understood within the learner's larger framework of knowledge. This suggests that interactive exhibits, curriculum, and other learning tools should be constructed, taking into account the prior knowledge and existing interests of the learner in relation to the information and experiences introduced” (p. 1). Constructivism also emphasizes the idea that although knowledge is a personal creation, the social aspect of creating that knowledge cannot be overlooked (Schwartz & Fischer, 2003).

As a theory, constructivism causes a radical shift in how we think about teaching, learning and knowledge creation. For Bereiter and Scardamalia however, the practical application of constructivism does not necessarily fit within their concept of knowledge building. "Knowledge building is clearly a constructive process, but most of what goes on in the name of constructivism is not knowledge building" (Scardamalia & Bereiter, 2003, p. 4). The reason for this lies in how each theory uses knowledge. Bereiter (1997) cites his experience with constructivist pedagogy and how very little of it “is actually concerned with the production of knowledge. Instead, it is concerned with the carrying out of projects that use knowledge but have some other objective than its production” (Bereiter, 1997, p. 9). This is an important distinction as it introduces a difference
between how knowledge can be used for learning and how knowledge can be used to create new knowledge.

For teachers attempting to discern the nuances between constructivism and knowledge building, it is important to understand that in knowledge building the teacher can still take a central role. “Constructivism is taken to mean independent hands-on activities, ignoring the outstanding examples of constructivist education that depend on teacher-led, highly focused inquiry” (Bereiter, 2002, Chapter 1, p. 1). He further emphasizes this point, “Sometimes the most important constructivist move you can make, the most vital way of promoting knowledge building, is to sit students down and teach them something” (Bereiter, 2002, Chapter 8, p. 35). The social aspect of constructivism is also represented in knowledge building with the idea that communities of learners work together to create and construct new knowledge. These knowledge building communities “develop a kind of collective expertise that is distinguishable from that of the individual members” (Scardamalia, 2000, p. 6). Thus, constructivism and knowledge building share similarities, especially in terms of incorporating the social aspect of learning, but in knowledge building the focus remains on creating new, and innovative knowledge.

Knowledge Building

Knowledge building is a difficult concept to grasp initially as it does not follow a defined set of procedures that allow for simple reproduction on the part of the teacher. It is a process aimed at creating a product, which Bereiter calls a
conceptual artifact (explanations, theories, solutions, algorithms), that improves current ideas (Bereiter, 1994; Bereiter, 2002). Scardamalia and Bereiter (2003) define knowledge building “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” (p. 2). The goal of knowledge building is to build upon and improve ideas, and this is an explicit principle that guides the process and is known to both teachers and students (Scardamalia & Bereiter, 2006). A key component of knowledge building is that it is a social process that results in the creation of public knowledge, which can then be used as part of the process for further knowledge building (Scardamalia, 2003). Scardamalia and Bereiter (2006) describe this as “a feed forward effect, in which new knowledge gives rise to and speeds the development of yet newer knowledge. In this context, student-generated theories and models are to be judged not so much by their conformity to accepted knowledge as by their value as tools enabling further growth” (p. 101). Thus, in knowledge building, the emphasis is placed on student ability to work with and develop knowledge as opposed to their ability to restate current knowledge. This is not to say that in the process of knowledge building all knowledge will be original, as there is a strong likelihood that students will end up coming to conclusions similar to current knowledge, but it is the process of reaching that conclusion that is the focus (Bereiter, 1994). Knowledge building gains legitimacy in terms of its usefulness for education from the idea that the discovery approach is accessible to children as early as grade one (Scardamalia,
2003) and that idea that it is a process that honours students' contribution to the knowledge of the community (Scardamalia & Bereiter, 2006). As students progress in education, they will become increasingly adept at the process of creating knowledge and, as Scardamalia and Bereiter (2003) argue, this will “more directly addresses the need to educate people for a world in which knowledge creation and innovation are pervasive” (p. 2).

It is important to note at this point that Bereiter and Scardamalia emphasize a significant distinction between learning and knowledge building. They define learning as “an internal, unobservable process that results in changes of belief, attitude, or skill” whereas knowledge building “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” (Scardamalia & Bereiter, 2003, p. 3). They describe the role of the teacher in this process as being able to effectively promote both learning and knowledge building (Bereiter, 2002) and thus, they do not view the traditional method of learning as a negative experience. In fact, Bereiter (2002) concedes, “No amount of knowledge building will produce all the learning that students need to acquire in school” (p. 33). Knowledge building does not endeavour to replace learning in schools, it is an alternative pedagogy that seeks to better equip and prepare students for life in a ‘Knowledge Society’.

**Knowledge Building and Online Learning Environments (OLE’s)**

Bereiter, Scardamalia and others have completed a large volume of work in adapting knowledge building to specific online environments (CSILE /
Knowledge Forum®). They have developed these environments as vehicles for advancing knowledge building in educational contexts. The scope of this paper does not deal with these specific environments but rather considers the question of how the concepts of knowledge building and constructivism can be effectively integrated into education, as we move towards a future that contains increasingly diverse online educational options, including Web 2.0 technologies, while remaining accessible to teachers.

The use of technology is a critical part of knowledge building and this typically takes the form of a communication tool, such as an online forum. This is highly valuable because in face-to-face learning, even the most robust discussions can be limited by time constraints. Also, it is difficult to keep track of, and go back to, those original discussions when new information is presented. Online forums allow those involved in knowledge building to develop ideas and questions, track and store those communications, and use them for further discussion and revision (Li, 2004). One drawback of online forums can be that they are mainly text-based environments and therefore they may not be accessible or appealing to all learners. New technological innovations such as Skype and Google Talk may change this but at this point neither is a mainstream technology in OLE’s.

Collaboration amongst participants is a core component of knowledge building and, as we move into the Knowledge Age, computers will figure prominently in that collaboration (Bereiter & Scardamalia, 2006). Perhaps most important will be the role of the Internet and how it can be used to facilitate
communication. When used effectively, the Internet has the potential to be “more than a desktop library and a rapid mail-delivery system. It becomes the first realistic means for students to connect with civilization-wide knowledge building and to make their classroom work a part of it” (Scardamalia & Bereiter, 2006, p. 98). However, simply using the Internet to collaborate does not constitute knowledge building and any online environment developed to support this purpose needs to be explicitly designed for it. Bereiter and Scardamalia (2006) identify these as Knowledge Building Environments (KBE’s), and they propose several characteristics that are essential to their success.

- “Support for social organization that goes beyond division of labour
- Support for collaborative creation and revision of conceptual artifacts
- Shared, user-configured design spaces with supports for citing and referencing one another’s work
- Ways to introduce higher-order organizations of ideas (in contrast to threaded discussion that only permits downward branching)
- Ways for the same idea to be worked within varied and multiple contexts
- Systems of feedback to enhance self and group monitoring of ongoing processes
- Linking of persons and groups on the basis of shared goals and problems rather than on the basis of shared topics of interest” (Bereiter & Scardamalia, 2006, p. 709)

This provides a framework for developing KBE’s while still allowing the developer freedom to adapt the specific environment to the specific context in which it will be used. Bereiter and Scardamalia caution that environments be designed to support “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” (Scardamalia & Bereiter, 2003, p. 6).

Expanding on this, Li (2004) offers additional criteria that should be considered when one is designing a KBE. He argues that creating a safe,
friendly and open online environment is crucial to its effectiveness. To meet this criteria, students can share online autobiographies, which allows them to share jokes and stories and helps to develop a learning community as opposed to a collection of individual learners (Li, 2004). Also stressed is the importance of explicitly teaching ‘netiquette’ and setting guidelines for online communication. This is not meant to discourage conflict, which can be beneficial if the conflict can be used to assist in reaching learning objectives. It is stressed however that negative conflict has the possibility to destroy the learning community and must be dealt with quickly.

The role of the instructor in a knowledge building environment is multifaceted and requires an acute awareness of the knowledge building process in order to be successful. It is the responsibility of the instructor to attempt to develop a sense of community within the collaborative group and they must work to ensure that the sense of community continues throughout the process. During the knowledge building process, the instructor must find the fine balance with regards to participating in the discussion. “Instructors should be careful not to jump into any discussion too fast or too often, or impose too much control, because doing so may constrain interaction or shut off conversation among students (Li, 2004, p. 27). Also, if the instructor does not participate in the discussion often enough, students may sense that the instructor is disengaged from the process, which can result in decreased discussion (Li, 2004). Instructors are also encouraged to allow students to take turns acting as facilitators for discussions. During these opportunities, instructors should inform
students that they should be treated as a regular participant in the discussion and that their opinions are open to questioning and criticism (Li, 2004). Small groups are encouraged for knowledge building environments, with the optimal size being 5 – 15 students, as too many students may create an unmanageable amount of discussion while too few students limits the opportunity for meaningful discussion and multiple insights (Engstrom, Santos & Yost, 2001; Li, 2004).

An exciting area of opportunity for knowledge building environments lies within the emerging Web 2.0 technologies, such as blogs, wikis and other social networking tools. These have become a “socio-technical phenomenon, which is indicative of the culture of today’s learners, who are the digital natives” (So, Seow & Looi, 2009, p. 378). The appeal of Web 2.0 is that users can create content at anytime, anywhere. There is no additional software to be installed on individual computers as each of the technologies is web based; all that is needed is a computer and internet connection in most cases. These technologies provide users with a simplistic yet sophisticated way of collaborating on, sharing, and publishing digital artifacts. So et al (2009) describe “a critical need to examine whether these benefits of Web 2.0 and other new technologies that have focused mainly on noneducational or recreational purposes can be transferred into educational contexts” (p. 378). As these technologies permeate the realm of education they may become increasingly effective knowledge building tools.
Conclusion

The process of knowledge building created by Bereiter and Scardamalia gives a method of moving past the mind as a container metaphor and provides a framework to prepare learners for life in the Knowledge Age. Education is facing a challenge, as it traditionally prepared students for life in the Industrial Age and as we move towards a Knowledge Society that rewards creativity and innovation, educational reform becomes imperative. Knowledge building is a constructivist activity that is socially mediated and allows learners to collaborate and create new knowledge from existing knowledge. Technology provides a means for students to collaborate and participate in knowledge creation, but technology by itself does not ensure knowledge building. The process must be carefully planned and the environment in which it takes place must be designed specifically for the purpose of knowledge building. Current technology focuses on text based online communication forums but Web 2.0 technologies offer new opportunities to diversify this process. Knowledge building is an evolving process that offers an exciting way to meet the current challenges of education and prepare students for life in the 21st century.
Bibliography


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