An idea-centered view of representing and assessing community knowledge

Huang-Yao Hong

Abstract: This paper examined the notion of community knowledge and its relationships with idea improvement, and proposed a way of using key terms to access and assess ideas for sustained knowledge building. A dynamic model of idea-centered knowledge building was elaborated to provide a rationale for the proposed assessment approach, and a semantic tool designed in Knowledge Forum—a computer-supported collaborative knowledge building environment—was introduced to illustrate possible ways of using key terms for assessing ideas and community knowledge. Possibilities and limitations of key-term use for sustained community knowledge building were discussed.

Keywords: Community knowledge, knowledge building, ideas, key terms, online automated assessment

Introduction

The purpose of this article is to clarify the concept of community knowledge and to propose a way of accessing it for sustained community knowledge building. As a theory of learning, knowledge building is defined as a social process focused on the production and continual improvement of ideas of value to a community (Bereiter, 2002; Scardamalia & Bereiter, 2003) and is facilitated by a set of principles which represent design challenges, ideals, and improvable objects in their own right (see Scardamalia, 2002, for details). These knowledge-building principles provide guidance for enculturating community members into a culture of working with ideas collaboratively and creatively in order to advance community knowledge. For example, the principle of "community knowledge, collective responsibility" emphasizes that "contributions to shared, top-level goals of the community should be prized and rewarded as much as individual achievements; and team members should produce ideas of value to others and share responsibility for the overall advancement of knowledge in the community" (Scardamalia, 2002, p.80). Yet, while community knowledge building is gradually being recognized as an important goal for innovative education reform (Hargreaves, 1999; Scardamalia & Bereiter, 1999), the concept of "community knowledge" remains difficult to grasp, much less assess it. The questions of "What exactly is community knowledge?" and "How is community knowledge measured?" remained to be explored (Hong, Teplovs, & Chai, 2007; Lee, Chan, & van Aalst, 2006). To address these questions, this paper proposed a dynamic view of using ideas to represent and assess community knowledge for sustained knowledge building. Apparently, clear explanation of the concept of community knowledge and its related assessment measures would facilitate further advancement of knowledge building research on a more solid foundation.

Understanding Community Knowledge

Nature of community knowledge

To understand the general nature of community knowledge, it is important to distinguish between personal and public knowledge. The former highlights a psychological view of knowledge and sees knowledge as private property possessed within an individual's mind (Hyman, 1999; Popper, 1972). In contrast, the latter emphasizes a social view of knowledge and sees knowledge as public property that has a social life of its own (Bereiter, 2002; Popper, 1972). As such, community knowledge must be public knowledge, and knowledge can never become communal if it is viewed as possessed only within individuals. Knowledge must be

made public (e.g., via intellectual conversation or note-posting in a forum) in order for it to be considered a candidate for community knowledge. However, not all public knowledge can be treated as community knowledge. Knowledge must also be kept in a place to which all community members can have access (e.g., on the class bulletin board or an online discussion forum) in order to be regarded as community knowledge.

One way to further understand the relationship between personal and community knowledge is to judge whether personal knowledge is externalized and shared in a community. For example, when doing individual project assignments, students may work independently without knowing what others are doing. In this case, community knowledge may be superficially regarded as the total sum of all students' individual knowledge, as there is no or little sharing of knowledge in the community. Alternatively, community knowledge may be more strictly defined as the frequently and deeply shared knowledge in the community. For example, in the kind of collaborative learning supported by the jigsaw method (Aronson & Patnoe, 1997), the goal is to have every community member master the same pre-specified knowledge. As such, only the essential core knowledge highly shared by all members may be seen as community knowledge.

Specifically related to learning environments that involve substantial online activities, there is an issue with regard to whether all public and shared knowledge both occurred offline and online can be captured in a community. For example, typically in a class, a common type of public knowledge is discourse among students (e.g., conversation in a hallway or discussion in a group). The issue is that such knowledge may be only ephemerally shared for a short time and thus does not have a sustained public life. Simply put, that knowledge is not really captured in the community; consequentially, not all community members can have access to that knowledge, either. Therefore, for community knowledge to thrive, it is important to have all knowledge be recorded in a shared, public community space (e.g., an online forum). Only when important ideas and thoughts can be captured or recorded in a secured public community space for continual access and improvement, they can contribute to the process of sustained knowledge building, and be regarded as community knowledge.

The role of ideas in community knowledge

To further elaborate what community knowledge is and its relationship with knowledge-building, it is important to understand the role of ideas in creating community knowledge. Knowledge building is idea-centered (Scardamalia & Bereiter, 2003). To create knowledge in a community, it is critical for community members to keep contributing new ideas in a community while improving existing ideas already captured and shared in a community. The importance role of ideas for sustained community knowledge advancement can be best explained by Popper's (1972) three-world epistemology. According to him, there are three different types of reality. World-1 refers to reality represented by material and physical entities. World-2 refers to reality as mental states constructed in the human mind; and World-3 refers to reality constituted by ideas or conceptual artifacts. As evidenced in history, ideas are important for solving problems and creating new knowledge, for example, the ideas of fire, wheels, print press, light bulb, and airplane, etc, were generated to solve real-world problems back in time, then progressively further improved with new knowledge being created accordingly. Because of humans' unique ability to create and work with ideas, World 3 becomes especially important for knowledge advancement. For instance, as commonly observed in science, research, or design communities, to create new knowledge means to continuously generate new ideas (such as new theories, hypotheses, or design concepts). These ideas, once generated, have a public life of their own in that they can be further improved by knowledge workers interacting with them. Unfortunately, as argued by Bereiter (2002), school learning tends to focus on changing students' mind in World-2, rather

than cultivating students' competencies to work creatively and collaboratively with ideas in World-3. Clearly, a critical question to ask in today's education is how to initiate students into a World-3 culture so that ideas can be more commonly conceived and transformed for the making of community knowledge. In contrast with traditional learning that is more focused on acquiring existing textbook knowledge (in World-2), an alternative solution to address the above question is allow students to tackle real-world problems by generating their own ideas (in World-3). As argued by Scardamalia (2002), "Knowledge problems arise from efforts to understand the world. Ideas produced or appropriated are as real as things touched and felt. Problems are ones that learners really care about—usually very different from textbook problems and puzzles" (p.78).

An idea-centered approach

Ideas represented as community knowledge

To capture community knowledge, the author and colleagues (Hong, Scardamalia, & Zhang, in press; Hong & Sullivan, 2009) proposed a dynamic model of idea-centered knowledge building (see Figure 1). Using this model, community knowledge can be represented by means of a collection of ideas created and distributed in a community. Consistent with Bereiter's (2002) notion about ideas, this model regards ideas as conceptual artifacts or epistemic entities indispensable for the making of new knowledge in a community. Once recorded in a community space (e.g., a database), ideas can be improved along two dimensions: breadth and depth. On one hand, the improvement of ideas in terms of breadth is a function of how these ideas interact with each other. On the other hand, the improvement of ideas in terms of depth is a function of how community members as knowledge workers collaboratively work together to enhance the explanatory coherence of ideas (Thagard, 1989). To advance community knowledge, therefore, means to facilitate idea improvement in a self-organizing trajectory through two simple network behaviors, namely, idea diversification and idea (co-)elaboration—an ideational process of forming, relating, and articulating ideas towards an emergent process of continual idea transformation. In light of this model, community knowledge may be defined as a collection of ideas/conceptual artifacts constructed in Popper's World-3 in a community. The quality of community knowledge as outcomes, and the effectiveness of its improvement processes, are therefore highly dependent on whether ideas can be continually generated and improved, and the quality of ideas may be broadly categorized by the following four different idea networks (see Figure 1): (1) emerging ideas (bottom left quadrant), (2) diversified ideas (bottom right quadrant), (3) elaborated ideas (top left quadrant), and (4) innovative ideas (top right quadrant).

Of these four networks, first, the network of elaborated ideas represents a type of community knowledge constructed by strong collaboration and weak knowledge-interaction. The strength of this idea network lies in its focus on enhancing the explanatory coherence of ideas (Thagard, 1989); however, with less diversified ideas or narrow perspectives, the innovative capacity of ideas in this network can also be limited (Chubin, 1976; Granovetter, 1983). Second, the network of diversified ideas represents an information-sharing network, because of its strong knowledge-interaction and weak collaboration. The strength of such network is its tendency to exchange ideas for broader perspectives. Nevertheless, the innovation potential of ideas can also be limited if ideas can not be further deepened, evaluated, and/or synthesized (Kling & Rosenberg, 1986). Third, the network of emerging ideas represents a network with low collaboration and knowledge-interaction; thus it is less innovative. Finally, the network of innovative ideas represents a more desirable network because it is moving toward sustained idea improvement with more balanced act between the two basic network behaviors of ideas: idea (co-)elaboration and diversification.

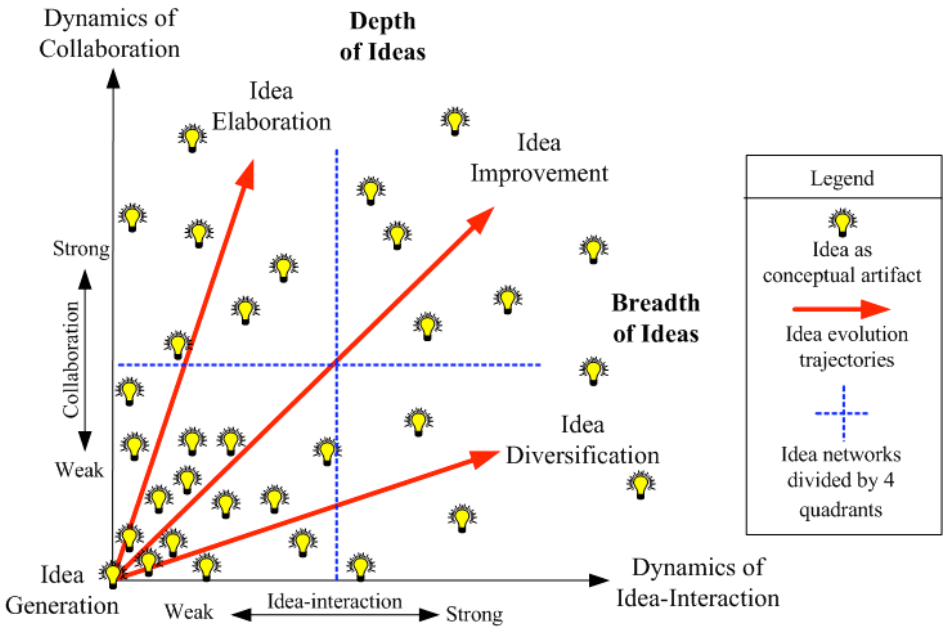

Figure 1: Community knowledge as a system of ideas recorded in a community (*Source*: adapted from Hong, Scardamalia, & Zhang, in press)

Idea-centered conceptualization of community knowledge

As an example, Figure 2 further develops the concept of community knowledge by illustrating how three community members' ideas may possibly interacts with one another. To explain, each of the three ovals represents a community member's ideas contributed in a community. Depending on how these ideas are being interacted, clarified, and/or synthesized, community knowledge may be represented in three ways. First, in a broadest sense, community knowledge may be represented by diversified ideas recorded in a community database as a form of distributed expertise in a community—ie, the area covered by A+B+C. This area would be mostly corresponding to the network of emergent ideas (Quadrant 3 in Figure 1). Second, in a narrower sense, community knowledge may be represented by relatively more frequent exchange and (co-)elaboration of ideas among community members—ie, the area covered by AB+AC+BC; and this area would be mostly corresponding to the networks of diversified ideas and elaborated ideas (Quadrants 2 and 4 in Figure 1). Finally, in a more restricted sense, community knowledge may be represented by a collection of highly interchanged and elaborated ideas—ie, the area covered only by ABC. Arguably, this represents a highly dynamic and interactive area where ideas are most likely to be substantially improved and become more innovative. This area would be mostly corresponding to the Quadrant 3 in Figure 1. Of course, Figure 2 can become even more sophisticated when there are more than three community members. But the main argument highlighted here is not so much about the number of members but whether ideas are being collaboratively worked on and diversely exchanged in the community in order to increase the depth and breadth of ideas. One thing to note is that both depth and breadth are important knowledge goals to pursue. How to achieve equilibrium by enabling idea improvement in an optimal self-organizing trajectory remains an important instructional design challenge.

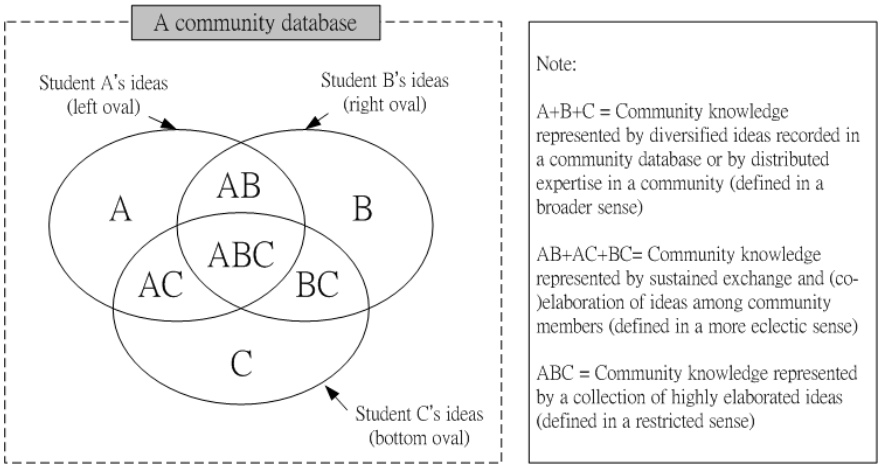

Figure 2: Conceptualization of community knowledge represented by ideas: Using three community members as an example

Using key terms to access and assess ideas

While using ideas to represent community knowledge seems workable, a next question to ask is how to provide an easy access to all ideas recorded in a community for further idea assessment and improvement. One possibility is to use key terms or keywords. There are several reasons to do so. First, as commonly characterized by their capacity to represent important concepts or ideas, key terms have been widely used for searching ideas (such as in academic papers or on Internet), for subject-indexing (such as in books), and for producing visual knowledge representation (e.g., semantic or propositional network; knowledge or concept map, and tag/word clouds). Take a word cloud for instance; it is visual depiction of key terms or words extracted automatically through intelligent computing from a database to describe the content knowledge recorded in that database. As an example, Figure 3 illustrated a word cloud consisting of frequently used key-terms related to Web 2.0. In this Figure, key terms were ordered by their popularity and visually weighted by font size according to the frequency of their use. Moreover, key terms can be easily designed to be hyperlinks that lead to the original ideas in full text recorded in a database. Second, by examining whether and how key terms are shared between individual members, it is possible to identify more intensely exchanged and inquired concepts/ideas (ie, community knowledge defined in a more restricted sense) from less frequently shared and inquired ones (ie, community knowledge defined in a broader sense). Figure 4 further illustrate how key terms can be used to represent both distributed and diversified ideas contributed by individuals (ie, the two ovals) and shared communal ideas (i.e., the middle, overlapped area) recorded in a community database. Arguably, number of key terms can serve as an indicator of the breadth of ideas inquired in the community. In contrast, frequency of key-term use can serve as an indicator of the depth of ideas collaborated and elaborated in a community. An additional strength is that such key-term related measures can be readily integrated into online learning environments for automated assessment, and with careful instructional design, they can also be easily used by teachers and students for immediate idea assessment and improvement.

Figure 3: A word cloud with key terms related to Web 2.0 (*Source*: Adopted from Wikipedia at http://en.wikipedia.org/wiki/Tag_cloud).

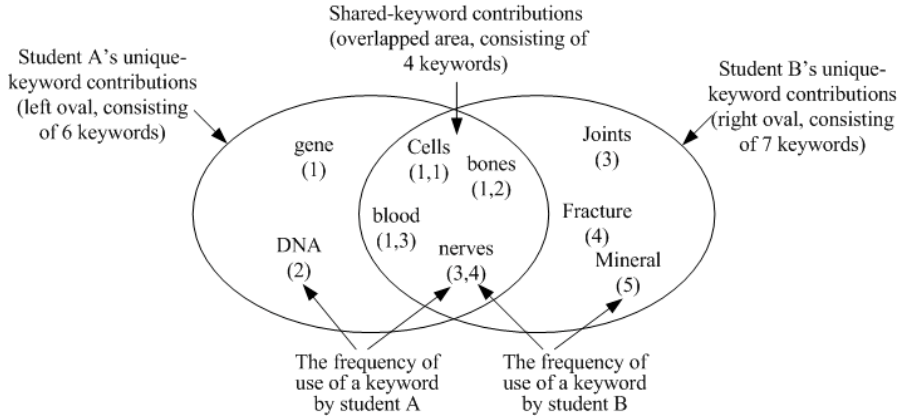

Figure 4: An example of using number of key terms and frequency of key-term use to represent and access to individual and communal ideas

A case example

To illustrate how to use key terms as a way to appraise the breadth and depth of ideas, below I summarize a recent study that compared two knowledge building initiatives (see Hong, Scardamalia, Messina, & Teo, 2008, for details). In Initiative 1 which lasted for 10 weeks, 9-to-10-year-old students from the Institute of Child Studies, University of Toronto, investigated human's internal body as a system. They studied how human's internal system (such as brain, organs, blood and cells) operated as a whole system to maintain life. In inquiry 2 which lasted also for 10 weeks, the same students investigated human's physical body as a system; they studied how human's eyes, hands, legs, and knees cooperated as a system to perform a long jump. Findings suggest that in Initiative 1 students asked more questions and generated more ideas as compared with Initiative 2. But in Initiative 2, while students asked fewer questions and also produced fewer ideas, they spent more time engaging in improving these ideas in order to address their questions of interest more in-depth. As a way of triangulation, another study (see Hong & Scardamalia, 2008) compared the total number of key terms and the frequency of key-term use between the two Initiatives. As shown in Figure 5, a lot of key terms were used (ie, discussed, elaborated, or referred) in low-to-medium frequency in Initiative 1, indicating richly distributed and diversified ideas in terms of the breadth of ideas. In contrast, there were more key terms that were used in high frequency in Initiative 2, indicating a more densely elaborated and interacted ideas in terms

of the depth of ideas. This outcome confirms the findings in the previous study (Hong, Scardamalia, Messina, & Teo, 2008) and suggests a possible way of using key terms to appraise the breadth and depth of ideas.

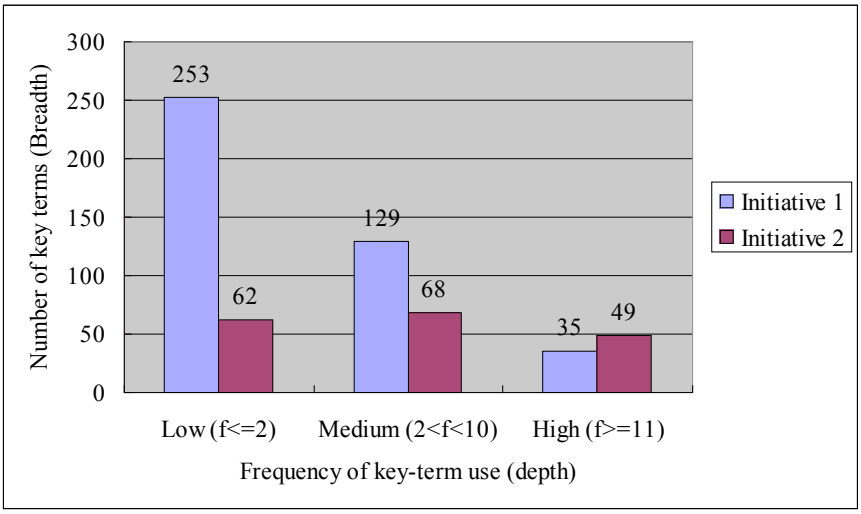

Figure 5: Using number of key-terms and frequency of key-term use to appraise breadth and depth of ideas between two knowledge building initiatives

Expanding the possibilities

The purpose of this paper was to explore the concept of community knowledge and to propose a way of assessing it for sustained knowledge building. To this end, I have explored the relationships between community knowledge and other types of knowledge (personal vs. public; non-shared vs. shared; and short-lived and long-lasting knowledge), discussed the role of ideas in representing community knowledge, elaborated an idea-centered view of community knowledge building, and explored the potential use of key terms as an easy access to ideas for further idea assessment and improvement.

To foster idea-centered knowledge building, the research team at the Institute for Knowledge Innovation and Technology, University of Toronto, has been working on designing a semantic tool (Figure 6) for use in Knowledge Forum—a computer-support collaborative knowledge building environment. The strengths of this tool can be summarized as follows: First, with its current capacity (version 4.6), the tool allows community members to compare key terms extracted automatically from different sets of notes and identify overlapped/shared key terms. As such, it can automatically provide an easy access to ideas for sustained idea assessment and improvement. Second, given its user-friendliness, the tool can be readily used by both students and teachers, virtually anytime and anywhere. This would allow automated, concurrent online assessment of community knowledge to be executed more easily. As an example to illustrate this point, during a recent study (Hong, Scardamalia, Messina, & Teo, 2008) in which this semantic tool was field-tested, it was found that using this tool, students were able to attain a meta-perspective on their collective knowledge work by constantly monitoring and reflecting on who worked on which ideas. As a result, students became more socially metacognitive and strategic in their collective efforts to advance community knowledge. It is posited that the continual advancement and development of this tool and its related measures will be able to further enhance and complement the existing online behavioral measures previously designed for Knowledge Forum (i.e., measures such as number of notes contributed, number of notes built-on, and number of notes read etc) for more sustained community knowledge building.

Admittedly, use of key-term measures also has its limitations. First, while key terms can serve as hyperlinks for users to have immediate access to the actual ideas, key terms alone are inadequate to explain the complex relationships between ideas. Apparently, the work in semantic latent analysis and use of ontologies would offer more sophisticated means for manipulating meanings of ideas and looking for associations between ideas. This limitation however also represents a fruitful area for further research. Second, Ryle (1949) argues "know-that" and "know-how" as two essential kinds of knowledge. Corresponding to sustained community knowledge building, know-that may refer to the key ideas and concepts collectively inquired in a community. Know-how may refer to the process knowledge that can help facilitate sustained improvement of these ideas and concepts. While key-term measures were proven useful to some extent in the present study, what these measures capture and represent are still more in line with "know-that". From a process viewpoint, community knowledge also involves a dynamic process with participants monitoring who is working on what ideas or problems and advancing knowledge in the community (Hong & Scardamalia, 2008). Automatically extracted key terms alone are not able to tell whether and how certain key ideas or concepts are progressively deepened or enriched over time. To tackle this challenge may require more integrated use of key-term measures with other more process-oriented measures (see eg, Lee, Chan, & van Aalst, 2006; and Zhang, Scardamalia, Lamon, Messina, & Reeve, 2007), so that not only community knowledge can be more fully represented and assessed as outcome but more effective knowledge building dynamics can also be measured and sustained.

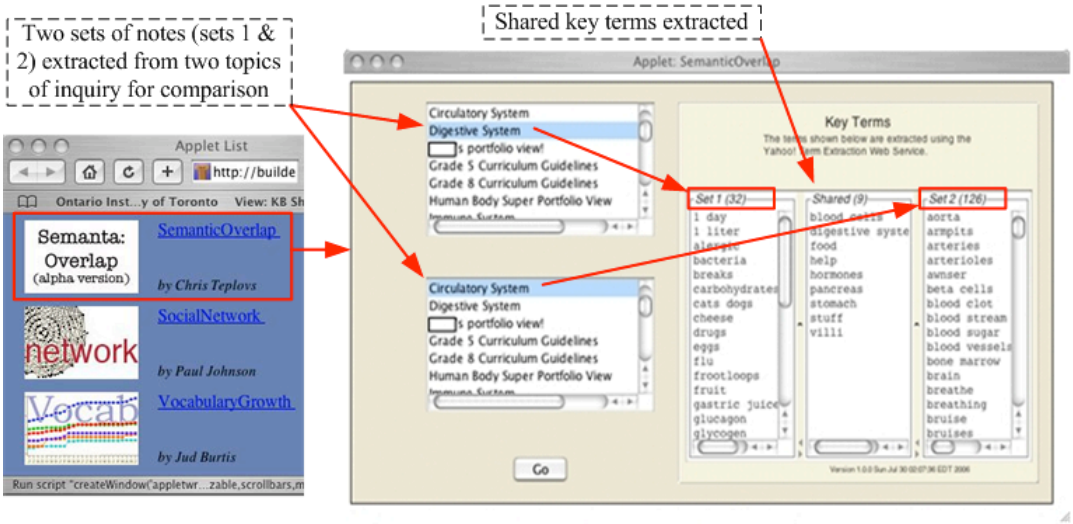

Figure 6: A semantic tool in Knowledge Forum: Illustrating shared key terms between two sets of *notes*

References

Aronson, E., & Patnoe, S. (1997). *The jigsaw classroom: Building cooperation in the classroom*. New York: Longman.

Bereiter, C. (2002). *Education and mind in the knowledge age*. Mahwah, NJ: Lawrence Erlbaum Associates.

Chubin, D. E. (1976). The conceptualization of scientific specialties. *The Sociological Quarterly, 17*, 448-476.

Granovetter, M. (1983). The strength of weak ties: A network theory revisited. *Sociological theory, 1*, 201-233.

Hargreaves, D. H. (1999). The knowledge-creating school. *British Journal of Educational Studies, 47*(2), 122-144.

Hong, H.-Y. & Scardamalia, M. (March, 2008). *Using key terms to assess community knowledge.* Paper presented at the annual conference of American Educational Research Association (AERA), New York.

Hong, H.-Y., & Sullivan, F. R. (2009). Towards an idea-centered, principle-based design approach to support learning as knowledge creation. *Educational Technology Research & Development, 57*(5), 613-627.

Hong, H.-Y., Scardamalia, M., & Zhang, J. (in press). Knowledge Society Network: Toward a dynamic, sustained network for building knowledge. *Canadian Journal of Learning and Technology.*

Hong, H.-Y., Teplovs, C., & Chai, C. S. (2007). On community knowledge. In B. Chong, A. Kashihara, J. Lee, T. Matsui, R. Okamoto, D. Suthers & F. Yu (Eds.), *ICCE 2007: Supplementary Proceedings* (pp. 292-295). Tokyo, Japan: IOS Press.

Hong, H. Y., Scardamalia, M., Messina, R., & Teo, C. L. (2008). Principle-based design to foster adaptive use of technology for building community knowledge. In G. Kanselaar, V. Jonker, P.A. Kirschner, & F.J. Prins (Eds.), *International Perspectives in the Learning Sciences: Cre8ing a learning world. Proceedings of the Eighth International Conference for the Learning Sciences – ICLS 2008, Vol. 1* (pp. 374-381). Utrecht, the Netherlands: International Society of the Learning Sciences, Inc.

Hyman, J. (1999). How knowledge works. *The philosophical quarterly, 49*(197), 433-451.

Kling, S., & Rosenberg, N. (1986). An overview of innovation. In R. Landau & N. Rosenberg (Eds.), *The positive sum strategy: Harnessing technology for economic growth* (pp. 275-305). Washington, DC: National Academy Press.

Lee, E. Y. C., Chan, C. K. K., & van Aalst, J. (2006). Students assessing their own knowledge building. *International Journal of Computer-Supported Collaborative Learning, 1*, 277-307.

Popper, K. R. (1972). *Objective knowledge: An evolutionary approach*. London: Oxford Univ. Press.

Ryle, G. (1949). *The Concept of Mind*. London, Hutchinson.

Scardamalia, M. (2002). Collective cognitive responsibility for the advancement of knowledge. In B. Smith (Ed.), *Liberal education in a knowledge society* (pp. 67-98). Chicago: Open Court.

Scardamalia, M., & Bereiter, C. (1999). Schools as knowledge-building organizations. In D. P. Keating & C. Hertzman (Eds.), *Developmental health and the wealth of nations: Social, Biological, and Educational Dynamics* (pp. 274-289). New York: Guilford.

Scardamalia, M., & Bereiter, C. (2003). Knowledge building. In *Encyclopedia of Education* (pp. 1370-1373). New York: Macmillan Reference, USA.

Thagard, P. (1989). explanatory Coherence. *Behavior and Brain Sciences, 12*, 435-502.

Zhang, J., Scardamalia, M., Lamon, M., Messina, R., & Reeve, R. (2007). Socio-cognitive dynamics of knowledge building in the work of 9-and-10-year-olds. *Educational Technology Research & Development, 55*(2), 117-145.