KNOWING TOGETHER, LEARNING APART: A PROPOSED FRAMEWORK FOR SUPPORTING INDIVIDUAL LEARNING THROUGH COLLABORATIVE KNOWLEDGE BUILDING TOOLS

Research-in-Progress

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Abstract

Learning theories and their supporting learning technologies fall into two broad categories: those that support individual learning and those that support communal knowledge building. This research in progress describes a hybrid framework that integrates these two categories and proposes the development of a comprehensive learning technology that encompasses both models. The system would support the cognitive processes necessary for collaborative knowledge building while simultaneously scaffolding the activities of individual exploration, understanding and internalization of knowledge. This paper describes the preliminary foundations for this hybrid framework, providing descriptions of existing learning theories and technologies and describing cognitive processes supported during various tasks in the proposed system.

Keywords: Learning theories, learning technologies, individual learning, personalized learning space, communal knowledge building, knowledge resources, knowledge sharing and building

Introduction

In the wake of Web 2.0 (O'Reilly 2006), a culture of participation, sharing and collaboration is pervading technology and society. This cultural shift is evident in higher education as well, where educators and researchers are exploring learning based on a socio-cognitive model of students as active participants in a globally connected world (Bandura 2006). This view of students as agents in their own learning creates tension with the more traditional view of students as passive recipients of knowledge, a tension that is evident in the numerous learning theories upon which educational efforts are based.

In an attempt to classify learning theories based upon common attributes, Sfard (1998) proposes two metaphors of learning that reflect the disparate views of students as active agents or passive recipients of learning. The *acquisition* metaphor is a classification for learning theories that represent knowledge as an entity to be accumulated and refined by an individual. In this class of learning theories, students are individual receptacles waiting for knowledge to be transferred to them by educators. The *participation* metaphor, on the other hand, focuses not on knowledge but on the activity of "knowing" (Sfard 1998, p. 6). In the participation metaphor, learning activities are ongoing and are influenced by the context in which they occur. Rather than isolated receptacles of knowledge, learners are viewed as members of a community in which they advance from novices to integral team members through their participation in learning activities.

Some researchers argue, however, that Sfard's participation metaphor is restricted in its focus on learning activities and communal participation, overlooking critical factors such as outcomes of learning (Paavola et al 2002; Paavola and Hakkarainen 2005). These researchers instead propose a *knowledge creation metaphor* that emphasizes advancing knowledge through social structures and collaborative processes (Paavola and Hakkarainen 2005). The knowledge creation metaphor acknowledges the individual learner's efforts as contributions to a knowledge building community while also recognizing the effect of the community on the individual's cognitive growth, adding as an outcome a product (report, presentation, wiki, etc.) of the collaborative knowledge building effort.

An exploration of learning technologies reveals that existing systems can similarly be classified as supporting either the knowledge acquisition or knowledge creation metaphors. In the case of the knowledge acquisition metaphor, personal learning environments (PLEs) support individual knowledge accumulation by enabling learners to customize their individual learning environments through the incorporation of tools and virtual spaces to assist in individual knowledge development (Kolas and Staupe 2007). On the other hand, collaborative knowledge building systems (CKBs) such as Knowledge Forum (Scardamalia and Bereiter 1999) implement the knowledge creation metaphor. CKBs provide support for sharing and commenting functions that are necessary for negotiating meaning (Beers et al. 2005, Barron 2003) and ultimately building communal knowledge (Paavola et al. 2002; Paavola and Hakkarainen 2005, 2009).

This research describes a hybrid framework, proposing a learning technology that combines both the knowledge acquisition and knowledge creation learning metaphors. It argues that, while the resource sharing and commenting necessary for communal knowledge building is critical for developing and expanding knowledge, ultimately that knowledge must be internalized by learners utilizing the knowledge resources most appropriate, meaningful, or helpful for them. An integrated learning system must scaffold activities required for both communal knowledge building and personalized learning.

Related Literature

The hybrid framework proposed in this research recognizes the importance of both learning metaphors: learning as knowledge creation (Paavola et al. 2003) and learning as knowledge acquisition (Sfard 1998). The end result of both metaphors is the individual's acquisition of knowledge or skills; the difference resides in the means used to achieve that acquisition. The knowledge creation metaphor argues that learning occurs as a result of participation in a knowledge building community; the acquisition metaphor focuses on individual learning activities as the primary tasks of an individual seeking knowledge.

Models of Learning Through Knowledge Creation

To examine how technology can support these two learning metaphors in combination, it is first necessary to examine various models of learning. In proposing the knowledge creation metaphor, Paavola et al. (2003) examined three models that reflected learning as a process of knowledge creation; this research focuses on two of these three models: Nonaka and Takeuchi (1995) and Bereiter (1985).

Nonaka and Takeuchi (1995) proposed an iterative model of organizational learning based upon the interactions of tacit and explicit knowledge. (Explicit knowledge is knowledge that can be easily codified, while tacit knowledge reflects individual expertise and understanding which is difficult to codify (Davenport and Prusak 2000).) In their model, Nonaka and Takeuchi (1995) defined four modes of knowledge conversion:

- *Socialization* is the process of sharing tacit knowledge between individuals.
- *Externalization* is the process of codifying tacit knowledge for the purposes of sharing it with a larger community.
- *Combination* is the process of integrating multiple explicit knowledge sources to provide coherent meaning.
- *Internalization* is the process of integrating explicit knowledge into previous knowledge and experience to make it one's own tacit knowledge.

These four modes occurred iteratively, effecting individual learning through the exchange and conversion of various forms of knowledge within an organization.

With the advent of Web 2.0, Chatti et al. (2007) proposed a blended learning process based on a combination of Nonaka and Takeuchi's model, knowledge management concepts and Web 2.0 technologies. The resulting framework posited that knowledge sharing and learning could be driven by: 1) communal knowledge creation, 2) networking and collaboration, and 3) intelligent searching integrated into the four processes of knowledge conversion listed above. For example, socialization could be achieved through e-mails or video chatting between learners and experts or through the sharing of instructional videos on sites such as YouTube. Externalization was supported by blogs and wikis through which individuals could codify their tacit knowledge to share with the community at large. Combination could also be achieved using blogs, wikis, and RSS to share codified knowledge and to remix it to create new or more meaningful knowledge. Internalization was supported through technologies such as games and simulations where learners could acquire specific skills, and could also be supported through reflection and sense-making in communal knowledge building.

Bereiter (1985) criticized the focus of the Nonaka and Takeuchi model as being too dependent upon knowledge residing in an individual. Instead, Bereiter's learning process emphasized knowledge as something that could be created, shared, and understood in the process of collaborative knowledge building. Scardamalia and Bereiter (1999) argued that learning communities should function as research communities (sharing, discussing and debating ideas), but while research communities focused on creating new knowledge, learning communities would focus on identifying knowledge that was new to the members of the community. The Knowledge Forum system (Scardamalia and Bereiter 1999) was developed to support just such activities in a learning community.

Personal Learning Environments and Collaborative Knowledge Building Systems

The disparities of the knowledge creation and knowledge acquisition learning models are reflected in the divergent research paths of existing learning technologies, with PLEs following the knowledge acquisition metaphor and CKBs following the knowledge creation metaphor. While the overarching goals of both types of systems are to support learning, PLEs follow the knowledge acquisition metaphor, focusing on supporting tasks involved in individual knowledge acquisition. CKBs follow the knowledge creation metaphor, supporting communal learning through knowledge building. Each of these technologies is discussed in greater detail below.

In general, a PLE is a system that supports individual learning through the creation of an environment in which learners can integrate their learning tools and learning objects. Although numerous, often

conflicting views of a PLE exist (Johnson et al. 2006), all of the views have in common the concept of supporting individual learning, thus reflecting the knowledge acquisition metaphor. PLEs have sometimes been defined as e-portfolios in which students document their learning through accumulation of knowledge artifacts. Other researchers view PLEs as tools to enhance informal learning. Still others argue that PLEs are redundant given the availability of Web 2.0 tools. In response to these differing definitions, and to address the shortcomings inherent in each, Johnson et al. (2006) propose a PLE model that supports activities such as relationship maintenance, communication, and codification. Regardless of the robustness of the Johnson et al. model, however, all of the aforementioned PLE definitions focus on individual knowledge acquisition and do not address the communal knowledge building activities considered critical by many learning theorists.

A hybridized description of a PLE was posited by Kolas and Staupe (2007). In their proposed personalized e-learning interface, learners would customize their learning environments by selecting those learning objects which were most appropriate for their style of intelligence (Gardner 1985), level of proficiency (Dreyfus 2002), and cultural dimension (Hofstede 2001). Through effective use of ranking and tagging of learning objects, students could either search for and retrieve relevant learning objects or request recommendations from the system based on their previous preferences. Although this hybrid learning system would enable students to extract learning objects from a larger collection of resources based upon individual understanding and preference, the researchers omitted any discussion regarding how these shared learning objects were acquired, rated, and tagged for consumption by the community.

Research in the area of Collaborative Knowledge Building systems (CKBs) has not suffered from the discord of conflicting definitions of PLEs. In general, CKBs are systems that scaffold group interactions such as sharing resources, contributing notes or comments, and working towards a single understanding of the shared knowledge. Systems such as WebGuide (Stahl 1999) and Knowledge Forum (Scardamalia and Bereiter 1999) have been tested in classroom settings to assist with communal knowledge building activities. WebGuide, for example, supports project-based learning; the system drives learner interactions towards a final goal of a single, coherent response – a final submission or project deliverable. Regardless of their specific implementations, CKBs differ from PLEs in their focus on knowledge as emerging from communal knowledge building efforts rather than individual knowledge acquisition.

Other researchers have explored collaborative knowledge building using Web 2.0 technology such as wikis to understand the cognitive processes of learning in such an environment (Cress and Kimmerle 2008). These researchers identified two cognitive processes that emerged during collaborative knowledge building: assimilation and accommodation (Piaget 1977a, 1977b). Assimilation was similar to knowledge acquisition in that new information was integrated into existing knowledge and experiences to form new knowledge. Accommodation occurred when there was a tension between new information and the learner's existing knowledge – the learner had to somehow accommodate this new information by modifying his previous understanding. To achieve these cognitive processes, learners had to use the internalization and externalization processes described by Nonaka and Takeuchi (1995). While internalization focused on the learner's acquisition of knowledge through assimilation and accommodation, the researchers pointed out that the process of externalization (codifying tacit knowledge into explicit knowledge) also served to not only share the learner's knowledge with others but to strengthen and clarify the learner's own understanding through the act of codifying her knowledge.

McLoughlin and Lee (2007) explored the integration of Web 2.0 technologies into higher education but with a focus on the technological affordances required to link process skills with socio-cognitive outcomes of learners. The affordances they identified were similar to those implemented in the CKBs discussed previously: connectivity/communication, collaborative discovery and sharing of resources, content creation, and aggregation/modification of knowledge. These affordances could be combined to create what the researchers called Pedagogy 2.0, in which content and curriculum is learner-driven, communication utilizes various forms of multimedia, and processes and learning tasks are authentic, experiential and inquiry-based.

Framework for Personal Learning Through Collaborative Knowledge Building

This research seeks to integrate the learning activities supported by both PLEs and CKBs through a

convergence of learning theories, methodologies, and eventually supporting technologies. As stated previously, both PLEs and CKBs and their learning metaphors, knowledge acquisition and knowledge creation, have similar goals: to support learning through the internalization of knowledge. Similarly, the methodologies involved in these metaphors, collaborative knowledge creation and individual acquisition of knowledge, are not at odds but rather can be used in pursuit of the single goal of learning.

This proposed framework bases its theoretical foundation on the learning process model proposed by Nonaka and Takeuchi (1995). The four cognitive processes of this model: socialization, externalization, combination, and internalization, are all evident in collaborative knowledge building yet have an intrinsic impact on the individual learner participating in knowledge building activities. A system based on this framework might include tasks such as creating or locating appropriate knowledge resources, tagging the individual resources, commenting, and rating the resources. Table 1 discusses some of these proposed tasks and their corresponding cognitive processes.

Table 1. Typical Knowledge Building Tasks and Cognitive Processes

Typical Task	Cognitive Process	Description
Identifying knowledge resources	Socialization	Learners must interact with other learners to better understand questions or issues to be addressed by knowledge resources. Learners may also use subject matter experts as resources.
	Externalization	Learners must have sufficient tacit knowledge of the subject to be able to formally express questions and assess the validity and value of new knowledge sources.
	Combination	Learners must compare a new resource to knowledge already present in the system to ensure that the resource offers something different or new. Learners may also expand knowledge by a unique combination of resources.
	Internalization	Learners must internalize the knowledge present in the new resource to enhance their own learning and continue to contribute to the growing body of knowledge.
Tagging knowledge resources	Socialization	Learners must develop a communally agreed upon taxonomy of terms with which to tag new knowledge resources.
	Externalization	Learners must be able to codify their understanding of the resource through the generation of appropriate tags.
	Combination	Learners must understand the keywords already in use for tagging to determine if an existing or new term is required to tag a new resource.
	Internalization	Learners must be able to assimilate or accommodate new classifications into their existing knowledge in order to generate appropriate tags.
Commenting on knowledge resources	Socialization	Learners must share their understandings and interpretations of the knowledge resources with other learners through commenting, summarizing or questioning.
	Externalization	Learners must be able to express their understanding of the new knowledge resource. As stated by Cress and Kimmerle (2008), this type of externalization not only shares the learner's knowledge with others but also deepens it for the learner.
	Combination	Learners can remix knowledge sources, commenting on interactions or interdependencies between various sources to increase knowledge or create new knowledge.
	Internalization	Learners must gain a tacit understanding of the knowledge resource in order to provide meaningful, insightful comments.
Rating	Socialization	Learners can review the ratings of other learners in their community

knowledge resources		and add their own ratings regarding the usefulness of the resource.
	Externalization	Learners can quickly codify their perceived usefulness of the knowledge resource through the rating process.
	Combination	Learners can compare usefulness ratings of various knowledge resources to identify those that may be most helpful to them. Reviewing highly rated resources may also lead to new knowledge formation through a fusion of the various resources.
	Internalization	Learners can locate those resources most useful to them individually by reviewing their own ratings of knowledge resources.

This framework moves beyond previous research in collaborative knowledge building by emphasizing individual learner cognition as well as group knowledge formation. Throughout each of the typical steps highlighted in Table 1, the learner is contributing to the community's collective knowledge while concurrently internalizing the developing knowledge through individual selection, analysis and, ultimately, acquisition. While the community's knowledge repository grows, each learner develops a unique understanding that is based on the group's collective knowledge as framed by the individual understanding of the learner.

The aforementioned activities support the knowledge creation metaphor through activities that build group knowledge through a shared repository of resources, comments, ratings, and tags. To support the knowledge acquisition metaphor and individual learning, the proposed framework includes a filtering mechanism enabling the learner to create a customized, personal environment in which the individual learner's preferred knowledge resources are consolidated. In this personalized space, the learner can continue to combine the selected knowledge resources into a coherent understanding and further refine her internalization of the group's collective knowledge through personal annotations, exploration and consolidation of knowledge resources. The two phases of the framework and the cognitive processes supported by each are shown in Figure 1. The socialization and externalization processes are unique to the Collaborative Knowledge Space because these activities focus on the sharing and codifying of knowledge. The combination process occurs in both the Collaborative Knowledge Space and the Individual Knowledge Space because the activity of combining codified resources can be performed by the group's members or by the individual. The internalization process similarly occurs in both the Collaborative Knowledge Space and the Individual Knowledge Space as the acts of assimilation and accommodation can be performed at the group level (e.g. the group may need to redefine its understanding of the problem based on new knowledge resources) and at the individual learner level.

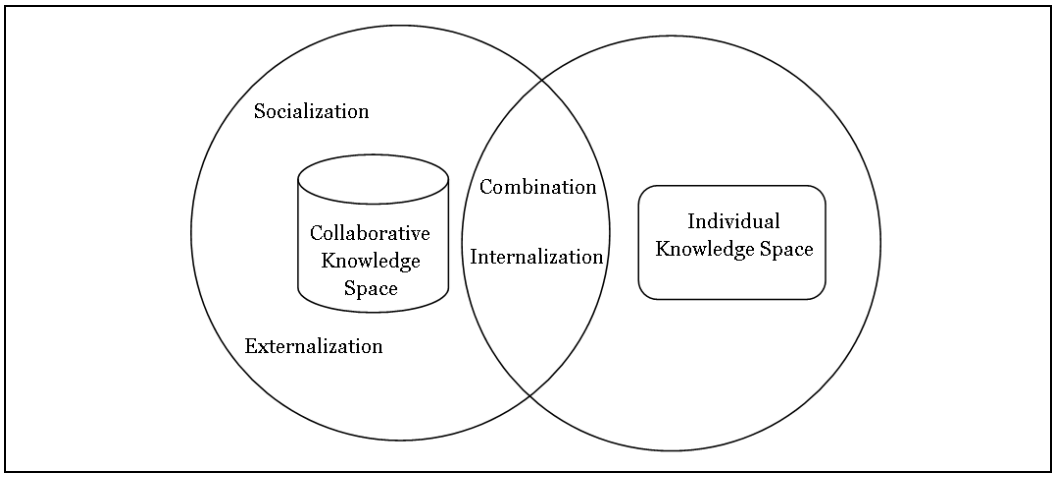

Figure 1. Proposed Framework and Cognitive Processes

Limitations and Future Work

As research in progress, this framework is a preliminary model based upon initial research into cognition and learning, collaborative knowledge building, personal learning environments, and Web 2.0 technologies. More research is required in all of these areas to further refine the proposed framework.

Upon finalization of the model, research through design will be used to iteratively implement a software artifact to instantiate the framework. Successful social media technologies will be examined to provide design guidelines. For example, social tagging can be modeled after social bookmarking systems such as Delicious. Collaborative knowledge building can be implemented using a wiki or blog-style content creation metaphor. Ratings can adopt the 5-star system familiar to users of online retailers such as Amazon.com. The resulting system will be tested in a classroom environment to explore the efficacy of the system and, more importantly, its impact on knowledge building and individual learning outcomes.

Conclusion

This paper describes research in progress to establish a framework supporting individual learning through the activities involved in collaborative knowledge building. Seeking to bridge the gap between CKBs and PLEs and between the knowledge creation and knowledge acquisition metaphors of learning, this research proposes a two-stage framework for a learning technology that supports the cognitive processes necessary for collaborative knowledge building while simultaneously scaffolding a personalized learning space to further refine individual exploration, understanding and internalization of knowledge. The social and communal nature of the knowledge creation metaphor, focusing on knowledge sharing and building, results not only in richer communal knowledge but also in learners prepared for lifelong learning and collaboration through experiential, inquiry-driven processes. At the same time, the knowledge acquisition of the individual is supported through a personalized learning space in which the learner can focus on the specific knowledge resources most helpful in supporting her unique understanding.

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