

A Learning Framework for Knowledge Building and Collective Wisdom Advancement in Virtual Learning Communities

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ABSTRACT

This study represents an effort to construct a learning framework for knowledge building and collective wisdom advancement in a virtual learning community (VLC) from the perspectives of system wholeness, intelligence wholeness and dynamics, learning models, and knowledge management. It also tries to construct the zone of proximal development (ZPD) of VLCs based on the combination of Vygotsky's theory of zone of proximal development and the trajectories of knowledge building. The aim of a VLC built on the theories of constructivism, situated learning, and knowledge building, etc., is to apply individual intelligence to online learning, bring the advantages of collaborative learning and collective wisdom into play, solve difficult problems in independent learning, and lead to the integration and sublimation of collective wisdom through long-term individual interactions, collaborative learning and knowledge building.

Keywords

Collective wisdom, Knowledge building, Virtual learning community, Collective intelligence, Knowledge management

Introduction

Educational Challenge in a Knowledge Society

The greatest challenge to education in a knowledge society is not how to effectively help learners to acquire a defined set of knowledge and skills, but in helping them to learn how to manage, work creatively with ideas and to contribute to the creation of new knowledge (Law & Wong, 2003). In knowledge building discourse, ideas, theories, hypotheses, and other similar intellectual artifacts are objects of inquiry to be scrutinized, improved, and put to new use as participants engage in progressive discourse analogous to the inquiry processes of research communities (Bereiter & Scardamalia, 1996). While education traditionally focuses on learning for which the goal is to enhance personal knowledge, in the knowledge building approach to education, the focus shifts to the construction and advancement of collective knowledge (Lamon, et al., 2001), and to interactive and collaborative learning from individual learning in a non-contextual situation (Gan, 2005, p.231).

Education in a knowledge society should enable learners to participate in the creation of new knowledge as a normal part of their lives (Scardamalia & Bereiter, 2003a). Education and practice need to undergo a revolution to become "idea-centered" from "activity-centered," and to become collaborative learning from independent learning, so that learners can embark on a knowledge building trajectory from a young age to prepare for the challenge (Scardamalia, 2002). Thus it is essential to construct and cultivate learning environments such as learning communities, organizations, campuses, etc., for learners to develop these abilities. With the development of information and communication technology (ICT), A virtual learning community (VLC) using knowledge building principles and practice (knowledge building community) is a powerful environment that immerses learners in the efforts to advance the frontiers of knowledge as they perceive them (Scardamalia & Bereiter, 2003b), and has the potential to become one of the most suitable environments for meeting these requirements (Scardamalia, 2002).

Virtual Learning Communities and Related Studies

With the booming development and exponential growth of VLCs, more and more studies have been conducted on how VLCs affect learners learning experiences, behaviors and effects by providing online interactive learning environments (Seufert, 2002; Ahern, Peck, & Laycock, 1992; Brown, 2001); and on how collaborative learning (O'Neil, et al., 2003; Stahl, 1999), collective knowledge building (Scardamalia & Bereiter, 1996; Scardamalia, 2002), knowledge management (Ubon & Kimble, 2002; Watanabe, 2001), and constructivism (Hughes & Daykin, 2002; Carr, et al, 1998), situated learning (Lave & Wenger, 1991; Oliver & Herrington, 2000) can be applied and brought into effect in VLCs. These studies have revealed the different characteristics of VLCs from various perspectives and profiles, and gained significant insights for comprehensively understanding VLCs. A few studies also researched the development of collective intelligence and wisdom in the network and community environment (Lévy, 1997; Smith, 1994; Harasim, 1990; Hakkarainen, et al, 2004; Pór, 1995; Heylighen, 1999; Nellen, 1999).

A *Virtual Learning Community* is a virtual learning environment in which a group of learners, who join together with common interests and the same learning objective, communicate, interact, discuss, and collaborate on a problem that has arisen from active learning, collaborative learning, and knowledge building, and then share each other's opinions, ideas, resources, knowledge, experiences, and collective wisdom. A VLC therefore fosters the advancement of knowledge building and collective wisdom, and learners ultimately achieve learning targets and acquire the abilities of learning how to learn to a higher level (Gan, 2005, p.39).

VLCs have the potential to change the dynamics of traditional classroom interaction and learning. However, the way of integrating different theories to research into the various profiles of VLCs has not been fully explored (Gan, 2005, p.9). This study therefore represents an attempt to research into the detailed characteristics of VLC and build an integrated framework through combining systems theory, multiple intelligences, e-learning, and knowledge management; and hopefully to offer a new and broad angle to view the development of VLCs.

Research Tasks

- A VLC is a systematic phenomenon which is composed of learners, teachers/facilitators, resources and environment. With a systems view of a VLC, this study analyzes the systematic characteristics and overall effects of a VLC, and creates a more comprehensive understanding the complexity of the relationships of its components.
- A VLC acts to amplify the collective intelligence of a group (Smith, 1994, p.4-6). When learners are facing a problem that is too large or difficult for one person to handle alone, they resort to the collective strength of a VLC. We examine the intelligence continuum in a VLC, and the processes of how collective wisdom can be integrated from individual multiple intelligences and collaborative intelligence to form collective intelligence to solve a problem.
- A VLC is an online learning organization. While no one member of the VLC possesses all the skills and knowledge that are required for solving a problem or fulfilling a task, members can interact and collaborate with each other to find a solution for the problem or task, and to enhance their higher-order cognitive skills of problem-solving and creative thinking in the long run. In this study, we explore the characteristics of different learning models in a VLC.
- A VLC is a community of practice with valuable knowledge capital and culture. We explore the processes of knowledge conversions between explicit knowledge and implicit knowledge, and four important components of a VLC from a viewpoint of knowledge management: personal knowledge management, learning organization, organization memory and organization culture.
- A VLC can be developed into a knowledge building community through putting the principles of knowledge building (Scardamalia, 2002) into practice. We try to summarize the cognitive processes of idea convergence and the trajectory of knowledge building, and bring forward the zone of proximal development of a VLC.

We frame and address these problems to guide our research and try to construct an integrated framework for knowledge building and collective intelligence advancement from a systems view through the integration of systems theory, collective intelligence and collective wisdom, learning models, knowledge management and knowledge building.

Learning Framework for Collective Wisdom Advancement

Collective Wisdom is a sustainable human ability that is created and fostered by the contribution of individual talents, skills, and diverse experiences to support a common purpose; it is also a dynamic ecosystem for individual and collective learning in which emergent patterns of meaning, coordination flows, insights, and inspiration interact, cross-fertilize, feed upon, and grow on each other (Pór, 1995). Thus, collective wisdom can be defined as the ability to gain a profound insight into deep understanding the essence of the world, which is derived from the processes of divergence, convergence, integration and creation of individual members' multiple intelligences in a group/team, organization or the whole society (Gan, 2005, p.70). As we come into a knowledge society, this collective ability becomes of fundamental importance.

A four-level framework can be constructed to analyze the advancement of collective wisdom from the perspective of the technological structure (See Figure 1):

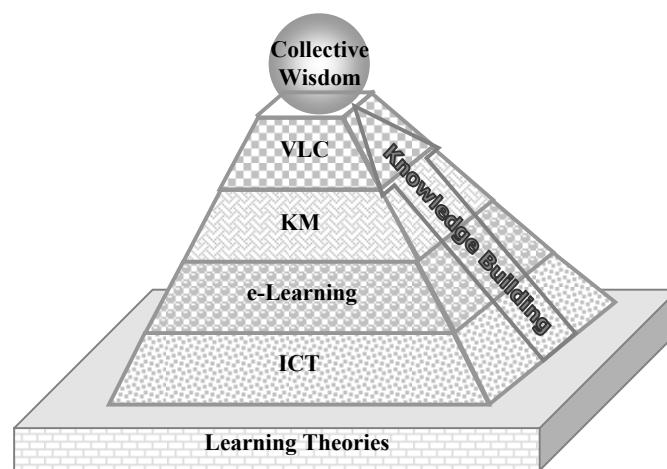


Figure 1. A four-level framework to support collective wisdom in learning communities

- *Information and Communication Technology* provides the network environment for the spread of collective wisdom far and wide. It is a new model of wisdom, in which every new idea is merged into the next new idea and then it produces a new understanding about the essence of being a human and the universe in which we live, that can be shared and spread through the new-born network connected around the world (Willard, 1981).
- *e-Learning*, which is extending toward digitization, networking, multi-media and artificial intelligence, is becoming the main platform for online/distance education and life-long learning as its software packages and platforms prevail, and is causing a magnificent transformation of learning models (Jansen, et al, 2002; Gan & Wang, 2005).
- *Knowledge Management (KM)*, which is becoming more and more important in the knowledge society, “combines the processes and application of technological tools to digitize, store, and make universally available, via electronic networks, the continuing creation and transference of knowledge and wisdom throughout the life cycle of the educational experience” (Galbreath, 2000).
- A *VLC* provides a flexible and open learning environment for practicing knowledge building, collaborative learning and converging collective wisdom, in which learners communicate information, discuss problems, pose new ideas, extend points of view, exchange learning experiences, debate opinions with each other and share a common understanding, and they also acquire, classify, store and share knowledge. Thus, learners not only have acquired new knowledge, but they also have attained the abilities of learning how to learn, enhancing their multiple intelligences, teamwork and collective wisdom (Gan, 2005, p.160).

Collective wisdom in a VLC can be viewed as a dynamic, living “ecosystem” for individual and collective learning in which learning groups/collective cooperatively enhance the wholeness and interconnectedness to deepen the

understanding of knowledge and to progressively integrate the individual intelligences. As a result, the VLC can attain higher-level wholeness and closer connectedness to shape the abilities of co-creation.

This study builds up a learning framework for knowledge building and collective wisdom advancement in a VLC from system wholeness, intelligence wholeness and dynamics, learning models and knowledge management (See Figure 2).

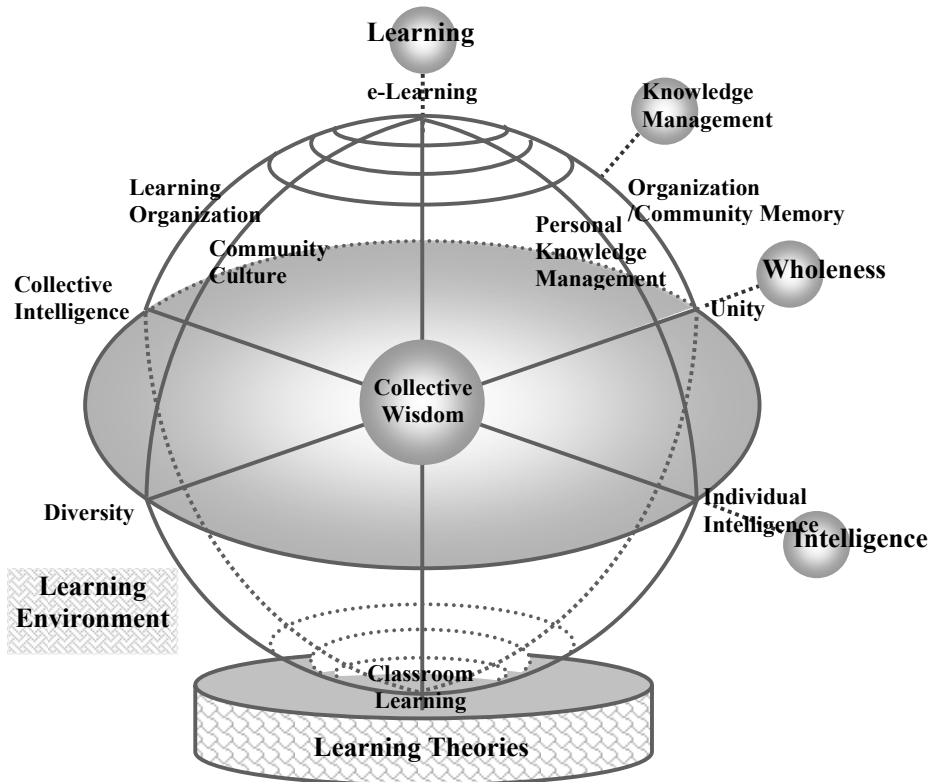


Figure 2. A learning framework for knowledge building and collective wisdom

Theoretical Analysis and Discussion

Systematic Wholeness Dimension

Unity and Diversity

Wholeness is the most basic and essential attribute of the system. Unity and diversity are two important attributes of wholeness (Harung & Harung, 1995). Unity is the common and general attribute of the system elements that interconnect and link various system elements and shape them into a united, dynamic wholeness. Diversity is the individualism and uniqueness of the system elements and the differences among system elements.

A group, an organization, a community, and society are different examples of united wholeness. Unity and diversity are the two most important perspectives in order to analyze the qualities of an organization and its members. People are organized to be a unity because they share common interests and have the same destination, but every member has many differences in personality, learning style, capability, intelligence level, and so on. It is just as Gardner said that the core perspective of multiple intelligences, whether in theory or in practice, lies in taking personality diversity seriously into account (Gardner, 1983).

Some scholars have dealt with the relationship between the learners' personality factors and the effects of online instruction (Anderson & Reed, 1998; Rasmussen & Davidson, 1998; Charlton & Birkett, 1999). A comparative experiment was also carried out (Wang, Li, & Liu, 2001), in which the relationship between online learning outcomes and five personal characteristics and educational attitudes such as perseverance, experimenting factor, creativity, ability to grow up in a new environment, and gender, were respectively researched. The results revealed that the learners' personality factors influenced the outcomes of online instruction to a great extent and different online instructional patterns should be offered to different learners based on their personal characteristics. A comparative experiment on the correlation between the learners' personal characteristics and computer-mediated communication (CMC) (Tolmie & Boyle, 2000; Wilson, 2000) was also carried out (Wang, Yang, & Liu, 2002), in which the relationships between personality factors, learning style, learning achievement, gender and computer-mediated communication were respectively researched. The results showed that these factors had a great influence on computer-mediated communication.

Systems Dimension

Systems theory insists that the universal relationships between system and system, system and components, system and environment must be studied from the perspectives of wholeness, connectedness, dynamics, hierarchy and self-organization (Daniel, 2006). A systems view enables us to explore and characterize the system of our interest, its environment, and its components and parts (Banathy, 1996, p.47). A VLC, which is organized around a certain purpose and composed of learners, teachers, facilitators, support staff, resources, network, and so on, has its relevant constituents, structures and features, and is a cohesive systematic whole. The learning characteristics of members in a VLC can be illustrated by two aspects: unity and diversity. Thus a VLC, in which learners do various learning activities as a collective in different groups or teams, is a hierarchical and structural system (Gan, 2005, p.154). The main characteristics therefore can be analyzed using the following four aspects (See Figure 3).

Hierarchy/Variation. As for the learners in a VLC, there are too many differences in their grown-up environment, life experience and cultural background; there are too many different features in personality, learning style and learning method; there are too many various levels in knowledge, cognitive ability and critical thinking ability; and there are also too many varieties in social communication, moral spirit and personal character. Thus, individuals in a VLC present too much diversity and variation. This variation is just like an unmagnetized magnet whose uniaxial magnetic poles are anisotropic.

Relevancy/Synergy. The learners mutually associate and influence each other in a VLC. The learning environment of a VLC will be destroyed if it is not suitably maintained. If a VLC is to be successful, one of the important factors to be manipulated is the community unity in learning destination, interest and commitment, and to make them synergize with one another -- that is, to produce a positive correlation rather than a negative one, to fully present learner specialties, and to facilitate the relevant factors towards the advancements in learning new knowledge, increasing learning performance, a higher cognitive level and advanced collective wisdom. This synergy is just like a magnetized magnet whose uniaxial magnetic poles are isotropic.

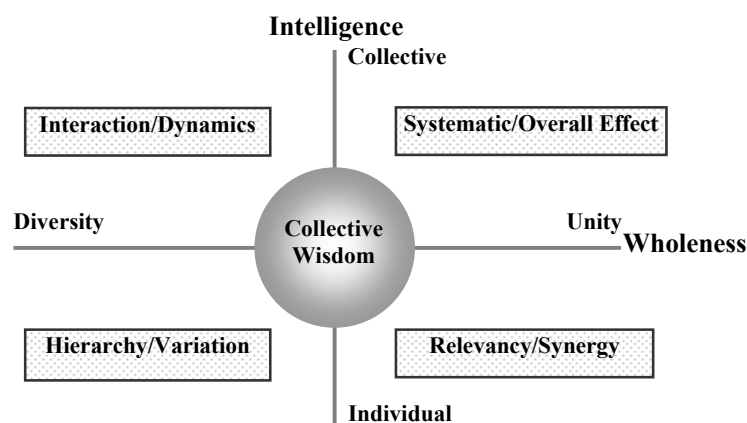


Figure 3. Systems dimension

Interaction/Dynamics. New knowledge is built and emerged in social dynamic interactions (Nonaka & Konno, 1998). The learner-centered learning in a VLC is mostly collaborative learning. It is a process of learners exchanging information, teaching and learning from one another, and also a process of taking care of each other, communicating feelings and exchanging opinions. During this, learners will experience a feeling of being accepted, trusted and identified by others through participating in activities, sharing outcomes, holding discussions and evaluating the achievements of one another. This extends the rich surroundings for enhancing social intercourse, cultivating communication skills, and developing self-awareness and a sense of community. Collaboration in a VLC also greatly increases individual collaborative capabilities and teamwork spirit by way of inspiring new ideas and the encouragement of one another (Gan, 2003a).

Systematic/Overall Effect. The overall effect is the most basic and important point in the systems theory view which insists that the whole function of a system is larger than the sum of the isolated elements respectively. Not only are the learners in a VLC independent from each other, but they also are interdependent and mutually restricted; therefore a VLC is an organic learning organization and system. The convergence of intelligence and wisdom in a VLC is an embodiment of this system effect. However, a VLC cannot necessarily give rise to a “positive” system effect; it can possibly bring out a “negative” system effect. If a VLC is expected to be successful, certain measures and means such as the applications of technical tools, learning environment design, learning resources, learners’ participation and interaction, learning commitment, information exchange and mining, knowledge sharing and knowledge management, must be taken into account to develop the “positive” system effect, and facilitate the emergence of new knowledge and the crystallization of collective wisdom in a VLC.

Intelligence Dimension

Collective Wisdom Continuum

The development of collective wisdom can be viewed from two aspects: from individual to collective and from intelligence to wisdom, so the advancement of collective wisdom can be identified as four stages (Gan, 2005, p.72) (See Figure 4):

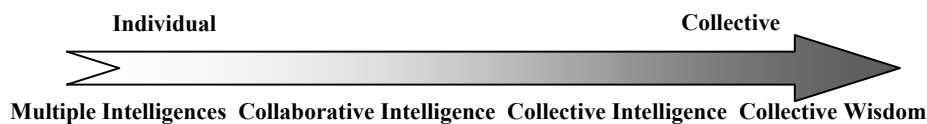


Figure 4. Collective wisdom continuum

Individual Multiple Intelligences. Howard Gardner (1983) formulated a list of eight intelligences: linguistic, logical-mathematical, spatial, kinesthetic, musical, interpersonal, intrapersonal, and the naturalist, which are the abilities of applying the whole spectrum of individual intelligences. Gardner suggests that different intelligences may be independent abilities -- a person can be poor in one area of skill but excellent in another domain. All of us possess the eight intelligences but in varying degrees of strength and skill.

Collaborative Intelligence. When a team participates in high-engagement activities, connecting with one another, a different kind of value -- collaborative intelligence -- is being created. Collaborative intelligence is the ability of a group or team collaborating with each other effectively, producing synergy and exerting all the strength of a team to an extreme extent. It is also the ability of synergy produced from the environment in which we live and the relationship with the environment with which we interact (Gan, 2005, p.73). Collaborative intelligence can be worked as an “intelligence amplification” (Smith, 1994, p.4-6) which could enable group thinking on a scale and level of significance that it has been impossible for individuals.

Collective Intelligence. “The notion of collective intelligence is that a group of human beings can carry out a task as if the group, it self, were a coherent, intelligent organism working with one mind, rather than a collection of independent agents” (Smith, 1994, p.1). Many experts have studied this phenomenon and listed many examples (Bonabeau et al., 1999; Heylighen, 1999; Susi & Ziemke, 2001). Collective intelligence is the ability of a group, a

team, an organization, a community and the whole society to learn, to solve problems, to plan the future, to understand and to adapt to the internal environment and the external world, with the convergence of individual or distributed intelligence and the integration of the whole strength and unity (Gan, 2005, p.73).

Collective Wisdom. Collective wisdom can be defined as the capacity of communities to cooperate intellectually in creation, innovation and invention (Lévy, 2004), and to learn, to work, and to solve problems effectively, which works like a cohesive wholeness whose function is larger than the components. Collective wisdom is the convergence of multiple intelligences and can shape deep insights and wide views. Thus, it is a continuum from individual multiple intelligences to collective wisdom. The development of collective wisdom is a process of up-and-down and spiral advancement. Much attention has been paid to collective wisdom as the Internet leads us to a vision of a “global brain” (Heylighen & Bollen, 1996; Heylighen, 1999), and more research and case studies on collective wisdom can be available from several websites (see: www.collectivewisdominitiative.org; www.collective-wisdom.org; www.wisdomcollective.com; and collective-wisdom.com; etc.)

Collective Intelligence and Collective Wisdom

Intelligence and Wisdom. According to webster.com, intelligence is: “(1) the ability to learn or understand or to deal with new or trying situations: REASON; (2) the ability to apply knowledge to manipulate one’s environment or to think abstractly as measured by objective criteria (as tests).” And wisdom is: “(1) accumulated philosophic or scientific learning: KNOWLEDGE; (2) ability to discern inner qualities and relationships: INSIGHT; (3) good sense: JUDGMENT.” Thus we can see that intelligence and wisdom are separate phenomena and operating in different dimensions. Intelligence is the ability to learn, to derive knowledge from information, to analyze and combine knowledge, and to understand and to face new unfamiliar challenges. Wisdom is the ability to apply knowledge into practice, and the ability to fulfill her/his needs in harmony with environment, to comprehend ethics and morality.

Intelligence is associated with explicit knowledge, reason, and the scientific method; wisdom is associated with implicit knowledge, understanding, judgment, insight, morality, a sense of beauty and appropriate action in social situations. It’s hard to have the latter without the former, but possible to have the former without the latter. All in all, intelligence is a thinking; wisdom is a knowing.

Collective Intelligence and Collective Wisdom. The differences between collective intelligence and collective wisdom are similar to that between intelligence and wisdom. George Pór (1995) defined collective intelligence as “the capacity of a human community to evolve toward higher order complexity thought, problem-solving and integration through collaboration and innovation.” Collective intelligence has the possibility of thinking at a different level than that of the individual. It is seen as the confluence of distributed cognition of “cultural and social context” (Vygotsky, 1978), and the cognitive processes and structures that emerge at the social level. Collective wisdom can be thought of as the collective capability to shape a profound insight into a deep understanding of the essence of the world, by integrating individual members’ multiple intelligences and strength, and close collaboration with each other, and cooperatively enhancing the wholeness and interconnectedness in a group. Collective wisdom is the product of long-term practices of a group or community with collective intelligence, and is the insight that only emerges in communities. Collective intelligence may lead to collective wisdom, but may also lead to “collective stupidity” (Heylighen, et al., 2004).

The distinctions between these concepts shown in Figure 4, just as the distinctions between the data, information, knowledge, and wisdom continuum, are not very discrete, thus the distinctions between each term often seem more like shades of gray, rather than black and white (Shedroff, 2001).

Intelligence Wholeness Dimension

Collective wisdom is a systems phenomenon. While individuals with multiple intelligences in a VLC are organized into a unity, collective intelligence and wisdom can be developed from individual multiple intelligences after a long-term practice of knowledge building in a community of practice. The intelligence dynamics can be analyzed from four progressive levels: individual multiple intelligences, interpersonal common intelligence, collaborative intelligence and collective intelligence (See Figure 5).

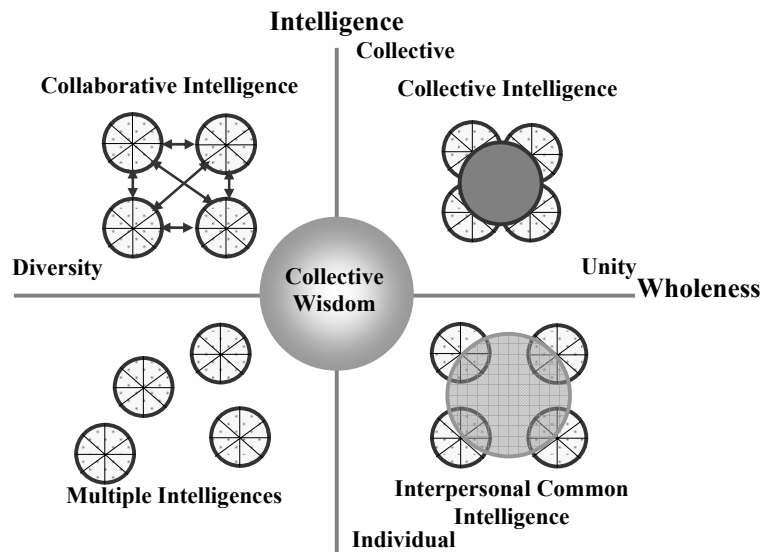


Figure 5. Intelligence wholeness

Multiple Intelligences. From the viewpoint of multiple intelligences (Gardner, 1983), every learner in a VLC has his/her own multiple intelligences with different levels and in different representations, and everyone has his/her own dominant intelligence and weak intelligence because everyone has his/her own specific characteristics of intelligence, personality and learning style. It is the differences in multiple intelligences, personal experience and cultural background that make individual learners treat the same thing/problem differently, present various opinions, and show the diversification that is the very source of creation, which is a capacity to initiate or generate new ideas that are novel and appropriate to the task at hand.

Interpersonal Common Intelligence. Multiple intelligences extraordinarily emphasize individual diversity (Gardner, 1983). Every one of the multiple intelligences is relatively independent, but all of the eight intelligences are close combined into a whole in a different way and to a different level or extent. There are two aspects of interpersonal common intelligence: (1) the similar intelligences among learners from scratch in a VLC. Although the participants in the same VLC have different intelligence levels, they have a similar average intelligence level by and large. For example, the learners who are to study a course should meet the initial requirements of this subject and have studied the relevant preceding courses. All in all, they possess the intellectual level and the knowledge requirements of this subject. (2) The outcomes of cognition and learning are similar. Learners in a VLC have a common intent and desire to attain a target. Through individual endeavor and collective collaboration, the learners' intelligences are advanced, and they achieve the learning target required by a subject syllabus and share a similar common understanding of knowledge at the end of the term (Gan, 2005, p.148).

Collaborative Intelligence. The problems posed by learners or emerged in learning in a VLC are also a good opportunity for learning. Learners understand and solve the problems through their collaborative intelligence and then enhance their individual intelligence. One of the challenges of collaboration in a VLC is how to apply individual diversity creatively and wisely because the diversities of individual learners may have a positive or negative influence on learning. Collaborative intelligence can be used to apply individual diversity to create a combined strength for collective problem-solving, knowledge building and learning targets. The representative characteristics of collaborative intelligence are as follows: learners provide help, resources, feedback for each other; query one another's opinions and explain the conclusions to one another; they trust and stimulate each other; and they also have good interpersonal ability and a willingness to work hard for a common goal through collaboration in order to attain the optimal learning achievement. Collaborative learning in a successful VLC results in the achievement of a sense of collaboration, active interpersonal relationships and high spirits.

Collective Intelligence. Collective intelligence presents the two kinds of connections of intelligence: first it confirms the independence of individual intelligence; secondly, it confirms the interaction of individual intelligence when observing an object in a complex environment (Wu, 2001). Collective intelligence is a “universally distributed intelligence” (Lévy, 1997) working with one mind, rather than a collection of independent intelligences (Smith, 1994, p.1). It is also the effective combination of distributed individual intelligence, and the collaboration and cohesion of individual intelligence; therefore it leads to fostering and improving the whole intelligence and wisdom in a VLC.

Intelligence Dynamics Dimension

The circle of spiral advancement of collective wisdom can be identified as four phases: intelligence divergence, convergence, cohesion, and innovation. The interplay of individual intelligence in a VLC also can be classified as four states: self-organization (autonomy), interconnectedness, integration, and co-creation (Gan, 2005, p.150) (See Figure 6).

Self-organization—Divergence. Every individual participant in a VLC is an independent learner who has his/her own learning plan, learning method and learning style. When learners encounter a problem, they can publish their problem in a VLC and ask for help from other learning companions. Owing to personal differences in intelligence levels, knowledge and cultural backgrounds learners treat every problem in different ways, with different visions, thoughts, and views; thus they can seek the solution in different ways and solve the same problem with different methods. As a result, different learners may produce a lot of outcomes or solutions to a problem, especially to an ill-structured problem. This is a process of brainstorming and thinking divergence.

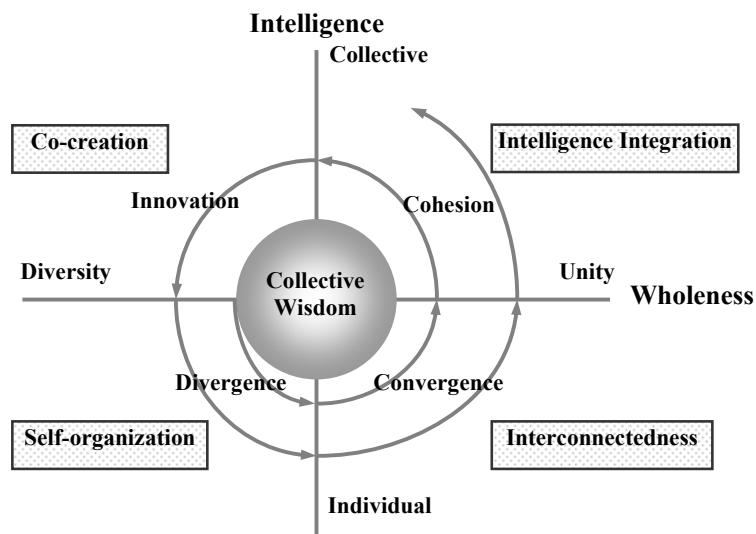


Figure 6. Intelligence dynamics

Interconnectedness—Convergence. The learners in a VLC poster their opinions about a problem, and discuss passionately. They may disprove a viewpoint and point out its shortcoming, or they may agree on an opinion, or represent an improvement on an idea. This is a process of interplay, interconnectedness and interaction among learners and a process of collective knowledge building. The facilitator in a VLC plays an important role in the process: firstly, he/she can put forward an enlightening idea or thinking clue for problem-solving. Secondly, he/she can actively pilot the direction of discussion; lead the problem-solving action to convergence; and foster the sharing of a consistent understanding. This is the process of progressive convergence of collective problem-solving.

Intelligence Integration—Cohesion. The process of learners discussing, debating and challenging a problem time after time in a VLC is also the process of learners exchanging, communicating, giving feedback, learning and self-

reflecting with one another. In the meantime, it is also a process of progressively forming the learners' abilities of sharing deep understanding, gradually increasing a higher cognitive level and ultimately tending to a consistent shared understanding. Shared understanding here has two meanings: firstly, in a well-structured problem, learners can ultimately achieve a consistent problem-solving solution (possibly more than one); secondly, in an ill-structured problem, there may be more than one solution (Zhu, 1996, p. 101-104). Shared understanding here is an inclination to similarity in which a similar understanding and grasp of the core of the problem is achieved through gradually seeking common ground while reserving differences, learners therefore can improve together the abilities of deep understanding and insight. New information and new knowledge in a VLC are also exchanged and shared, and collective intelligence is progressively upgraded in the course of learning, which is definitely a long-term, spiral and accumulative process to collective wisdom.

Co-creation—Innovation. Learning in a VLC is mainly student-centered in which learners not only learn new knowledge, but also, more importantly, cultivate the consciousness of innovative thinking and creative ability. Learners cannot be satisfied with only seeking the solution to a problem, but they should acquire higher level critical thinking skills. Namely, they should exert divergent, critical and imaginative thinking, and then probe into the deep meaning behind the problem, pose new questions or new ideas, based on the previous problem that has been solved. One of the characteristics of co-creation in a VLC is that learners can creatively use their personal diversities and brainstorm the common problems in which they are interested.

Learning Models Dimension

It is a continuum from traditional schooling to e-Learning. In fact, real learning for the most part is blended learning. There are two main online learning models in VLCs: independent learning and collaborative learning. A VLC is a most suitable environment to combine the two patterns of learning models and bring them into effect (See Figure 7).

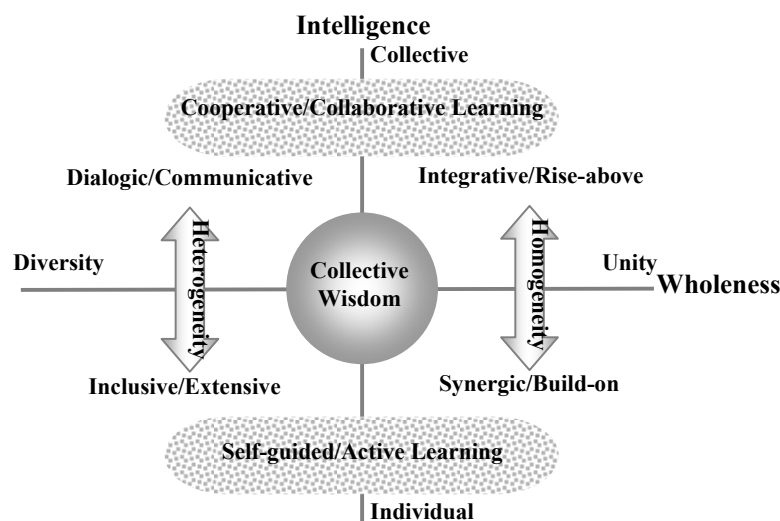


Figure 7. Learning models

Independent Learning

Independent learning (individualized learning) or self-guided/active learning in a VLC is one in which students independently choose learning contents, make learning plans, arrange timetables and places for study, with the network providing learning environment support, multiple choices of learning contents, optimal instructional support for every student, and teaching students in accordance with their aptitudes. Thereby, students can acquire and renew their knowledge through self-study.

Collaborative Learning

Collaborative learning in a VLC is an educational approach to teaching and learning that involves groups of students working together to solve a problem, complete a task, or create a product in which discussion, communication and collaboration take place among students, and between a teacher and students, with the network providing a collaborative learning environment. It leads students to cultivate a positive learning attitude, collaborative spirit and interpersonal relationships, and acquire some higher level cognitive skills (Zhu & Zhong, 2003, p.124-128).

Collaborative learning looks upon teachers and students as learning resources and an environment, in which students put knowledge building principles into practice through interaction and collaboration, and therefore presents the essence of constructivism. To make collaborative learning successful and maximize learning outcomes, the essential components of cooperation must be carefully considered such as positive interdependence; face-to-face interaction; individual and group accountability; interpersonal and small group skills; and group processing (Johnson, Johnson, & Holubec, 1993).

There are four main constructivist educational approaches to learning, which are considered as environments for facilitating students into practice, collaboration and communities of learners with the support of ICT. The four approaches are learning by design, project-based learning, problem-based learning, and knowledge building (Bereiter & Scardamalia, 2003b). Knowledge building, which can be defined simply as “creative work with ideas that really matter to the people doing the work” (Scardamalia & Bereiter, 2003a) and its basic objective is to “advance the frontiers of knowledge as these are perceived by the students,” offers the possibility of integrating all the other three approaches into an overarching learning environment that provides fuller and more authentic immersion in the actual life of a knowledge society (Bereiter & Scardamalia, 2003b).

Knowledge Management Dimension

Macro-vision of Knowledge Management

The aim of learning is to acquire new knowledge and furthermore to turn knowledge into life wisdom, in which knowledge management plays more and more important roles. We can review its roles in VLCs from four aspects: personal knowledge management, learning organization/community, organization/community culture, and organization/community memory (Gan, 2005, p.165) (See Figure 8).

Personal Knowledge Management. Personal knowledge management is the key to knowledge management, successful community of practice, and successful cultures in general. Individuals should use the methods and tools of knowledge management to manage personal knowledge in view of knowledge management (Gan, 2003b). Individual learning and working, and personal amassing, organizing, storing, applying and innovating new knowledge must be combined with individual intelligence development, career design, and life blueprint to gain individual knowledge and wisdom from the vision of knowledge management. In comparison with acquiring new knowledge, the ability of learning how to learn is much more important. The objective of education is not only to attain new knowledge, but more important to foster the improvement of learning ability and individual wisdom.

Learning Organization/Community. The fifth discipline of a learning organization (Senge, 1990) provides a powerful theoretical basic and methodological guideline for a learning organization and community of practice. The new idea and knowledge presented in different stages in a VLC must be linked up and stored in the database, and the individual intelligences must be integrated to foster the shared understanding and the improvement of new idea and knowledge in the whole VLC in which instructors or teachers should try to use systems thinking and knowledge management, and make full use of various learning methods and learning tools to foster the discovery, spread, storage, sharing and innovation of new knowledge. In the course of this, the learners’ learning ability, thinking power and creativity are incubated progressively.

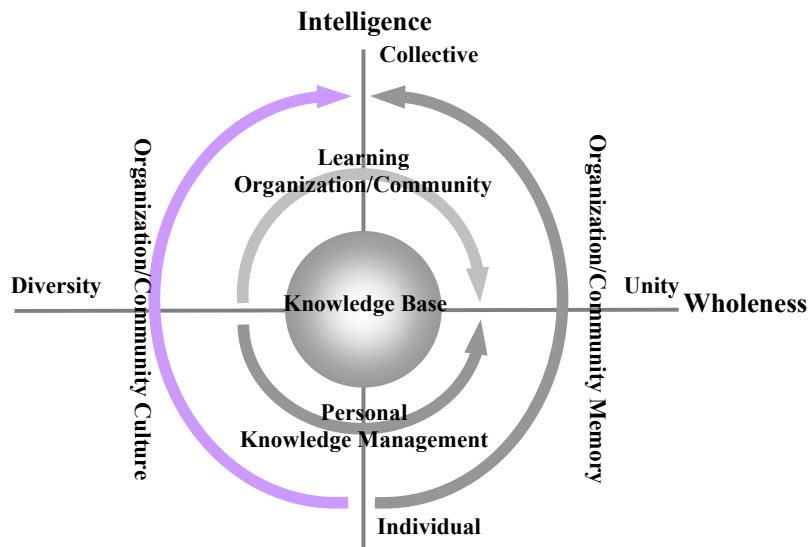


Figure 8. Four elements of knowledge management

Organization/Community Memory. Organizational memory can be characterized as a comprehensive computer system or collective memory which captures an organization's accumulated know-how and other knowledge assets, and makes them available to enhance the efficiency and effectiveness of knowledge-intensive work processes (Kuhn & Abecker, 1997). Building organization/community memory is an important stage in building a successful VLC in which the new knowledge derived from different sources must be sorted, organized, refined and stored in order to integrate isolated, scattered knowledge into organization/community memory. Knowledge engineering, case-based reasoning and agent technology provide the technological support for building organization/community memory.

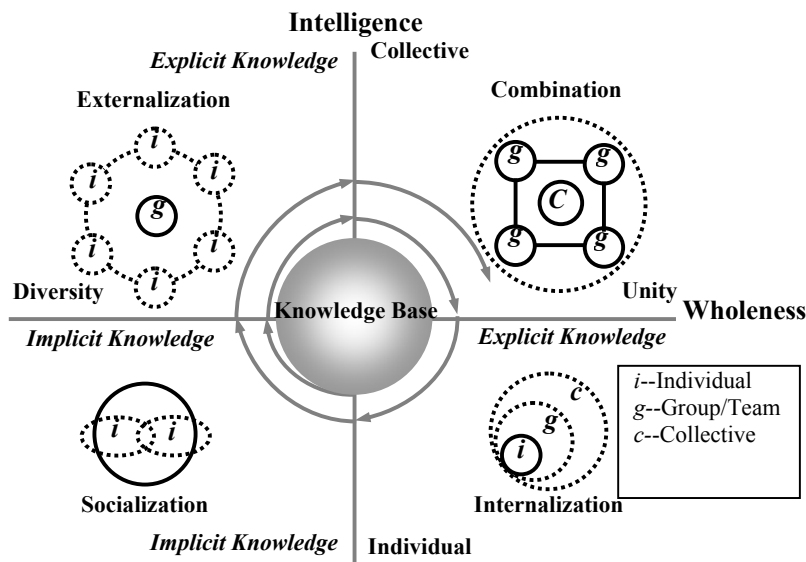


Figure 9. Knowledge conversions in a VLC

Organization/Community Culture. The most important feature of a VLC is its strong cultural maintenance which is composed of a sense of a common vision, a sense of belonging, a realization of self-worth, and so on, that can cultivate participants into stable and loyal members of a VLC. If the cultivation of the community culture is ignored,

the VLC will fail as usual. Thus in the course of implementing knowledge management, change management must be paid particular attention to (Cropley, 2004), and the facilitator should foster the cultural innovation in a VLC and transform learners' traditional notions of learning (Gan & Tao, 2006).

Micro-vision of Knowledge Management

Knowledge management comes to have a double-value effect through knowledge sharing. A VLC therefore is a most suitable environment where knowledge sharing can be easily and directly achieved. A typical application of knowledge management is in a community of practice and knowledge building community.

The knowledge conversions in VLCs are based on the knowledge conversions between individual knowledge and collective knowledge. From the vision of collective, individual knowledge is implicit knowledge relative to collective knowledge. The knowledge produced through individual interactions and emerging from VLCs is collective knowledge and is owned by all members, thus it is explicit knowledge. We can describe the knowledge conversions in VLCs based on Nonaka's SECI (Socialization, Externalization, Combination, and Internalization) model (Nonaka & Takeuchi, 1995, p.63-69) (See Figure 9).

Socialization. Socialization is a process of sharing personal experiences through social interactions among learners in a VLC, and then creating new, value-added implicit (tacit) knowledge such as sharing mental models, technical skills and know-how. Implicit knowledge can therefore be spread through its socialization in a VLC. Learners acquire and transfer implicit knowledge through observation, imitation and practice in the past and at present. For instance, apprenticeship is a typical model of sharing implicit knowledge between mentor and apprentices. However, VLCs or communities of practice offer a wider range of conditions and environments for implementing the transfer of implicit knowledge among learners, and for creating new knowledge from practice.

Externalization. The externalization of knowledge in VLCs is a process in which learners convert their implicit knowledge (relative to collective knowledge) to explicit knowledge (collective knowledge) by way of dialogues and discussions among learners in which ideas and technical know-how are presented by words, pictures and diagrams, and so on. Aiming at the topics or themes that are interesting to all members of a VLC, members share their special experiences, feelings and ideas, and they present explicitly their individual implicit knowledge by discussions, visualization, experiments, and trigger innovative thoughts in the process of interactions. In the externalization of individual knowledge, the implicit knowledge can be explained and externalized by metaphor, simulation, and can be formed into the conceptual knowledge after formalization.

Combination. If the new knowledge, which is scattered in notes of a learning/knowledge forum stored anywhere in the database of a VLC and is fragmented, messy and discrete after learners have discussed and interacted frequently, has not been summarized, ordered and combined according to certain rules or regulations such as meta-data, it is difficult for learners to find useful and needed knowledge in the database, therefore the expected goal of knowledge sharing and knowledge conversion cannot be easily achieved. Combination is a conversion process in which the concepts derived from above externalization are converted into a sorted knowledge system. Specifically put, for getting to the goal of managing knowledge, a VLC tries best to bind together the explicit knowledge from externalization and then to sort, adjust, categorize, and synthesize it, and next, to store it in the knowledge base in which learners can easily look for and retrieve what they need by any means, anywhere, and at any time. Moreover, this diffusion process of explicit knowledge can create newer and more systematized knowledge, and it is the implementation stage of converting individual knowledge into collective knowledge (Gan, 2005, p.164).

Internalization. The internalization of knowledge in essence is an active learning/training process. Only when the collective knowledge obtained from socialization, externalization and combination has been internalized into personal implicit knowledge, and then shaped into a sharing schema and skill does it become valuable assets and active (non-inert) knowledge. The internalization process transfers community explicit knowledge to the individual. Learners progressively accumulate and enrich their knowledge through internalization.

The above, four-way conversion model is a continual, extending and spirally progressive process in which individual learners continue to create new knowledge; and a VLC gradually accumulates explicit knowledge and progressively increases the volume of the knowledge base. On one hand, collective knowledge is converted to personal knowledge

through deep dialogue and collective inquiry; on the other hand, personal learning problems are converted into public issues through community processing (group processing), and then personal problems are solved by way of collective knowledge. Thus it makes for a better circulation — speeding up individual learning and innovation in VLCs.

Knowledge Building and Zone of Proximal Development of a VLC

Knowledge building and Knowledge Building Processes in a VLC

“Knowledge building may be defined as the production and continual improvement of ideas of value to a community, through means that increase the likelihood that what the community accomplishes will be greater than the sum of individual contributions and part of broader cultural efforts” (Scardamalia & Bereiter, 2003a). The distinction between learning and knowledge building is that, just as Scardamalia and Bereiter (2003a) put, “learning is an internal, unobservable process that results in changes of belief, attitude, or skill; knowledge building, by contrast, results in the creation or modification of public knowledge.” In knowledge building pedagogy, all ideas are treated as improvable, and idea improvement is its basic, explicit principles (Scardamalia, 2002). In knowledge building environment, community members continue to create new knowledge of value to the community and to enable further knowledge advances.

From the perspective of cognitive and intelligence development, and the trajectories of knowledge building in a VLC, the processes of knowledge building can be classified into four successive stages: sharing, negotiation, co-construction, and integration from the macro-analysis vision; and the cognitive behaviors of knowledge building can be classified into nine phases from the micro-vision (Gan, 2005, p.265) (see Table 1).

Table 1. Stages of knowledge building and collective wisdom advancement in a VLC

Cognitive behaviors	Stages/Descriptions
	<i>Sharing</i>
<i>Question</i>	Propose a question, opinion, idea or topic (well-structured/ill-structured); introduce a new concept; describe the origin, background, context, definition, purpose and intention of the question.
<i>Explanation/Clarification</i>	State a fact, concept and theory; explain an opinion; clarify the misunderstanding and blurring of meaning.
	<i>Negotiation</i>
<i>Conflict Support</i>	Cause contradiction; pose a substitute or different opinion and evidence. Support other’s idea or standpoint, and expound it further with an example, experience, etc.; or improve other’s idea.
<i>Defense</i>	Stick to the opinion of one’s own; defend the preceding statement with a further interpretation and evidence.
	<i>Co-construction</i>
<i>Evaluation</i>	Verify a hypothesis or opinion; make an evaluation or judgment about a viewpoint, suggestion and plan.
<i>Consensus building</i>	Try to achieve an agreement or consistent understanding on a theme or problem-solving.
	<i>Integration</i>
<i>Synthesis</i>	Organize and integrate different ideas; make a generalization or summarization; draw out a consistent conclusion.
<i>Reflection/Extension</i>	Reflect on the problem-solving strategy, elicit a general rule; apply the rule to a new context.

Zone of Proximal Development of a VLC

The preceding successive stages—sharing, negotiation, co-construction, and integration—are four progressively rising processes with no definite boundary. Therefore it can be compared with the Zone of Proximal Development

(ZPD) (Vygotsky, 1978) and combined into the Zone of Proximal Development of a VLC (Gan, 2005, p.266) (See Figure 10).

Zone of Actual Development of a VLC. Although the learners in VLCs have individual differences just as discussed above and their zones of actual development are different from one another respectively, there are no big differences in the same VLC; otherwise, there is no base for common language and learning groundwork. It is the diversity they own that is necessary to share, discuss and debate in the VLC. This is a process of idea generating and idea sharing. Therefore the zone of actual development of a VLC can be compared to the stage of “sharing” in knowledge building.

Zone of Proximal Development of a VLC. This zone can be compared to the stages of “negotiation” and “co-construction” in knowledge building. By means of collaborative learning, learners complete meaning construction in the course of debating, arguing, rebutting, defending, assessing and judging different ideas. This is a process of negotiation and construction of meaning, and idea linking in which learners can attain higher levels of achievement than they can do in self-study.

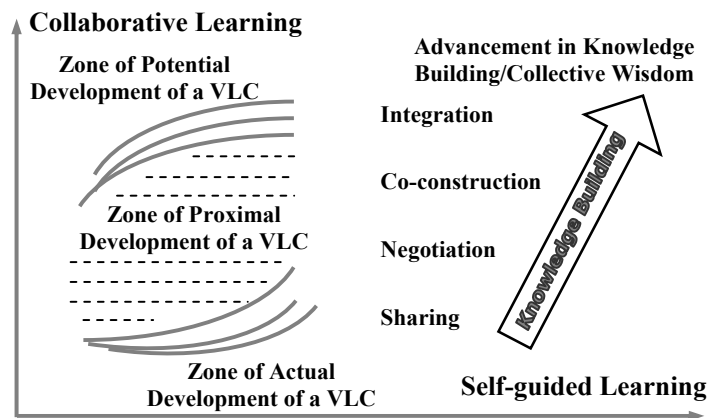


Figure 10. Zone of proximal development of a VLC

Table 2. Characteristics of knowledge building and collective wisdom advancement in VLCs

Convergent process	Communication process	Learning process	Learning outcome	Knowledge building stages	ZPD of VLCs
Divergent thinking (Idea generating)	Monologue	·Brainstorm (problem initiating)	·Diversified ideas ·Divergent or loosely linked state of personal ideas	<u>Sharing</u> ·Question ·Explanation /Clarification	Zone of actual development
Divergent to convergent thinking (Idea linking)	Dialogue	·Debate and negotiate ·Construct collectively (Problem solving)	·Personally deeper understanding, meaning negotiation and conceptual change ·Idea improvement ·Shared deep understanding ·Cognitive intelligence advancement	<u>Negotiation</u> ·Conflict ·Support ·Defense <u>Co-construction</u> ·Evaluation ·Consensus building	Zone of proximal development
Convergent thinking (Intellectual convergence)	Resonance	·Synthesize (Problem solved)	·Extending shared understanding ·Idea convergence ·Integration of collective wisdom ·Wisdom advancement	<u>Integration</u> ·Synthesis ·Reflection /Extension	Zone of potential development

Zone of Potential Development of a VLC. This zone can be compared to the stage of “integration” in knowledge building. If there are only idea divergence and idea linking and no idea convergence, there will be no knowledge building and the formation of new knowledge and collective wisdom. The integration is none other than the progressive process of convergence. Through the improvement, generation, summarization, induction and synthesis of ideas, and the reflection on problem-solving strategies and learning processes, learning in the whole VLC will move to a new and higher level. The outcome of these long-term practices inevitably leads to the advancement of learners’ potential capabilities.

Summarization of Knowledge Building and Cognitive Behaviors in VLCs

It should be pointed out that knowledge building can not be completed for once. The four stages of knowledge building are processes of recurrence and spiral upgrade. The end of one circle is the start of another. Only after learners experience the long-term practices for recurrent circles can learners acquire knowledge building abilities and advance their mental models, moving collective wisdom to a higher level in a VLC. After analyzing the developmental trajectories of knowledge building and collective wisdom advancement, we can summarize the processes of communication, learning, and cognitive behaviors relevant to knowledge building and collective wisdom advancement (Gan, 2005, p.267) (see Table 2).

Conclusions

The aim of a VLC built on the theories of constructivism, situated learning, and knowledge building, etc., is to apply individual intelligence to learning, bring the advantages of collective wisdom into play; solve the difficult problems in independent learning; and lead to the integration and sublimation of collective wisdom through long-term interaction, collaboration and knowledge building. As a result, it is a necessary and viable way to construct a learning framework for knowledge building and collective wisdom advancement in VLCs from perspectives on systematic wholeness, intelligence wholeness and dynamics, learning models and knowledge management.

This study analyzes the knowledge building and collective wisdom advancement in a VLC from four dimensions:

- *Systematic Wholeness.* Unity and diversity are two important angles to analyze the participants’ characteristics in a VLC. Unity is the essential base of building a VLC and diversity is a source of innovation.
- *Intelligence Wholeness and Intelligence Dynamics.* Collective wisdom is a system phenomenon. It is a continuum from individual multiple intelligences to collective wisdom. Thus the different stages and characteristics of intelligence wholeness and intelligence dynamics are completely analyzed.
- *Learning Models.* Independent/individualized learning and collaborative learning are two main learning models. A VLC is a most suitable environment for learners’ practicing knowledge building collaboratively and actively and for advancing collective wisdom.
- *Knowledge Management.* Knowledge Management emphasizes knowledge sharing, the conversion between implicit knowledge and explicit knowledge, community of practice and knowledge innovation, it therefore provides an essential support for knowledge building, individual and collective wisdom advancement.

In the end, the zone of proximal development of a VLC and the processes of communication, learning and cognitive behaviors relevant to knowledge building and collective wisdom advancement are constructed and discussed based on a combination of Vygotsky’s theory of the zone of proximal development and the trajectories of knowledge building.

The main work of this study is that it puts forward an integrated framework for knowledge building and collective wisdom advancement in VLCs, which is based on current theories and some research results in education, psychology, learning, cognitive science, knowledge management, and educational technology. The theoretical analysis applies these theories into a VLC environment and examines its characteristics from different perspectives for better understanding of the essence and processes of VLCs.

The main goal of this research is that the framework can offer a new viewpoint for looking at the different profiles of online learning and VLCs, allowing educators to think of ways of applying the principles of constructivism, situated learning, collaborative learning, knowledge building, collective intelligence and wisdom into online learning and

VLCs. Also, we wish this study could attract the educators' attention from distance education and stimulate some discussions on how to better integrate different theories and apply them into practice.

There are also some theoretical constraints and limitations on this framework:

Firstly, although some experiments were conducted on validating several main principles of knowledge building (Scardamalia, 2002; Lamon, Reeve, & Scardamalia, 2001; Gan, 2005, p.270-365) and idea divergence/convergence in a VLC (Gan, 2005, p.252-263), and some on the relations between student characteristics, cognitive and learning styles, and the effects of online learning (Anderson & Reed, 1998; Rasmussen & Davidson, 1998; Charlton & Birkett, 1999; Tolmie & Boyle, 2000; Wilson, 2000), which are close related to the unity and diversity in this framework. It is evident that the framework seems to be an ideal-typic model, but until now there are still lacking rich empirical and systematic evidence and experiments that can fully prove this framework from integrated perspectives. To lay a solid foundation for this framework, our main work in the future is to probe into the relationships of different components of the framework, to find out the weaknesses and revise them, and strengthen the theoretical foundation by conducting further fundamental experiments.

Secondly, although the framework has been brought forward, how to better integrate these theories into VLCs still needs to be further explored. Although there are, for example, some literatures on the merging of e-Learning and knowledge management (Barron, 2000; Marshall, B., et al., 2003; Vasilyeva, et al, 2005; Ubon & Kimble, 2002), and on the application of knowledge management into an online community of practice (Beinhauer, 2000; Kim, et al., 2003), the application of knowledge management into VLCs is still at an initial stage and needed to be further explored, and its effectiveness is also needed to be examined (Smits & Moor, 2004).

Thirdly, this study is development research. "Development research is often initiated for complex, innovative tasks for which only very few validated principles are available to structure and support the design and development model" (van den Akker, 1999). The aim is not to elaborate and implement complete interventions in the framework, but to come to (successive) prototypes that increasingly meet the new and innovative requirements. "The process is often cyclic or spiral: analysis, design, evaluation and revision activities are iterated until a satisfying balance between ideals and realization has been achieved" (van den Akker, 1999).

It should also be noted here that the emphasis on the importance of collective intelligence and collective wisdom in this study is not intended to belittle the role and importance of an individual mind and a compelling idea. Instead the processes of empowering and expanding collective intelligence and collective wisdom in VLCs can be used by individuals also, for example, to cope with a great deal of routine work so that he/she has more time, resource and support for creativity.

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