Teachers' understanding of knowledge creation: A phenomenography of Singapore Chinese Language teachers

Yuh Huann Tan, Singapore Centre for Chinese Language, Nanyang Technological University, Singapore, yuhhuann.tan@sccl.sg

Seng Chee Tan, Centre for Research & Development in Learning, CRADLE, Nanyang Technological University, Singapore, sengchee.tan@nie.edu.sg

Abstract: Knowledge creation approach of education is critical to prepare our children for the knowledge society. However, uptake of redesigning learning activities using knowledge building approach by school teachers is slow and one possible factor lies in teacher's understanding of knowledge creation as a phenomenon, but research in this area is lacking. This is a phenomenographic study with 16 Chinese Language teachers in Singapore to explore their understanding of knowledge creation. Four categories of teachers' understanding of knowledge creation emerged: limited creation by specialized few; creation by anyone for self and others; interpersonal creation for self; interpersonal co-creation with others. These four categories are marked by variations along three key themes: types of creator, individual/group involvement, and purpose. We examine differences between teachers' understanding with the 12 principles of Knowledge Building and suggest future interventional study that might facilitate teacher's adoption of knowledge building approach.

Keywords: knowledge creation, conceptions, language teachers, Chinese language, phenomenography

Introduction

The advent of Knowledge Age (Stewart, 1997) has implications on various facets of our lives, including human social enterprise, economies, and education. Today, knowledge-based organizations are finding ways to innovate and develop new capabilities to harness values of knowledge resources (Carlucci, 2014). Consequently, having knowledge workers capable of creating values through knowledge creation become competitive advantage of organizations and countries alike. Since one of its key goals of education is to develop and empower individuals to contribute to their societies, schools are expected to prepare future members of the workforce for the knowledge economy (Tan, Hung, & Scardamalia, 2006) and to be confident citizens in a knowledge society. To advance knowledge creation in education, Bereiter (2002) proposed the theory of Knowledge Building. Beyond just comprehension and application of existing knowledge, knowledge building aims at developing the competency and disposition of learners in advancing existing knowledge akin to activities by scientists, and members of "knowledge creating companies" (Nonaka, 1991). However, many schools are apparently not ready to prepare learners for the knowledge-based work place (Sawyer, 2008). K-12 teachers appeared reluctant to redesign teaching and learning to facilitate students toward creating knowledge (Scardamalia & Bereiter, 2010).

While there are many factors that influence a teacher's classroom practices, beliefs is an area explored in teacher cognition research (Borg, 2003). Beliefs are "psychologically held understandings, premises, and propositions about the world that are felt to be true." (Richardson, 1996, p.103). Herein, we argue that a teachers' understanding of knowledge creation could potentially affect decisions made related to their teaching and learning practice; to adopt knowledge creation pedagogy or not is one such decision.

Literacy capability is one key competency required of knowledge workers to contribute competitively in the knowledge economy (OECD, 2000). In schools, language lessons are the main conduit in developing students' literacy. With regard to teachers' understanding of knowledge creation, Tsai, Chai, Wong, Hong, and Tan (2013) observed that little is known about how teachers conceptualise knowledge creation as a phenomenon; it follows that how language teachers understand knowledge creation is also limited. We argue that it is important to first understand language teachers' conception of knowledge creation before we could understand any reason behind their (non-)adoption of knowledge creation pedagogy.

This study was conducted in Singapore, where the bilingual language policy is a cornerstone of her education system that was established even before her independence in 1965 (Gopinathan, 1988). All Singaporean students need to offer at least two language subjects in schools – an English Language subject taken by all students, and a Mother-tongue Language subject, dependent on the student's ethnicity. Typically, a Chinese student will study Chinese Language, a Malay student will attend Malay Language lessons, and an Indian student will take up Tamil Language.

The scope of the current study focuses on Chinese Language (CL) teachers. The qualitatively different ways of how CL teachers conceptualise knowledge creation is examined.

Knowledge creation in education

To advance learning in education, Paavola, Lipponen, and Hakkarainen (2004) first proposed that a knowledge creation metaphor view of learning is necessary. Building on the acquisition and participation metaphors by Sfard (1998), they examined three existing models of knowledge creation and highlighted a commonality found in existing knowledge creation models, which is the collective dynamic processes involved in development of shared objects of activity that transformed existing knowledge and practices. Our review of literature revealed that all three models were used to examine education in K-12 schools contexts, albeit to different extent. While Nonaka and Takeuchi (1995)'s and Engeström (1999)'s models situated knowledge creation in workplace and organizations, Bereiter's model is closely related to educational settings. Focusing on education in K-12 schools, the concept of knowledge building was proposed by Scardamalia and Bereiter (1994) as they advocated the transformation of schools from a place that focuses on individual learning, to a place where students engage in community discourse akin to research communities. Facilitated by technology (Scardamalia, 2004), the focus on individual's learning achievement is shifted to creation of knowledge valued by the students' community or beyond. Bereiter (2002) argued that students learn as they create knowledge, but the reverse may not be true. Learning through knowledge building is guided by 12 principles that capture sociocultural and cognitive dynamics of the pedagogy (Scardamalia, 2002), which are summarized into 3 sets of tenets.

The first set is *Idea-centric knowledge building* — consisting principles (1) real ideas, authentic problems, (2) improvable ideas, (3) idea diversity, and (4) rise above. Students investigate real-world problems that arise as they attempt to understand the world around them; they put forth different ideas by constructing epistemic artifacts; ideas are treated as improvable and continual idea improvement will lead to "rise above", that is, integration of ideas for deeper, more complete explanation of a phenomenon at a higher level.

The second set is *Knowledge building practices* — consisting principles (5) pervasive knowledge building, (6) constructive uses of authoritative sources, (7) knowledge building discourse, and (8) embedded and transformative assessment. To attain idea improvement, students should be engaged in discursive discourse that advances knowledge progressively as problems of understanding are identified and examined; authoritative sources of knowledge are important for supporting the refinement of ideas but students should also learn to critically evaluate and apply these information; assessment is a necessary and integral part of knowledge building as it helps students to monitor their advances, identify problems and gaps as their discourse proceeds; knowledge building practices should not be sporadic and be confined to a particular context (e.g., a certain topic, subject, or class) but it should pervade across contexts.

The third set is *Knowledge building identity* — consisting principles (9) epistemic agency, (10) community knowledge, collective responsibility, (11) democratizing knowledge, and (12) symmetric knowledge advancement. As students engage in their knowledge building learning activities, they should also begin to examine their roles in the community, and develop their identity as a knowledge builder; this includes assuming agency in using knowledge criteria to improve ideas, taking up responsibility to advance the community's knowledge in addition to individual learning, acknowledging the rights of every individual to contribute ideas, embracing diversity in views as strength of the community, and appreciating exchange of ideas leads to the collective advancement of knowledge for all individuals in the community.

Existing studies on knowledge building that focus on school teachers as the main subject of study span three areas, namely pre-service teachers education (e.g., Chan & van Aalst, 2006), formal in-service teachers' professional development (e.g., Hartnell-Young, 2009), and teachers' in-situ knowledge building practices in school (e.g., Zhang, Hong, Scardamalia, Teo, & Moley, 2011). Hong, Chen, Chai, and Chan (2011) examined pre-service teachers' view on knowledge building after they had experienced the pedagogy through taking part in a course. It was found that while student-teachers believed in the importance of knowledge building, they perceived knowledge building as non-feasible in actual practice. Perceived barriers to knowledge building included disbelief in students' knowledge building capacity, the need to help learners accumulate pre-specified knowledge efficiently for the purpose of examinations, and holding on strongly to the view of equal responsibility across all members in the group. Chai and Merry (2007) reported in-service teachers agreeing that professional development courses conducted with knowledge building pedagogy increased active meaning making during the course. However, these teachers voiced that knowledge building is time consuming, and believed that only their high-ability students would benefit. While these studies reported on teachers' perception of knowledge creation, participants' conceptions of knowledge creation were assumed. Studies that examined people's conceptions have shown that we cannot assume others' conceptions are the same as ours, nor what teachers hope their students would have learnt (e.g., Carlton, Fülöp, & Marton, 2001). Similarly, as teacher educator, we cannot assume the conceptions of teachers about knowledge creation, whether they

had experienced knowledge building practices or not. Existing studies, however, lack close examination of conceptions of teachers, including language teachers, on knowledge creation as a phenomenon. This study aims to address this research gap. The main research question of the current study is, "What are the qualitatively different ways in which Singapore Chinese Language (CL) teachers conceptualize knowledge creation?"

Methods

Taking into consideration the embryonic state of research on CL teachers' conceptions of knowledge creation, a qualitative study could help to deepen the understanding of gaps identified in the previous section. While there are many different approaches to qualitative research, phenomenography is appropriate in this case as it focuses on a person's understanding through thoughts or experience, including those perceived, conceptualized or lived (Marton, 1981). Focusing on the second-order perspective, phenomenography is primarily interested in how an aspect of the world appears to people; this is different from a first-order perspective which describes and theorizes about any phenomenon in the world (Marton, 1981; Marton & Booth, 1997). Herein, the phenomenographic lens is appropriate for examining the qualitatively different ways in which knowledge creation is experienced and conceptualized by Singapore CL teachers.

As a phenomenographic study, the aim is to investigate variation in the ways a phenomenon – in this case knowledge creation – is understood. Conceptions of the phenomenon are not infinite, but often exist in limited number of qualitatively dissimilar ways (Marton 1986/1988). The outcome of the study is constitution of a structured *outcome space* (Marton & Booth, 1997) representing key aspects of the qualitatively different ways of understanding knowledge creation by the participants. The structure of the outcome space is based on the critical aspects of variation between different views described in the *categories of descriptions*. Categories of description represent a collective view of how knowledge creation is experienced by all participants (Marton & Booth, 1997); specific individual's experience cannot be pinpoint from the overall description.

To increase the chance of maximizing variation of meaning, selection of participants with diverse characteristics is desirable (Åkerlind, 2005). A total of 16 CL teachers of diverse professional characteristics, and demographics participated in the study. A further elaboration of the sample follows:

- Years of experience as a CL teacher: <4 years: 25%, 4-10 years: 13%, 11-20 years: 31%, >20 years: 31%
- Levels taught: Primary level: 25%, Secondary level: 63%, Junior college level: 12%;
- Professional status/appointments: Teachers: 31%, Master teachers: 25%, Heads of department: 13%, Headquarters Officers: 19%, Academics: 12%;
- Gender: Female: 75% , Male: 25%;
- Academic qualification: Bachelor's degree: 19%, Master's degree: 69%, PhD: 12%

Face-to-face interview, the dominant mode of data collection in phenomenography, was chosen as the data collection mode as it afforded researchers to constantly clarify meanings with participants. Each individual semi-structured interview, lasting 60-90 minutes, was audio-recorded, and transcribed. Participants were provided with the list of interview questions one week before the interview. All interviews, except one, were conducted in Chinese as it is the language they felt more comfortable with because as the participants are all CL teachers. As such, most quotes appearing in this writing are translated from their original expressions in Chinese.

We adopted an iterative process for data analysis (Åkerlind, 2012) that involved repeated readings of interview transcripts. During reading, similarities and differences in meaning across transcripts were identified through compare-and-contrast method. Quotes that were perceived to have similar meanings were grouped. The groupings were monitored for minimum variation of meaning within a group, and maximum variation between groups. Quotes could be re-sorted to different groups during this process. In addition, key relationships that distinguished one group from another, known as *dimensions of variation*, were noted. Repeated reading, comparing, and sorting were carried out until a consistent set of groupings emerged. Each grouping, or category, represents a qualitatively different meaning or way of understanding knowledge creation. Together, these *categories of description* constitute the outcome space.

Findings

Four qualitatively different ways of understanding knowledge creation emerged during the data analysis, with knowledge creation variously conceived as: (1) limited creation by specialized few; (2) creation by anyone for self and others; (3) interpersonal creation for self; (4) interpersonal co-creation with others.

The four categories are marked by variations along three key themes, or *dimensions of variation*, which serve both to link and separate the different ways of understanding knowledge creation. The three themes represent variation in perceptions of: (1) *type of creator* regarded as who is capable of creating knowledge, ranging from specific named person, or persons in named groups, to anyone; (2) *individual/group involvement* is about the persons involved when knowledge creation takes place, whether it is activity of an individual person, or other persons may be involved in this activity; (3) *purpose* is related to the outcome of knowledge creation, that is, who might benefit from the knowledge creation, whether is the creator him/herself, or other people.

The four different ways of conceptualizing knowledge creation are outlined below, represented as the following detailed *categories of description*.

Category 1: Limited creation by specialized few

Within this category, knowledge creation is seen as an activity that is limited to a named person, member of a specified group of people, or a person with specific traits. Named personality include founder of Facebook, Mark Zuckerberg; founder of Apple, Steve Jobs; inventors such as Thomas Edison, and Albert Einstein. Specified groups of people include philosophers, scientists, bakers, and teachers. Traits that make one a knowledge creator include people who are observant and not satisfied with existing knowledge, stimulated by needs to create, or being well-educated. These people are perceived to be creating knowledge for a purpose beyond self. Outcomes of knowledge creation appears to be focused on advancing humanity. For example:

- I feel it's Steve Jobs. He created knowledge of mobile phones, and a mobile phone culture…prior to him all of us may not know this, but I feel that he changed our concept of handphone.
- Einstein, Edison, scientists like them are creators of knowledge. That's my understanding...they created non-existent knowledge for future generations, including others belonging to their generation.
- When scientists discovered micro-organisms, this is creation. Or, when anti-cancer treatment is discovered, these people are creators of knowledge.
- Someone who deeply understands existing knowledge can create knowledge, such as teacher, or well-educated person.

Although the different quotes showed different specific individuals creating different knowledge, one thing in common is that these individuals are perceived to be creating knowledge individually. This is despite the fact that Steve Jobs is but one of the three co-founders of Apple Computers Incorporated.

Category 2: Creation by anyone for self and others

With a marked difference from the previous category, knowledge creation, in this category, is viewed as an activity that is available to any person. Any person extends from children, students, housewife, hawker selling food, and even domestic helper at home. As anyone now becomes a knowledge creator, the purpose of creating knowledge sees an extension towards oneself, in addition to benefiting people around the creator. For example:

- Why does she create? To her, it's probably everyday she's cooking the same dishes. Others begin to not eat what she cooked. Seeing food being thrown away is a great blow to her. She feels the need to change, and change is manifested as her creations.
- A hawker selling char kway teow (a local food), he wants to fry the best kway teow unique from others. In the process, he has to find ways to make his fried kway teow stands out. This is the hawker creating knowledge.
- I believe everyone is capable of creating knowledge. There could be a difference in levels, to create something for own consumption, or to create a 'by-product' for others. Take Steve Jobs as a good example. While he develops his thinking, accumulates his experiences, his dreams, pulling everything together, he created a lot of by-products. His Pixar, his iPad…

While the benefits of knowledge creation have extended compared to the previous category, knowledge creation remains to be understood as something that involves only the creator: an individual at work.

Category 3: Interpersonal creation for self

Category 1 to 2 have described knowledge creation as being understood as an activity that involves only an individual, regardless of whether the person is a specific individual, or any person including adults and children. In this category, knowledge creation is seen as not only an individual is involved, but it may involve other people around the person. Knowledge creation takes place with others present. However, the focus of beneficiary is only around oneself. For example:

- I believe knowledge creation cannot be carried out without conversation. As I've just said, you need to gain understanding of existing knowledge. How do you do that? Talk to others.
- Firstly, the person who searched for it…I'm the one knowing it, and if I come back to share…if someone else is interested with whatever that is being shared, think about it, reflect upon it, act on it or work on it, I think it can bounce off new knowledge along the way.
- Among three persons, there could be one who is passively listening, not saying a single word. However, in this process, the conversation among the other two persons could have stimulated his thinking, and he develops an opinion. Take Facebook for example, although it's social media, it allows knowledge to be recreated because everyone gets to see it.

Category 4: Interpersonal co-creation with others

As with the previous category, knowledge creation is seen to involve both the individual and others interacting. However, the purpose of knowledge creation has moved beyond focusing on the individual. Instead, the focus has become a co-creation activity enabled by interpersonal interaction. Every person involved in the discourse contributes to the knowledge created. For example:

- Originally, knowledge creation should take place among people, among two persons, or what Confucius said, "When I am with two others, they will serve as my teachers". But, most people would not notice (this is knowledge creation). Say, as we are conversing, we are in fact creating knowledge too. But others may only see it as just a chat.
- The first way (of creating knowledge) is to derive new things from existing. The second way is possibly, as mentioned earlier since there's an interaction, the creation is a collaborative one (among individuals). It is through the interactions that a temporary conclusion is reached.

Relationship between the categories

Category 1 to 4 represent the key qualitatively different ways of understanding knowledge creation as described by the CL teachers interviewed. It should be noted that the four categories are not independently constituted. The categories form a hierarchical relationship based on inclusivity as seen in Table 1. In other words, the understanding of knowledge creation represented by categories higher in the hierarchy includes awareness of the aspects of knowledge creation represented by categories lower in the hierarchy, but not vice versa. As the nature of awareness determining human experience is inherent, phenomenographers believe that internal relationship would exist among different ways of experiencing a phenomenon (Marton & Booth, 1997). Such internal-relatedness is present in the findings described in the four categories.

Table 1: Dimensions and the inclusive nature of relationships between categories

Dimensions	Categories			
	1	2	3	4
Type of creator	Specific	Specific *and anyone*	Specific and anyone	Specific and anyone
Individual/group involvement	Individual	Individual	Individual; *individual and others*	Individual; individual and others
Purpose	Others	Others *and self*	Others and self, *with focus on self*	Others and self, with focus on *both self and others*

The four qualitatively different ways of understanding knowledge creation described above were marked by expanding complexity along the following three themes, or dimensions of variation, in awareness of different aspects of knowledge creation: (1) The *type of creator* who creates knowledge — with a varying focus across categories from specific named person or named group (category 1) to any person (categories 2-4); (2) The *involvement* of individuals or groups when knowledge creation takes place — with a varying focus across categories from an individual activity (categories 1-2) to an interpersonal activity where more than one person is involved in knowledge creation (categories 3-4); (3) The *purpose* relates to who benefits from the outcome of knowledge creation — with a varying focus across categories from serving others or self to serving self and others.

The relationship between categories and dimensions of variation is logically constituted. The hierarchical inclusive relationships reflect the core premise of phenomenography on ways of experiencing a phenomenon (Marton & Booth, 1997). At the lower end of the hierarchy, the understanding of knowledge creation focuses on only specific persons may create knowledge; the creation is an individual activity that begins with a purpose of serving others in mind. At the higher end of the hierarchy, the understanding of knowledge creation sees expansion in focus to include interpersonal creation that first begins with a focus on self, followed by expansion to see co-creating as purpose driving the creation.

The ways of understanding presented in the categories focus on critical aspects of different ways of understanding or experiencing knowledge creation. In the next section, we describe some non-critical variations that have emerged during data analysis. Reporting these findings that do not fit into the outcome space may aid our overall understanding of how CL teachers conceptualize knowledge creation (Åkerlind, 2012).

Non-critical variations
Non-critical variations are themes that emerged from participants' descriptions but do not fit into any hierarchical relationship in the outcome space. These include, (1) the outcomes, and (2) pre-requisites.

Outcomes
The outcomes of knowledge creation refer to what is produced at the end of the knowledge creation process. Based on participants' descriptions, outcomes vary across three major groups, (1) material things creation (e.g., Facebook; light bulb; an essay; a reflection in a diary), (2) process-related creation (e.g., work processes; how to cook), and (3) mental creation (e.g., Archimedes' principle; an improved idea; a concept; daily reflections).

Pre-requisites
The pre-requisites of knowledge creation refer to conditions that must be fulfilled before knowledge creation can take place. Participants' understanding vary across two types of requirements before knowledge creation may take place, (1) internal conditions (e.g., existing knowledge as a foundation; believes one can create new and useful knowledge; ability to create), and (2) external conditions (e.g., availability of time; personal psychological space granted by adult).

Discussion and conclusion
Having analyzed the qualitatively different ways of how CL teachers understand knowledge creation, we can now compare these understandings that emerged from empirical data, to those themes that emerged in the knowledge creation literature.

First, we can compare the dimensions of variations against the 12 principles that capture sociocultural and cognitive dynamics of the knowledge building (KB) pedagogy (Scardamalia, 2002). First, the types of creator who creates knowledge. The principles of epistemic agency, authentic ideas and improvable ideas suggest that everyone, including school children, can be knowledge creator. In fact, by arguing that schools should be transformed into knowledge building organization, Scardamalia and Bereiter (1994) have already assumed that school children are capable, and should be treated as legitimate participants in knowledge creation. Based on the categories of description, we observe that in CL teachers' conception, it is possible for students in schools, where our particular interest lies in this case, to be knowledge creators. In addition, 'improved idea' appears as an outcome of knowledge creation, which suggest another alignment with KB's principle of improvable ideas. For knowledge creation to take place, we find 'existing knowledge as a foundation' under pre-requisites as understood by CL teachers. Scardamalia and Bereiter (2010), however, qualified that even though school children may not be able to create knowledge new to the world, they can be engaged in creating knowledge new to their community. In so doing, we are engaging them in interpreting existing knowledge in service of an inquiry, which is one of the knowledge creation processes engaged by scientists. Scientists do need to interpret other's findings, and create new knowledge by building on the "shoulder of the giants", the famous quote attributed to Isaac Newton. It appears that in this dimension, CL teachers' understanding appear to

align to KB principles, which could possibly mean CL teachers are one step closer to designing knowledge creation into learning activities.

Second, the involvement of individuals or groups when knowledge creation takes place. Knowledge building identities – such as democratizing knowledge and symmetric knowledge advancement – clearly suggest a group and collective effort, and processes such as knowledge building discourse suggests a socio-collaborative process. In short, knowledge creation involves individuals, but the social collaborative effort is an essential condition, rather than a nice-to-have condition. In fact, many other knowledge creation models -- including organizational knowledge creation (Nonaka & Takeuchi, 1995), expansive learning (Engeström, 1999), and collaborative knowing (Stahl, 2004) – suggest the criticality of social collaborative conditions. A community is important for knowledge creation for several reasons: the more competent others can provide the necessary scaffold or modelling, the group can leverage distributed expertise in a joint inquiry, or diversity of ideas provide necessary ingredients and conditions for idea improvement. Looking at the categories of descriptions, we observe that 'the others' only begin to appear in the latter half of the hierarchy. While we can arguably say that CL teachers do conceptualize knowledge creation as an activity where others are involved, the emphasis on others only in the higher end of the hierarchy do not suggest CL teachers understood social collaboration as essential. This could possibly present a hindering factor of when CL teachers are embarking on designing learning activities for knowledge creation.

Third, the purpose relates to who benefits from the outcome of knowledge creation. Knowledge building recognizes individual's gain (symmetric advancement in knowledge) as well as contribution to and advancement of collective knowledge (community knowledge, collective responsibility). In fact, placing knowledge artifacts in a group space was one of the reasons for using Knowledge Forum (an online forum) as a technological support. This group access to the knowledge artifacts is a key enabler for other social collaborative processes discussed earlier. By subjecting one's ideas to other's scrutiny and suggestions for improvement, it also necessitates the use of epistemic criteria to defend one's ideas, thus developing the epistemic agency of the participants. Examining the categories of description, while the idea of others 'gaining' from knowledge creation appears right at the lowest level of the hierarchy, the concept of advancing collectively only emerges at the highest level of the hierarchy. This could mean that while CL teachers recognize the individual and others stand to gain from knowledge creation, the understanding of collective responsibility may not be strong. This lack of understanding may have been reflected in the outcomes of knowledge creation; it is not evident any of the outcomes represents a result of community knowledge being advanced.

After looking at the individual dimensions through the KB principles as a lens, we now examine the categories as a whole. Among the four categories of conception of knowledge creation, Category 4 seems to be aligned with knowledge building principles whereas Category 1 seems most antagonistic to knowledge building. Whereas Category 2 and 3 are somewhere in between. However, we need not treat the existing status as preconditions that must be fulfilled before embarking on knowledge building. Knowing the conception of knowledge creation of a teacher provides information about which aspects of change might be necessary. The next step could be using intervention strategies to develop the teachers in relevant areas. For example, if a teacher thinks that only scientists can create knowledge, case examples of how ordinary people can collectively create new inventions might be able to change their conception. For a teacher who does not conceive the essentiality of social collaborative efforts in the advancement of knowledge as a collective, knowledge-creating companies such as Facebook and Apple, the two favorites among the participants, could be used as case examples in the exploration of meaning behind respective KB principles.

Future studies can explore the use of social psychological interventions for teachers, which entails identifying and resolving the cognitive blocks that shape how they interpret the world. Aronson, Fried and Good (2002) found that students who actively explored information on effortful learning are more likely to complete their degrees. Future studies can also explore teachers' conception of knowledge in relation to their conceptions of knowledge creation. Tsai et al. (2013) proposed that in the discussion of the knowledge creation phenomenon, epistemology would be a related topic to consider.

In short, this study initiates an exploration into teacher's understanding of the phenomenon of knowledge creation, which could affect teachers' volition and methods of adopting knowledge building pedagogy in their classrooms.

References

Åkerlind, G. S. (2005). Phenomenographic methods: A case illustration. In J.A. Bowden & P. Green (Eds.), *Doing developmental phenomenography* (pp. 103-127). Melbourne: RMIT University Press.

Åkerlind, G. S. (2012). Variation and commonality in phenomenographic research methods. *Higher Education Research & Development, 31*(1), 115-127.

Aronson, J., Fried, C. B., & Good, C. (2002). Reducing stereotype threat and boosting academic achievement of African-American students: The role of conceptions of intelligence. *Journal of Experimental Social Psychology, 38*(2), 113–125.

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

Bereiter, C., & Scardamalia, M. (2010). Can children really create knowledge? *Canadian Journal of Learning and Technology, 36*(1).

Borg, S. (2003). Teacher cognition in language teaching: A review of research on what language teachers think, know, believe, and do. *Language Teaching, 36*(2), 81-10.

Carlton, M. A., Fülöp, M., Marton, F. (2001). Peeling the Onion: Student teachers' conceptions of literary understanding. *Scandinavian Journal of Educational Research, 45*(1), 5-18.

Carlucci, D. (Ed.). (2014). Guest editorial: Knowledge-based value creation dynamics in 21st century organizations. *Measuring Business Excellence, 18*(1), 1-7.

Chai, C. S., & Merry, R. (2006). Teachers' perceptions of teaching and learning in a knowledge-building community: An exploratory case study. *Learning, Media & Technology, 31*(2), 133-148.

Chan, C. K. K., & van Aalst, J. (2006). Teacher development through computer-supported knowledge building: Experience from Hong Kong and Canadian teachers. *Teaching Education, 17*(1), 7-26.

Gopinathan, S. (1998). Language policy changes 1979-1997: Politics and pedagogy. In S. Gopinathan, A. Pakir, W.K. Ho, & V. Saravanan (Eds.), *Language, society and education in Singapore: Issues and trends* (2nd ed., pp. 19-44) . Singapore: Times Academic Press.

Halstead, J. M. (1996). Values and values education in schools. In J.M. Halstead & M.J. Taylor. (1996), *Values in education and education in values* (pp. 3-14). London, UK: Falmer Press.

Hartnell-Young, E. (2009). Learning for teaching: Building professional knowledge on a national scale. *Canadian Journal of Learning and Technology, 35*(1), 8. Retrieved from http://www.cjlt.ca/index.php/cjlt/article/view/516/246

Hong, H. -Y., Chen, F. -C., Chai, C. S., & Chan, W. -C. (2011). Teacher-education students' views about knowledge building theory and practice. *Instructional Science, 39*(4), 467-482.

Marton, F. (1981). Phenomenography: Describing conceptions of the world around us. *Instructional Science, 10*(2), 177-200.

Marton, F. (1986/1988). Phenomenography: A research approach to investigating different understandings of reality. *Journal of Thought, 21*(3), 28-49. Reprinted 1988 in R. R. Sherman & W. B. Webb (Eds.), *Qualitative research in education: Focus and methods* (pp. 141-161). London: Falmer Press.

Marton, F. & Booth, S. (1997). *Learning and awareness*. Mahwah, New Jersey: Lawrence Erlbaum Associates Publishers.

Nonaka, I. (1991). The knowledge-creating company. *Harvard Business Review, 69*(6), 96-104.

OECD. (2000). *Literacy in the information age: Final report of the international adult literacy survey*. Retrieved from http://www.oecd.org/education/country-studies/39437980.pdf

Paavola, S., Lipponen, L., & Hakkarainen, K. (2004). Models of innovative knowledge communities and three metaphors of learning. *Review of Educational Research, 74*(4), 557-576.

Richardson, V. (1996). The role of attitudes and beliefs in learning to teach. In J. Sikula (Ed.), *Handbook of research on teacher education*, (2nd ed., pp. 102-119). New York: Macmillan.

Sawyer, R. K. (2008, May 15-16*). Optimising learning: Implications of learning sciences*. Paper presented at OECD/CERI International Conference Learning in the 21st Century: Research, Innovation and Policy. Retrieved from http://www.oecd.org/edu/ceri/40805146.pdf

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. (2004). CSILE/Knowledge Forum®. In *Education and technology: An encyclopedia* (pp. 183-192). Santa Barbara: ABC-CLIO.

Scardamalia, M., & Bereiter, C. (2010). A brief history of knowledge building. *Canadian Journal of Learning and Technology, 36*(1).

Sfard, A. (1998). On two metaphors for learning and the dangers of choosing just one. *Educational Researcher, 27*(2), 4–13.

Stahl, G. (2004). Building collaborative knowing: Elements of a social theory of CSCL. In J.-W. Strijbos, P. Kirschner & R. Martens (Eds.), *What we know about CSCL: And implementing it in higher education.* (pp. 53-86). Boston, MA: Kluwer Academic Publishers.

Stewart, T. A. (1997). *Intellectual capital: The new wealth of organizations.* New York: Doubleday.

Tan, S. C., Hung, D, & Scardamalia, M. (2006). Education in the knowledge age: Engaging learners through knowledge building. In D. Hung, & M. S. Khine (Eds.), *Engaged learning with emerging technologies* (pp.91-106)*.* The Netherlands: Springer.

Tsai, C. -C., Chai, C. S., Wong, B., Hong, H. -Y., & Tan, S. C. (2013). Positioning design epistemology and its applications in education technology. *Educational Technology & Society, 16*(2), 81-90.

Zhang, J., Hong, H. -Y., Scardamalia, M., Teo, C.L., & Mor1ay, E.A. (2011). Sustaining knowledge building as a principle-based innovation at an elementary school. *Journal of the Learning Sciences, 20*(2), 262-307.