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Development and validation of the knowledge-building environment scale

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ABSTRACT

This study aimed to develop a knowledge-building environment scale (KBES). Based on the knowledge building pedagogy, the authors identified three core dimensions that could reflect the creative extent of knowledge building environment in the classrooms. Three independent samples were recruited to validate the reliability and validity of the scale. First, sample A (n = 332) was used to generate the factors through exploratory analysis. It resulted in a scale of three factors which contained "working with ideas," "assuming agency" and "fostering community" dimensions. Second, a series of competing models were established and evaluated by confirmatory factor analysis through sample B (n = 575). The comparison shows that the hierarchical model was the most efficient model with good reliability and validity. Finally, the cross-validation of the hierarchical model was tested by sample C (n = 575) to confirm its stability and predictive power. The result of the KBES can provide institutions that are interested in promoting knowledge building with a tool for evaluating the learning environments.

1. Introduction

One emerging issue in education that has attracted much attention is how knowledge is taught in schools and what kind of competencies should students possess in a knowledge-based society. Many believe that the knowledge and skills that students should learn today are different from the industrial age. Emerging consensus points to the insufficiency of focusing on learning declarative/descriptive knowledge but ignoring the application of knowledge to real life. Furthermore, students' lack of understanding of knowledge building/knowledge creation activity is increasingly a concern among educators (Macdonald & Hursch, 2006; Zhao, 2012). Consequently, much attention has been devoted to reforming schools to cultivate students' abilities to cope with the rapidly changing world in the 21st century (Partnership for 21st Century Skills, 2011). To effect the changes, it is necessary to create new perspectives among teachers and learners on knowledge building and help them to regard learning as a dynamic, critical and innovative process. Consequently, it is necessary to explore further how we cultivate students' knowledge-building ability (Hong & Sullivan, 2009).

"Knowledge building" involves social negotiation processes among a group of learners/knowledge creators that strive to continuously generate and improve ideas. Ideas, which could include a variety of forms such as theories, design, conjectures and narratives, are the epistemic materials that are to be articulated and transformed through progressive discourse in a knowledge building community. Through the notion of knowledge building, Scardamalia (2002) offered a new direction to think about students' learning processes. The key point in the knowledge-building theory is to focus students' epistemic work on idea creation and ever evolving improvement in a learning environment. In practice, students need to take ownership to create ideas that address problems of understanding; they should work with others and try to advance their ideas continuously. These processes are usually supported by networked computers and collaborative software to help raise students' effective understanding of knowledge and abilities (Chan & Chan, 2011).

While the knowledge-building approach has been studied for more than two decades, specific instruments that measure the creative extent of knowledge building classroom or environment are rare. A recently developed instrument is Student Perception of Classroom Knowledge Building (SPOCK) (Shell et al., 2005). While it aims to assess knowledge building climate in class, a close examination indicates that its theoretical foundation is not fully in line with Scardamalia and Bereiter's (2006) knowledge building theory and pedagogy. The knowledge building concept referred to in the SPOCK is more generally concerned with knowledge association among different subjects of knowledge (e.g. relating what one has learned in a math class to what he or she is learning now in a science class), rather than with knowledge creation or innovation. Another related instrument is Questionnaire on Collaboration (QC) which was developed by Chan and Chan (2011). It was designed to help assess the perceptions of collaborative learning—an important aspect of knowledge building. Unfortunately, this questionnaire is inadequate for several reasons. First, Chan and Chan only measured one key factor (with 12 items), that is, students' experiences of collaborative learning in a knowledge building environment. However,

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as argued later in this paper, the complex knowledge building construct is likely to be better represented by several factors/dimensions. Second, although Chan and Chan reported reliability and validity for the questionnaire, it is not clear how the items of QC were generated and there was another issue of low variance explained by EFA, with only about 30%. Third, the QC was developed using eight secondary schools in Hong Kong, which may limit its utility in university context. Given the lack of instruments specifically designed based on knowledge building theory and pedagogy, it is timely to develop a knowledge building environment scale and explore possible dimensions/indicators to understand the creative and social-cognitive dynamic of knowledge building in the learning environments. As such, two specific aims guided this investigation: (1) to generate items for a knowledge-building environment scale (KBES); and (2) to evaluate the KBES for reliability and validity. In the following sections, we first elaborate the need to develop such instrument by reviewing studies related to learning environments; then, we further conceptualize the possible dimensions for developing the scale by reviewing studies pertaining to knowledge building.

2. Literature review

2.1. Learning environments

Previous studies have shown that depending on the kind of learning environments provided by teachers, it can have tremendous influences on student learning processes and outcomes (Eggen & Kauchak, 2007; Pierce, 2001). For example, Pierce (2001) found in a case study that at-risk students' learning performance can be greatly enhanced by a constructive learning environment. According to Duffy and Jonassen (1992), learning environments may be broadly categorized into two types: teacher-centered and student-centered. The former usually sees learning environments as a place for teachers to implement direct teaching or lecturing and for students to acquiring knowledge from authoritative knowledge sources (that is, teachers or textbooks) (Adams & Engelmann, 1996; Goodnough, 2003; Peters & Kortecamp, 2010). While being recognized as an efficient way for knowledge delivery, such environment has been criticized for neglecting learners' individual differences and creative capacity for knowledge creation. In contrast, the latter (student-centered) sees learning environments as a place for fostering more constructivist-oriented instruction. It promotes more innovative learning activities for students. As such, teachers guide students to inquire, explore, and/or problem-solve in a more creative and adaptive manner (Sawyer, 2004, 2006). From a knowledge-building perspective (as contrasted with a knowledge-telling perspective), it is of great importance to foster more creative, student-centered learning environments. Accordingly, it is equally important to develop relevant instruments in order to assess learning environments that highlights knowledge creation.

Unfortunately, as indicated by a review paper (Fraser, 1989), studies concerning learning or class environments have mainly tried to examines students and teachers' general perception of classroom learning, rather than the creative aspects of class learning in particular (e.g., see also Chávez, 1984; Johnson, Johnson, & Anderson, 1983; Leff et al., 2011). For example, in an early study, Trickett and Moos (1974) developed the Classroom Environment Scale, focusing on measuring the psycho-social environment of high school learning environments. The scale sees a learning environment as a dynamic social system and its assessment mainly focuses on student–student interactions and teacher–student interaction. As another example, Leff et al. (2011) developed and validated a classroom climate observation assessment tool, but its main goal is similarly to measure the social climate of classrooms. Thus, there is an apparent lack of relevant instruments to measure creative extent of learning environments that foster students' knowledge building or creating capacity.

As argued above, enhancing students' innovative capacity is imperative for the knowledge society. As such, to design supportive environments within which creative knowledge work can be cultivated has become even more pressing. To this end, within the area of knowledge building research, an important line of studies has been investigating knowledge building theory as an innovative pedagogical approach to foster more creative learning environments (Hong, accepted for publication; Hong, Chang & Chai, accepted for publication; Zhang, Hong, Scardamalia, Teo, & Morley, 2011). For instance, Zhang et al. (2011) investigated whether knowledge building as a principle-based pedagogical approach (rather than a procedure-based approach) helped cultivate a creative learning environment. Hong et al. (accepted for publication) investigated whether idea-centered instruction as a knowledge building approach can provide a creative learning climate; they employed the Creative Climate Questionnaire designed and developed for business use (Ekvall, 1996) due to the lack of valid instruments for assessing the knowledge building environments. Clearly, there is a need to develop pertinent instruments for measuring knowledge-building environment and this remains a challenging task. In the following, we further elaborate the conceptual background of knowledge building and conceptualize possible dimensions for constructing the knowledge building environment scale.

2.2. Knowledge building

In contrast with learning that is focused on knowledge acquisition in traditional classrooms, a knowledge-building environment encourages learners to produce diverse ideas and develop, refine or elaborate the ideas through progressive discourse. Working with ideas in dialogic manner helps students to address emerging understanding and beget deeper questions while they are engaged in solving epistemic problems. The elaboration and advancement of ideas are dependent on interactions among knowledge workers or epistemic agents. If agency – which refers to the psychological status of being self-initiative and -directed as an epistemic agent – is not fostered in such a learning environment, ideas are less likely to be improved and they may stagnate, resulting in the loss of a dynamically diverse environment.

Scardamalia and Bereiter (2006) proposed that knowledge and ideas should not be seen as personal properties, but should be treated as public, social epistemic entities which can be continuously improved via community learners' interaction with and innovation of ideas (Hong & Sullivan, 2009; Scardamalia & Bereiter, 2006). Engaging learners in a knowledge-building environment as a cohesive group forms a knowledge-building community where the learners exhibit epistemic agency (which refers to the amount of individual and/or collective control people have over the whole process of their knowledge work). Accordingly, they are guided within the community to address authentic problems and to engage in active and thoughtful interactions, so as to transform and improve the ideas for collective knowledge advancement (Scardamalia, 2000; Scardamalia & Bereiter, 2006).

Scardamalia (2002) articulated 12 principles that guide knowledge building. These principles help to foster the social dynamics involved in knowledge-building environments. They include authentic problems; improvable ideas; idea diversity; rise-above; epistemic agency; community knowledge; democratizing knowledge; symmetrical knowledge advances; pervasive knowledge building; constructive use of information; knowledge building discourse; and concurrent assessment. These principles support the transformation of the classroom into a knowledge-building community. In this way, knowledge building is defined as a social process with focus on the production and continual improvement of ideas of value to a community (Scardamalia & Bereiter, 2003). According to Hong, Chen, Chai, and Chan (2011), these principles could be generalized into three essential knowledge-building dimensions: ideas (as building blocks of knowledge), agents (as knowledge workers), and community (as a place for sharing and creating knowledge). Serving as design ideals and/or challenges, the successful employment of these principles can be attained through the manifestation of working with ideas, assuming agency, and fostering community in a learning