Fostering More Informed Epistemic Views Among Students Through Knowledge Building

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Abstract: Understanding students' epistemic views is critical for educators to understand how they work with ideas and knowledge. The present study explored how college students' online collaborative inquiry activities may inform their epistemic views. A mixed-method analysis revealed that students' online knowledge-building and inquiry activities were associated with the change of their epistemic views. When engaging in more productive group inquiry activities, a more sophisticated epistemic view conducive to continual idea improvement for knowledge advancement was more likely to develop among students.

Introduction

The demand for new knowledge and novel ideas to solve existing and emerging societal problems is increasing (Csikszentmihalyi & Wolfe, 2014; Drucker, 2011). Because ideas are essential for knowledge-creating and problem-solving and human beings are naturally capable of idea generation, it has become increasingly more important for educators to think about how to foster students' creative competency to generate and work creatively with ideas (Koh, Chai, Wong, & Hong, 2015). The educational challenge for knowledge innovation or creation, in particular, is how to maintain sustained effort for the improvement of ideas (Scardamalia & Bereiter, 2003; 2006). Traditional educational approaches tend to emphasize the importance of acquiring and accumulating knowledge from textbooks and instructors, while neglecting the more innovative part of transforming students into knowledge workers who can produce and improve ideas for their knowledge work (Scardamalia & Bereiter, 2015). Papert (2000) refers this educational phenomenon as "idea aversion" (i.e., dislike of ideas), and he further argues that typical learning environments are less likely to help students produce and work with their own ideas. Instead, they are designed for direct instruction for teachers (cf. Sawyer, 2004; 2011). Ideas initiated by students are treated with little value and are not much appreciated (unlike textbook knowledge that are favoured in most learning environments).Accordingly, students not encouraged either to dedicate themselves to pursue and materialize their ideas for the sake for knowledge advancement. To address this concern, the present study engaged students in the process of continual production and improvement of ideas.

Epistemological views concerning idea-centered knowledge work

The important role ideas played in a knowledge-intensive society may be best explained by Popper's (1972) three-world epistemology. Popper postulates three different forms of ontological reality to explain how the three epistemic worlds come into being. The three epistemic worlds are: (1) the natural/physical world (World 1), (2) the psychological world (World 2), and (3) the humanly-constructed conceptual world (World 3). In brief, World 1 refers to natural or physical reality, and can exist by itself with no human presence. World 2 considers reality as a mental state created in the human mind. It is a private world consisting of a person's personal thoughts and feelings, and the experiences of his or her perceptions and interpretations of World 1. In contrast, World 3 conceives reality as being constructed by man-made "ideas" as conceptual artefacts; these in turn give form to all other humanly-constructed, materialistic artefacts that further substantiate the existence of World 1. Popper especially highlights the important contribution of World 3 to human civilization that is caused by humans' exceptional imaginary capacity to work with and act upon ideas—ideas that are readily existent or emergent—and to transform them into feasible solutions and accepted knowledge for solving problems. Unfortunately, as argued by Bereiter (2002), traditional school education tends to value change in a student's mind-as-a-container in World 2 (e.g., by delivering knowledge from authoritative sources such as textbooks and teachers to the student), but neglect the importance of initiating students into a World 3, idea-centered, knowledge-building culture. The question of how to transform a World 2-oriented education that highlights knowledge acquisition into a World 3-oriented knowledge-building education remains an open pedagogical challenge.

Knowledge building pedagogy

Knowledge building is defined as a collaborative process that is focused on continuous work with ideas of value to a community (Scardamalia & Bereiter, 2006). Knowledge building can be characterized by three distinctive pedagogical design features: it is idea-centred, principle-based, and community-focused. First, building on

Popper's (1972) epistemological framing of World 3, knowledge building emphasizes the value and importance of ideas as epistemic entities for human knowledge construction, and considers idea improvement to be at the centre of all learning activities. Second, knowledge building employs a principle-based--rather than a procedure-based--pedagogical design to ensure the sustained improvement of ideas (Zhang, Hong, Scardamalia, Teo, & Morley, 2011). This design is very different from a highly structured, procedure-based instructional design for guiding classroom practices (Reigeluth, 2013). A pre-specified procedural design usually prescribes classroom activities in advance. Teachers are sometimes even required to carry out their instruction using certain teaching scripts (see Sawyer, 2004). In contrast, a principle-based approach only employs a number of guiding pedagogical principles to ensure maximum flexibility so that students can work adaptively with their self-generated ideas. For example, the knowledge-building principle of "idea diversity" highlights the fact that diversified ideas are essential to sustained knowledge advancement, "…just as biodiversity is essential to the success of an ecosystem. To understand an idea is to understand the ideas that surround it, including those that stand in contrast to it. Idea diversity creates a rich environment for ideas to evolve into new and more refined forms" (Scardamalia, 2002, p. 79). Third, knowledge building highlights community-oriented, rather than individual-oriented, knowledge practice. While ideas must be generated by individuals, continuous improvement of ideas relies on a whole community's collaborative effort. In particular, the quantity and quality of the ideas being enriched and refined are highly dependent on the effectiveness of social interactions in the community. Given the importance of fostering students' capacity to produce and work innovatively with ideas for knowledge work, the present study attempts to investigate (1) whether sustained idea improvement in a knowledge-building environment is related to a more constructivist-oriented, idea-centered World 3 epistemic view that is essential for creative knowledge work, and (2) whether the development of a constructivist-oriented, World 3 epistemic view is related to online collaborative inquiry activities.

Method

The participants in this study were 41 undergraduate students from a national university in Taiwan. The course was offered by the teacher-education program in the university to students who planned to teach about nature sciences and living technologies at primary schools after they graduate from university. The university is ranked as one of the top 10 universities in the nation. Over the past few years, supported by a grant from the nation's Ministry of Education, the university has been deeply dedicated to improving its course quality, with a reform preference toward transforming traditionally more didactic modes of teaching into more constructivist-oriented teaching practices. This reform movement created an opportunity for KB theory and technology to be introduced into this course as an alternative method of teaching and learning. The ages of the participants in this course ranged from 18 to 20. The duration of this course was 18 weeks.

The duration of the course was one semester. The main goal of the course was to help students develop a better understanding of the role of ideas in knowledge creation. To this end, they were guided to engage in the knowledge-building process, and as a learning outcome they were required to design some living technology products that could be used to enhance the quality of people's daily lives. To facilitate student learning, knowledge-building principles (e.g., "idea diversity", as discussed above) were employed to enable cycles of progressive idea improvement.

A pre-post survey on students' epistemic views, focusing on the nature of ideas and using the following open-ended questions, was employed: What are "ideas"? What are the criteria for a good idea? Why? Where do ideas come from? Can ideas be improved? If so, why can they be improved and how can they be improved? If not, why could they not be improved? As shown in Table 1, a coding scheme was developed, using Popper's (1972) conceptual framework of a three-world epistemology, to score students' responses to the above questions (Strauss & Corbin, 1990). If a response matched with a given coding category of an epistemic view (i.e., a World 2 or World 3 view), one point was given, with the maximum number of points for each of the two epistemic views being three. Inter-coder reliability, using the kappa coefficient, was computed as 0.90. In addition, participants' interaction patterns in the Knowledge Forum were analysed to provide a basic understanding of participants' online behaviour and learning processes (e.g., the average number of notes contributed, read, built on, etc.). T-tests were conducted to compare the differences between World 2 and World 3 epistemic views to see whether there is any change in students' views over time after they engaged in knowledge practice for a semester.

Table 1. Coding scheme based on Popper's conceptualization of ideas

Theme	Code	Example
World 3 view of ideas	Concrete object	After being put into practice, ideas can be presented in multiple forms such as a plan, a study, a real-life object, a commercial product, etc. (S24)

	Interaction with the world	Ideas can be formed from prior or present experiences in daily life.(S20)
	Group endeavour for advancing knowledge	Ideas are usually improved after idea interaction and group discussion. (S02)
World 2 view of ideas	Abstract concepts	An idea is a kind of abstract thought produced from thinking. (S19)
	Reflection	Ideas are one's personal points of view about something. (S10)
	Personal knowledge growth	Ideas can help improve one's intelligence. (S23)

Results

Epistemic view

As Table 2 shows, in the pre-survey, the participants' understanding of the nature of ideas was quite limited, as their epistemic view scores (i.e., 0.62 for World 2 views and 0.73 for World 3 views; all three aspects combined) were way below the average (which is 1.5, with the maximum score being 3.0). Moreover, Table 3 also shows that there were no significant differences between students' World 2 and World 3 views in any of the three aspects. In the post-test, it was found that there was a change in students' World 3 views, as their epistemic view score for the World 3 view increased from 0.73 to 1.67 (with all three aspects combined), while their World 2 views of ideas remained very much the same. This suggests that, after working collaboratively with ideas for a semester, students became more aware of the important role of ideas as epistemic entities for sustained knowledge creation. In particular, there were significant increases in the scores for each of the three coding aspects of the World 3 epistemic view. The participants tended to see that: (1) ideas can be treated not merely as abstract concepts, but as concrete objects that can be tinkered with and modified; (2) ideas can be derived not just from reflective thinking within one's mind-as-a-container, but from interaction with the physical world (e.g., by interacting with the environment); and (3) not only can ideas be used for personal knowledge growth, but they can be collaboratively and innovatively improved to advance community knowledge. Overall, the findings suggest that students started to develop a more informed World 3 epistemic sense that is critical for collaborative knowledge building.

Table 2. Comparisons between World 2 and World 3 epistemic views in pre-post tests

Test	Aspects of epistemic view	World 2 view		World 3 view		*t*-value
		M	*SD*	*M*	*SD*	
pre-test	Concrete object	0.34	0.48	0.32	0.57	0.22
	Interaction with the world	0.93	0.82	1.17	0.92	-1.08
	Advancing group knowledge	0.59	0.67	0.71	0.93	-0.61
	Three aspects combined	0.62	0.30	0.73	0.47	-1.24
post-test	Abstract concepts	0.32	0.47	1.44	1.00	-6.40***
	Reflection	0.61	0.67	1.66	1.28	-4.38***
	Personal knowledge growth	0.44	0.55	1.90	1.05	-5.70***
	Three aspects combined	0.46	0.31	1.67	0.81	-8.71***

***$p<.001$

Overall online interaction and inquiry activities

As mentioned earlier, in order to design technology products, students engaged in cycles of sustained idea improvement that required problem identification, idea generation, idea diversification, idea reflection, and idea synthesis. They usually began this process by identifying authentic problems derived from their personal life experience (M=13.90, SD=9.17 for the mean number of problems identified). They then moved on to produce initial ideas of how to address their problems of interest by posting notes online (M=27.49, SD=18.80 for the mean number of notes contributed). To diversify their ideas, they read and/or built on one another's notes (M=397.85, SD=225.67 for the mean number of notes read; and M=20.83, SD=18.75 for the mean number of built-on notes). In the meantime, to facilitate idea search and exchange for diversification, they marked keywords within notes (M=18.22, SD=15.06 for the mean number of notes that contained keywords). To reflect on and improve the ideas further, they tried to build on, annotate and/or revise one another's notes (M=8.15, SD=9.65 for the mean number of annotations; M=4.22, SD=4.02 for the mean number of revisions). They also used customizable scaffolds to facilitate the inquiry process (M=22.41, SD=21.09 for the mean number of scaffold supports), with the purpose of integrating ideas for the eventual improvement of their technology products. All the online activity measures were found to be significantly correlated with one another ($.60 < r < .99$, $p < .01$), suggesting that the more actively the participants were engaged in one online inquiry activity, the more likely they were to engage in another activity as well.

Moreover, the learning groups in this course were formed based on individual interest in self-identified technology problems. To examine differences in group performance, the average score (M=6.90, SD=3.87) of students' epistemic views obtained in the pre-post survey was used as a separation point to divide the groups into more-informed groups (with higher scores) and less-informed groups (with lower scores). As a result, it was found that there was a significant difference in terms of epistemic scores between the more-informed groups and the less-informed groups ($F(1, 39) = 6.19$, $p < .05$). Further analysis of online performance was conducted, and it was found that the more-informed groups were more active, and engaged more, than the less-informed groups in all aspects of online activities except for the reading activity. However, none of the differences were statistically significant. But, when the length of inquiry for each group was counted and then compared, it was found that there was a significant difference between the more-informed and the less-informed groups ($F(1, 39) = 4.17$, $p < .05$), indicating that a longer inquiry time seemed to contribute to higher epistemic view scores.

Discussion

To sum up, knowledge-building pedagogy, with a focus on sustained idea improvement, seemed to be useful as a means to help students develop an informed World 3 epistemic view for knowledge advancement. However, if students only focus on lower-level idea exchange and sharing activities for knowledge building, their epistemic views may not change much. One important thing to note is that there was still room for students in even more well-informed groups to enhance their high-level inquiry skills in order to become more effective knowledge builders. Further studies will look into this to help us to identify more effective instructional know-how.

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