Facilitating Belief Change in Teacher-Education Students through Knowledge Building

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Abstract*:* This study investigates the effects of engaging students in a knowledge building community on their belief change in science teaching. Participants were 19 teacher-education students. An online knowledge building environment enabled by Knowledge Forum technology was employed in this course to engage students in collaborative knowledge building and to help them learn about various science-related teaching methods and instructional design. Preliminary findings showed that towards the end of the semester students began to change their beliefs in science instruction to become more student-centered.

Our society is entering into a knowledge-based society (UNECO, 2005), and due to the increasing need for new knowledge in order to address new problems derived from this knowledge-intensive society, helping students develop a more creative and constructive capacity to approach and produce knowledge is becoming more important. To address such knowledge need or challenge, the role of teachers has also gradually been regarded as a facilitator for promoting more autonomous learning, collaboration, and knowledge construction among students. In order to help foster such creative capacity among students, it is thus necessary for teachers to also possess a more creative and constructive view on their teaching practices. Arguably, students who are under the influence of such constructive view of teachers would also more likely to change their learning roles from knowledge "receivers" to knowledge "constructors" and "collaborators," and to better understand how to work more creatively with others to advance knowledge for the benefit of their belonged community (Brown 1997).

Building on these arguments, in order to better prepare future teachers for a knowledge-based society, the present study intends to help future teachers develop a more informed and constructivist-oriented view that regards learning as a knowledge-innovation, rather than knowledge-acquisition (Hong & Sullivan, 2009). To this end, an online environment, called "Knowledge Forum," designed based on an educational theory called "knowledge building" (Scardamalia, 2002; Scardamalia &

Bereiter, 2003) was employed in this study. "Knowledge building" is a social process focused on the production and continual improvement of ideas of value to a community (Scardamalia & Bereiter, 2003); and "Knowledge Forum" (KF)," is designed to foster an online knowledge-building environment. Previous research has suggested that the integral use of knowledge pedagogy and technology was able to help students learn, develop, and work productively to advance knowledge as a class community (Hong, Scardamalia, Messina & Teo, 2008; Scardamalia, 2002; Scardamalia, Bereiter & Lamon, 1994). Arguably, engaging teacher-education students in a knowledge-building environment would also help them develop a more active and constructive view towards teaching and student learning. However, such hypothesis remain to be examined.

Method

Participants and Design

Participants in this study were 19 teacher-education students taking a *"Teaching Methods in Elementary School Natural Sciences"* course from a teacher-education program in a national university. Their ages range from 19 to 24 (M=20.79, SD=1.08) and none of them had any prior teaching experiences. The duration of the study is a whole semester, which is about eighteen-weeks long.

The present study employed an educational theory called "knowledge building" to support the instructional design of the course experimented. To put this theory into practice, the researchers used an online knowledge building platform called "Knowledge Forum" (KF) to facilitate students' collaborative learning and reflection. The main instructional goal in the course is to engage students to work in the "Knowledge Forum" platform and to build their knowledge together.

This course required every student to perform two different but related teaching practices, with the second practice must be different from the first one in terms of teaching method. This activity was in part designed to help teacher-education students understand the nature of teaching methods as being more diversified, rather than ritualistic and script-oriented (thus to avoid viewing teaching as ritualistic practices). Due to time constraint, however, all teaching practices were done in group, with each group consisting of 2 to 3 students. It is expected such activity design would not only help students explore different teaching methods, but also learning to observe and appreciate diversified ways of teaching from each other. As for the part of class discussion, the instructor would try to facilitate discussion and debate around questions and challenges emerged from students' teaching practices. For instance, after a group of students finished their teaching practice, the class would discuss some questions such as "What have you learned from this teaching practice?" or "what do you think are some more characteristics of good science teaching?" There were usually no pre-determined answers to most of the questions discussed. Under an open environment, teacher-education students were encouraged to cultivate a habit of reflection on their teaching practices. As for the part of online activities, teacher-education students were required to extend their in-class discussion and reflection by posting their observations and ideas to Knowledge Forum in order to continue sharing and reflecting with each other students. Through constant interaction within their online learning community, teacher-education students can thus keep generating diversified ideas, and capitalizing on other people's views and comments in order to improve their own teaching practices

Data Source and Analysis

The current study employed a within-subject design. The main data sources included: (1) online discourse in the form of notes posted to and recorded in a Knowledge Forum database, (2) a survey with open-ended questions concerning ideal teaching and learning, and (3) video-taping of all students' teaching practices. In this preliminary analysis, only the first two data sources were employed. First of all, to analyze students' online activities, we employed the Analysis Tool Kit (ATK) in Knowledge Forum to document students' learning and knowledge building activities, which include: (1) note production, (2) annotation, (3) build-on. In addition, when posting a note, it is suggested that students should enter the following information, including (1) note title, (2) note scaffolds, (3) note content, (4) keywords, and (5) problem inquired. These functions were designed to help students perform a higher-level thinking about the problem they are to discuss. Second, surveys with six open-ended questions concerning students' views on ideal science teaching and learning were employed in this study. The six questions are as follows: (1) what do you think is an ideal way to teach science? (2) What do you think are the key factors to ensure successful science teaching? (3) What constitutes an ideal science teacher? (4) What do you think is an ideal way to learn science? (5) What do you think are the key factors to ensure successful science learning? (6) What does an ideal environment meant to you? The six questions in this survey can be divided into two dimensions: ideal science teaching (questions 1-3), and ideal science learning (questions 4-6). To analyze, an open coding procedure was adopted (Strauss & Corbin, 1990) and it had resulted in eleven codes/themes (see Table 1), These eleven codes were then further categorized into the following two main dimensions: (1) teacher-centered (codes 1-3); (2) student-centered (codes 4-11). To analyze, paired-sample t tests were conducted to examine the pre-post differences in terms of change in teacher-education students' beliefs in science teaching and learning.

Table 1: Coding scheme of students' views on ideal science teaching and learning

Categories	Codes	Example excerpted from students' statements (translated from Chinese)
Teacher-centered	1. Teacher should provide and maintain good physical learning environment	A laboratory with complete equipments. (S12)
	2. Deliver good lecture	A teacher should deliver correct scientific concepts to students. (S8)
	3. Teach how to conduct experiments and verify theories	Scientific theories should be verified by using experiments or hands-on activities. (S1)
Student-centered	4. Provide an open and free learning environment	Teacher should provide an open environment for students to discuss and think. (S16)
	5. Foster students' different learning aptitude	Be aware of when to adjust one's own teaching methods in response to different student needs. (S11)
	6. Enable diverse and creative teaching	To make science-related learning resources lively and novel; to teach creatively. (S14)
	7. Inspire students' inquisitive and curious nature about sciences	Inspire students' curiosity to inquiry science-related actively. (S3)
	8. Encourage students to interact and cooperate with each other	To interact and create something with others; to solve problems together. (S12)
	9. Encourage students to think and reflect	Inspire students' to think and reflect; develop a habit of independent thinking. (S13)
	10. Promote student agency own	Try to build own knowledge; build one's own scientific understanding. (S6)
	11. Guide students to explore and innovate by using experiments	Generate new thinking and being creative by means of conducting experiments. (S17)

Results

1. Overall knowledge building process in Knowledge Forum

Throughout the semester, the participants not only performed their teaching practices, but also regularly reflect on their science teaching practices online in Knowledge Forum. Table 2 shows their online activities. Overall, participants generated, read, and shared ideas by posting many notes; they also gave feedback by "linking, "annotating" or "building on" each other's notes in order to diversify their ideas. In addition, they also highlighted key concepts or keywords (M=9.6; SD=6.89) that were often discussed in their notes. In general, the data suggest that teacher-education students not only generated many ideas via note-posting, but were able to diversify each other's ideas by linking each other (e.g., giving and receiving feedbacks) online. Building on this knowledge building process, we further elaborate students' belief change in science teaching and learning.

Table 2: The statistic of teacher-education students' online interaction

	N	**Sum**	**M**	**SD**
#Notes Created	19	330	17.4	9.06
% of Notes linked	19	1373(%)	72.20%	20.30%
# Annotations	19	17	0.9	1.41
# of Build-on	19	258	13.6	9.39
# of keywords in notes	19	182	9.6	6.89

2. Teacher-education students' views on science teaching and learning

As shown in Table 3, in the beginning of the semester, teacher-education students' views on science-teaching and –learning were more "teacher-centered." For example, in terms of teaching method, they preferred lecture, (e.g. to directly convey knowledge to student). Basically, teacher-education students think the teacher should "*follow the principle of science teaching,"* (S8) and "*teacher should teach about the key concept to students clearly."* (S6) Most of them think that the main duty of teaching is to help student understand the exact scientific knowledge. And, in terms of learning environment, they were more concerned about providing with students good "physical" environment (e.g., good facilities). For example, they mentioned that teachers should "*prepare experiment materials, videos for watching movies, and any other equipment."* (S1) and "*students should know more scientific facts and practice repeatedly."* (S16)

But towards the end of the semester, teacher-education students' views became more student-centered. They started to think that science teacher should provide opportunities to allow more student-initiated inquiry and practices, as well as to enhance their thinking and collaborative abilities. For instance, some teacher-education students mentioned that "*teacher should help design relevant activities, to let students enjoy the learning process and generate more independent thinking.*" (S2) In terms of the nature of science teaching, many teacher-education students also started to emphasize the importance of knowledge building in science. For example, one mentioned that "*science is a discipline that keeps innovating, discovering, and exploring...; therefore, it is so important for science education to help students develop independent thinking ability. Ideal science teaching is to help student create any possibilities in the world. By means of each student's various ideas, science education should help create a learning environment with endless possibilities*." (S16) As another student further commented, "*an open environment is an open learning space without any pre-defined correct answers...under this open environment, they [students] could think about science deeply...teacher could help foster students' creativity and imagination; students can feel free to inquiry based on their curiosity in science*." (S3) In addition, it was also found that some important concepts, which were not seen in the beginning of the semester, started to surface, for instance: "Enable diverse and creative teaching", "Encourage students to interact and cooperate with each other" and "Promote student agency own".

Table 4 further summarizes the overall pre-post changes in beliefs among the participating teacher-education students. As it shows, there is a significant change towards desired student-centered views in the post test. It's obviously that in the beginning of the semester, teacher-education students tended to support a more teacher-centered view (N=40), focusing more on how to deliver scientific facts to students and help students conduct step-by-step experiments; they also tended to think it is important to follow certain learning principles and conduct laboratory experiments to verify knowledge. In contrast, towards the end of the semester, teacher-education students' view started to become more student-centered. They begun to think that teacher should empathize with what students need and feel, and then help create an open environment for them to inquire more freely, and interact with and reflect on each other's many ideas.

Table 3: Results about students' views on science teaching and learning

Categories	Codes	Pre-test		Pro-test	
		frequency	%	frequency	%
Teacher-centered	1. Teacher should provide and maintain good physical learning environment	13	72.2%	6	33.3%
	2. Deliver good lecture	10	55.5%	7	38.8%

	3. Teach how to conduct experiments and verify theories	17	94.4%	9	50%
Student-centered	4. Provide an open and free learning environment	8	44.4%	16	88.8%
	5. Foster students' different learning aptitude	2	11.1%	5	27.7%
	6. Enable diverse and creative teaching	3	16.6%	12	66.6%
	7. Inspire students' inquisitive and curious nature about sciences	8	44.4%	14	77.7%
	8. Encourage students to interact and cooperate with each other	6	33.3%	9	50%
	9. Encourage students to think and reflect	5	27.7%	13	72.2%
	10. Promote student agency own	0	0%	11	61.1%
	11. Guide students to explore and innovate by using experiments	1	5.5%	10	55.5%

Table 4: *T*-test results with regard with students' views on science teaching and learning

	Pre-test		Post-test		t-value
	M	SD	M	SD	
Teacher- Centered	13.33	3.51	7.33	1.53	0.059
Student- Centered	4.125	3.09	11.25	3.37	0.000**

*p<.05 **<.01

Discussion

The present study was conducted in an online knowledge building environment called Knowledge Forum and its purpose was to help teacher-education students develop more informed beliefs towards science teaching and learning. In summary, there are two main findings from this study. First, analysis on online activities have suggested that students were highly interactive and collaborative in Knowledge Forum. Second, , an additional content-analysis on a survey with regard to participants views on science teaching and learning has suggested teacher-education students' views on science teaching were able to shift from more teacher-centered to more diverse and student-centered towards the end of the semester. Overall, after engaging in "knowledge building" activities in Knowledge Forum for a whole semester, it was found that teacher-education students were able to build a more student-centered view of science teaching and learning. Finally, the present study has still other qualitative data (such as online discourse and video-taping of students' teaching practices in class) that have not been analyzed. Further analysis will try to use these data to further triangulate the preliminary findings in this study.

References

Brown, A.L. (1997). Transforming schools into communities of thinking and learning about serious matters. *American Psychologist*, 52(4), 399-413

Chen, S. (2006). Development of an instrument to assess views on nature of science and attitudes toward teaching science. *Science Education, 90*(5), 803-819.

Hong, H.-Y., Scardamalia, M., Messina, R., & Teo, C. L. (2008). Principle-based design to foster adaptive use of technology for building community knowledge. In G. Kanselaar, V. Jonker, P.A. Kirschner, & F.J. Prins (Eds.), *International Perspectives in the Learning Sciences: Cre8ing a learning world. Proceedings of the Eighth International Conference for the Learning Sciences – ICLS 2008, Vol. 1* (pp. 374-381). Utrecht, the Netherlands: International Society of the Learning Sciences, Inc.

Hong, H.-Y., & Sullivan, F. R. (2009). Towards an idea-centered, principle-based design approach to support learning as knowledge creation. *Educational Technology Research & Development, 57*(5), 613-627.

Scardamalia, M., Bereiter, C., & Lamon, M. (1994). The CSILE project: Trying to bring the classroom into World 3. In K. McGilley (Eds.), *Classroom lessons: Integrating cognitive theory and classroom practice* (pp. 201-228). Cambridge, MA: MIT Press.

Sawyer, R. K. (2004). Creative teaching: collaborative discussion as disciplined improvisation. *Educational Researcher, 33*(2), 12-20.

Strauss, A. L., & Corbin, J. (1990). *Basics of qualitative research: grounded theory procedures and techniques*. Newbury Park, CA: Sage Publications.

UNESCO. (2005). Towards knowledge societies. New York: UNESCO Publishing.