Facilitating belief change via computer-supported collaborative knowledge-building

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Abstract: In this study, we investigated prospective teacher-education students' belief change in a CSCL environment enabled by knowledge building pedagogy. Data mainly came from a belief survey and students' online discussion. The results indicated that engaging students in collaborative work with knowledge was conducive to making their teaching beliefs become more student-centered.

Introduction

Quality teaching is essential to effective education and is deeply influenced by teachers' teaching beliefs (Clark & Peterson, 1986; Pajares, 1992; Richardson, Anders, Tidwell & Lloyd, 1991; Stuart & Thurlow, 2000; Wilson, 1990). Teaching beliefs, however, are difficult to change and are shaped by one's past learning experiences (Entwistle, Skinner, Entwistle, & Orr, 2000; Nespor, 1987; Rath, 2001; Schaefer & Zygmont, 2003; Stuart & Thurlow, 2000). Thus, during the stage of teacher education, it is essential to examine teacher-education students' teaching-related beliefs, and more importantly to help them develop more informed and diversified teaching beliefs. To help teacher-education students reflect on their own teaching beliefs while experiencing other possible kinds of teaching beliefs, this study developed a knowledge building environment that focused on sustained production and improvement of ideas of value in a community (Scardamalia & Bereiter, 2003)—i.e., Knowledge Forum, a computer-supported collaborative knowledge–building environment. It is posited that learning in a more socio-constructivist manner would provide teacher-education students with more opportunities to collectively reflect on teaching beliefs and eventually construct more informed teaching beliefs.

Method

Participants (N=28) were teacher-education students taking a course about science teaching. The course was 18 weeks long and aimed to help students develop more informed teaching beliefs and practices regarding student-centered and constructivist-oriented teaching beliefs and practices. Previous studies showed that teacher-education student's teaching beliefs were more teacher-oriented and less informed. The instructional design was based on knowledge building pedagogy, with Knowledge Forum (KF) being employed to complement knowledge building via sustained idea improvement. All students' ideas and discussion related to improving teaching practice were recorded in a KF database. To make the course more efficient within limited time span, in the beginning of the course, students were paired and were required to practice their teaching (i.e., to co-teach) twice—therefore, there was 28 times of practices in total, with practices 1-14 being referred to as the first phase, and practices 15-28 as the second phase. During their practices, students were guided by knowledge building pedagogy to discuss and reflect on their teaching online in KF. Both the instructor and students worked as community members. In particular, the instructor served as a facilitator to engage students in online discussion and to improve their teaching practice. Everyone could freely propose questions and comments in KF for deep discussion and reflection. Data mainly came from a pre-post belief survey and online posting in KF as described below:

1. Analysis of the belief survey. The belief survey contains the following questions which were adapted from Tsai's (2002) study with only minor text revision to suit for this study: (a) What do you think is an ideal way to teaching science, and why? (b) What do you think are the key factors to ensure successful science teaching, and why? (c) What constitutes an ideal science teacher, and why? (d) What do you think is an ideal way to learn science, and why? (e) What do you think are the key factors to ensure successful science learning, and why? (f) What does an ideal science learning environment meant to you, and why? The survey data were analyzed using a pre-determined coding scheme (see Table 1). Using 50% of this data, the inter-rater reliability (kappa coefficient) were computed to be 0.92 (p<.01).

Table 1. Coding Scheme of teaching beliefs

Category	Example
Teacher-centered teaching beliefs	"[Teachers should provide] complete laboratory materials and various equipments".
	"[Teachers should] transfer basic knowledge, by giving lectures and helping students establish knowledge base".

	"Teaching through demonstration and experiment is important."
Student-centered teaching beliefs	"Open and comfortable environment."
	"Respond to students' differences and needs by using suitable teaching pedagogy".
	"Stimulate learning motivation and curiosity".

2. Analysis on online posting (with a focus on learning processes). Online posting was analyzed via multiple ways. First, we analyzed student participation patterns by employing descriptive analysis (e.g., number of notes contributed, number of notes read, and number of notes built-on). Second, we analyzed the function and quality of feedback for the two phases of teaching practices. In terms of function of feedback, we adopted the same coding scheme used for the above survey to code teaching beliefs, including feedback for improving "teacher-centered" teaching practice and feedback for improving "student-centered" practice (see Table 2). Using notes as units of analysis, the inter-rater reliability of this coding was computed to be 0.94 (p<.01) (using using 50% of this data and kappa reliability coefficient). In terms of the quality of feedback, we employed the coding scheme by Dempsey, Driscoll, and Swindell (1993) which contains four evaluative categories, including "no feedback", "simple verification feedback", "specific feedback" and "elaborated feedback", with the latter ones representing better quality feedback (see Table 3 for rating procedure). This analysis used sentences as units of analysis, the inter-coder reliability (using 50% of the data and Spearman correlation) was computed to be 0.91 (p<.01). Pair-sample t-test was performed to examine whether there were any significant differences in terms of both the function and quality of feedback between the two different phases of teaching practice.

Table 2: Definition of each coding category regarding function of feedback posted on Knowledge Forum

Category	Examples of student answers
Teacher-centered	The two teachers' classroom management was good, and the managing processes also went well, too.(s11) If I were you, I would explain the purpose and principles of this experiment first. Then, I would explain the process of the experiment, and after that, try it out. (s09)
Student-centered	The designed content of the lesson was inviting, which increased the interaction between students and the teacher really well, and also made the students to think more actively. (s14) After finishing the learning activities using learning sheet, the teacher and the whole class should go through the questions again and rethink about the activity, to give the students time to reflect on what they did and ideas they generated based on their observation; this is great! (s15)

Note: The " s + number " represents a particular student in the class.

Table 3: Coding scheme regarding quality of feedback posted online in Knowledge Forum

Category	Definition	Examples from the answers of student teachers
No Feedback	Presents a question and requires a response, but does not indicate whether the response is good.	Magnets are marvelous things, they make me think of the magnet board and fishing game I played with when I was in elementary school. (s22)
Simple verification Feedback	Simply informs the learner of a "good" or "bad" response.	The teaching tempo is really good, such as the time management and classroom management; everything was good! (s13)
Specific Feedback	Informs the learner what the good response should be.	You can ask students more questions before explaining. Sometimes you forget to give the students feedback. (s06)
Elaborated Feedback	Provides an explanation for why the learner's response is good or bad or allows the learner to review materials relevant to the attributes of a good response.	After the explanation, you can let the students identify the bugs on the stage; this way, you can both facilitate some interactions, and get to know better if they can really identify the categories of bugs or not. (s15)

Results

1. Belief change as learning outcome

As Table 4 shows, it was found that the score of participants' teacher-centered beliefs dropped significantly after the semester. At the same time, the participants' student-centered beliefs significantly raised after the semester.

Table 4: belief change assessed in the beginning and at the end of the semester

Category	Pre-test		Post-test		t-value
	M	SD	M	SD	
Teacher-centered	1.08	1.35	0.46	0.76	2.54*
Student-centered	5.15	2.49	8.00	3.26	-4.58**

*p<.05 **p<.01

2. Learning processes: Online KF activities

Pre-post comparisons were made between two phases of teaching practice (9 weeks for each phase) in terms of basic online KB activities/measures (see Table 5). Overall, the findings suggest that the time and effort spent on collaborative learning and discussion in KF were progressively increasing over time. Figure 1 showed that students' built-on links on KF. There was a lot of feedback and suggestions made for each teaching practice as shown in each note cluster (the arrow signals who provided feedback to whom), indicating that students were reading and sharing ideas for improving teaching frequently.

Table 5: Profiles of participants' online performance

	Phase 1		Phase 2		t-value
	M	SD	M	SD	
1. # of notes created (contribution)	11.39	4.69	13.81	5.13	-2.38*
2. # of notes read (community awareness)	124.39	69.56	187.18	137.33	-2.75*
3. # of notes built on (collaboration)	9.75	4.38	12.93	4.60	-3.29**

*p<.05 **p<.01

3. Learning processes: function and quality of feedback

First, in terms of the function of feedback, as Figure 2 shows, it was found that feedback given to enhance "teacher-centered" beliefs decreased while feedback given to enhance "student-centered" beliefs increased. The result of t-tests showed that there was a significant decrease from the first phase of teaching practice (Practices 1-14) to the second phase of teaching practice (Practices 15-28) in terms of "teacher-centered" beliefs (M=6.11, SD=2.78, for 1st phase; M=3.71, SD=2.24, for 2nd phase; t=4.62, p<.01), while there was a significant increase in terms of the feedback provided to enhance "student-centered" beliefs (M=5.07, SD=3.11, for 1st phase; M=7.25, SD=2.77, for 2nd phase; t=-4.52, p<.01).

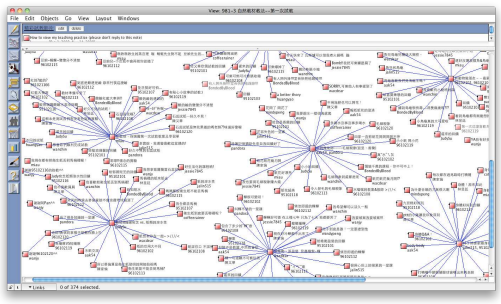

Figure1. Students' collaborative built-on links in a KF view (i.e. a discussion board).

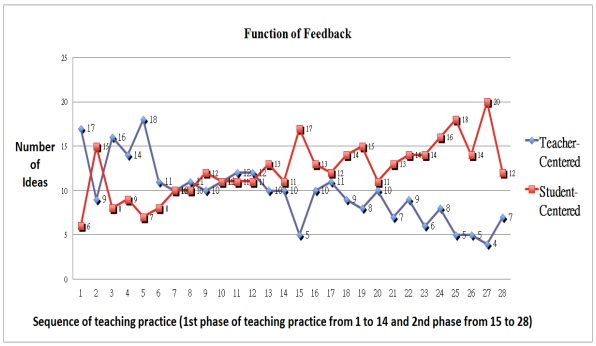

Figure 2. Function of feedback: To improve teacher-centered or student-centered teaching

Moreover, it was found that in terms of quality of feedback, there was a significant change in terms of how the quality of feedback changed in the 28 individual teaching practices (14 each for the first, and second, phase of the teaching practice). The results of t-tests (see Table 6) indicate that better quality feedback (e.g., elaborated feedback) contributed by teacher-education students progressively increased over time, while the lower quality feedback (such as no feedback or simple verification feedback) gradually decreased over time.

Table 6. T-test results regarding quality of feedback between two phases of teaching practices

	First Phase		Second Phase		t-value
	M	*SD*	*M*	*SD*	
No feedback	0.05	0.05	0.03	0.03	2.15*
Simple verification feedback	0.30	0.08	0.23	0.09	4.07**
Specific feedback	0.29	0.09	0.26	0.09	1.49
Elaborated feedback	0.36	0.11	0.44	0.14	-3.82**

*p<.05 **p<.01

Conclusion

To sum up, the instructional design in this study is based on knowledge building pedagogy. Each participating teacher-education student was required to practice his or her teaching twice. After practice, they collectively reflected on their teaching beliefs and practice to better understand more diversified possibilities of teaching and learning approaches. During the process of teaching practice, participants provided teaching feedback online in KF for discussion and systematically integrated their feedback into their instructional design for their second teaching practice. By discovering and solving related problems occurred during their first teaching practice, students were able to improve their teaching ideas/practices by re-designing their instruction. The results showed that after working continuously to generate, build on, and improve their ideas and practices, the teacher education students could generate more elaborated feedbacks and ideas about teaching, and those feedback/ideas tended to support more student-centered beliefs. In addition, the results of the pre-post belief survey also suggested that the participants' teaching beliefs shifted from teacher-centered to student-centered ones. The findings confirm previous research in that it is possible to help students transform their beliefs by engaging them in computer-supported collaborative knowledge building environment/community (Chang & Hong, 2011; Hong & Lin, 2010). Further studies will be conducted in order to better understand the process of belief change for teacher-education students.

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