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Promoting Elementary Students' Social Studies Understanding Through Computer-Supported Knowledge Building Discourse

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Abstract: This study investigated a designed Knowledge Building (KB) environment for productive inquiry in the social studies domain. Fifty grade 5 students in a primary school in China participated in the collective inquiry into *The History and Evolution of Chinese Characters*. Combining KB theory and principles, we built a three-phase learning design of *Ideation* - *Theory Building* - *Reflection* (ITBR) to support the inquiry. Quantitative results suggest the role of the designed KB environment in promoting collaborative interaction and the depth of discourse. The qualitative analysis identifies dynamic themes for engaging students in productive KB discourse. This study sheds light on how KB can be developed in the non-science domain using the ITBR design to enrich sustained collective inquiry.

Introduction

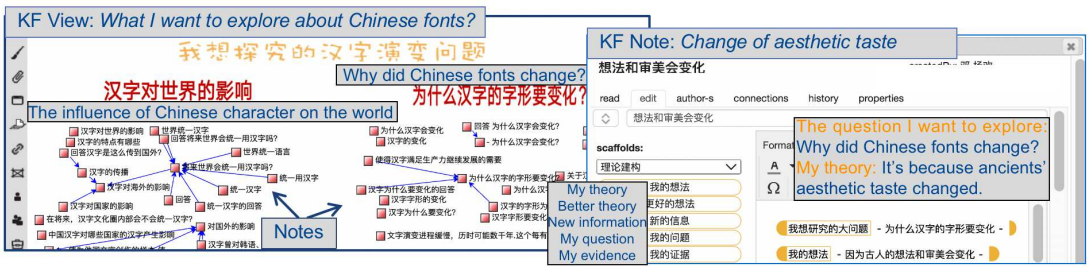
Knowledge Building (KB) focuses on idea improvement and productive inquiry in knowledge-creating communities (Scardamalia & Bereier, 2014). Most KB studies highlight learning environments focused on KB culture development (e.g., inviting diverse ideas) (van Aalst, 2009), theory building (e.g., improving collective ideas) (Reeve et al., 2008), and reflective assessment (e.g., reflection on the learning process) (Lee et al., 2006) to promote community knowledge advances. There has been substantial evidence that KB could advance community knowledge, mostly in science domains and the process of scientific inquiry (Scardamalia & Bereier, 2014; van Aals & Truong, 2011). Knowledge Forum® (KF) was designed to support such creative communities (Scardamalia, 2002) where students' complex, discursively rich interactions occur. The interactions involving bringing up individual ideas and supported evidence have reportedly positive associations with social studies outcomes like historical narration (Resendes & Chuy, 2010). We conjectured that KB could take the form of idea generation, idea improvement, and collective reflection in social studies like in scientific inquiry. In this regard, we developed a design model, *Ideation* (diverse ideas generation) - *Theory Building* (collective idea improvement) - *Reflection* (learning process reflection) (ITBR), to promote collaborative interaction and sustained inquiry among young children. Two questions examined in this study include: RQ1: Did the ITBR embedded KB environment support students' collaborative interaction and the depth of KF discourse? What are the predictors of the depth of KF discourse and domain understanding? RQ2: How did students engage in community knowledge advances with the support of the ITBR embedded KB environment?

Methods

Fifty grade 5 students from a primary school in China participated in the KB course *The History and Evolution of Chinese Characters.* Students were encouraged to conduct collective discussions on KF *views* that provided places for diversified topics (Figure 1). Students post their ideas as *notes* on KF *views* with the support of KF scaffolds.

The ITBR model was used to promote KB collective inquiry on KF. In Phase 1, students were supported by the scaffolds related to *Ideation* (e.g., *My question* and *My theory*) to put forward their questions and ideas; and seven problems they wanted to explore were identified. In Phase 2, using *Theory Building* scaffolds (e.g., *My theory* and *My evidence*), they collaborated on six promising problems in opportunistic groups. In Phase 3, supported by the *Reflection* scaffolds (e.g., *I used to think* and *How I changed my ideas*), they reflected and synthesized the process of community knowledge advances.

Figure 1
KF View and Note



UCINET (Borgatti et al., 2002) was employed to examine collaborative interaction. An adapted coding scheme (Chuy et al., 2011; Fu et al., 2016; Hakkarainen, 2003) was used to investigate the depth of KF discourse (Table 1). The teacher's reflective journals and students' artifacts are also resources for qualitative analysis. Students' final exam scores of the course were used as the domain understanding scores.

Table 1
KB Discourse Moves Categories

	Definition	Examples
Questioning	Q1: *Fact-oriented questions*	What was Oracle?
	Q2: *Explanation seeking*	Why did Chinese characters' fonts change?
	Q3: *Sustained inquiry*	How did English letters fonts change?
Theorizing	T1: *Simple claim*	I do not think so.
	T2: *Proposing an explanation*	Because writing tools have changed.
	T3: *Supporting an explanation*	The characters become square with the emergence of the brush.
	T4: *Improving an existing explanation*	Scholars simplified complex Characters for easier learning.
Community	C1: *Linking to Web materials*	Linkage from Baidu.
	C2: *Shared regulation*	This question has been asked at least three times!
	C3: *Synthesis of diverse ideas*	Chinese characters have a growing impact on all countries.
	C4: *Meta-discourse efforts*	I changed my point of view based on the group discussion.

Findings

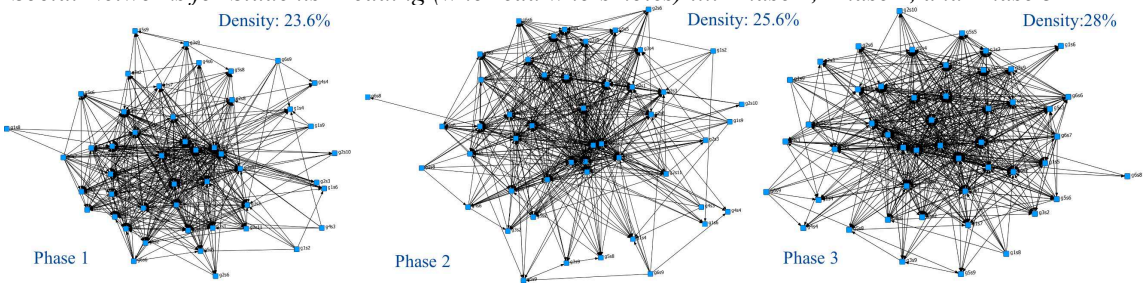
RQ1: Did the ITBR embedded KB environment support students' collaborative interaction and the depth of KF discourse? What are the predictors of the depth of KF discourse and domain understanding?

Students created 247 notes in five weeks. Each student used 13.74 scaffolds and read 30 other students' notes on average.

Changes of collaborative interaction

The changes in collaborative interaction of the KB community across phases were examined by UCINET. Students were found to engage in deepening collaborative interaction through the three phases (Figure 2). The density of the social network rose from 23.6% in Phase 1 to 25.6% in Phase 2 and reached 28% in Phase 3, revealing deeper collaborative interaction over time. Such continuous improvement reflects increased community awareness and continuous diffusion of community knowledge in the KB community. Each student's degree centrality of the network was traced from UCINET as collaborative interaction index for further regression usage.

Figure 2
Social Networks for Students' Reading (who read who's notes) till Phase 1, Phase 2, and Phase 3

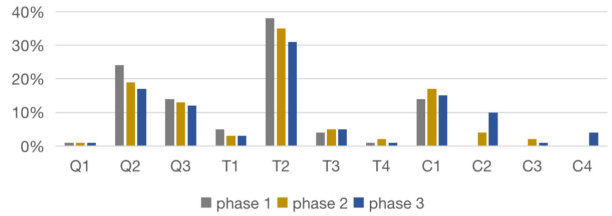


Changes of the depth of KF discourse

KF notes were coded to evaluate the depth of discourse using the adapted coding scheme (Table 1). Students gradually improved KF discourse from lower-level *Explanation seeking* and *Simple claim* in Phase 1 to higher-level *Supporting an explanation* and *Shared regulation* in Phase 2 and Phase 3 (Figure 3). Further paired samples t-tests identified the difference on *Supporting an explanation* between Phase 1 and Phase 2 (t (49) = -2.172, p = .035), and *Shared regulation* between Phase 2 and Phase 3 (t (49) = -2.830, p = .007). These findings suggest the depth of KF discourse shifted from simple communication to deeper discourse across phases. Each move of the depth of KF discourse was combined with the depth of KF discourse scores for further analyses.

Figure 3

Changes of Depth of KF Discourse



Note. *Questioning*: Q1: *Fact-oriented questions*, Q2: *Explanation seeking*, Q3: *Sustained inquiry*; *Theorizing:* T1: *Simple claim*, T2: *Proposing an explanation*, T3: *Supporting an explanation*, T4: *Improving an existing explanation*; *Community:* C1: *Linking to Web materials*, C2: *Shared regulation*, C3: *Synthesis of diverse ideas*, C4: *Meta-discourse efforts*.

Prediction of the depth of KF discourse and domain understanding

Students' collaborative interaction, depth of KF discourse scores, and domain understanding scores were used in linear and hierarchical regressions. Linear regression results show that students' collaborative interaction could predict their depth of KF discourse, as in $R^2 = .22$, F (1, 48) = 13.55, $p = .001$. Further hierarchical regression demonstrated that collaborative interaction could predict their domain understanding, as in $R^2 = .12$, F (1, 48) = 6.26, $p = .016$. More specifically, when students' KF discourse scores were entered, an additional 10% of the total variance was explained, as in $R^2 = .22$, F (2, 47) = 6.54, $p = .003$. These findings suggest that students' collaborative interaction was a good predictor of students' depth of KF discourse, and students' depth of KF discourse was a good predictor of domain understanding over and above their collaborative interaction on KF.

RQ2: How did students engage in community knowledge advances with the support of the ITBR embedded KB environment?

Qualitative analysis of rich data (teacher's reflections, students' artifacts, and KF notes) was conducted to explore how students generated initial ideas and inquiry interest (*Ideation*), improved community ideas (*Theory Building*), and reflected on the learning process (*Reflection*). Students' idea improvement and collective inquiry processes were identified through qualitative analysis, including the following five themes.

Theme 1: Publishing initial inquiry interest and putting forward relevant questions. Students engaged in *Ideation* and published their ideas and questions about *The History and Evolution of Chinese Characters* on KF to develop a community idea improvement culture. A total of 10 topics that students were interested in were proposed, such as *Hieroglyphics, Oracle,* and *Square Characters.* Pointing to those topics, students put forward questions they wanted to explore, which were identified into seven problems (e.g., *Why did Chinese fonts change? What is the influence of Chinese characters on the world? and Will Chinese characters change in the future?*).

Theme 2: Seeking simple explanations and generating preliminary claims. For those problems, students posted many different ideas about different aspects of the evaluation of Chinese characters and gave their simple claims or initial explanations for their questions. For example, for the problem "*Why did Chinese fonts change?*" one student explained, "*It's because ancients' aesthetic taste changed.*" and another student claimed that "*Ancients changed the character fonts for the convenience of communication.*" Through collective efforts, students advanced their collective inquiry into those problems.

Theme 3: Identifying promising problems and engaging in deep theory building. Six promising problems were selected for in-depth explorations, correspondingly explored by six opportunistic interactive groups. During group theory building, students proposed diverse explanations (e.g., "*for change of writing tools*" "*for political reasons*") and gave evidence to support their interpretations (e.g., "*writing tools changed from knife to brush, movable-type printing…*"). They also raised further related questions (e.g., "*Why is there such a big difference between the fonts of Xiaozhuan and Lishu?*") and explored them. Finally, they synthesized their arguments (e.g., "*There are three reasons: political needs, changes in writing tools, and convenient writing*").

Theme 4: Conducting idea improvement activities, synthesizing community ideas, and diffusing community knowledge. After group theory building, six groups shared their group knowledge in the class. They continued to improve and integrate ideas to deepen and diffuse community knowledge. For example, after listening to other classmates' presentations, one student further raised a new claim, "*Chinese characters may become simpler symbols in the future,*" and new questions were raised (e.g., "*Will other languages' fonts change?*"). Students continued to build their theories, integrate community knowledge, and realize the deepening and diffusion of community knowledge.

Theme 5: Reviewing the learning process and reflecting on the learning gaps. Finally, students reflected on their collaborative learning process. They reflected on their collective inquiry process like historians (e.g., "*I learned the real history when collecting sources*"), shared their experience of community knowledge advances (e.g., "*the combination of views will make the answer more perfect*"), and obtained a sense of achievement (e.g., "*when I publicly display my views, I feel like a linguist*"). They expressed that "*listening to other people's views attentively was important.*" These results demonstrate how these 5th-grade pupils reflected and promoted collective inquiry through progressive collaborative interaction in the designed environment of ITBR.

Conclusion

This study proposed the *Ideation-Theory Building-Reflection* design to support KB in the social studies domain. The quantitative analysis found that the designed KB environment can advance students' collaborative interaction and the depth of discourse. Moreover, the collaborative interaction and the depth of discourse can predict domain understanding. The qualitative analysis identified five themes and recognized how students engaged in community knowledge advances. Results indicate students' discourse deepened from lower-level *Explanation seeking* in Phase 1 to higher-level *Supporting an explanation* and *Shared regulation* in Phases 2 and 3.

This research suggests that KF interaction can improve domain understanding and provides an example of idea-generating, theory building, and collective reflection that can be adapted in the non-science domain. The research also reveals the process of community knowledge advances as *Explanation seeking* - *Supporting an explanation* - *Shared regulation*. This study highlights that even young children could engage in KB discourse and advance community knowledge under the designed KB environment. Future works should explore the evolution of group knowledge processes that facilitate the development of students' higher-level discourse moves during an extended KB period.

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