Scaffolding Epistemic Understanding of Discourse and Knowledge Building Using Knowledge-Forum Analytics and Reflective Assessment

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Abstract: This study investigates how students developed an epistemic understanding of the nature of discourse and engaged in productive inquiry using analytics and reflective assessment. The study reports on a case study of a class of Grade 11 students, working on collective inquiry in Artifacts Design in a knowledge-building environment supported by Knowledge Forum® (KF). A key design involved students engaging in reflective assessment by reflecting on their KF discussion using analytics information with the help of visualizations of ideas-building networks. Results indicated that the students developed their understanding of discourse and engaged in productive online discourse progressively. The analysis also suggested how students with different understanding levels of discourse performed differently in their KF work. Qualitative analyses revealed how students developed their epistemic understanding and productive inquiry through analytics-supported reflections.

Introduction
As educational goals change and technology advances, the development of the new educational skills and learning capabilities needed for the 21st century knowledge era is drawing widespread attention (OECD, 2018). Knowledge Building (KB), as an educational and CSCL model, aims to acculturate school-aged students to work as scientists and engage in scientific, disciplinary, and dialogic practice for knowledge advancement (Scardamalia & Bereiter, 2014). Students worked collectively, engaging in idea-centered progressive discourse to post ideas, generate questions and explanations, and reflect on and revise theories, supported by Knowledge Forum (KF), a collaborative discussion workspace developed to support progressive inquiry. It is widely believed that learning analytics affords students opportunities to engage in reflective assessment processes, particularly in a knowledge-building community. There is a body of empirical evidence indicating the significant impact of analytics-supported reflective assessment approaches on students’ metacognition, productive discourse moves, and collective learning (Lee et al., 2016). Engaging in an analytics-supported reflective assessment approach involves reflecting on the state of knowledge-building efforts, using analytics to support that reflection from multiple perspectives. This study designed an analytics-supported reflective assessment environment augmented with the visualization of KF ideas-building networks, to examine and scaffold the development of students’ epistemic understanding of the nature of discourse and progressive inquiry. Specifically, two research questions were addressed: (1) What characterized students’ epistemic understanding of discourse, and what change over time? (2) How did students with high and low level epistemic understanding engage in the KF inquiry differently?

Methods
Pedagogical design and data sources
Thirteen Grade 11 students studying visual arts participated. The key design focused on students’ collective meta-reflection of KF work using analytics of “ideas building” (1) Cultivating a knowledge-building classroom culture (Weeks 1-2), (2) KF inquiry and collective meta-reflection (Weeks 3-4), (3) Deepening inquiry with collective reflection and coordinating of ideas for rise-above (Weeks 5-6). Students deepened their inquiry on KF following reflective assessment. Various data were collected including (1) Students’ pre- and post-test epistemic understanding of discourse. (2) KF discourse. (3) Students’ reflective assessment journals.

Data analysis and results
RQ1. What characterized students’ epistemic understanding of discourse?
Students’ responses on epistemic understanding of discourse were analyzed using a three-point scale ranging from simple to more sophisticated understanding of discourse towards a knowledge-building approach. A second rater
RQ2. How did students with high level epistemic understanding engage in the KF inquiry differently?

The second research question examined how students contributed to and engaged in KB discourse. We used KBDeX, an analytic tool that uses social network analysis techniques employed in KB research to examine students’ collective involvement in KB discourse (Oshima et al., 2012). KB discourse was exported to KBDeX and produced three analysis networks - students, discourse, and keywords. This paper examined how students with different levels of epistemic understanding performed differently in their KF inquiry using the keywords network. Students were divided into high- and low-level groups based on their post-test epistemic understanding of discourse. As Figure 1 shows, analysis of the keywords network and comparison of the two groups suggested that students with higher epistemic understanding engaged more productively in the progress discourse by integrating key ideas for advancing collective knowledge (words highlighted in red represent the keywords used by the students in the KF discussion).

![Figure 1. Visualization of keywords network between high- and low-level groups](image)

Further to the social network analyses, content analysis was conducted to examine how students engaged in productive KB. Students’ writings in KF were parsed into inquiry threads based on the conceptual problems (Zhang et al., 2009). Individual notes were used within each inquiry thread as the unit of analysis and coded using a theory- and data-driven coding scheme (Chuy et al., 2011; Hakkarainen, 2003). A second rater coded 30% of data, and the inter-rater reliability was .94 for questioning, .83 for theorizing, and .89 for community. Paired sample t-tests were conducted to examine whether students engaged in more productive discourse over time. Significant changes were obtained from Phase 1 to Phase 3, in terms of sustained inquiry, $t_{(12)} = -2.250, p<.05$; supporting an explanation, $t_{(12)} = -2.551, p<.05$; and connection, $t_{(12)} = -2.245, p<.05$. The results suggest students engaged in asking explanation-seeking questions and proposing ideas in Phase 1, sustained their inquiry by asking further questions and supporting their ideas with elaboration and examples in Phase 2, and reflected on the state of knowledge-building efforts in Phase 3. These analyses suggested the role of the designed analytics-supported reflective assessment environment in supporting students’ productive discourse engagement.

Conclusion and implications

This study sheds light on the use of analytics and reflective assessment approaches to scaffold students’ development of an epistemic understanding of the nature of discourse and knowledge building. Analysis of KF work using KBDeX indicated how students with different levels of epistemic understanding of discourse performed differently in their KF discussion. Content analysis of KF discussions suggested how the analytics-supported reflective assessment journal supported students’ engagement in productive discourse progressively over time. In sum, this study is particularly important, as few studies have focused on how students’ epistemic understanding of the nature of discourse can be scaffolded using analytics-supported reflections to help them engage in productive discourse.

References


