Fostering sustained idea improvement with principle-based knowledge building analytic tools

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Huang-Yao Hong [a, *], Marlene Scardamalia [b], Richard Messina [c], Chew Lee Teo [d]

[a] Department of Education, National Chengchi University, Taiwan
[b] Institute for Knowledge Innovation and Technology, University of Toronto, Canada
[c] Dr. Eric Jackman Institute of Child Study (OISE), University of Toronto, Canada
[d] Ministry of Education, Singapore

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ABSTRACT

The purpose of this study is to explore the use of principle-based analytic tools to improve community knowledge building in a class of Grade 5/6 students. A flexible design framework was used to engage students in use of three analytic tools—a Vocabulary Analyzer, a Social Network Tool, and a Semantic Overlap Tool. These tools are built into Knowledge Forum technology so principle-based assessment is integral to knowledge work. The primary source of data was discourse generated by students in Knowledge Forum over a school semester (approximately four months). Findings based on a mixed-methods analysis reveal principle-based knowledge building analytic tools to be effective in increasing the frequency with which key terms are used by individuals, in their own productive vocabulary as well as in the shared community space, thus creating a more discursively connected community. Results additionally show a shift from problem generation and breadth of inquiry to increased self-assessment, reflection, and depth of inquiry; also, students report significant ways in which knowledge building analytic tools can increase knowledge building capacity.

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1. Introduction

Knowledge Building[1] is a social process focused on production and sustained improvement of ideas valuable to a community (Scardamalia & Bereiter, 2003, 2006). Knowledge building principles represent design ideals, challenges, and improvable objects in their own right (Scardamalia, 2002; Scardamalia & Bereiter, 2006). The Knowledge Building conceptual framework underlies Knowledge Forum technology and its analytical tools (cf. Ali, Asadi, Gašević, Jovanović, & Hatala, 2013) that are designed to extend both individual and community capacity for engaging in challenging knowledge work (Scardamalia, 2003, 2004).

Knowledge Forum provides a community knowledge space for community members to work with ideas (Hong, Chang, & Chai, 2014; Hong & Chiu, in press). Students enter notes into a virtual problem-solving space (a "view" in Knowledge Forum),

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* Corresponding author. National Chengchi University, No. 64, Sec. 2, Zhinan Rd., Wenshan District, Taipei 11605, Taiwan.
 E-mail address: hyhong@nccu.edu.tw (H.-Y. Hong).
[1] Because the term "knowledge building" now appears in many documents, often without definition, we use lower case with the generic term and capitalize Knowledge Building when referring to the approach originating in the University of Toronto Knowledge Building laboratory and promoted by organizations such as Knowledge Building International.

thus externalizing their ideas so that community members can engage in collaborative discourse. Participants contribute individual and co-authored notes, build on and annotate the notes of others, add keywords, and create rise-above notes to synthesize different notes with related ideas. Knowledge-building activities (e.g., generating and revising ideas, reading and building on ideas of others, linking ideas, and so forth) are recorded in the Knowledge Forum database. An analytic toolkit underlying Knowledge Forum captures data for automated analysis, enabling visualizations that provide feedback to users.

In this particular study, we tested three new tools including a Vocabulary Analyzer, a Social Network Tool, and a Semantic Overlap Tool. The Vocabulary Analyzer has been developed to trace the growth of a user's vocabulary over time and to assess a user's vocabulary level against words entered into a pre-defined dictionary (for example, words considered important for use when working in a specific domain or concepts identified as important in curriculum guidelines). The Social Network tool can be used to assess group dynamics or community members' interactivity; for instance, which community members are collaborating with each other, as indicated by response to their work. Those working in isolation are evident because of the lack of interaction. The Social Network tool also shows the number of notes a community member builds on, links to, references, annotates, or in other ways interacts with. The Semantic Overlap tool is used to compare key terms or keywords extracted from different notes (or sets of notes) and to indicate the overlapping words or phrases. The overlap tool can work with any evaluative criteria that community members select, such as curriculum guidelines or readings for a unit. Thus for example, the overlap between terms in the student discourse and concepts identified in curriculum guidelines can be assessed. The Semantic Overlap tool can also be used to identify idea similarity, as indicated by the key terms shared between members. Fig. 1 illustrates how the three tools are integrated into Knowledge Forum and provides an example of a view and a note. Figs. 2–4 further show the interface of each of the three tools and important tool features.

1.1. Principle-based design

An important goal of the development of new tools is to continually improve the capacity of Knowledge Forum as a knowledge-building environment. Even more challenging is establishing effective and productive knowledge practices surrounding the use of analytic tools. Issues abound; for example, under what conditions should the tools be used, and by whom—teachers, researchers, students, administrators? Can they be used for individual and group assessment, for routine evaluation and higher-level goals of knowledge advancement, and so forth? Recent work demonstrates that with carefully constructed pedagogical design, these tools can serve as powerful knowledge building tools used by even very young children (Ma, Matsuzawa, Kici, & Scardamalia, 2015; Resendes, Scardamalia, Bereiter, Chen, in press; Zhang, Hong, Scardamalia, Teo, & Morley, 2011). The current study aims to elaborate the concept of principle-based pedagogical design as a way to advance this work.

Principle-based design is theory-driven as elaborated by Scardamalia and Bereiter (2007, in press). Principle-based knowledge building analytic tools are very different from procedure-based designs that focus on efficient paths to pre-defined goals. Pre-specified instructional procedures are often highly-organized (Gagne, 1987; Gagne, Briggs, & Wager, 1988). The case for ritualistic learning activities was elaborated by Brown and Campione (1994); scripted learning benefits are elaborated by Najafi, Zhao, and Slotta (2011). While proceduralized and carefully guided instruction has been found to improve students' academic achievement (e.g., Kirschner, Sweller, & Clark, 2006), disadvantages include knowledge telling
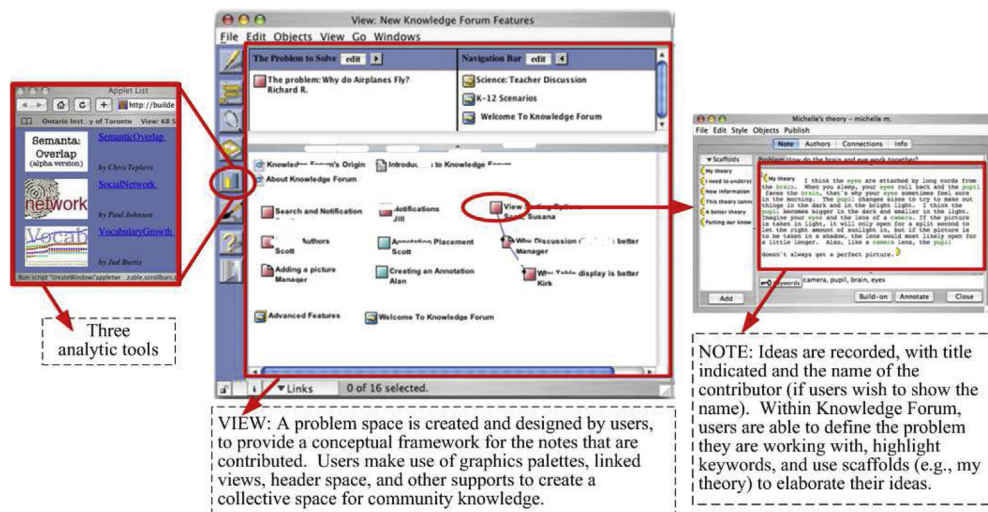

Fig. 1. Three tools and examples of a view and a note.