Design and Development of a Formative Assessment Tool for Knowledge Building and Collaborative Learning

Jan van Aalst, Carol K. K. Chan, Yuen-Yan Chan, Wing-San Wan, Stella Tian, The University of Hong Kong, Pokfulam Road, Hong Kong
Email: vanaalst@hku.hk, ckkchan@hku.hk, yychan8@hku.hk, wan.zero@gmail.com, stellat@mail.ustc.edu.cn

Abstract: This work proposes a theoretical perspective on formative assessment that is more consistent with knowledge building. Based on this, a system for assessing knowledge building and collaborative learning was designed and developed. The system converts a Knowledge Forum tuplestore to an SQL database and then utilizes queries based on four types of general questions students may have about their work. We also report results from usability trials.

Introduction

There is much interest in education in the analysis of discourse — writing, reading, and other actions — in Web-based environments. The best known environments include learning management systems like Moodle® and WebCT®, and more specialized inquiry environments such as Knowledge Forum®. However, there still is a lack of tools that are widely available for analyzing this discourse. The premise of the work reported here is that it is important that students have access to information about their collaborative discourse, with a view to improving their performance. That is, we look to server logs as a potential source of information that can be used for formative assessment (Black & Wiliam, 1998). This is particularly important for knowledge building, which emphasizes epistemic agency and self-assessment.

Goals

This work aims at using current software technologies to enhance knowledge building and collaborative learning through formative assessment. We designed and developed a web-based tool which works with general CSCL platforms such as Knowledge Forum®. The objectives of the project were:

1. To develop a theoretical perspective on formative assessment that is more consistent with knowledge building and collaborative learning,
2. To develop indicators that are intuitively linked to the most important aspects of 1; and
3. To design and implement a web-based formative assessment tool based on the indicators in 1.

Theoretical Framework

Knowledge Building

Knowledge building is an educational model that involves computer-supported discourse, in which students' efforts are directed at advancing the collective knowledge in a community (Scardamalia, 2002). Students are not just trying to understand things for themselves but aim to add something new to what is known in the community. Knowledge building can be supported by CSCL technologies such as Knowledge Forum®.

Formative Assessment

Since the seminal work by Scriven (1967), there had been various perspectives about formative assessment (such as Black and Wiliam, 1998; Taras, 2005, 2009; Yorke, 2003). We point out that for knowledge building a view of formative assessment is needed that deeply integrates assessment with knowledge building. We consider assessment as the collection of information involved in students' own inquiry into their knowledge building. It is not epistemologically distinct from knowledge building, except that the domain of the inquiry is not subject matter (e.g., science concepts) but the process of knowledge building.

Tool Design and Development

The tool aims at answering the following four questions raised by teachers and students in the context of knowledge building: (1) Are we collaborating? (2) Are we putting our knowledge together? (3) What happens to ideas over time? And (4) What's happening to my stuff?

These questions are motivated by knowledge-building theory. For example, "Are we collaborating?" is relevant to Scardamalia's (2002) principle of individual cognitive responsibility for collective knowledge advancement, and "What is happening to ideas over time?" to the principle improvable ideas. We constructed indicators to answer the above queries, as described briefly below. Wherever appropriate, we also discuss how they can be traced from CSCL usage available in more general systems.

Are we collaborating? We consider the structural features of a community and suggest the concept of "collaborative friends" – participants who interact with one another's contributions. One can set thresholds for being a collaborative friend (e.g. who build on more than 2 of his/her notes) and ask how many collaborative friends he/she has, and what percentage of participants have at least 4 such collaborative friends.

Are we putting knowledge together? This query reveals the extent to which synthesis and rise-above are occurring. It can be measured by, for example, number of notes that are opened more than once by a same reader (to indicate whether participants are returning to notes at all) and number of notes that include references (links) to other notes (to make connections between notes).

What Happens to Ideas over Time? Two indicators for idea improvement can be *awareness of new concepts* and *use of new concepts*. The former measures how many students have come across to a note with a new keyword introduced (assuming keyword signifies a new concept); the later examine the uses of keywords in new notes and whether the use of a keyword is sustained over time and diffuses through the community.

What's Happening to My Stuff? This query is presented at individual level. It enables one to learn about gather how they, personally, are doing in the community. For example, one can check about their most influential notes (e.g. which notes created by me were built-on by more than *n* students?) and monitor the uptake of the notes in the community.

Based on the above perspectives, we designed and developed an assessment system that integrates with Knowledge Forum®. It is developed using contemporary software approach and a flexible, three-tier architecture, so as to cater for interoperability and the integration with other generic CSCL systems. A graphic-rich, user-friendly web interface is provided for teachers and students to self-assess their knowledge building efforts (Figure 1).
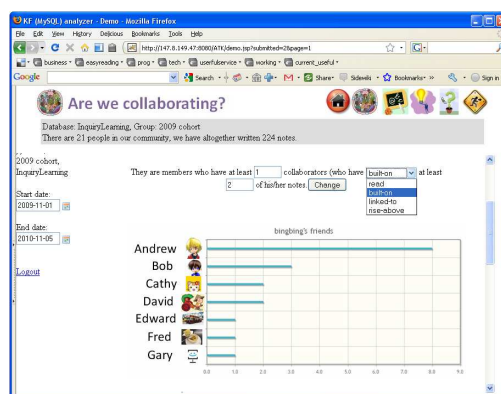

Figure 1. Web-based user interface for answering the questions in natural language, e.g. are we collaborating?

Evaluation for Usability

Preliminary tests for usability have been conducted by inviting teachers who use conducted knowledge building in their classroom to analyze their students' participation using the proposed system. User feedbacks indicate a positive view with most teachers found the tool useful and enabled them to reflect about possible improvements, for example, identifying at-risk students for further scaffolding and follow up.

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