Methods and Technologies to Promote Information-Centered Knowledge Construction

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Abstract

This alternative event for the 2013 iConference is a combination of lightning talks, a demonstration of an assessment technology for knowledge construction in complex domains, and a hands-on exercise in using the tools discussed. The unifying logic for this presentation is that meaningful learning often involves solving challenging and complex problems that allow for multiple solution approaches and a variety of acceptable solutions. While it is important to prepare students to solve such problems, it is difficult to determine the extent to which various interventions and programs are contributing to the development of appropriate problem-solving strategies and attitudes. Simply testing domain knowledge or the ability to solve simple, single-solution problems may not provide support for improving individual student ability or relevant programs and activities. A reliable and robust methodology for assessing the relevant knowledge constructions of students engaged in solving challenging problems is needed, and that is our focus.

Keywords: complex problems, dynamic assessment, information representation, measurement

Introduction

The objectives of this special event session are (1) to build awareness of the connections between the representation of information and the construction of knowledge, (2) to illustrate a framework for conceptualizing these relationships, (3) to introduce the issue of measuring how information representations contribute to knowledge construction, (4) to demonstrate a specific technology for assessing how knowledge is being constructed by a learner, and (5) to provide an opportunity to practice with regard to a common information representation/knowledge construction problem.

The practical knowledge construction problem to be illustrated and involved in the practical activity is a design problem. Designing and developing learning resources and activities is an experience familiar to most educators. The specific design problem involves a decision about multiple ways to represent information about a particular complex and ill-structured problem-solving situation to be presented to learners so as to promote deep thinking about that complex problem. The topic for the design exercise is climate change. The targeted learners are 9th grade students in an earth science class. The problem to be introduced involves developing a policy with regard to carbon dioxide (CO2) emissions aimed at reducing global warming, which is presented mid-way through the course and used as a capstone activity to be completed by small groups (3 to 5) of students. A representative expert solution will be available for discussion towards the end of the session to discuss the notion of dynamic formative feedback based on the knowledge constructions provided by participants.

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Discussion

The session includes short, provocative, lightning talks (Pechu Kucha) by each of the panelists. The focus of these lightning talks is on methods, tools, and technologies that can be used to assess how the use of information in a learning situation is contributing to the construction of knowledge. The first

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issue is a general framework that involves the introduction of representations of mental models and how they can be used as a basis for assessment; a tool that has been used successfully for this purpose is HIMATT (Highly Integrated Model-based Assessment Tools and Technologies; Pirnay-Dummer, Ifenthaler, & Spector, 2010). An extension of HIMATT that explicitly supports dynamic formative feedback to learners engaged in problem solving activities is the second issue addressed (Ifenthaler, 2012). A simulation-based learning environment for pre-service teachers and how it can support refinement of classroom teaching is then presented (Knezek & Christensen, 2009). The focus then shifts to special populations and how these tools and technologies can be used to support individual needs (Tyler-Wood, Ellison, Lim, & Periathinuvadi, 2011). Motivational and affective factors (e.g., enjoyment) that can be considered in the implementation of the tools and technologies is also discussed (Kim, 2012). The concluding provocative contribution demonstrates a synthesis of the panelists' talks to understand individual mental model representations and support the effective construction of knowledge.

The basic logic behind these presentations begins with a widely accepted constructivist epistemology. Individuals create internal representations to make sense of their experiences. These internal representations are not directly observable but they are critical for effective knowledge construction and problem solving. It is possible to elicit re-representations of these constructions during a problem solving activity and use those to (a) identify student problems, including both cognitive and non-cognitive problems, (b) offer meaningful, just-in-need feedback, and (c) evaluate the efficacy of a learning activity. The underlying assumption is that measuring progress of learning and understanding is fundamental for promoting effective knowledge construction and deep understanding of complex and challenging problems.

At the end of these presentations, there are three additional activities: (a) reactions and reflections from participants, (b) a structured exercise for pairs of participants using a particular annotated concept mapping technique to construct a knowledge model about a selected topic of general interest to information scientists and technologists, and (c) opportunities to share some of these constructions with the full group.

Conclusion

The issue of measuring the impact of information-centered tools, technologies and methodologies on the effective construction of knowledge is of critical importance to the general education community and of specific relevance to those working in the area of information studies. The way that information is represented and used in educational contexts is known to have an effect on how different persons [mis-]interpret and [mis-]understand that information. Moreover, the ability to offer real-time, problem- and learner-specific feedback on representations and understanding is of obvious relevance in helping learners construct effective mental models and knowledge structures. The goal of this session is to bring these issues to the forefront and to illustrate at least one approach that has shown strong promise in promoting effective knowledge construction based on information representations. The expected short-term outcome of this session is a paper indicating tools and technologies that appear useful in promoting effective knowledge construction and problem-solving skills.

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