Using a Systematic Review for Cross-Theory Comparisons

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Abstract: A solid theoretical foundation is essential for designing effective educational technology. However, different theories may offer competing recommendations, and it is important to balance multiple theoretical perspectives in technology design. In this poster paper, we describe how a systematic review methodology, traditionally used in the medical field, can be applied in a learning sciences context to identify student behaviors and learning conditions that are beneficial to learning. We present the process and early results by examining the overlap and discrepancies between knowledge building and inquiry learning theories as they relate to pedagogical best practices.

Keywords: systematic review, inquiry learning, knowledge building

Introduction

Educational technologies are becoming increasingly appealing for instruction; however, in order to develop effective instructional interventions, a solid theoretical foundation is critical. Theory provides a way of framing one’s thinking, understanding and critiquing educational practices, and guiding actions. While literature searches and theory-based approaches are common across all forms of scholarship, they typically adopt a single theoretical lens. The selected theory then guides the choice and application of all other aspects of the research process, such as data collection and data analysis (Crotty, 1998). Adopting a single perspective is inherently incomplete and limiting (Abes, 2009), so rather than being confined by a single theory, researchers and designers should instead consider bringing together multiple theoretical perspectives. Cross-theory experimentation of this nature can lead to rich results and new possibilities.

This paper is part of a larger project where we combine multiple theoretical perspectives with a study of existing educational technologies and pedagogical practices to develop design recommendations. In this paper, we describe the first step of this process, conducting a systematic review to identify student behaviors and learning conditions that are beneficial to learning. A systematic review is a thorough and comprehensive methodology for conducting a literature review that locates existing studies, selects and evaluates contributions, analyzes and synthesizes data, and reports the evidence with clear conclusions (Denyer & Tranfield, 2009). It involves several steps including forming a research question, identifying databases to search, developing explicit search strategies, developing inclusion and exclusion criteria for selection of articles, and extracting data in a standardized format. Systematic reviews are common in medical research and have been used to develop evidence-based medical practice guidelines (Abbas, Raza & Ejaz, 2008). With the push towards more evidence-based practices in education, we see systematic reviews as an important methodology to apply to learning sciences. We intend to use this methodology across many learning theories, but as a first step, we have tested our methodology across two prominent theories: knowledge building (Scardamalia & Bereiter, 2006) and inquiry learning (Bruner, 1966). We show the promise of this approach through a brief qualitative synthesis of our initial findings.

Methods and results

The first step of a systematic review is to establish a clear and concise research question. Our research goal was to identify overlap and discrepancies between student behaviors and related learning conditions across a variety of learning theories. The second step is to locate and select studies by determining literature sources, identifying databases, formulating keyword search strategies, and developing inclusion and exclusion criteria. The literature search for this systematic review was restricted to journal articles published from 2001 to 2014. This allowed us to focus on recent technological developments and results. For our literature source, our search was restricted to the eight journals affiliated with The International Society of the Learning Sciences to keep the review process manageable. We conducted a search in the PsycInfo and Scopus databases using our university library’s search engine on the abstracts of the papers looking for our target learning science theory keywords or their variations (e.g., “inquiry learning,” “inquiry based learning,” “inquiry-based learning”).

The next step in a systematic review is to perform the search and screen the results using pre-determined inclusion and exclusion criteria. Since we wanted to combine theory with a study of existing educational technologies and pedagogical practices, our inclusion criteria required the abstract to mention: (a) A controlled
experiment, design-based research, or case study in a formal or informal learning environment that was designed using principles of the target learning theory, (b) Use of technology or an intervention, and (c) Analysis and discussion of results. We chose to limit the detailed analysis to ten papers per theory to balance between an exhaustive search and a sufficient count. While this paper details the methodology with only two selected learning theories, the overall project goal is to review ten theories of learning (approximately 100 papers). We prioritized diversity of authors, interventions, and publishing journal, in that order. Citation count was used to break ties.

To extract data in a standardized format, student behaviors were operationalized as individual or collaborative actions in which students engage that are beneficial to their learning. These behaviors are typically overt and observable as well as product-oriented and student-driven. Examples include students engaging in discourse, writing an explanation, and generating a hypothesis. Learning conditions were operationalized as events or situations that foster the productive behaviors with the intention of helping students in the learning process. Learning conditions tend to be process-oriented, instructor- or technology-driven, and domain-independent. Usually these conditions are provided in the form of assistance by the teacher or system agent; for example, a teacher asking open-ended, metacognitive questions or prompts provided by an agent to encourage reflection. We reviewed the selected articles focusing on explicit, author-identified behaviors and related conditions.

Next, we compared across theories, looking for overlap as well as discrepancies. One overlap we identified was that both theories argued that students should write or provide an explanation for their proposed solutions (Aalst & Chan, 2007; Song & Looi, 2012). In addition, both knowledge building and inquiry learning encourage the student to engage in the act of locating information and extracting relevant data for the given problem. There is a discrepancy however in how students should use that information. In inquiry learning studies, students used the information to construct evidence based arguments and justifications, whereas in knowledge building studies, students engaged in discourse around the information gathered and reflected on their own learning by comparing with others’ work. Finally, studies under both theories encouraged teacher involvement, for example, by asking open-ended meta-cognitive questions to guide the inquiry with the common goal of developing deeper conceptual understanding. Technology that afforded a private space for individual note taking as well as some public space to share ideas with the rest of the group emerged as one common motif of this study.

Conclusions and implications
This research was grounded in the idea that as technology and pedagogy advance, a multi-theory approach is needed. To illustrate the promise of using a systematic review in learning sciences research, we conducted a systematic review to identify student behaviors and learning conditions in knowledge building and inquiry learning literature. We plan to review additional theories using the same methodology to develop a design framework. The findings will contribute to the knowledge base towards designing educational technology that effectively balances user needs with pedagogical theory and the affordances of advanced learning technologies.

References

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