Ogata, H. et al. (Eds.) (2015). Proceedings of the 23rd International Conference on Computers in Education. China: Asia-Pacific Society for Computers in Education

Scoping Research with a Focus on Questioning

Jon MASON
International Graduate Centre of Education, Charles Darwin University, Australia
jon.mason@cdu.edu.au

Abstract: This conceptual paper outlines a cross-disciplinary research agenda focused on situating questioning while engaging with the digital environment. It builds upon earlier research focused primarily in the area of *why*-questioning that identified significant difference between *information* and *explanation* as distinct goals of inquiry. Consequences of this distinction point to limitations of current digital technology, particularly from the perspective of an individual researcher engaging in prolonged, reflective inquiry. The digital environment offers numerous options to support inquiry but is dominated by the *search paradigm* in which the *informational* bias of search engines abbreviate inquiry, and therefore, questioning. While other digital options such as scholarly collection services, social media, and question-answering services also support inquiry there are limits to which these services can provide targeted support for sense-making activities such as in-session questioning, reasoning, interpreting, identifying connections, discerning relationships and implications, evaluating competing explanations, as well as development and validation of understanding. Within the research agenda outlined here the relationship between sense-making and questioning has emerged as a pivotal area to investigate. In a very reflexive way many questions arise – as the scope of this inquiry includes inquiry itself. What can be learned from a focus on *questions as data*? How might question formulation be supported online? What digital technologies are successfully used to support sense-making? In what ways might human-computer interfaces be further developed in order to scaffold deep and prolonged in-session questioning? In what ways might ontologies of questioning support such an endeavour? While situated at the nexus of educational research and information science, this research agenda is both informed by, and positioned to inform, other domains of research and innovation, including human-computer interaction, knowledge management, and communications design. Of particular interest is how application of the Question Formulation Technique and recent innovations in automated Question Generation might be utilized.

Keywords: questioning, inquiry, question formulation, sense-making, digital technology

1. Introduction

For a researcher, particularly at an early career stage, it can be important to articulate and make explicit a *research agenda* (the scope of research interest). Through doing so, a clear focus is established that can be communicated to colleagues as well as providing an overall coherent framework for a range of research projects to be situated within. This paper represents an outline of my own work-in-progress aimed at achieving this. Its focus is on questioning and sense-making within the digital environment, and this presents a reflexive dimension. Thus, while questioning represents a focus of inquiry, this paper does not set out to answer or report upon a primary research question as such.

Questioning has been integral to education for many centuries. The art of asking questions was most famously developed by Socrates as a pedagogical technique nearly twenty five hundred years ago. For Socrates, dialogue involving questioning was the principal means for uncovering the truth, revealing misconceptions and assumptions, exposing poor argumentation and prejudice, or discovering wider perspectives through clear reasoning (Guthrie, 1989; Stumpf, 1983). Socratic questioning can also be seen as a key foundation of the critical thinking movement and scaffolding techniques within constructivist literature (Mason, 2011; Paul & Elder, 2007; Paul, 1990; Wood, Bruner, & Ross, 1976).

Despite questioning having a long history within education, the actual *ability* to question is surprisingly under-researched given its complexity. The act of questioning is complex because it can seek or invite a range of very different responses – answers, facts, data, information, advice,

explanations, understanding, reasons and dialogue. Indeed, a question often generates other, deeper questions. In digital environments, however, close analysis reveals that support for question formulation and refinement, as well as prolonged in-session questioning, is under-developed. The frontier that this research therefore aims to explore is the rich variation in human sense-making during questioning and how analysis of questions might inform development of digital scaffolds.

Conceptually, this research agenda builds upon the cross-disciplinary foundations and findings from my PhD dissertation (Mason, 2014a), a study that investigated the "*why* dimension – asking, learning, understanding, knowing, and explaining *why*" in the context of digital learning. Specifically, the research agenda going forward is focused more broadly on questioning – in particular, question formulation and generation that can be supported by digital technology and extends beyond the *search paradigm*, a construct used to describe the informational bias of search engines in abbreviating inquiry as keywords, and therefore, also abbreviating questioning (Mason, 2012b). In doing so it aims to examine the implications for digital services development arising from two key categorical distinctions within knowledge discovery and construction that were identified in my PhD dissertation:

- *Informational* versus *explanatory* content (see Figure 1)
- *Meaning-making* versus *sense-making*

It is typically the case that for inquiry instigated with informational goals the search paradigm is likely to be the most effective strategy. While it is the case that *browsing* is sometimes considered to be complementary (though distinct) from *searching*, it can also be considered as a subset in the context of this paper. Thus, searching for the nearest pizza shop is a simple example that would likely return clear and direct information to a query and would not normally require ongoing sense-making. Conversely, for inquiry that seeks an explanation, the content of a response might require extended reflection and sense-making – such as, *why is it so difficult to end the violent conflict in the Middle East?*

The distinction between *meaning-making* and *sense-making* is made for a number of reasons and dealt with at length in my PhD dissertation. Within this research agenda, it is important because "[sense-making] does not necessarily invoke meaning-making and is an activity that has a prominent role in human-computer interaction" (Mason, 2014c, p. 206). Moreover, questioning can proceed with or without meaning-making. Through dialogue, however, these distinct activities can be seen to converge for the simple reason that dialogue cannot proceed without some form of meaning-making..

In this short paper extensive use is made of conceptual representations. The rationale for doing so is in presenting complementary visualizations of the range of topics of interest and their relationships with each other. Significantly, artefacts such as concept maps are an example of an output of sense-making (Mason, 2014a). While concept mapping tools can also invoke meaning-making based upon semantic content their utility is not defined in such terms (Mason, 2014c).

Three figures are thus presented that indicate the scope and focus of this research agenda: Figure 1 presents a concept map used in my PhD dissertation to show a distinction between information and explanation which arises particularly in the case of why-questioning; Figure 2 presents a concept map of the key topics and how they are perceived to relate to each other; and, Figure 3 represents where the research is theoretically situated, from a disciplinary perspective. While these figures have been developed to be sufficiently expressive to communicate the scope of the research agenda this paper first provides some background discussion on sense-making and why it has been chosen as a pivotal construct. This is then followed by discussion on questioning and why it is pivotal to inquiry. Finally – given that the evolution of the digital environment has facilitated a shift toward student-centred pedagogies, self-regulated learning, and inquiry-based learning – the discussion focuses on tools that have been developed to facilitate this: automated question generation within the field of intelligent tutoring systems (Olney, Graesser, & Person, 2012) and the Question Formulation Technique (QFT), a teaching tool aimed at teaching students how to ask their own questions (Rothstein & Santana, 2011).

2. Sense-Making and Questioning

2.1 Sense-Making

Making sense of things is a fundamental need and disposition of human beings and probably predates the invention of language (Mason, 2014c). The term sense-making (also sensemaking), however, has

only appeared as a construct within academic discourse in recent decades – across a broad range of disciplines (Dervin, 1998, 2005; Russell, et. al., 1993, 2008; Klein, et. al., 2006; Weick, 1995; Snowden, 2002). Digital environments bring expanded scope to this construct through providing novel and extended ways for sense-making to be expressed, explored, supported, and scaffolded.

This topic has been of particular interest to me for some years, initially in the context of modelling the various facets of knowing (*knowing-that*, *knowing-how*, *knowing-why*) given the convergence of digital systems designed for learning management, knowledge management, and performance support (Mason, 2008; Mooney, 2011). It is also a topic within information science that is essential for understanding of the structure and content of various metadata schemas and modelling of knowledge within educational contexts (Mason, 2009).

As my research agenda evolves it is expected that numerous discrete research projects focused on sense-making within the digital environment will be initiated – projects that will be positioned to have implications for both human-computer interface development and pedagogical practice.

2.2 Questioning

Questioning is a key foundation of all inquiry and research. It can also be considered to be a subset of inquiry and an activity broader in scope to search. Within the digital environment, however, there are significant constraints that limit natural questioning to dialogic rather than single user contexts. Despite this, the intrinsic extensibility of the Web also provides opportunities for development and deployment of novel tools that can support questioning (Graesser, et al., 2010; Graesser, et al., 2008; Lauer, et al., 2013; Mason, 2014a; Mason 2014b; Mason, 2014c; Mason, 2011).

Questions can be formulated in a rich diversity of ways, from the trivial to the complex, and research does not take place without them. This research will investigate questions classified according to user-assigned topics, their situational or conditional provenance, and collected at various scales of aggregation. The underlying assumption is that questions can function as data, whether as discrete elements of inquiry or within larger collections. Such data has potential to reveal aspects of human sense-making through analysis of their formulation, structural composition, situational relatedness, and semantic content. Data can also be collected when on-screen options for question formulation and refinement are presented. Through closer analysis of the form and function of questions, this research is positioned to inform the design of digital scaffolds and services that directly support – and advance – online inquiry.

Mainstream search engines do not facilitate or encourage deep thinking or prolonged inquiry. Their power and prevalence is embedded in contemporary digital devices and lies in abbreviating inquiry through keywords. In this *search paradigm* questioning becomes a casualty and is cut short. Within the broader digital environment, however, it is well supported through dialogue enabled by social media. The large subscriber bases of community question-answering services like Quora and Research Gate also testify to this function and their utility. Despite such options, the scaffolding of individual reflective inquiry through digital tools remains limited and is dominated by the search paradigm and the parsing of simple semantics. Arguably, this is at odds with trends in flexible education that place emphasis upon inquiry-based and self-regulated approaches to learning.

Recent developments in search technologies are also significant in their exploitation of developments in natural language processing – for example, the Watson DeepQA project (Ferrucci, et al., 2010, 2013; Fan, et al., 2012), which is now a cloud-based machine learning service. However, such projects are focused on improving the precision and efficacy of *answers* to questions in online systems. In this research, however, *answers are not within scope*. Understanding this limitation is critical as it enables a sharper focus upon question structure, function, nature of formulation, and intent.

From an inquiry-based learning perspective Rothstein and Santana (2011) have developed the Question Formulation Technique (QFT) as a method that stimulates student inquiry and questioning skills. As a pedagogical approach its underlying aim is to shift the role of the teacher away from the instigator of questioning. It follows a simple sequence of activities that begins with open brainstorming of all possible questions relevant to an agreed question focus. A key characteristic is a disciplined approach to limiting the activity to question generation – in other words, considering answers is not pursued. As a teaching academic, I have successfully used this technique on numerous occasions with my own students. It is also consistent with the vision of a "new culture of learning" outlined by Thomas and Seely Brown (2011, p. 81):

We propose reversing the order of things. What if, for example, questions were more important than answers? What if the key to learning were not the application of techniques but their invention? What if students were asking questions about things that really mattered to them?

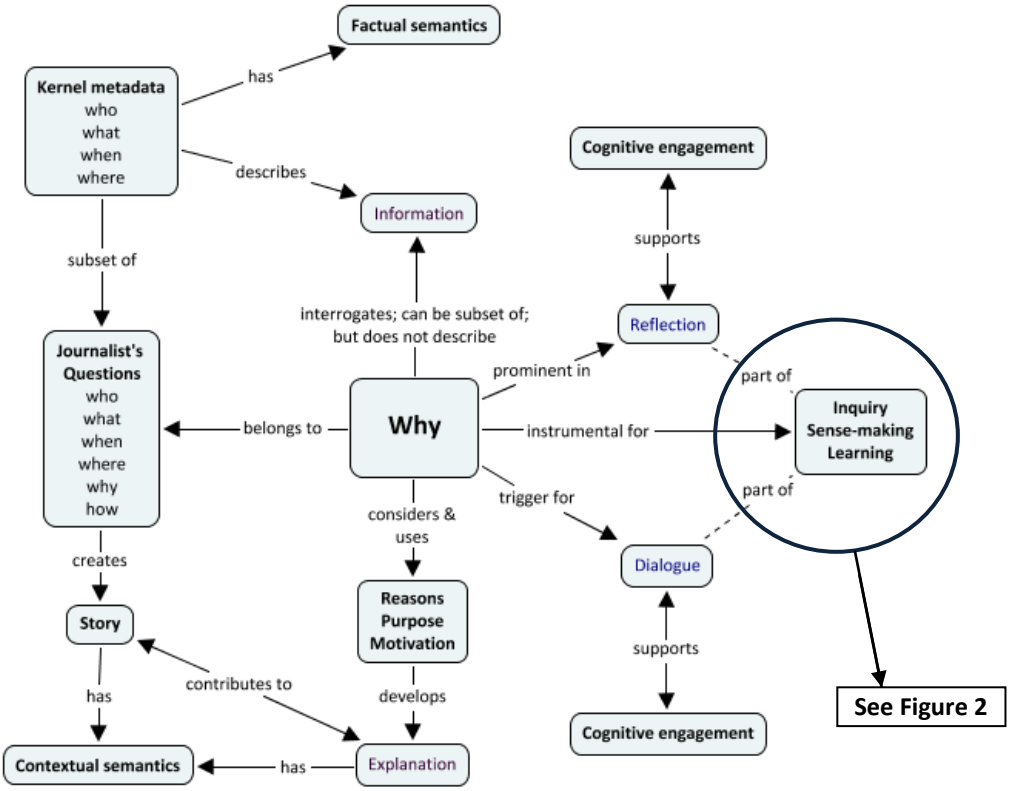

Figure 1. Conceptual domain of topics and semantics associated with *Why* (Mason, 2014a).

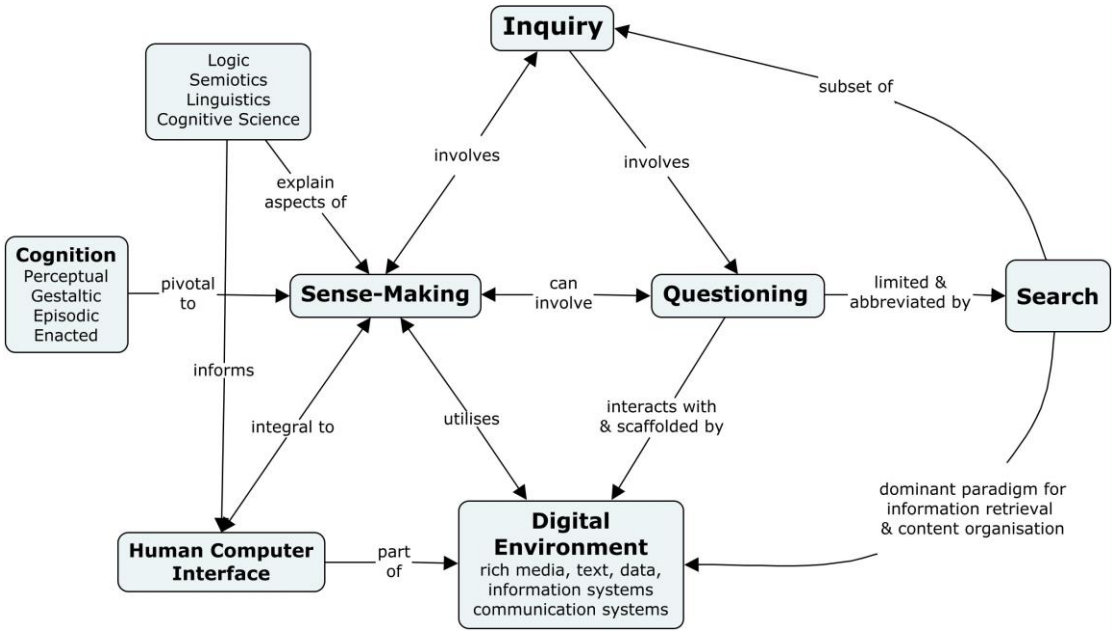

Figure 2. Conceptual map of emerging research agenda.

Figure 3. Cross-disciplinary focus.

3. Concluding Remarks

This paper has been developed with the intention of inviting comment at the workshop on *Technology Enhanced Learning by Posing/Solving Problems/Questions* to be held at ICCE2015 in Hangzhou in China in late 2015. It is a feature of this paper that it *does not* report on a research question as is typically the case at research-based conferences; rather, it presents the context from which a number of research questions emerge, such as: *What can be learned from research that has a focus on questions as data? What can be learned from the structure, function, formulation, and intent of questions? What digital technologies are successfully used to support sense-making? In what ways might human-computer interfaces be further developed in order to scaffold deep and prolonged in-session questioning? In what ways might ontologies of questioning be utilised?* In pursuing these and other related questions it is assumed that there are numerous ways in which digital technology can be harnessed to enhance learning and facilitate research. Through focusing on questioning as a sense-making activity – and *questions as data* – the expected outputs of activities resulting from the research agenda as outlined are novel strategies and services that could be used to support questioning within the digital environment.

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