A COMPARATIVE STUDY OF SOFTWARE TO AID THE DEVELOPMENT OF A CONCEPTUAL FRAMEWORK FOR INSTRUCTIONAL DESIGN THEORY

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Abstract

This paper examines the possibility of technology supporting and facilitating the organisation and development of knowledge in a particular field through critical discourse. Three examples of discourse-structuring technologies have been investigated to determine whether selected software might support critical discourse to capture the knowledge required to structure academic debate. It is envisaged that the technologies will provide a tool to aid the development of a conceptual framework for instructional design theory development.

Keywords

collective memory/ knowledge resource, distributed research communities, instructional design, online knowledge communities, ontology

Introduction

In the Information Age, the importance of being able to organize vast quantities of information and knowledge and be able to draw meaning from that knowledge is increasingly apparent. Information-rich institutions of higher education use technology for administrative management, information access and delivery in libraries, research and development, as a medium of communication, and for teaching and learning. Teaching and learning rely on the transfer, processing of, and reflection on information, and technology may facilitate this exchange. These technologies assume that the collective interpretation of an object or idea is invariably accomplished through discourse.

The authors of this paper are instructional designers at the Distance Education Centre, the University of Southern Queensland (USQ), and teachers of an online course, *Designing Instruction for Flexible Learning*. As with practising instructional designers, the learners in this online course are presented with various theories of instructional design and are required to analyse and to articulate viewpoints on theory, and to apply such theory to their own professional context. In the instructional design field, there are vast quantities of information and knowledge, not to mention various theories and points of view, and learners and practitioners need to be able to effectively manage this knowledge to draw meaning from that information. The study was instigated by the need to efficiently and effectively manage this knowledge.

Study Method

The authors explore why the use of computer technology might facilitate the organisation and development of knowledge in a particular field through discourse analysis. The authors then examine how this can be achieved by performing a comparative study to determine whether selected software might support critical discourse to capture the metaknowledge required to structure academic debate. This debate is often expressed only implicitly in publications, i.e., the author's challenge or support of an existing theory may not be stated explicitly. The long-term aim of the investigation is to find a means to facilitate co-construction of knowledge in order to achieve shared meaning and understanding, with a focus on instructional design theory.

Three examples of discourse-structuring technologies have been selected for comparison. The three examples are of systems for structuring interpretation-oriented discourse: sense making in meetings (QuestMap - Compendium), journal peer review (Digital Document Discourse Environment - D3E), and scholarly debate (ScholOnto). These technologies have been selected because the authors of this paper perceive that they may facilitate:

- collaborative learning and the development of learning communities;
- knowledge and discourse management; and
- the development of ontological frameworks;

and hence aid the development of a conceptual framework for instructional design theory development.

Collaborative Learning and the Development of a Learning Community

Collaborative learning is an educational 'buzz word', with writers using it to describe a variety of different learning situations. Roschelle and Teasley (1995, p. 70) defined collaboration as "a coordinated, synchronous activity that is the result of a continued attempt to construct and maintain a shared conception of a problem". Within the education framework, new standards are being defined based on a student-centred curriculum, increased interactive learning, integration of technology into the educational system, and collaborative study activities.

One of the key elements for successful collaborative learning is peer-to-peer sharing of experiences. Free-flow of information, ideas and advice from many participants is important for increasing exposure to different problem-solving approaches, different viewpoints and different spheres of knowledge, each of which enhances an individual's learning, adaptiveness and ability to recognise opportunities (Harasim *et al.,* 1995; Haythornthwaite, 1996). Only by requiring learners to demonstrate explicit comprehension, e.g. through activity and participating in online discourse, can teachers be sure that any deep understanding has occurred.

Knowledge and Discourse Management

Advances in technology have meant that there is now software available to facilitate and track written discourse in many contexts, e.g. meetings, scholarly debate and Internet communication. Internet technology can support the structuring of discourse, commonly in a threaded discussion, and provides a permanent record of the process. This record serves as a collective memory resource for subsequent reinterpretation. Making discourse structured and persistent changes the context and nature of that discourse—and such interventions must be introduced with care. Structuring makes explicit certain elements of the discourse that were previously implicit. Given these changes, a key challenge is to design the structuring technologies such that the changes enhance the discourse. As a consequence of the primary interaction to accomplish the immediate task, the software must also provide a scaffold for a structured, reusable memory resource for future use and users.

Development of an Ontological Framework

Motta, Buckingham Shum and Domingue (2000) discuss a number of technologies developed to support ontology-driven document enrichment and illustrate their ideas in the domains of electronic news publishing, scholarly discourse and medical guidelines. They note that animportant activity in knowledge management is 'to convert text to knowledge' (O'Leary, 1998). They use the term 'ontology' to indicate 'a specification of a reusable conceptualisation' (Motta, Buckingham

Shum & Domingue, in press, p. 2). Their approach is ontology-driven, in the sense that the construction of the knowledge model is carried out in a top-down fashion, by populating a given ontology rather than in a bottom-up fashion, by annotating a particular document (Gruber, 1993). More simply, an ontology can be seen as providing a representational scheme (a vocabulary) for describing a range of models. The ScholOnto software supports the development of ontologies.

Comparison of the Three Examples

The specific software examples (namely QuestMap, D3E, and ScholOnto) are now examined in detail.

QuestMap (Compendium)

QuestMap is a problem solving software (developed by Corporate Memory Systems, Inc. and later marketed by GDSS, Inc.). The key component of QuestMap is the use of a display system – much like one on an online whiteboard. The participating members of project team use QuestMap to capture the key issues and ideas during discussions and to create a shared understanding within a collaborative team environment (Selvin, 1999). All the messages, documents and reference material for a project can be placed on the 'whiteboard' and the relationships between them can be graphically displayed. Major corporations for strategic planning, environmental planning, business product re-engineering and new product design have used QuestMap.

QuestMap's origins lie in the problems faced by teams working over weeks or months to design business processes. The set of techniques which represent the approach revolve around a graphical hypermedia system for the development and application of:
(i) question-oriented templates, which serve as semiformal ontologies to structure the subject matter of a particular project (see Figure 1); and
(ii) a set of metadata tags that can be assigned to any concept in the database.

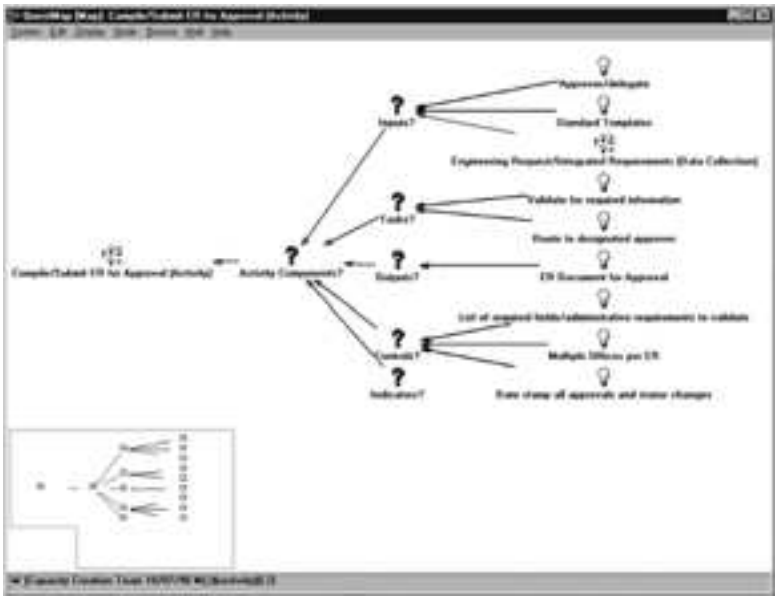

Figure 1: Example of a QuestMap question-oriented template (Selvin, 1999, Figure 4)

Digital Document Discourse Environment (D3E)

Digital Document Discourse Environment (D3E) (online) converts an HTML document into an environment with a user interface for navigating and discussing documents. D3E is currently freely available to academic and other non-profit making organisations, and collaborative partners of the software designers who are members of the Knowledge Media Institute (KMi), UK Open University team. The D3E software supports and documents online discussion of published literature, thus making explicit learners' discussion of ideas presented in the literature. The software has been used to

create the Journal of Interactive Media in Education (JIME) which is a freely available peer reviewed, electronic journal (e-journal) targeted at researchers and practitioners interested in educational technology, both in school and workplace settings (JIME 1996). JIME articles are published in a web document-discussion user interface, which tightly links the article to an area for review comments and discussion. Reviewers can post comments under threads based on the journal's review criteria (e.g. originality of ideas), or they can make section-specific comments. The review process is designed to enable authors, reviewers and the wider community to engage in constructive discussion as opposed to the conventional anonymous issuing of a verdict. Once published readers use the software for critical discourse. Figure 2 illustrates this document interface.

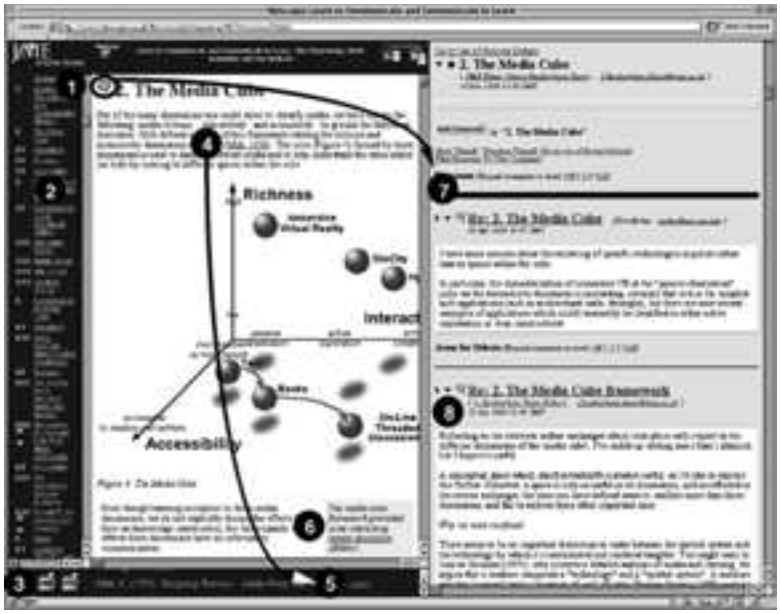

Figure 2: JIME document interface (Sumner & Buckingham Shum, 1998)

[1] Comment icon embedded in each section heading: clicking displays section-specific comments;
[2] active contents list extracted from the section headings;
[3] print versions as HTML and PDF;
[4] numeric or author/date citation automatically linked to corresponding reference in footnote window;
[5] a reverse hyperlink is inserted for each citation of a reference;
[6] an editorial note to draw attention to a controversial issue in the author-reviewer debate that 'made it' into the published version;
[7] section-specific review comment;
[8] an editorial comment summarising the review discussion and specifying change requirements.

(Note that there are two versions of the user interface: one as shown, and for smaller displays, the document and discussion are placed in separate browser windows.)

ScholOnto

ScholOnto, in beta phase at present, has the goal to devise new ways for distributed research communities to track and interpret their literatures. The Knowledge Media Institute (KMi) developers of ScholOnto believe the web server architecture will enable research communities to publish and analyse their literatures in new ways through the creation of an evolving conceptual network of claims and debates. Because ScholOnto is still under development, evaluation of the software is dependent on information presented in the literature. Developers of ScholOnto are interested in:

- intellectual lineage of ideas: e.g. where has this come from, has it already been done?
- the impact of ideas: e.g. what reaction was there to this, has anyone built on it?

- perspectives: are there distinctive schools of thought on this issue?
- inconsistencies: e.g. is an approach consistent with its espoused theoretical foundations?; is there contradictory evidence to a claim? and
- convergences: are different streams of research mutually reinforcing in interesting ways? (Buckingham Shum & Selvin, 2000, p. 5)

The ScholOnto project seeks to address the fundamental requirement for an ontology capable of supporting scholarly research communities in interpreting and discussing evolving ideas, overlaying *interpretations* of content, and supporting the emergence of (possibly conflicting) *perspective*s. The ScholOnto software provides an environment for scholars to make such claims in explicit, computer-readable form (whereas normally they remain implicit in a document's text, or undeclared). The types of claims specified within the ScholOnto software include 'support, similarity, causal, inference and taxonomic'. The goal is to provide a *summary* representation of ideas and their interconnections, in order to assist analysis of the ideas presented in the literature.

Motta *et al.* (in press) believe that this approach has advantages over textual media for tracing the intellectual lineage of a document's ideas, and for assessing the subsequent impact of those ideas—that is, how they have been challenged, supported and appropriated by others. ScholOnto has developed an ontology to support scholarly debate (see Figure 3) and once ScholOnto is released, the ontology will be used to characterise scholarly relations between documents. ScholOnto aims to be domain independent and useable by non-knowledge modellers. The authors of this paper are investigating the application of ScholOnto to create an instructional design ontology to inform discussion of theory and practice within the instructional design community.

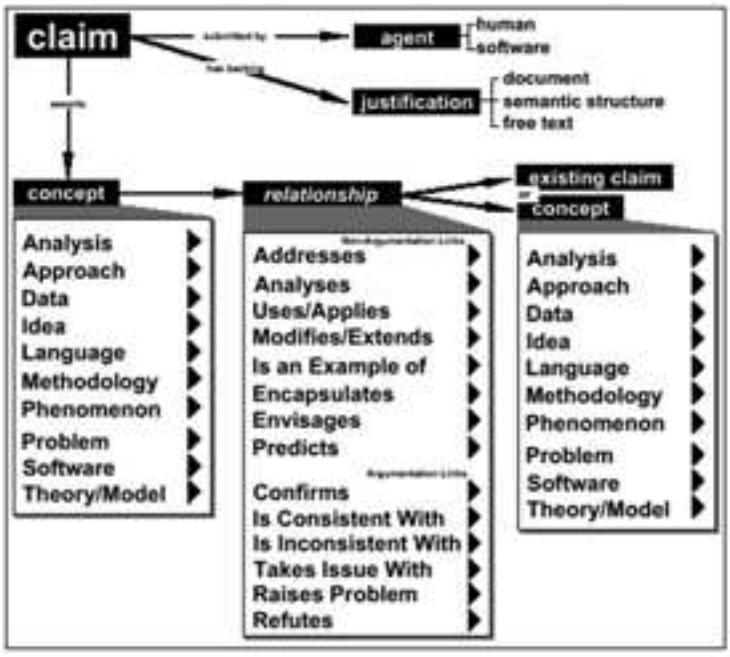

Figure 3: The structure of a scholarly claim in an ontology

Results/ Findings

QuestMap was trialled at USQ to manage the discourse that emerged over a series of meetings held by a software implementation team. D3E was trialled briefly within an online course and later by several professionals in the instructional design field. As mentioned previously, ScholOnto is still in beta phase and trialling of this technology is underway. To assist in the selection of a suitable tool, Table 1 compares the three technologies focussing on the following attributes:

- the collective activities for which the programs provide support;
- the way in which they mediate and represent discourse;
- the manner in which they function as collective memory resources;

- geographical spread of participants (same time/same place? etc.);
- participatory design and evolution of the discourse structuring scheme;
- facilitation/mediation;
- integration with existing practices;
- significant computational 'added value'; and
- integrations with existing technical infrastructure.

This table is an adaptation of several tables of information compiled by Buckingham Shum and Selvin (2000) and is also informed by the trials conducted by the authors.

Criteria	***QuestMap***	***D3E***	***ScholOnto***
Supports collective activities	• Visual sensemaking • Meeting facilitation • Project management	• Structured discussion of structured documents • Peer review and debate	• Research publishing and dissemination • Research debate • Literature analysis
Represents discourse as…	• Hypertexts rendered as concept maps	• Threaded discussion	• Knowledge-based semantic nets
Functions as a collective memory resource	• Expresses all stake-holder perspectives • Captures decision rationale • Traces documents to underlying motivations and assumptions • Hypertext linking • Visual landmarks	• Provides a document specific interpretative space • Preserves intellectual history of document	• Makes explicit a community's perceptions of a piece of work • Structures ongoing debates
Geographical spread	• Synchronously in meetings • Asynchronous via the Internet	• Asynchronous via the Internet	• Asynchronous via the Internet
Participatory design and evolution of he discourse structuring scheme	• Stakeholders can understand the visual mapping notation without explanation • Issue maps are created in real time for immediate verification and ownership of the record	• JIME's peer review discourse scheme has minimal formality and has not changed since journal launch • Other D3E applications have introduced new categories specific to the domain	• Core ontology will be refined following public releases and use • Research groups and communities will evolve their own extensions to the core ontology
Facilitation /mediation	• In a well understood domain, the facilitator's main role is to capture discourse in the tool	• JIME editors facilitate the review discussions and assist new editors in overseeing the review process	• Demonstrate the range of codification and discourse possibilities as communities begin to use the system, more experienced members will model possible uses
Integration with existing practices	• Used to augment teams addressing real problems • Imports from, and exports to established organizational notations and document types	• The conventional textual scholarly document is the central focus, plus familiar threaded discussion • JIME breaks from the traditional review model	Possibilities: • Integration with peer review processes (cf. JIME) • Integration with journal submission and publication • Integration into teaching contexts

Criteria	*QuestMap*	*D3E*	*ScholOnto*
Significant computational 'added value'	• Import/export from/to other documents • Reduces mundane conversion tasks	• Uses the Net to support scholarly debate in a reflective, but more timely, manner than possible in paper journals • Review debate on specific themes and sections is clustered together	Possibilities: • Knowledge-based services will assist in managing the discourse network • Semantic search agents • Semantic filtering • literature visualisations
Integrations with existing technical infrastructure	• Standard applications extended to translate to/from Compendium • Accessible over intra/internet Exports to website	• Accessed over the Net via a web browser, plus plugins for some interactive materials • Automatic HTML-conversions	• Accessed over the Net via a Web browser + Java applets Possibilities: • Email submission of documents for codification

Table 1: Comparison of discourse-oriented technologies for collective memory (adapted from: Buckingham, Shum & Selvin, 2000)

Discussion

QuestMap (Compendium) has been evolving since 1993 and is used in many business projects. It has specific application to a business context, but could be used for project management in any context. At USQ, the use of QuestMap to manage the discourse over a series of meetings of a software implementation team proved to be useful in terms of capturing key decision items and preventing time wasted in revisiting decisions made at previous meetings. The software also enabled quick information dispersal and exchange. However, the authors of this paper concluded that this software did not easily enable the level of critical discourse required for this particular exercise.

D3E uses a generic document-discussion interface and is used in many contexts by many groups. It has been used with JIME, which has been published since 1996 and continues to be used in this way. Use of this software by a number of instructional design professionals appeared to encourage focussed discourse on key issues in the literature selected for the study. Further investigation of this model is underway at USQ and it is envisaged that it will be utilised within a relaunched electronic journal, e-Jist (online). The results of this trial have encouraged the authors to implement the software within a course delivered only online at Masters level (*Designing Instruction for Flexible Learning*).

The ScholOnto project started in 1999. The modelling environment is in place and the literature modelling is underway. The success of software implementation of this kind in an educational environment relies on co-operation, or a 'willingness to share knowledge', either a basic work premise or is enforced by external constraints. Users must also gain personal benefit from the application of the software. For instance, academic analysis and publishing require scholars to read, refer to and praise/ criticise each other's work. The application of ScholOnto to document and make this process explicit clearly benefits academic discourse. However, this technology still is not in a format that can be easily applied and the authors are awaiting further developments before proceeding with practical implementation. It is anticipated that an example of the application of this technology will be available by the end of 2001.

The next stage of this study involves trialling the selected software programs further to determine the ability to capture the metaknowledge required to structure academic debate and support the authors'

quest to find innovative approaches to sharing, accessing and understanding knowledge. This will then lead on to an exploratory investigation designed to gather information from an international group of instructional design professionals in terms of using the technology to facilitate critical analysis of academic discourse. Developing sophisticated, electronic tools is one matter, but implementing their use for communication between people is quite another. This may be the greatest challenge.

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