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Use of concept mapping to integrate the different perspectives of designers and other stakeholders in the development of e-learning materials

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Abstract

Multi-disciplinary teams and stakeholders are involved in the production of e-learning materials and all have differing and valuable perspectives. A range of factors such as availability of new learning technologies, pedagogy or the learning market, may direct the design process. This article argues that a constructivist methodology for course design enables a project manager to build on all contributors' perspectives in a "bottom up" rather than a "top down" approach and be aware of any weaknesses and undesirable dominating influences. Concept mapping provided the basis for an e-learning development project at the University of Surrey to develop such a constructivist methodology. The design team and wider stakeholders each produced individual concept maps and were analysed to identify both commonalties and unique contributions that might influence design. The project manager then integrated the individual maps to produce an overall map of the project and found the process valuable for a more critical and holistic approach to directing the project.

Introduction

The design of e-learning activities (like the design of educational multimedia products) requires co-ordinated teamwork. Boyle (1997), for example, reports that web-based learning development work is likely to require the expertise of subject or academic specialists, instructional design, expertise in web page design and production, web programming, editorial skills, course management and marketing. It is very unlikely that any one person can provide all these abilities and e-learning projects therefore tend to rely on the work of teams to achieve their aims. Good design will be the best possible integration of all the views and know-how of the design team and will also take account of the perspectives of a wider community of stakeholders.

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Furthermore, what each and every individual contributes to the design process is often different, first because the role, skills and activities are different, and second, because their own perception of the overall task is coloured by their experience of wider influences on design. There is a danger that one view or prerogative will lead the project; this could be "the need to design saleable products"; "the desire to use state-of-the art technology" or a teacher-centred notion of "content delivery". The design team will also be influenced to a greater or lesser extent by wider stakeholders in the project such as institutional level managers, project funders, sponsor or project partners. Again there is a danger that a single perspective could emerge as dominant. We identify three dominant influences on e-learning: available technology, the pedagogic approach and the learning market. The article explores why a critical view on all three is needed to avoid the predominance of a single approach.

Project co-ordination and integration may be achieved by leadership. Thus for example, one expert (frequently the project manager) may attempt to "pull back" from any particular specialism and prescribe the process as a whole. However, in this article we describe another approach that is based on our efforts to promote shared understanding and a "bottom up" design methodology as opposed to a leadership model.

To achieve this methodology we have drawn on the theories of constructivist learning. A constructivist view is that learning is built up from the learner's perspective rather than delivered from an "expert" at the top. Instructional design has increasingly drawn upon constructivist views of learning and this is indeed the approach we support. Similarly, we argue, design teamwork requires a learning process that is best constructed by the designers and a wider community of stakeholders rather than imposed from "the top". Thus, in this article we present a constructivist design methodology that can build upon the perspectives of all stakeholders and at the same time identify any weaknesses in the design process or tendency to be dominated by a single perspective.

Concept mapping is a technique that has been shown to facilitate constructivist learning. We proposed using this technique as part of our design methodology to:

(a) help those in the design process make explicit to others what it is they think is important and what they can contribute;
(b) help the team as a whole (and the team manager if there is one) better understand what are the dominant influences on design and what is overlooked by the team;
(c) help those in the team reflect on how their work can be best integrated with the work of others.

We use research and development of online learning environments for adult students at the University of Surrey to illustrate the application of the concept mapping technique to design methodology and to demonstrate its value. Team members and stakeholders were invited to construct maps that represented their understanding of the project and its priorities. After identifying both common concepts and unique concepts

presented in the participants' maps, the project leader was able to construct an overall map of the project as well as identify areas of weakness. We finally suggest that this constructivist methodology might be valuable for other design teams who may identify different problems in obtaining unity and balancing priorities.

Dominant influences on the design and use of e-learning materials

There are widespread assumptions that we now live in an information society in which C&ITs (communication and information technologies) are changing the way we live, work and learn (Webster, 1995). There are three dominant influences on the so-called "C&IT revolution" and the implications it has for learning. Firstly, much discussion of C&ITs and learning tends to focus on the technology that is then weakly linked to wider debates on learning. There is danger that amongst all the hype and optimism, technologically determinist assumptions mask very complex techno-social relations (Dutton, 1999). Viewing technology to be the driving force in e-learning means that the emphasis is on what the technology can achieve without looking at a wider learning context.

Secondly, the online learning design literature has recently recognised the value of embedding pedagogic theory in the design process. Learning technology designers increasingly recommend student interactivity and constructivist approaches over instructionist approaches based on transmission of content from instructor to student or "drill and practice" (Boyle, 1997; Laurillard, 1993). However, while technology may not be the driving force here, pedagogic design still needs careful unpacking to provide a critical appreciation of users access to, and appropriation of, the communication technologies. Social scientists have recognised the development and implementation of technologies involves many choices and options. Social and economic factors, as well as the availability of other technologies, affect these choices and outcomes. Thus it cannot be assumed that learning technologies will necessarily bring about a paradigm shift away from instructionist methodologies towards more interactive, student centred and constructivist learning design and use (Dutton, 1999; Kirkup and Jones, 1996). Traditionalists in academia may be reluctant to give up their control of content, and questions of student access and institutional and individual costs also need to be carefully addressed as part of learning design.

Thirdly, many argue that education has undergone a "postmodern" shift away from a liberal human rights discourse towards education as a commodity that is subject to market discipline and global economics (Shore and Selwyn, 1998; Usher and Edwards, 1994). Efficiency and accountability become increasingly important, as Higher Education becomes more competitive, and the production processes of learning become more akin to the production processes of business. The influence of the business approach to learning is likely to emerge as a strong influence on the development of e-learning, especially in management and marketing circles. But while early advocates of virtual learning emphasised efficiency savings, appreciations of the huge development and delivery costs are also growing.

How can a design team ensure that they facilitate learning environments where the learner is in control and avoid reproducing technology-led and/or content driven delivery and/or business-led modes? The challenge is to integrate all the perspectives of a multi-disciplinary team and avoid a "gravitational attraction" towards technology driven and/or instructor led paradigms of instructional design, while at the same time being market-aware rather than market-led.

Developing a constructivist design methodology using concept mapping

This article develops a methodology by which design teams can reflect their own needs, activities, priorities and objectives in the design process. In the ALaaDin (Adult Learning at a Distance) project at the University of Surrey we used a concept mapping technique to capture the different perspectives on the project taken by both the design team members and other stakeholders.

Concept mapping (Novak, 1998) is one of a generic set of graphic methodologies, including, for example, "mind maps" and "spider diagrams", all of which can be used to help individuals explore their knowledge and understanding for themselves or to share their views with others (Tarquin and Walker, 1997; Trowbridge and Wandersee, 1998: 95–131; Hamer *et al*., 1998: 74–83). Concept mapping, in particular, is useful for sharing meaning between people and teams because it has rules that, when understood, help to remove ambiguity. Many minor variations of the concept mapping methodology exist (see Kinchin, 1999; Kinchin *et al*., 2000) but most applications also include conventions such as:

(a) placing concepts in boxes with directional links that show the map reader how to navigate;
(b) ensuring that the most inclusive (or broadest) concepts are placed at the top of the map and subordinate ones at the bottom to create hierarchy;
(c) the anchoring of concepts in examples so that the meaning of concepts is as clear as possible.

There is an extensive literature documenting the benefits of concept mapping in student teacher classroom interactions (Adey *et al*., 1999), in businesses and in informal learning situations (see, for example, Trochim, 1989) and likewise, an extensive literature exists documenting cognitive and learning processes as revealed by concept map analysis (see Kinchin *et al*., 2000 and Silverman, 1989 among many others). On the whole, however, and as used here, concept mapping is a simple means of helping people share meaning by explaining to one another their views and cognitive frameworks about a topic. As views and understanding change as a result of sharing of meaning and individual or group learning, concept mapping also helps to record "change" and conceptual development.

The use of concept maps to facilitate constructivist design was tested in the ALaaDin project. ALaaDin aims to provide online learning environments for adult students in non-vocational areas of study. Although located in the School of Educational Studies, the project has external sponsors and partnerships and is very much a part of wider

interest in online learning in both Higher and Continuing Education as well as government promotion of e-learning.

The concept maps were constructed during an interview with each of the stakeholders and designers. The designers included two experts and providers of course content (Academic subject specialists), an Instructional designer, a Web page author and a Programmer. Meanwhile, the other stakeholders included the Course Administrator, the Marketing Manager for the educational centre in which the learning will be offered to students, a prospective Student, the Centre Director and a project Sponsor. These individuals were invited to list their top priorities for the project and link these concepts in a hierachical map (for examples see appendix). One or both of the authors of this paper assisted the map producers by asking for clarification of concepts and encouraging them to make links between the concept boxes. Map producers were also given opportunities to amend their initial ranking of concepts into high, intermediate or low positions on the map so as to reflect these discussions. The initial ordering was often altered significantly by the end of the process demonstrating that such maps produce a more accurate, richer picture of participants' views than would be gained from a simple priorities listing exercise.

Map makers were given a few days to reflect on the views they had chosen to present and prioritise and suggest any minor changes. The maps' contents and structures were then analysed by the authors of this paper using qualitative methods (see Kinchin *et al*., 2000).

The results we show here include:

(a) an analysis of similarity and difference in views and concept priorities among the individuals of the design team and other stakeholders including the identification of unique individual contributions;
(b) the construction of an overall map of the project from the data above that can be used to evaluate the existing priorities of the project and identify any weaknesses.

Analysis of the concept maps: congruence, conflict and individual contributions

The concepts appearing in the ten concept maps were categorised and then analysed for the frequency of occurrence of concepts. Table 1 shows the three most common concepts and the estimated priority level (high, intermediate, low) that this concept had on each individual's map. In addition, the unique contributions that did not easily fit into any of the categories in common of the ten individuals are listed.

The "content" of the materials was the most frequently mentioned concept (8 times), and "learning" was the second (7 times). These are both very general terms and were unpacked in more detail in several of the maps. The tutor and students/learners were all mentioned 6 times but were not included in the analysis since these are key actors rather than factors that might influence design. Marketing was also a common concept

Table 1: Common and unique concepts identified by the ten representatives of the project

		Common concepts and their priorities			
Map producer	*Role*	*Course content*	*Learning*	*Marketing*	*Unique contributions*
Derek	Academic subject specialist	–	high	low	• Existing distance learning methodologies
Sue	Academic subject specialist	intermediate	intermediate	–	–
Paul	Educational designer and researcher	intermediate	high	–	• Individual ownership of learning • Helping students to learn from their mistakes
Greg	Web-page designer	intermediate	high	low	• Understanding "best practice" elsewhere • Providing IT help-line support "to users"
Edmund	Programmer	intermediate	–	–	• Integrity (of interactive materials)
Heidi	Course Administrator	low	–	high	• Field-work activities • Quality assurance of academic content
Martha	Course Marketing Manager	–	–	high	• Originality • The competition • Predicting future markets and trends in education • Market research • Niche products
Sarah	Student	high	intermediate	–	• Time-tables for study
John	Sponsor	low	high	–	• Exclusion/access issues • Learning centres • Learning networks • Project management
Lesley	Centre Director	intermediate	low	intermediate	• Flexibility of product design • Awareness of sponsor values • Reputation of the Centre and University • The academic "level" of provision

NB Missing values (–) show where the individual(s) did not represent specific concepts in their map. Names are pseudonyms.

mentioned 5 times. Assessment, accreditation and feedback (to students), course administration, cost effectiveness, learning technology choice, peer interactivity, and product attractiveness were also mentioned, but by a minority of map makers.

The frequency of reference to "learning" as well as the more obvious "course content" is gratifying in that it indicates a good degree of congruence amongst the design team and other stakeholders. The congruence, particularly amongst the design team, could be due to recent close work and discussion on the merits of a constructivist learning approach. However, while content often appeared in the intermediate positions within the maps' hierarchies, by contrast learning was either a high or a low-level/ unrepresented concept. The design team, not surprisingly given the recent discussions, gave learning a high priority, while the other administrative stakeholders ie, Centre Director, Administrator and the Marketing Manager, gave learning a low position, or did not include learning in their maps at all.

Marketing, another frequently mentioned concept, also followed this high/low concept pattern but in reverse. The administrative group gave marketing top priority, while the design team gave marketing little consideration. While not unexpected, this split indicates that there is a tension between the educational values embedded in the product-led approach of educationalists and the demand-led approach favoured by managers and administrators. Greater dialogue between the two groups, and individual reflection of their own maps is a possible method of resolving this tension and ensuring that the product design is market sensitive as well as learning focused.

The unique contributions of individuals were also examined to identify potential areas of weakness in the project methodology. It is particularly interesting that unique contributions have been made most commonly by the Marketing Manager, the Sponsor and the Centre Director (people not directly involved in the design and development process). Quality and integrity (of the product), timetable and structure, IT support help-lines, access issues, use of learning centres and networks and the reputation of the Centre/University were identified as among the areas for further consideration. Each of these has implications for course design. These are areas that could easily be overlooked, and including them produces a much more holistic and integrated view of the project. In addition, the simple process of asking "others", who contribute to the work of the team, to express their opinion early on is a key part of developing understanding and building good working relationships to support the project. Asking for views later in the project when much is already prescribed is unlikely to result in improvements.

Gaining an overview of the project and identifying values and weaknesses

Paul Shabajee (1999) wrote a small but important paper entitled "Making Values and Beliefs Explicit as a Tool for the Effective Development of Educational Multimedia Software—a Prototype". His definition of "values" is loose and encompasses everything from epistemology, pedagogical and end-user descriptions and corporate mission statements: in effect, it is the sum total of personal beliefs and opinion among the production team. It is in this sense that we too refer to "values"—it is the driving force

behind what it is the design team set out to do and why, and although usually buried deep, it is that which is brought to the surface by the process of concept mapping and discussion among the design team.

To gain an overview of the project and its values, the Project Manager produced a map of the project in its wider educational context (see Fig 1.) from integration of individual maps and drawing upon on the above analysis. The product and its learning contents were placed at the centre of the map because nearly all the team identified these as fundamental to the project. The first level of context for this product is the design team and its activities. This level is represented as an inner circle. This circle is in turn placed within the wider circle of University, Sponsors, Partnerships and wider debates and ideologies concerning online and distance learning. All the themes that have emerged from the individual concept map analysis were represented in the three layers. Project priorities are represented in capitals and additions by the Project Manager (see below) are in italics.

Initial inspection of the map revealed that common terms such as "product specification" and "product testing" that are common in the educational technology design literature were conspicuous by their absence. This is not altogether surprising since Shabajee (1999, 101–113) and others suggest that the identification of the values that belie the "idea" for an educational product is a necessary first step and one that comes before product specification in the design process.

Another explanation for the lack of product evaluation in the maps is provided by the map producers' interpretation of the role of technology in e-learning. While our analysis indicates that the values that underlie the project derive from pedagogy not technological hype, we were concerned that the "downstreaming" of references to learning technology in the maps of Edmund and Sarah (see appendix), and the absence of technology from all other contributions apart from the Sponsor's, could indicate a "black boxing" of technology (ie, that the role of technology is taken as given and is not in need of unpacking). Thus the project is in danger of taking an ingenuous approach to learning technologies by uncritically assuming that technology will deliver the project aims without the need for full evaluation. Because the Project Manager (also an author of this paper) had not yet contributed a concept map, she placed some additional concepts on the map for further reflection and consideration by the team. These additions have equal weighting to those of the rest of the team and so this is not a "top-down" approach. One area of particular importance that emerged from the analysis is the role of prototype testing and evaluation; a critical phase in design models, but not acknowledged by other team members.

The overall map was circulated amongst the design team and stakeholders to enable them to gain an overview of the project and review how their individual expertise fits into the wider picture. Discussion of the maps in team meetings led to agreement that more emphasis on product evaluation was needed. Participants were also given the opportunity to give feedback and none expressed dissent from this "group view" of the project.

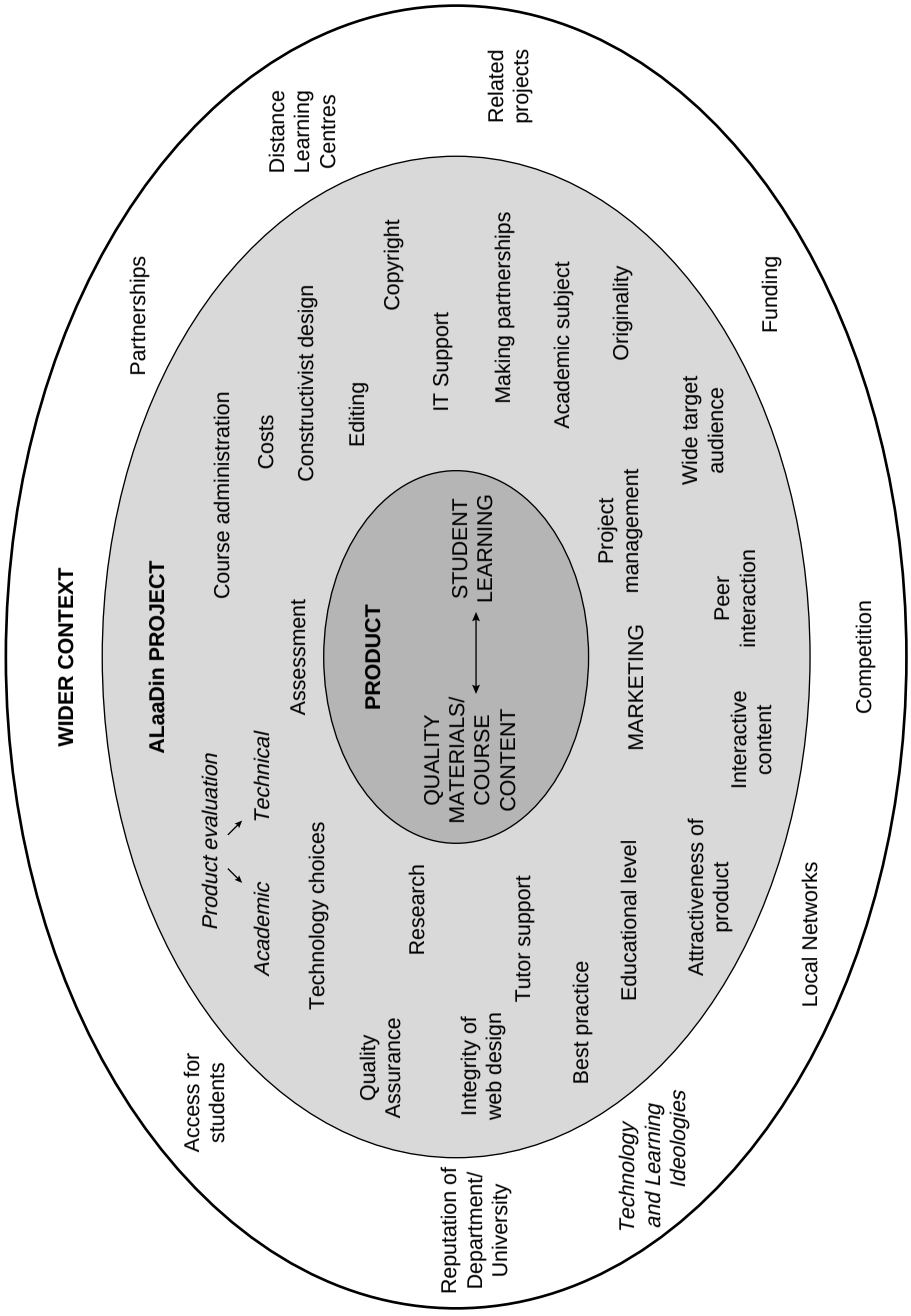

Figure 1: Overall map of ALaaDin project

Conclusion

The constructivist design methodology we have presented here provides a means of gaining benefits from multi-disciplinary work in e-learning design and correct for any weaknesses or undesirable dominating factors. Concept mapping has proved to be a powerful tool in the achieving the best out of a design team. The approach can help resolve potential conflicts between instructivist or constructivist positions, avoid technological determinism and can provide balance between financial and market led prerogatives and educational values. Furthermore, and perhaps, more importantly, the model we prescribe is "owned" by all the stakeholders in the design process. It is not a "value set" or "identity" prescribed by an external director or manager, but a description of working relationships and activities, all of which contribute to the "whole". For those of us who would ascribe to the view that meaningful constructivist learning is facilitated by ownership and control of the learning process, it is important that the design process of educational materials should also adhere to this "value set". Finally, we recommend that reflection on the process of design, whether this is achieved through concept mapping or any by other means, is well worth spending time on in any e-learning project.

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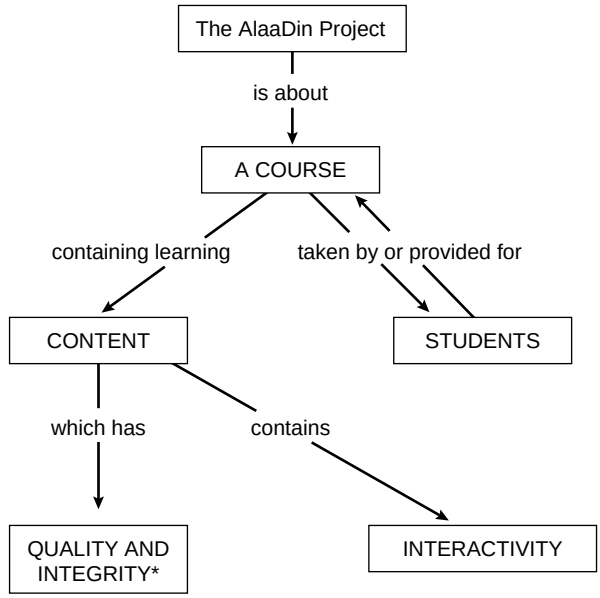
Appendix: Some examples of concept maps

Edmund's map (Edmund is an 'expert' programmer and designer of interactive technology products, but is relatively new to work in educational design).



* By which Edmund explained that he meant good product functionality, seamlessness, consistency of 'look and feel' and making the best use of technology to achieve these aims.

Sarah's map (Sara is an adult learner).