

CREATING CONSTRUCTIVIST LEARNING ENVIRONMENTS ON THE WEB: THE CHALLENGE IN HIGHER EDUCATION

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ABSTRACT

Australian universities have traditionally relied on government funding to support undergraduate teaching. As the government has adopted the 'user-pays' principle, universities have been forced to look outside their traditional market to expand the undergraduate, post-graduate and international offerings. Alternate delivery methods in many universities have utilised web-based instruction as a basis for this move because of three perceptions: access by the target market is reasonably significant, it is a cost-effective method of delivery, and it provides global access.

Since the mid sixties, the trend for both on-campus teaching and teaching at a distance has been to use behaviourist instructional strategies for subject development, which rely on the development of a set of instructional sequences with predetermined outcomes. These models, whilst applicable in a behaviourist environment, are not serving instructional designers well when the theoretical foundation for the subject outcomes is based on a constructivist approach to learning, since the constructivist group of theories places less emphasis on the sequence of instruction and more emphasis on the design of the learning environment. (Jonassen, 1994. p 35). In a web-based environment this proves to be even more challenging.

This paper will review current research in design goals for web-based constructivist learning environments, and a move towards the development of models. The design of two web-based subjects will be explored in the context of the design goals developed by Duffy and Cunningham (1996 p 177) who have produced some basic assumptions that they call "metaphors we teach by". The author seeks to examine the seven goals for their relevance to the instructional designer through the examination of their relevance to the web-based subjects, both of which were framed in constructivist theory.

1. INTRODUCTION

Australian universities have traditionally relied on government funding to support undergraduate teaching. As the government has adopted the 'user-pays' principle, universities have been forced to look outside their traditional market to expand the undergraduate, post-graduate and international offerings. Alternative delivery methods in many universities have utilised web-based instruction as a basis for this move because of three perceptions: access by the target market is reasonably significant, it is a cost-effective method of delivery, and it provides global access.

There has been a widespread increase in the use of web-based instruction, (Simbandumwe (1997), Parson (1997)). In fact one report identified fifty-one institutions (forty-four from US, four Australian and two from UK) which offered either undergraduate or post graduate online courses (Fyvie, 1997). However Boshier et al (1997 p 347-8) examined 127 courses and expressed concern that some sites emulated "the worst of face-to-face courses where power relations are unproblematised and learners constructed as passive recipients of information".

Many web-based subjects have not utilised the full capability of this technology, a trend in education that is not unfamiliar. In fact a shift in approaches to pedagogy is required by teachers as well as a way of supporting alternate frameworks for instruction within a web-based environment.

Behaviourist instructional strategies, which rely on the development of a set of instructional sequences with predetermined outcomes, have been used as a basis for subject development since the mid-sixties. Seels and Glasgow (1990, p3) described the process as “defining what is to be learned, planning an intervention that will allow the learning to occur, and refining the instruction until the objectives are met”. Since World War Two, a number of models for instructional design have been developed which give clear guidelines for the novice instructional designer in the areas of design and development (Dick and Carey, 1990; Gagne, Briggs and Wager, 1991).

These models, whilst applicable in a behaviourist environment, are not serving instructional designers well when the theoretical foundation for the subject outcomes is based on a constructivist approach to learning. The constructivist group of theories places less emphasis on the sequence of instruction and more emphasis on the design of the learning environment. (Jonassen, 1994. p 35). In a web-based environment this proves to be even more challenging.

This paper will review current research in design goals for web-based constructivist learning environments, a move towards the development of models. Two web-based subjects will be examined to determine if they meet the design goals identified. One subject was taught wholly at a distance. The author was not involved in the design or teaching of this subject and as a consequence the identification will be from a paper presented by the instructional designers at a recent conference and subsequent discussion with a member of the design team. (Kirkwood and Ross, 1997) The second subject involved a combination of distance (including web-based) and face-to-face teaching. The author was involved in the design of this subject with the lecturer and a doctoral student.

The design of these subjects will be explored in the context of the design goals developed by Duffy and Cunningham which have produced some basic assumptions which they call “metaphors we teach by” (Duffy and Cunningham, 1996 p 177). By examining two web-based subjects, both of which were based in constructivist theory, the author seeks to examine the seven goals for their relevance to the instructional designer.

2. REVIEW OF CONSTRUCTIVIST THEORY

There are diverse views on what the term ‘constructivism’ means however they tend to share the following beliefs:

1. Learning is an active process of constructing rather than acquiring knowledge and
2. Instruction is a process of supporting that construction rather than communicating knowledge. (Duffy and Cunningham, 1996. p 171).

Duffy and Cunningham cite von Glaserfield’s statement as the common ground: “Instead of presupposing knowledge is a representation of what exists, knowledge is a mapping, in the light of human experience, of what is feasible” (von Glaserfield, 1989, p 134 in Duffy and Cunningham, 1996).

The history of constructivism in education and philosophy indicates that this is not a new theory. (Duffy and Cunningham, 1996. p 173). They cite the work of Vico (early 18th century), Rousseau (1760) and indicate that one of the greatest influences was John Dewey (1916, 1929, 1938) for his arguments against the educational framework of memorisation and recitation and his push for new methods to meet the changing needs of the newly emerging industrial society. He argued that “education is not a preparation for life, it is life itself” (Dewey in Duffy and Cunningham, 1996. p 173).

Cognitive psychology principles have also strongly influenced the development of constructivist theories. In this move away from the outcomes based behaviourist theory, more attention was given to the learning process and a greater degree of autonomy and initiative was given to the learner:

“Cognitive theory concentrates on the conceptualisation of students’ learning processes. It focuses on the exploration of the way information is received, organised, retained and used by the brain.”
(Thompson et al, 1996. P 11)

Within that branch of philosophy known as epistemology, constructivism has been a move away from the earlier ideas about objectivism. Whilst both objectivism and constructivism focus on the experience of the real world, the difference is that “meaning is imposed on the world by us, rather than existing in the world independently of us” (Duffy and Jonassen, 1991 p8).

Reeves (1992) indicates the two beliefs can be displayed as a continuum where the objectivists advocate such ideas as:

- knowledge can be separate from knowing;
- the user gains knowledge objectively through the senses; and
- learning involves gaining truth that can be measured with tests.

and at the far end of the continuum (after von Glaserfeld, 1989) the constructivist theory which focuses on such ideas as

- the existence of knowledge only occurs within humans who construct their own reality;
- knowledge is constructed subjectively by people based on their earlier experiences and the way people reflect and metacognitively organise these thoughts;
- if the learner acquires the strategies that meet the objective then learning has occurred; and
- measurement occurs only through estimation with observation or dialogue (Reeves, 1992).

A rich learning environment is seen as a major goal in constructivism where “prime emphasis is placed on the unique interests, styles, motivations and capabilities of individual learners so that learning environments can be tailored to them” (Reeves 1992).

A variety of types of constructivism have emerged including radical, social, physical, evolutionary, post-modern, social constructionism and information – processing constructivism (Heylighen, 1993 p2; Ernest, 1995 p 459).

Heylighen identifies the role of social constructivism as being more in the middle ground than von Glasersfeld’s position of radical constructivism. He explains that it “sees consensus between different subjects as the ultimate criterion to judge knowledge. ‘Truth’ or ‘reality’ will be accorded only to those constructions on which most people of a social group agree (Heylighen, 1993. p2). This can be seen as the “socially and culturally situated context of cognition” (Duffy and Cunningham, 1996 p 175) which is contrasted with the cognitive constructivist viewpoint that “learning is seen to occur when the learner’s expectations are not met, and he or she attempts to resolve the discrepancy between what was expected and what was encountered” (Duffy and Cunningham, 1996 p175). This is the view that is derived from Piagetian theory (Piaget, 1977) and is reflected in the writings of von Glasersfeld (1989, 1992) and Fosnot (1989).

The definition of constructivism used as a basis for this paper is that reality is constructed or interpreted by a learner through that learner's perception of experiences:

“so an individual's knowledge is a function of one's prior experiences, mental structures, and beliefs that are used to interpret objects and events . . . the mind produces. mental models that represent what the knower has perceived. These models are used to explain, predict, or infer phenomena in the real world . . . much of reality is shared through a process of social negotiation.” (Jonassen, 1994 p35)

3. DEFINING A CONSTRUCTIVIST LEARNING ENVIRONMENT

The notion of a learning environment is somewhat new in the context of instructional design. The goal for instructional designers has been to create an instructional episode for the students, with measurable outcomes, that required the learners to interact in some way with knowledge which was prescribed for them and transmitted to them either via a teacher or some other mechanism. The active participation of the learner in the learning process has become the basis for new directions for learning theories since the seventies. But what impact has this had on instructional design? Models for instructional design, though many and varied, have one definite thing in common: they can be replicated over time in a number of instructional contexts.

There is a focus on instructional sequences or a prescriptive set of activities or thoughts. Constructivism, with its focus on learning rather than instruction, challenges the instructional designer to look for new models, but it seems that by its very nature, constructivism defies the concept of a model. Jonassen suggests in fact that it is not possible to create one since “knowledge construction is context-specific” (Jonassen 1994 p37). The difference he asserts is that rather than designing instructional sequences, the emphasis is on the design of a learning environment (Jonassen 1994 p35).

Wilson takes this idea of a learning environment further:

“Thinking of instruction as an environment gives emphasis to the ‘place’ or ‘space’ where learning occurs. At a minimum, a learning environment contains:

- the learner;
- a ‘setting’ or a ‘space’ wherein the learner acts, using tools and devices, collecting and interpreting information, interacting perhaps with others, etc” (Wilson, 1996 p4).

Wilson identifies that the role of instructional design theory then is to provide a set of principles or concept models to assist teachers and designers in these environments. (Wilson 1996 p 5). He defines a constructivist learning environment as “a place where learners may work together and support each other as they use a variety of tools and information resources in their guided pursuit of learning goals and problem-solving activities” (Wilson 1996 p 5).

He expands this concept to include Perkins notion of a “rich learning environment” which emphasise ‘construction kits’ (such as Lego) or authoring kits (such as *Hyperstudio*) and phenomenaria (“areas for presenting, observing and manipulating phenomena” such as ‘instructional simulations’ (Perkins, 1991). He also includes components of traditional learning environments: information banks, such as teachers, books, videos; symbol pads, such as exercise books, word processors etc; and task managers, for the provision of guidance and feedback and new direction (eg the teacher, computer based instruction, assignment in a textbook).

The role of the task manager is shared in a constructivist learning environment between student and teacher. He stresses that students have more control in this environment and the teacher takes on the role of ‘coach and facilitator’ (Wilson, 1996 p6/7), though in many situations this is better described as ‘co-learner’ (Harper and Hedberg 1997).

4. A REVIEW OF THE DEVELOPMENT OF DESIGN GOALS

In 1991 Jonassen identified “constructivist criteria” for the conception of evaluation methodology which he had drawn from cognitive psychology (Jonassen, 1991 p 11). From this he took the first tentative steps towards identifying design goals in constructivist learning environments:

- the negotiation, rather than imposition, of goals and objectives;
- task analysis consideration be given to appropriate interpretations and provision of the intellectual tools that are necessary when learners are constructing knowledge;
- the promotion of multiple perspectives of reality through these tools and within the environment;
- the provision of generative, mental construction ‘tool kits’ embedded in relevant learning environments that facilitate knowledge construction by learners; and
- evaluation should become more goal-free (see Jonassen, 1991b) and should be used for self analysis (Jonassen, 1991 p12) .

Jonassen and Duffy moved further towards a design model in 1994 by analysing some projects that purported to be constructivist learning environments. They determined three common elements, context, collaboration, and construction, as being fundamental to the environment, which are key processes rather than products. Later he added the use of conversation to the common elements (Jonassen et al, 1995). From these processes they determined a set of heuristics for a design process, which indicate that such an environment should support:

- Knowledge construction which is:
 - founded on internal negotiation of meaning;
 - established as a social negotiation of reality;
 - assisted by exploring real world environments and the creation of new environments; and
 - developed into mental models.
- A context for learning which is meaningful and authentic and makes use of knowledge constructed, which should:
 - be supported by such things as case based scenarios which are situated in the real world and based on authentic tasks;
 - require an understanding of both problem solving methods and thinking processes in that specific context; and
 - be modeled by a performer who is skilled though not necessarily expert.
- Collaboration, both student/student and student/teacher, where the teacher becomes a coach or mentor rather than the holder of knowledge who:
 - employs and encourages social negotiation; and
 - supports an intellectual toolkit to encourage mental modeling through internal negotiation (Jonassen, 1994 p 37).

Duffy had also been exploring design goals with Cunningham and Knuth (Cunningham, Duffy and Knuth, 1993) where they had devised seven pedagogical goals (Honebein, 1996 p 11/12).

Eight instructional principles for designing constructivist learning environments in a problem solving context, were identified by Savery and Duffy (1995, p32-34).

There are a number of commonalities between the two groups as can be identified in Table 1. where the design goals are compared.

Table 1

Comparison of design goals specified by Cunningham et al (1993) compared to the design goals specified by Savery and Duffy (1995)

| Cunningham et al 1993 | Savery and Duffy 1995 |
|--|---|
| 1. provide experience with the knowledge construction process | 1. give the learner ownership of the process used to develop the solution |
| 2. provide experience in and appreciation of multiple perspectives | 2. encourage testing ideas against alternative views and alternate contexts* |
| 3. embed learning in realistic and relevant contexts | 3. anchor all learning activities to a larger task |
| | 4. design an authentic task |
| | 5. design the task and the learning environment to reflect the complexity of the environment they should be able to function in at the end of learning. |
| 4. encourage ownership and voice in the learning process | 6. support the learner in developing ownership for the overall problem or task |
| 5. embed learning in social experience | 7. encourage testing ideas against alternative views and alternate contexts * |
| 6. encourage the use of multiple modes of representation | 8. design the learning environment to support and challenge the learner's thinking |
| 7. encourage self-awareness of the knowledge construction process | 9. provide opportunity for and support reflection on both the content learned and the learning process |

* Note this design goal covers both areas in Cunningham et al's design goals.

A further refinement of these design goals from Duffy and Cunningham have produced some basic assumptions which they call "metaphors we teach by" (Table 2) (Duffy and Cunningham, 1996 p 177). They base these metaphors in the socio-cultural relationships of constructivism. The main change to the earlier design goals is the addition of "learning is mediated by tools and signs". They identify learning as a "matter of constructing and navigating a local, situated path through a rhizomous labyrinth, a process of dialogue and negotiation with and within a local socio-cultural context" (Duffy and Cunningham, 1996 p 177). The tools are technical tools and the signs are semiotic tools. They support the view that thinking is dialogic, connected to another, either directly through communication or indirectly through semiotic mediation: signs (eg. language, mathematics etc) and/or tools (eg. computers and televisions) which are drawn from the socio-cultural context (Duffy and Cunningham, 1996 p 177).

Table 2

Design Goals of a Constructivist Learning Environment or Metaphors to teach by
(Duffy and Cunningham, 1996)

- | | |
|----|--|
| 1. | All knowledge is constructed; all learning is a process of construction |
| 2. | Many worlds views can be constructed: hence there will be multiple perspectives |
| 3. | Knowledge is context dependent, so learning should occur in contexts to which it is relevant |
| 4. | Learning is mediated by tools and signs |
| 5. | Learning is an inherently social-dialogical activity |
| 6. | Learners are distributed, multidimensional participants in a socio-cultural process |
| 7. | Knowing how we know is the ultimate human accomplishment |

By examining two web-based subjects, which were based in constructivist theory, the author sought to examine the seven goals for their relevance to the instructional designer.

5. MULTIMEDIA DESIGN AND DEVELOPMENT (MDD)

This is a virtual web based environment created by Kirkwood and Ross (1997) which is on offer to distance education postgraduate students in two courses at the University of Southern Queensland, Australia. There were no entry-level requirements for the subject and enrolled students were located in different parts of the world. A minimum computer specification was recommended to the students to enable the use of newer technologies.

The educational philosophy of David Ross, the lecturer involved, determined the constructivist nature of this subject. His requirements included an activity base, which made use of collaborative learning and a high level of interactivity. He made use of his background in manufacturing engineering by proposing that a simulation of an industry project be used as the focus of the subject. In keeping with the content he wanted to make use of some of the newer communication technologies including real-time audio and video and a synchronous chat space. (Kirkwood and Ross, 1997 p 234-235)

The design team worked with Ross to create a roleplay situation for the students where they were required to become employees of a simulated company where Ross was the Chief Executive Officer (CEO).

“The student-employees would be answerable, individually and collectively, to the CEO for the timely completion of activities, including design and development of multimedia products, the preparation of company documents such as mission statements, a set of company objectives, an organisational chart for the company and a statement of personnel requirements.”

(Kirkwood and Ross, 1997 p 235)

The assessment activities including the design of a homepage (completed individually), a presentation of a product idea, a business plan design and the identification of personnel requirements for the company. These last three activities all contributed to a final online presentation and were collaborative in nature. Kirkwood and Ross also indicated that they were organised in such a way “that there was a gradual increase in activity, interactivity, communication and complexity” (Kirkwood and Ross, 1997 p 237).

The resultant presentation gave evidence of a truly exciting subject offered in this web-based environment which “exceeded all expectations of creativity, quality and depth” (Kirkwood and Ross, 1997 p 238).

6. IMPLEMENTATION AND EVALUATION OF TECHNOLOGY BASED LEARNING (IETBL)

Another innovative subject, which combined face-to-face meetings with videoconferencing and a web site, is on offer to postgraduate students at the University of Wollongong, NSW, Australia (Agostinho, Lefoe and Hedberg, 1997). The enrolled students were located in Sydney and 80 kilometres south in Wollongong at the main campus. There was a fourteen week time frame with students meeting for three hours each week and the lecturer alternated attendance at the sites. ISDN videoconferencing was used for the first hour most weeks then students interacted via the web site for the remaining two hours.

As the evaluation of technology was integral to the subject several discussion methods, both synchronous and asynchronous, were trialed including live chat spaces, Internet Relay Chat (IRC), and discussion forums. Problem based learning was used as a basis for the subject to improve critical thinking skills and to build on prior experience and knowledge. Students prepared web study guides and collaboratively workshopped these topics both through videoconference and the web site.

7. ANALYSIS OF MDD AND IETBL

The framework of design goals (Duffy and Cunningham, 1996) provides starting points for designers to create constructivist learning environments. A comparison of the two learning environments described here indicate that it is the designers' interpretation of the goals and the way they are translated into learning activities that provides the unique experience in each constructivist learning environment. Jonassen points out the difficulties in designing constructivist learning environments because "knowledge construction processes are, at least to some degree, context specific" (Jonassen, 1994, p37). Although design goals may provide a direction for the designer, it would be difficult to provide a model as detailed as many of the previous instructional models. As a comparison the key features can be reviewed through aspects of Duffy and Cunningham's framework of design goals.

1. All knowledge is constructed: all learning is a process of construction

Through the provision of teaching activities for students to direct their own learning, the designer acknowledges the students' need for autonomy in the learning process in order to construct their own understanding (Duffy and Cunningham, 1996, p178).

In IETBL the learners negotiated a study topic, either from a suggested list or from their own research. These topics provided the impetus for workshops, including web study guides, about the topics and for discussion about key issues, moderated by the student presenters.

The group in MDD also negotiated topics, initially through presentation of their product idea and later through their participation in the business plan.

For both groups there was an element of choice, but within restrictive guidelines.

2. Many world views can be constructed: hence there will be multiple perspectives

Designers need to provide learning experiences which encourage students to look beyond their own view, since in order to have a world view one's own view needs to be compared to the alternatives. Multiple perspectives can be determined through engagement with text but are best created through engagement with others, though discussion and argument.

In IETBL this is best indicated through the Successmaker activity where students formed teams to tender for the evaluation of the implementation of this product in schools. The teams determined a company name and made a presentation to the other groups via videoconferencing. This activity could also be done in a web-based environment.

MDD also provided students with a collaborative problem solving activity which required students to negotiate the product they would advertise then collaborate on the business plan to market this product. The students from diverse backgrounds and cultures followed an intense process of negotiation and discussion to complete their product.

3. Knowledge is context dependent, so learning should occur in contexts to which it is relevant

The provision of realistic or authentic contexts for learning is the basis for many constructivist learning environments (Brown, Collins and Duguid, 1989; CTVG, 1992). The learning environment should "stimulate learners so that their thinking is related to actual practice" (Honebein, 1992 p 20).

The MDD environment does this particularly well through the simulation of an industry project of a company which, at the end of the session, had to showcase the company product in an online environment during a one hour virtual conference. The lecturer became the Chief Executive Officer (CEO) of the company and the students became the employees.

In IETBL the students were situated in a learning environment which required them to evaluate a number of technology based learning tools. Consequently their tasks involved using a variety of cognitive tools within this learning environment, and through the challenges involved in this were able to assess the viability of many of the tools. The student study guides coupled with their presentation strategies and use of the tools situated them in a learning environment that required them to both implement and evaluate the tools they were using for the process.

4. Learning is mediated by tools and signs

The idea of mediated action in which ample theory of higher mental processes is grounded is identified as the basis for constructivism as viewed by Cunningham and Duffy (1996). They support the view of Wertsch (1994) who suggest that the “essence of mediated action is that it involves the tension between the mediational means as provided in the socio-cultural setting, and the unique contextualised use of these means in carrying out particular, concrete actions (Wertsch, 1994 p205).

The computer as used in both environments has aspects of both tool and sign. It has been used as the tool to access the environment where cognitive tools can be used to support learning. The MDD subject used both aspects of tool and sign. Students were required to apply for their position in the ‘company’ through the design of a home page. They also used their homepage to store their contributions to the collaborative components: their idea for the company product, business plan and personnel requirements. All contributions were then used for the final online presentation. IETBL also used this process where students provided online study guides to support their tutorial. The use of language for mediation is further explored in goal 5.

5. Learning is an inherently social-dialogical activity

This goal is a component of goal 4, which emphasises the importance of language as the mediational means (Duffy and Cunningham 1997, p180). It has been separated from the previous goal because of its importance since group discussion is emphasised in constructivist learning environments as one of the keys to understanding. Duffy and Cunningham argue that the main way that “mental functions are altered by the mediation of language signs is that knowledge, and thereby learning, becomes a social, communicative and discursive process, inexorably grounded in talk.” (Duffy and Cunningham 1997, p181).

Communication through the learning environment was a key feature of both subjects particularly where the students were geographically isolated. It is through dialogue in chat rooms, discussion spaces, email (MDD and IETBL); through the use of RealAudio (MDD) and through such technology as videoconferencing (IETBL) that the students were able to develop as members of their learning community, to develop shared understanding, to challenge and to question the key issues of their area of study. MDD held CEO meetings where progress reports were made (via Netscape Chat), Product Management meetings run by the staff without the CEO present and a Newsgroup. IETBL students used synchronous and asynchronous discussions during workshops and for collaborations as well as email. Analysis of these discussions has been referred to in earlier papers and is the basis for a doctoral student’s thesis (Agostinho et al 1997, Agostinho et al 1998).

6. Learners are distributed, multidimensional participants in a socio-cultural process

This concept moves away from the idea that learning is effective internalising of knowledge towards one that involves a connection with communities and a pattern of participation in community. It should not be a lonely act of a single person but a matter of being “initiated into the practices of a community, of moving from legitimate peripheral participation to centripetal participation in the actions of a learning community” (Duffy and Cunningham p181).

MDD provides this extremely well through the simulation of a company. The lecturer stated “I hope that part of their thinking will be at a corporate level – at the upper management level. I want students to consider me the leader of this company and not just as the one giving them grades at the end” (Kirkwood and Ross, 1997 p 236). However the socio-cultural process experienced by these students may have proved quite challenging since they were from a variety of countries they were drawing from a variety of different cultural experiences. The Australian concept of a company and its operations may be very different from one located in Asia.

IETBL students also became part of a learning community through their participation in workshops led by other students which involved students at both sites forming pairs to present a topic to other students then workshopping the concepts with the rest of the group to enhance

and develop a shared understanding. International students in this subject may have been disadvantaged through a lack of cultural understanding of this process and their belief systems of how learning occurs.

7. Knowing how we know is the ultimate human accomplishment

Duffy and Cunningham (1997) identify self-awareness of learning and knowing as the most important goal. They stress that rather than the ideas of metacognition (Flavell, 1979) which “stress the strategies for efficient processing” (Duffy and Cunningham, 1997 p 181), they use the term “reflexivity” which they identify as meaning self-referential. They argue that the essence of reflexivity occurs when “we experience or are shown a situation where our existing beliefs are inadequate, [so] our awareness of our own state of knowing is enhanced” (Duffy and Cunningham, 1997 p 181).

In the MDD subject the students were participating in a simulated company. As part of the community they had to negotiate the direction of the collaborative project and to value the perspectives of others whilst developing their own belief structures. In other words they started to take real control and responsibility for their own beliefs. However this process may not have been made explicit to the students involved. They would need to monitor these changes, for example through a reflective journal, in order to be aware of existing beliefs and the changes that may occur to this belief structure.

In the IETBL subject, some students evaluated the subject’s implementation as part of their assessment, so that they were constantly reflecting on their own learning and the process involved in the implementation of the subject. These students kept a reflective journal throughout the semester. When students ran their own workshop they were able to reflect on previous workshops and their own belief structures on how learning occurred to design their own workshop. An examination of these journals would be required to determine to what extent reflectivity on the learning process has occurred.

8. CONCLUSION

As increased bandwidth becomes a reality the possibilities for interaction via audio and video links will improve. Many web-based courses have already moved from the provision of lecture notes on the web to increasingly providing avenues for communication and interaction, through synchronous and asynchronous discussion. Therefore socio-cultural processes and socio-dialogical aspects can be supported through these environments, where the students are separated by distance or time. Through the provision of real world contexts and opportunity for collaboration, the learning experience can be designed to provide opportunity for students to take control of their own learning.

Current instructional design models do not provide effective strategies for designing constructivist learning environments. However good instructional designers have always moved beyond the models by adapting and manipulating them for a specific context.

The design goals identified by Duffy and Cunningham (1996) require further development if they are to be used by novice instructional designers. Some practical examples by the authors would serve to place them in a context that may be more meaningful to the learner. Whilst they elaborate on a problem based learning environment (Duffy and Cunningham, 1996 p 191), they do not elaborate on the difficulties experienced in managing such an environment on the web. Nor do they make explicit the difficulties encountered in supporting the social-dialogic process in this environment, particularly where the student is a novice with technology. Further development of the goals with more practical guidelines for their implementation may make them more useful in the design process.

Currently they provide experienced instructional designers with a framework for designing web-based constructivist learning environments that are a useful starting point for design, opening up interesting new areas for research.

9. REFERENCES

- Agostinho, S., Lefoe, G., & Hedberg, J. (1997). Online Collaboration and Problem Solving for Effective Learning: A Case Study of a Post Graduate University Course, Proceedings of AUSWEB97 The Third Australian World Wide Web Conference, Southern Cross University, Lismore.
<http://ausweb.scu.edu.au/proceedings/index.html>
- Agostinho, S., Hedberg, J., Lefoe, G., (in press) Constructing Problems in a Technology-Mediated Learning Environment. *The Journal of the Learning Sciences*
- Boshier, R., Mohapi, M., Moulton, G., Qayyum, A., Sadownik, L., and Wilson, M., (1997) Best and worst dressed web courses: Strutting into the 21st Century in comfort and style in Mitchell, I., (Ed) *Distance Education* Vol 18, No 2. (pp 327 - 349)
- Brown, J.S., Collins, A., and Duguid, S. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher*, 18(1), 32-42.
- Cognition and Technology Group at Vanderbilt. (1992) The Jasper Series as an example of anchored instruction: Theory, Program, Description and Assessment Data. *Educational Psychologist*, 27(3), 291 – 315
- Cunningham, D., Duffy, T. M., & Knuth, R. (1993) Textbook of the Future. In C. McKnight (Ed.) *Hypertext: A psychological perspective*. London, Ellis Horwood Pubs.
- Dick W. & Carey L. (1990) *The Systematic Design of Instruction*, Glenview Ill. Scott Foresman & Co.
- Duffy, T. M., and Jonassen, D.H. (1992). Constructivism and The Technology of instruction: A conversation. Lawrence Erlbaum Assoc. Inc. New Jersey.
- Duffy, T. M., and Cunningham, D. J., (1996). Constructivism: Implications for the design and delivery of instruction, In D. H. Jonassen, (Ed.) *Handbook of Research for Educational Communications and Technology*, NY: Macmillan Library Reference USA
- Ernest, P. (1995). The one and the many. In Steffe, L. and Gale, J. (Eds) *Constructivism in Education*. Lawrence Erlbaum Assoc. Inc. New Jersey (pp.459 – 486)
- Fosnot, C.T. (1989). Enquiring teachers, enquiring learners: A constructivist approach for teaching. New York: Teacher's College Press.
- Fyvie, C. G., Lee, Dr Kar-Tin, Clark, T. (1997) Review of online education and training materials - are we better off? In Osbourne, J., Roberts, D, and Walker, J., *Open, Flexible and Distance Learning: Education and Training in the 21st Century* 13th Biennial Forum of Open and Distance Learning Association of Australia pp 174 – 178
- Gagne, R.M., Briggs, L., and Wager, W.W. (1974) *Principles of Instructional Design*. Harcourt, Brace Jovanovich Publ. Fort Worth. Texas.
- Harper, B. and Hedberg, J. (1997). Creating Motivating Interactive learning Environments: a constructivist view. In Kevill, R., Oliver, R., and Phillips, R. *What Works and Why*, 14th Proceedings of Australian Society for Computers in Tertiary Education. Academic Computing Services, Curtin University of Technology, Perth, Western Australia.<http://www.ascilite.org.au>
- Heylighen, F. (1993) Epistemology, introduction. *Principia Cybernetica*. <http://pespmc.vub.ac.be/EPISTEMI.html>
- Honebein, P. (1996). Seven Goals for the design of constructivist learning environments. In Wilson, B. *Constructivist Learning Environments*. Educational Technology Publications, New York.
- Jonassen, D.H. (1991) Evaluating Constructivist Learning. *Educational Technology*, 31(9), 28-33
- Jonassen, D. H., (1994). Thinking Technology: Toward a constructivist design model. *Educational Technology*, 34(3), 34-37.
- Jonassen, D., Davidson, M., Collins, C., Campbell, J., and Haag, B.B., (1995). Constructivism and Computer-Mediated Communication in Distance Education. *The American Journal of Distance Education*, 9(2), 7-26
- Kirkwood, J. and Ross, D., 1997. Multimedia design and development: An industry simulation project delivered on the Internet. In Osbourne, J., Roberts, D. and Walker, J., *Open, Flexible and Distance Learning: Education and Training in the 21st Century*, 13th Biennial Forum of Open and Distance Learning Association of Australia pp 174 – 178

- Perkins, D. (1992) Technology meets Constructivism: Do they make a marriage. In Duffy, T. M., and Jonassen, D.H. *Constructivism and The Technology of instruction: A conversation*. Lawrence Erlbaum Assoc. Inc. New Jersey.
- Piaget, J. (1977) *The Development of thought: equilibration of cognitive structures*. New York: Holt.
- Reeves, Tom, 1992, 'Effective Dimensions of Interactive Learning Systems' Keynote address for *Information Technology for Training and Education Conference (ITTE '92)*
- Savery, J. R., & Duffy, T. M. (1995). Problem Based Learning: An Instructional Model and Its Constructivist Framework. *Educational Technology*, September-October, 35(5), 31-38.
- Seels, B. and Z. Glasgow, (1990), *Exercises in Instructional Design*, Columbus, Merrill
- Thompson, A. D., Simonsen, M.R., Hargrave, C. P. (Eds) (1996). *Educational Technology A Review of the Research* Association for Educational Communications and Technology, Washington.
- Von Glaserfeld, E. (1989) Constructivism in Education. In Husen, T. and Postlewaite (Eds.), *International Encyclopaedia of education*. Oxford, England: Pergamon Press. 162-163
- Von Glaserfeld, E. (1992). Constructivism Reconstructed: a reply to Suchting. *Science and Education* 1, 379 – 384
- Wertsch, J., (1994). The Primacy of mediated action in socio-cultural studies. *Mind, Culture and Activity* 1, 202 - 208
- Wilson, B. G. (Ed.). (1996). *Constructivist Learning Environments: Case Studies in Instructional design*. Educational technology Publications. Englewood Cliffs NJ.

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