Investigating Concept Mapping and Stimulated Recall to Reveal Academic Teacher Beliefs and How They are Enacted Through Learning Designs for the Web

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Abstract: Increasingly, academic teachers are designing their own web sites to add value to or replace other forms of university teaching. These web sites are tangible and dynamic constructions that represent the teachers thinking and decisions derived from an implicit belief system about teaching and learning. The emphasis of this study is to explore the potential of the research techniques of concept-mapping and stimulated recall to locate the implicit pedagogies of academic teachers and investigate how they are enacted through the learning designs of their web sites. The rationale behind such an investigation is that once these implicit belief systems are made visible, then conversations can commence about how these beliefs are transformed into practice, providing a potent departure point for academic development.

Introduction

The choices that academic teachers are making in the design and use of educational technologies are greatly influencing the quality of learning opportunities available to students. That academic teachers make informed educational choices then, is of great concern to those with a vested interest in the quality of higher education. Most universities provide academic teaching staff with opportunities for academic teacher development to assist with the adoption and integration of technologies such as the internet. Such staff development tends to focus on the development of technical literacy skills or teaching techniques and approaches that might engage students by utilizing the technology. A significant body of research has demonstrated that academic teachers' conceptions about teaching distinctly influence their teaching approach and practices (for a synthesis of this body of research see Kember, 1997). Therefore, any staff development program that seeks to sway academic teachers approaches and practices, must address such belief systems (Kember, 1997, p.271). To influence such implicit belief systems methods need to be located that will first make them explicit. Once visible, academic developers have the opportunity to posit theoretically-based alternatives that may have an impact on the academic's internal and dynamic conversation between pedagogical beliefs and how they are enacted in technology enhanced practice.

Situational Context

This study focuses on a project being conducted at a faculty within The University of Queensland. The three year Learning Enhancement Project aims to improve the quality and flexibility of distance and on-campus learning through the technological enhancement of targeted programs and courses. As an educational designer at UQ, my role lies largely in providing academics with learning opportunities that will expand their understanding of educational theories, principles and practice, and improve the quality of teaching and learning at the university. Academic teachers like those involved with the Learning Enhancement Project, are under increasing pressure to work in new technologically enhanced learning environments that require new skills and approaches. A key question for educational design practitioners is

'how can educational designers empower academic teachers to make informed educational choices in the design and use of educational technology?'

Aim of the Research Study

Involvement with the faculty over the last two years has indicated that the faculty academics have a range of experience with using technology in their teaching and an equally varietal range of educational technology design and integrational approaches and practices. The aim of this research project is to investigate the ability of the research tools of concept mapping and stimulated recall to assist in revealing academic teacher belief systems and how these are translated into practice. The author contends that from such a revelation and the ensuing self-awareness, there may be opportunities to discuss educational theory as relevant to practice – thereby enabling teacher development.

The Study

The overall research design for this study is a case study as defined by authors such as Shulman (1996) and Yin (1994). Case methods provide the opportunity for an in-depth reflection into aspects of one's practice, thereby contributing to the construction of dialogue, memory and reasoning across a profession. This case study, while situated in the context of the Learning Enhancement Project at UQ, connects conceptually with cases of technology adoption and academic staff development in other universities and educational institutions. The knowledge and insights gained from this study should contribute to an improvement in my own practice as an educational designer by understanding methods that may locate an appropriate juncture from which to commence conceptual-change based staff development.

The Literature

A number of studies conducted into academic teacher conceptions (for example, Fox, 1983; Prosser, Trigwell, & Taylor, 1994) have attempted to categorise the types of conceptions held by academic teachers. Most of these studies developed categorisations and descriptors that had a high degree of commonality which has given considerable credibility to this area of research (Kember, 1997). Organising frameworks based on the relationship between teacher, learner and content utilised categories that were inherently teacher-centred or student-centred, and considered the source of knowledge. Student-centred categories were usually explicitly implied as superior, and the author of this paper subscribes to this opinion also.

In the application of academic teacher beliefs to educational technology, Reeves (1992) and Reeves & Reeves (1997) appear to be the first to research this area. Reeves realized that the investment in the evaluation of technological innovations in education was poor compared to the money being expended toward further development. In searching for a way to compare and evaluate such innovations Reeves investigated the complex relationships that technology forms with the educational contexts in which it is used. Reeves and Reeves argue that 'pedagogical dimensions' demonstrate the pedagogical influences derived from interactive and web-based learning systems. That is, learning occurs under the influence of the implicit pedagogy of academic teachers rather than as a result of the media or its properties.

Bain also recognised the need to understand the influence academics' educational assumptions had on 'learning technologies' and in turn on student learning. In collaboration with McNaught, Mills, and Lueckenhausen (1998a; 1998b), Bain incorporated concepts from Reeves' research to further investigate the influence of academics' educational beliefs on the design and use of computer-facilitated learning in higher education.

Methodologies

The pilot study to investigate the research techniques required the collection of in-depth data from an individual academic. The academic who participated in this study did so on a voluntary basis and was selected because of availability when data collection needed to take place. This participant had been involved with the UQ Learning Enhancement Project for the past three months and had been working with the educational designer on a variety of courses over the past year.

The data collection activity took place over two consecutive days and consisted of a stimulated recall activity using a think-aloud approach, a concept mapping exercise, and an interview on the concept map. The researcher decided to do the stimulated recall task on the participant's WebCT site as the first step in the data collection process as this would provide the participant with a comfortable and familiar environment in which to begin her participation in the study. On day one, the stimulated recall exercise was conducted using the WebCT site that the academic was utilizing in the current teaching semester as the stimulus for recall. Afterwards, the academic completed a concept mapping task on 'effective university teaching using the internet'. After some instruction on how to construct concept maps, and initial construction, the academic took the map home and completed it that night. The following day the map was brought to the researcher and then a semi-structured interview was conducted about the concept map.

Stimulated Recall Activity

Stimulated recall is a method that attempts to access the subject's meta-cognitive knowledge in response to a stimulus. McMeniman et al. espouses that stimulated recall 'confronts' teachers with their recent actions thereby minimizing superficial self-presentation. The stimulated recall technique was investigated in the context of this study as a method which might uncover the thinking and decision-making processes that contributed to the design and practical use of the academic's web site as a teaching and learning tool. The web site provided a snapshot of the academic's knowledge-in-action, while the stimulated recall task provided the opportunity for the academic to reflect on the thinking that underpinned their learning design decisions. It was hoped that this process would uncover some of the thinking processes that guide their teaching practice.

A think aloud approach was taken to the task to minimize interruption to the thinking process, and minimize researcher bias or the researcher leading the participant in any way. The participant was asked to report on their thoughts as they reflected on the design of the web site and how it was intended to be used for student learning. However, one must necessarily take into account that there is always some slippage between what goes on in ones head and actuality.

The data was collected using a cassette tape recording and an on-screen capture software 'Camtasia' that recorded the voice in synch with screen capture and mouse movement culminating in the creation of a video file. This video provided a contextual record of the sound recording.

Concept mapping task and interview

Concept mapping is said to assist in making declarative knowledge including the relationship between concepts visible. The concept mapping method has been used extensively in science education research and more recently in studies of expert and novice knowledge domains (Olson & Biolsi, 1991, p.240). It also offers researchers a method of documenting and exploring conceptual change. Concept maps have drawn criticism regarding reliability and validity issues. Novak (1998) advocates that such issues are addressed in the natural transparency of concept maps to reveal the essential characteristics of constructivist learning. Validity, he says, can be appraised by an informed evaluator through the propositional relationships and the hierarchical structures of the map itself (Joseph. D. Novak, 1998, p.192).

A semi-structured interview was conducted to access a narrative account on the concept map constructed by the participant. A set of guiding questions were developed prior to the interview but ad hoc questions were developed during the interview to follow certain lines of inquiry. A semi-structured approach allowed

some flexibility in the mutual construction of the account while assuring that core issues were canvassed. The data for the semi-structured interview about the concept map was collected using a cassette recorder.

Data analysis

Empirical studies in the area of academic teacher beliefs have typically involved at least 12 participants, and occasionally hundreds. Most studies used a qualitative approach with no preconceived hypotheses and predominantly conducted semi-structured interviews using indirect questions. Analysis typically consists of using a grounded approach where categories of beliefs emerge from the data. The majority of studies utilized two or more independent researchers to analyze at least some of the data, and the identification and definition of the categories was an iterative process that involved comparisons across cases (Kember, 1997, p. 258-259).

Given the scale of this pilot study, it was inappropriate to try and derive categories that may be more broadly applicable from this data. The researcher decided to use established categories and dimensions to analyze the data, but with some reservations. There is a high risk of trying to force the data into the established categories, and the analysis of data without emergent coding may be open to being misrepresented. On the other hand, Kember compared 13 studies in this research area and established that there was a 'high degree of consistency in identified categories' (1997, p. 259). This researcher however, would prefer not to put too much emphasis on the categories themselves for this pilot project. Instead this investigation is more concerned with the knowledge elicitation techniques of stimulated recall and concept mapping.

Categorizations: Orientations, dimensions, and continuums

This case study utilized existing orientations and dimensions for data analysis put forward in research by Kember Reeves et al., and Bain et al. While Table 1 outlines the orientations and dimensions actually used for data analysis, there were a number of dimensions which significantly overlapped in meaning and were therefore removed. Other dimensions were removed because of lack of relevance to data.

Pedagogical Beliefs Orientation:

Multi-level conceptual categorisation (Kember, 1997)

Teacher-centered/ content-orientated			Student-centered/ learning-orientated	
Imparting information	Transmitting structured knowledge	Student teacher interaction	Facilitating understanding	Conceptual change/ intellectual development

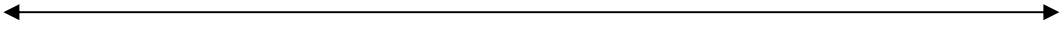
Role of discussion in learning (Bain et al., 1998b)

Incidental	Central

Instructional sequencing (Reeves, 1992)

Reductionist	Constructivist

Teaching Practice, Learning Design and Function Orientation:



Task orientation (Reeves 97)

Academic (abstract)		Authentic (experiential)	
Collaborative learning (Reeves 97)			
Unsupported		Integral	
Learning Process (Bain et al., 1998a)			
Reproduction		Construction	
Focus of assessment (Bain et al. 98)			
Know more		Know differently	
Feedback to students (Bain et al. 98)			
Minimal	Fixed	Responsive direct	Responsive scaffolded

Table 1: Orientations and dimensions drawn upon for data analysis

Within each dimension a continuum exists which represents at one end a teacher-centred content driven belief or practice system and at the other a student-centred constructivist belief or practice system. In Kember's multi-dimensional categorisation, two broad high level orientations are represented with two subordinate conceptions each. The boundary between the subordinate conceptions is blurred to indicate that transition across each pair is relatively easy. The middle conceptual and transitional area is where teacher-student interaction are first recognised as important (Kember, 1997, p. 264).

It is worth noting, that while academic teachers' beliefs and practices may be characterised by the continuum, it is unlikely that they can be pinpointed on it. It is this researcher's opinion that beliefs and practices may span an area of the continuum and may also be dependant on a number of factors including the discipline under investigation. Academic teachers' implicit and explicit beliefs and practices may also be more dynamic than static. This author subscribes to Pratt's (1992) definition of 'teaching approach' as 'a dynamic and interdependent trilogy of actions, intentions and beliefs' (p. 206).

Data related to the concept map and associated interview were coded by and matched to the dimensions and their scales for the belief orientation. As the stimulated recall exercise was designed to try and locate how these beliefs were enacted in practice, data from this exercise was coded by and matched to the teaching practice, learning design and function orientation. Definitions of each dimension were provided in the relevant literature and were employed in the coding-matching exercise.

Results and discussion

Data from the concept map, interview transcript and stimulated recall transcript were aligned with descriptors of the orientation continuums to illustrate the beliefs and practices and assist in analysis. Table 2 summarises the data analysis by indicating the range along each continuum that the data appeared to represent.

Beliefs					
Multi-level conceptual categorisation	Teacher-centered/ content-orientated			Student-centered/ learning-orientated	
	Imparting information	Transmitting structured knowledge	Student teacher interaction	Facilitating understanding	Conceptual change/ intellectual development
Role of discussion in learning	Incidental	2	3	4	Central
Instructional sequencing	Reductionist	2	3	4	Constructivist
Teaching practice, learning design and function orientation					
Task orientation	Academic (abstract)	2	3	4	Authentic (experiential)
Collaborative learning	Unsupported	2	3	4	Integral
Learning Process	Reproduction	2	3	4	Construction
Focus of assessment	Know more	2	3	4	Know differently
Feedback to students	Minimal	Fixed		Responsive direct	Responsive scaffolded

Table 2: Profile of participant's beliefs and practices

The participant beliefs and practices appear to be influenced toward a student-centered/ learning orientated approach to teaching, but as there are content orientated aspects to the academic's beliefs and practices an arrow indicates the range and direction of orientation.

The concept map drawn by the participant reveals complex relationships and a sophisticated propositional structure between concepts which appear to be indicative of her current level of development as a teacher. It is interesting to note the academic's reflection on their development over the past year in interview:

> *I think my teaching a year ago has been very much in this mode here* (points on concept map to content; lecture notes and notes from readings) *where I was thinking about content and lecture notes, a little bit about assessment a little bit about laboratory…*

The participant mapped out her beliefs about using the internet for university teaching quite clearly which revealed a lot about her underlying pedagogical beliefs. In both the interview data and concept map the participant indicates that lecture notes, readings and content are still important, but that student interaction is a significant part of her design, as is group work, problem solving, and the context of professional practice. Within Kember's categorisation the academic appears to be moving in the direction of conceptual change/ intellectual development.

Reeves defines instructional sequencing as 'the belief underlying the instructional design'. The reductionist end of the continuum represents the belief that students must master components before a final holistic task can be achieved. At the other end of the continuum, the constructivist will place learners in a realistic context to achieve a learning task, and scaffolding and coaching is provided as required. The participant's concept map shows that content is derived from professional practice and that cases are derived from practice also. Online chat and discussion provide scaffolding, coaching and feedback

mechanisms to achieve a realistic task. At the same time there is still a dependence on lecture notes and notes from readings – although it is not clear as to whether some level of mastery of this content is a prelude to solving the cases.

The use of case-based learning on the site provides evidence of authentic/ experiential learning in practice. The presence of PowerPoint files that '*help them pick out what I see as the most important things*' demonstrate that there is also a dependence on academic abstract knowledge. Collaborative learning is clearly an integral part of the site: '*the students work together in groups and interact with each other to try and solve problems*'.

The learning process, while strongly constructive through case-based learning, still has significant emphasis on the lecture PowerPoints: '*these presentations have been put onto the web site to help the external students with their study'*. This appears to infer that the PowerPoints and indeed the 'content' of the course must be 'studied'. This kind of thinking aligns with a more reproductive (knowledge) approach.

The focus of the assessment on the site is based around the cases. By using challenging problems in authentic contexts, and working in groups to solve the problems, the emphasis appears to be on knowing differently rather than knowing more, however there are also examinations in the course. While there is a strong tendency in the 'knowing differently' direction of the continuum, this may not be exclusively so.

Feedback is an important part of the site: '*you can put messages up and you can give feedback, you can interact in the same way as if you have a PBL* (problem-based learning) *class in front of you*'. Various mediums are utilised for feedback including discussion areas, online chats and email.

Discussion and Reflections

The combination of techniques used in this study appeared to be successful in eliciting knowledge of the academic's beliefs about using the internet for university teaching and how that was applied in practice. The concept mapping exercise and interview were an effective way of revealing the academic's implicit conceptual beliefs and their relationships in regard to effective university teaching using the internet. While there was justification to use the orientations and dimensions derived from others research for this pilot single case, this was not an ideal way of analyzing the data. To some extent, these categories limited the interpretation of the data.

Olson and Biolsi observed that people with higher levels of expert knowledge tend to talk about what they are trying to achieve, their goals, and 'retrieved thoughts and knowledge' that are assisting them to achieve those goals (1991, p. 245). This was certainly reflective of the data. The data seemed to indicate that the participant's internal beliefs and external practices are moving in the direction of 'expert knowledge'.

Conclusion and Implications for studies in this area

Previous studies in academic teacher beliefs appear to have depended primarily on interviews. The data elicited from this study provided evidence that concept mapping is an effective way of analyzing teacher beliefs and that stimulated recall appears useful in investigating their application to practice. It is envisaged that with this kind of data, the researcher will be able to confront the academic with their beliefs, and beliefs translated into practice. Multiple case studies planned for the future will use a grounded theory approach and the orientations and dimensions developed by other authors will be considered after coding and categorizing the raw data. If possible, multiple coders will be used to make coding and categorization more reliable. Further studies will also investigate the use of this data as a departure point for conceptual-change based staff development.

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