
# Creativity and constraint: Understanding teacher beliefs and the use of LMS technologies

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Most universities still offer Learning Management Systems (LMS) as the 'one size fits all' technology solution for all teachers across all disciplines. Using LMS across diverse campuses has resulted in efficiencies-of-scale for administrators, however LMS integration into teacher practices is minimal (e.g., Conole & Fill, 2005) and teachers' creative space can be limited for discipline-based innovation. Together, these realities indicate that there are significant barriers to the effective use of LMSs, especially for teaching and learning purposes.

To overcome such barriers, the complex and less visible internal space of teacher beliefs must be understood in relation to teachers' pedagogical contexts and the affordances they can identify. This paper reports on the findings of six qualitative case studies of teachers at different stages of LMS integration and the extent to which teachers reconciled their beliefs. The results highlight the need for technology environments that better accommodate teacher diversity.

Keywords: teacher beliefs, teacher diversity, affordances, LMS, university teacher education

## Introduction

While educational technologies in university education are widely promoted for their potential to enrich, enhance and extend student learning experiences, they have not yet met with these expectations (Hedberg, 2006). And yet these technologies continue to have an increasingly integral role in university teaching and learning practices. A product of multimedia and internet technology developments at universities in the 1990s (Apedoe, 2005), the Learning Management Systems (LMSs) market has expanded significantly across higher education; particularly since the early 2000's. Typically LMSs provide a range of technology tools for both pedagogical and administrative purposes and offer a standard 'one size fits all' online teaching and learning solution at most universities. According to Coates *et al.,* (2005), university administrators purchased LMS technologies because they found these systems alluring based on their understanding of what an LMSs might offer. There were strong positive perceptions that LMSs may provide: more efficient ways of teaching; more access to university education; economies of scale for teaching and technology support; more flexibility for students; more enriching student learning experiences; and a way to meet student expectations of technology use. Surprisingly, research into the pedagogical implications of using LMS technologies in higher education is still very immature (Coates et al., 2005). Additionally, there has been very little research on use of LMSs by university teachers (McGill & Hobbs, 2008; Palmer & Holt, 2009). While these systems have been purchased with unprecedented enthusiasm, university teachers have not always embraced them quite as enthusiastically. Their uptake, adoption and integration into teaching and learning practices continue to be problematic.

The less visible internal/mental space of teacher beliefs offers crucial insights to this dilemma. Teacher beliefs infiltrate teacher thinking, planning and decision-making in any teaching and learning environment and can act as a filter to change (Yerrick, Parke, & Nugent, 1997). In a technology

environment, this internal space comprises both teachers' pedagogical beliefs and their beliefs about the roles, value and use of technologies in their teacher practices. These belief systems are key to understanding why technology integration into university teaching practices is minimal and largely focused on administrative uses and information management and dissemination rather than on learning and teaching. Drawing on six qualitative case studies of teachers at different stages of technology integration, this paper reveals how this internal space of teacher beliefs is inextricably linked with teachers' pedagogical contexts and to the technology affordances they can identify for their own practices. A major significance of this study is the potential to apply findings to university teacher education approaches to support future learning and teaching in any virtual or physical technology-enriched spaces.

## The problem of a standardised LMS environment

While the introduction of a single product LMS across diverse university campuses has resulted in efficiencies of scale and the ability to provide targeted technical expertise, it has also reduced the creative designer space for teachers to innovate at a local level. Compared with the early 1990's, when university teachers had more opportunities to select their technology tools from a more differentiated technology environment/tool set, LMSs offer a single, all-encompassing technology solution. They are designed based on a set of assumptions and for particular kinds of administrative and pedagogical applications. There is little room for personalising these environments and their interfaces without expert programming help and thus it is highly unlikely that LMSs will meet the needs of all teachers across all disciplines. While they are easy to use for more generic and teacher or content centred tasks such as information dissemination and administration and for standard (if rather cumbersome) communication tasks, they are not easily configurable to the ways that teaching and learning may be envisaged for a discipline or by an individual teacher. Successful technology integration needs to be considered not only in terms of access and availability, but also in terms of how teachers embrace and use it (Pajo & Wallace, 2001).

Recent studies reported in Australia (Alexander, 2005; Hedberg, 2006; Weaver, Spratt, & Nair, 2008), Canada (Zhou & Xu, 2007) and Sweden (Garrote & Pettersson, 2007) suggest that LMSs are mainly used to distribute information, to create efficiencies for the teacher and to save time. While this may be the technology reality, it is disappointing compared to earlier technologists' dreams that web technologies would transform learning and teaching (Hedberg, 2006). However, perhaps it is unsurprising that LMSs are used to support more traditional didactic approaches when, as Apedoe (2005) points out, LMSs were originally introduced by faculty working in higher education who typically drew on teacher and content-centred pedagogical approaches. Recent studies that have evaluated both teacher and student perceptions of LMSs have found discrepancies (McGill & Hobbs, 2008; Palmer & Holt, 2009). Staff were less satisfied with LMS environments than students. University teachers did not believe that they supported their teaching activities to the extent that students believed it supported their learning activities (McGill & Hobbs, 2008). Furthermore, McGill and Hobbs (2008) highlight that while the student use LMSs from an end-user point of view, the teacher has the dual roles of designer/developer and as end-user interacting with the course and students once it is established. From an end-user point-of-view, students enjoy the flexibility and convenience of using an LMS and have reported a preference for a consistent interface (Steel, 2007). Many have suggested mandatory LMS use and that teachers may require better training to exploit the potential of such systems. While training and teacher development opportunities are unquestionably important, it is the teacher-as-designer role in an LMS environment that requires closer examination. It is in this designer space that teacher beliefs are most influential. While LMSs are changing to 'mash up' with more Web 2.0 technologies, the filter of teacher beliefs is likely remain persistent in how teachers envisage designing and teaching with technologies.

## Teachers' pedagogical beliefs and beliefs about technologies

In universities and elsewhere, teachers' pedagogical beliefs vary greatly in sophistication, depth and complexity. Even with an education-related degree, teacher expertise and experience vary. However, fundamentally, student-centred and learning-oriented beliefs and practices are generally accepted as underpinning the kinds of technology practices that lead to deeper and more active learning that enriches the student learning experience (e.g. Becker, 2000; Conole & Fill, 2005; Gallini & Barron, 2001-2002; Judson, 2006). As pointed out by Hicks, Reid and George (2001), the technology itself does not create quality learning; it is the access to relevant and timely learning opportunities that are designed by the teacher and offered via technology. For teacher-oriented and content-oriented pedagogical beliefs, LMSs can be used in ways that reinforce a more traditional and didactic lecture and tutorial mode of university teaching. Many would argue however, that web-based technologies in particular, afford a plethora of teaching and learning possibilities around communication, interaction, collaboration, 'real-world' or

authentic learning, independent learning, feedback and flexibility. Such uses of technology would be more likely to be designed by teachers who are toward the student-centred and learning-oriented end of the pedagogical beliefs continuum.

However, even if a teacher holds more student-centred beliefs, if they do not believe that the technologies on offer help to translate their pedagogical model and vision, then the teacher may use the technology minimally, with reservation or not at all. Many university teachers have little experience of learning in an educational setting enabled by technology. Without this experience, it may be difficult to envisage using technologies to design for learning that they believe is valuable and effective. It may also be challenging to believe that using technology can contribute toward good educational outcomes. The following quote from Lewis, Agarwal, and Sambamurthy (2003) conveys the significance of 'beliefs' in determining teacher behaviours around technology use:

> Beliefs represent the cognitive structures that an individual develops after collecting, processing and synthesizing information about an information technology, and incorporate individual assessments of various outcomes associated with technology use. Beliefs have been shown to have a profound impact on subsequent individual behaviours toward information technology. (p.658)

Until teacher beliefs in an LMS environment are examined more thoroughly they remain a hidden space. Also, given the tacit nature of teacher beliefs, they are amongst the most challenging influences to research. While university teachers' pedagogical beliefs have been investigated to some extent in technology environments (e.g., Bain & McNaught, 2006; Bain, McNaught, Lueckenhausen, & Mills, 1998; Reeves & Reeves, 1997), their beliefs about LMS technologies themselves have been largely overlooked, particularly as they relate to the value, role and use of LMS for teachers' whole teaching contexts. An examination of teachers' belief systems and practices in an LMS environment is necessary to understand the constraints of these systems as well as to provide insights into the ways that teachers reconcile and translate their beliefs in such an environment. Furthermore this kind of knowledge is likely to be highly relevant and applicable to university teacher education approaches.

## This study

Although it has been reported that teachers' reactions to using LMSs are mixed, there is little research on how teachers are using LMS technologies in their practices. Palmer and Holt (2009) insist that there is a 'pressing need' to better understand how university teachers are using LMSs in their teaching and are concerned about the pedagogical sophistication of LMS usage (p.379). This paper reports on brief examples from six qualitative case studies of teachers at different stages of LMS integration and how these teachers reconciled their pedagogical beliefs, beliefs about web technologies and their pedagogical contexts to help them identify the potential and constraints of LMS technologies for use in their teaching practices.

## Methods

The findings reported in this paper constitute a component of a larger study that investigated the interrelationship between university teachers' pedagogical beliefs, beliefs about web technologies and their technology practices (Steel, 2009a). That study used a qualitative multiple case study design where data was gathered using a combination of a retrospective stimulated recall, concept mapping and interview techniques to access participants' belief systems and technology practices in the LMS Blackboard. Further details of the methodology are detailed in prior work (e.g., Steel, 2006; Steel, 2009b). For this paper, comments were collected and analysed from interview data that was specifically related to questions asked about how these teachers believed that LMS technologies has enabled and constrained their teaching practices. These questions were asked at the end of each stimulated recall interview when their aims, learning designs and decision-making had been explored. Also, these enablers and constraints surfaced naturally throughout the interviews. A recent change from WebCT™ to Blackboard™ had caused issues for some teachers.

### Sample

Six university teachers, Jack, Jules, Kara, Luke, Simon and Tulula were purposively recruited for the larger study from an Australian Group Of Eight (G08) research-intensive university. Purposive or judgment sampling involves the researcher using their experience and prior knowledge of groups to select participants according to clear criteria (Gay & Airasian, 2000). A profile of the participants is provided in

Table 1. For that study it was important that participating teachers were actively using the LMS and thus had beliefs about practicing in that technology environment. To add more breadth to the study, equal numbers of teachers were recruited from Arts-Humanities disciplines and Science-based disciplines. The participants self-selected their discipline category. It was important to include participants from a range of different disciplines because teacher beliefs in some disciplines may be better supported or constrained by the capabilities of LMS technologies than others. For example, aviation is one discipline that uses multiple-choice testing extensively and as such may find stronger affordances in the LMS compared to say orchestral studies.

**Table 1: Participant profiles**

| | Jack | Jules | Kara | Luke | Simon | Tulula |
|---|---|---|---|---|---|---|
| Institutional Teaching Award/ Non-award | Award | Non-Award | Award | Non-Award | Non-Award | Award |
| Discipline | Arts-Humanities: Psychology | Science: Horticulture | Science: Business | Arts-Humanities: Sports Sciences | Science: Medical Sciences | Arts-Humanities: Education |
| Age group | 46-55 | 46-55 | 46-55 | 46-55 | 46-55 | 36-45 |
| Academic position | Senior Lecturer | Lecturer | Senior Lecturer | Lecturer | Lecturer | Senior Lecturer |
| Teaching experience at university | 6-10 years | 6-10 years | 3-6 years | 6-10 years+ | 3-6 years | 10-15 years |
| Educational qualifications | Yes (2) | Yes (1) | Yes (1) | Yes (2) | Yes (1) | Yes (5) |
| Years experience using web for T & L | 5-10 years | 2-3 years | 3-5 years | 2-3 years | 1-2 years | 5-10 years |
| No. of courses designed for LMS | 2-3 courses | 2-3 courses | 4-5 courses | 2-3 courses | 4-5 courses | 6-10 courses |
| DEST* category for course | Web dependant | Web dependant & fully online | Web dependant & fully online | Fully online | Fully online | Web supplemented & web dependant |

* In 2001, the Department of Education, Science and Training (DEST) conducted a study of Australian universities to ascertain the extent of online education in those universities. They allocated categories of online education as follows:
  - Mode A: Web Supplemented (participation online is optional for the student)
  - Mode B: Web Dependent (participation online for each activity is a compulsory requirement of participation although some face-to-face component is retained)
  - Mode C: Fully Online (there is no face-to-face component)

  DEST is now known as Department of Education, Employment and Workplace Relations (DEEWR).

Half the sample comprised teachers who had won institutional teaching awards prior to the data collection that occurred during 2005-2006. This criterion institutionally esteemed teachers was of interest in relation to their likely level of pedagogical expertise. Due to the rigorous process of winning a teaching award, it was probable that these teachers had coherent and well articulated pedagogical belief systems and had attained a high standard of teaching practice. However, it is also acknowledged that how teaching excellence awards are judged is often a matter of contention (see Chism, 2006; Kirkpatrick & Thorpe, 2000) and as such this assumption may be flawed. Coincidentally, these award winners, Jack, Kara and Tulula, had used technologies in their teaching for a longer duration than other participants. It was also a coincidence, rather than a criterion, that all teachers held at least one education-related qualification. Details such as age group, academic position, length of teaching experience, number of courses designed for LMS environments and category of courses according to DEST* were also collected. Consequently, it was noted that there were teachers in the sample who used LMS technologies to supplement other teacher modes, as an integral part of their course and for fully online course delivery.

## Results and implications

This section presents some of the data from the six case studies that are related specifically to teachers' beliefs, their pedagogical and disciplinary visions of technology use and their LMS practices. Specifically, it highlights some of the ways LMS technologies were enabling to the visions of these teachers and some of the ways they constrained creativity and led to some disjuncture between beliefs and practices.

### Beliefs to practice

Most participants spoke at length to convey the beliefs that underpinned their practices in LMS environments. While teachers' pedagogical beliefs varied in depth and complexity across the sample, all teachers recognised that their designer role was pivotal to offering quality learning experiences using LMS technologies. Teachers were generally cognisant of students' aspirations and there was a common desire to offer authentic or situated learning opportunities in all cases with the exception of Simon. In fact, disciplinary interpretations of teaching, learning, knowledge and research were influential to teachers as they envisaged student activities and interactions in technology environments. The ways these disciplinary perspectives played out highlighted teacher and disciplinary diversity.

*Jack*
Jack, whose discipline of psychology, was very research oriented, spoke about the need for his students to discover, research and critically analyse the course content as they engaged with it. He wanted to use LMS technologies to support his course goals and his student learning principles. He envisaged using LMS technologies to get his large classes of first year students more actively involved in their learning. Although he still gave weekly on-campus lectures and tutorials, he believed that students would benefit from having a safe online space where they would be less intimidated in expressing their views compared to the large tutorial and lecture theatre spaces. Additionally, he wanted to acculturate students toward deeper learning through giving them opportunities to experience theory. Through compulsory weekly 'IT activities', students used the discussion board and quiz tools to engage with course concepts between classes. He had accessed some funds to employ an instructional designer to help him design activities using the LMS that replicated classic psychological theories and could be integrated back into his on-campus classes.

Jack believes that using the LMS has enabled him to communicate better with his students (using discussion board and announcements) and to lessen student anxiety. By integrating the online activities directly into on-campus classes, Jack has managed to engage students with material before tutorials. In this way, Jack believes, students can

> Move from a kind of personal thing into more professional opinion. And I think that having this web site helps us to reinforce that. We really want our students to become professional thinkers.

Jack believes that his only limitation is his own creativity and his own confidence in exploring other technology options.

*Jules*
For Jules, in the discipline of plant sciences, helping students to understand complex scientific concepts and applying theory to practice are central to his teaching. On campus, he has abandoned formal lectures in favour of a more conversational and interactive pedagogical style that is aimed at helping students identify and address gaps in their knowledge and learn from one another. Online, Jules had also had some assistance designing a totally online course for his distance students. However his development work was done in WebCT and he was disappointed in how it was presented in Blackboard.

One area where Jules found the LMS had particularly enabled his teaching was through the use of the flash animations and interactive simulations of scientific process. However these had been programmed by an expert and they were not part of the LMS as such. Jules also realised that for some students, who have full-time jobs and are geographically distant from the campus, using LMS technologies offered them an opportunity to participate in university as well as some flexibility to juggle their studies with other commitments.

With a small student cohort studying online, Jules's experience of using the LMS had been disappointing. In fact it had fulfilled his earlier fears that the technology would not easily support his conversational

teaching style and his disciplinary goals. The LMS did not provide the tools he felt he required to emulate the level of human interaction he enjoyed face-to-face. He found that with small student numbers online discussion was limited. Additionally, the lack of capacity to read students body language meant that he couldn't gauge their understanding easily. There were also the practical elements of applied science. Although he had been creative in setting students home-based experiment tasks, using problem-based learning approaches and using metaphors and visual analogies to help students understand scientific processes, he felt that nothing could replace a hands-on, interactive laboratory-based experience.

> Because we are in experimental science, you know, doing things on the web, is not consistent with one's philosophy about doing science as well as learning it.

Jules was also concerned that too much text on the screen was de-motivating to students and he found the navigation in the LMS highly inflexible for his needs.

*Kara*

According to Kara, the disciplinary area of business is dynamic and requires innovative and agile thinkers. Coming directly from industry five years earlier, Kara had developed a strong interest in learning and teaching. She had even developed her own theory of learning and teaching that was a hybrid of classic educational theories such as Constructivism and Social Constructivism and the Japanese business management theory of SECI (Nonaka & Konno, 1998). The result was Kara's 'ESCIE'. This was both a learning theory that incorporated students' processes of internalising and externalising knowledge and expertise through socially mediated and other learning mechanisms, and a metaphor. Her metaphor was the 'Australian Esky' which she described as 'a prime Ocker socialisation piece of paraphernalia'. Kara believed that social learning was a powerful tool for students' knowledge creation.

Kara was confident with computers and had always used them in business. Translating her pedagogy into a technology environment was a reasonably easy and natural process for her. Structured discussion forum activities were central to her course and her content modules and assessment tasks were focused on authentic resources and activities. She used 'hooks', such as video interviews, to engage her students initially and made her expectations of students' performance very clear using scaffolding and communication via announcements and the discussion board. When asked what LMS technologies had particularly enabled her to do she responded that it meant that students had more flexible access to the content and were better able to utilise both the real world and the world of virtual reality. It also addressed a major concern of Kara's around distance students being able to access the same quality of learning experiences as her internal students. Kara wanted both cohorts to feel included and she felt that using LMS communication technologies 'developed a course culture around students interacting with each other and with me'.

Kara also pushed the LMS technology to its limits and was at times frustrated by her own lack of programming knowledge to configure the LMS more fully. She also felt that when using technologies like LMS it was quite difficult to convey complex concepts. This meant that teachers had to design the course extremely well and also engage online themselves rather than expect the technology to do this for you. Kara also lamented the fact that students could not easily do presentations online and that practical or field experiences could not be replicated.

*Luke*

In the postgraduate sports sciences program, students were generally already working in the field. This meant that students were often geographically dispersed and worked all kinds of hours. Luke was used to on-campus teaching and had recently moved toward the use of LMS technologies for these reasons. The technologies enabled the kind of flexibility that his postgraduate students required to participate in further study. Pedagogically, Luke subscribed to the idea that knowledge is socially constructed. He felt his role as a teacher was to get inside students heads and challenge their assumptions. He believed that authentic learning experiences should be designed around giving students the opportunity to consider alternative conceptions based on evidence. However, when Luke tried to translate his pedagogical beliefs into an LMS environment he did not have a positive experience. When he used discussion forums, for example, he found that students expected him to be online continuously and his teaching workload increased dramatically.

> It personally killed me. I had 28 students online, I was working 3 times as hard with 28 students online as I was teaching to 200 students face to face. And not being a touch typist, this made it very, very difficult!

For Luke, who was acutely aware of the university's expectations of academics in terms of research, teaching and service, he had to be realistic about how much time he could allocate to online teaching. The result was that he based his online courses on readings and quizzes despite the fact that philosophically he hates multi-choice quizzes. There was no communication mechanism in his Blackboard course. Rather, he asked that students contact him via telephone during his regular office hours. This was not ideal.

> It would be terrific if we could do more video streaming of some of the lectures. It would be good if we could start to use video-cam to communicate rather than being on the phone. Actually see each other as you talk to each other, to make it a bit more personal, rather than just being over the telephone.

Luke was also interested in how he could motivate students to engage more and share ideas and practices with each other online without causing his own workload to become prohibitive.

*Simon*

As a relatively early career academic in medical health sciences, Simon's pedagogical beliefs were still evolving. He was indifferent about whether he used a traditional face-to-face lecture and tutorial mode or whether he used an LMS system. He believed that generally he could replicate the same pedagogy in both environments. His postgraduate course was offered in distance education mode and had a Blackboard site for online tutorials through the chat interface. He scheduled these weekly so that he could pose and field questions and engage students with the printed content they were mailed.

Simon was very excited about the possibilities of LMS technologies. In particular he could see that there could be some good cost and administrative efficiencies as student numbers increased. This meant that they could probably provide the content online; which would be cheaper and easier to handle and would mean that the course was offered completely online. He also felt that in the health sciences related field, using ICTs was the way of the future in terms of patient care and continuing professional development for health professionals.

Generally, Simon was very happy with the LMS technologies and felt that the greatest limitation was staff training. This was both in terms of identifying what could be done with these technologies and learning how to teach with them effectively. Another area of concern was that he felt he could not use his own body language when interacting online and this limited his performance and style in the delivery of content. He was keen to have some capacity to incorporate audio and video.

> I want to find out the facilities available on Blackboard for those sort of lectures. If there are any audio and video facility available, so that students can view some lectures, brief lectures and some power points to be included into the lectures so that students can access them while viewing the printed material.

*Tulula*

Tulula, a teacher in the discipline of education, believes that learning and teaching is a collaborative partnership between learners and teachers. The concepts of social inclusivity and social learning are important to Tulula. They underpin her belief, 'in the Vygotskian sense', that the most valuable learning takes place when people 'get a chance to predict, to test, and to hear themselves explaining their understandings to others'.

LMS technologies offer her both affordances and constraints. Tulula believes LMSs can be designed to cater to a range of diverse learning styles and enable multiple ways of connecting students to learning, and their learning community. They help Tulula to provide students with educational opportunities regardless of their geographical location. They also enable her to express her 'messy-minds' approach more cohesively. However, depending on her aims and objectives, she believed that LMS technologies were not suitable for all her courses. Even in courses where she used them extensively she found some practical limitations.

In the final year undergraduate course, she drew on an adventure-based pedagogical approach several reasons. She wanted to invite her final year education students to imagine the adventure analogy as they transitioned toward being fully-fledged professionals. Their adventure was about their own personal professional journey where they had to make decisions, network with peers and monitor and manage their own learning in order to move forward. However, while in WebCT she had used programmers to create a highly visual and contextual interface for her approach she had experienced several constraints with the move to Blackboard. These had meant that her workload had escalated and consequently she had needed

to find funds to employ more online tutors. Apart from the inability to properly incorporate a visual and interactive contextual interface, group management was cumbersome and CD Rom integration was impossible.

> It's more complex than I would like because the technology doesn't allow me to do things. So the students have to have a reader CD and a video cd, they have to have lessons on how to use those (because they don't integrate with the site). There's a whole range of things that we have to do to just get them working with the technology that would be nice not to have to do. It's not as intuitive as I would like it to be.

She was also disappointed in some of the tools offered such as the text-based discussion boards which she felt were now a bit passé. She wanted access to video streaming technologies, and tools where students could self-allocate to work teams and more push and pull technologies to facilitate communication more easily.
Referring to LMS technologies she said 'It's like being in the lolly shop you know, can I do that? No, you can't do that. But can I do this?'

### Disjunctures and constraints

Although this was only a small sample, there was an enormous diversity of beliefs, practices, and pedagogical and disciplinary vision for LMS use. For some there were obvious tensions when they could not fully translate their personal vision into an LMS environment. Attention to disciplinary perspectives and ways of knowing were evident in most cases. While Jack and Simon were quite satisfied with the use of LMS for their particular course vision, the remaining cases had specific needs that were unable to be accommodated. At times, technology factors constrained the teacher's vision of learning and teaching in their disciplinary context. At other times, this meant that due to the capabilities of the technologies or the teachers' interpretation of the technology affordances or the way that learning was designed in that environment, there were disjunctures between core pedagogical beliefs and LMS practices.

For example, Jules and Luke expressed tensions and discomforts about the social aspects of learning that featured strongly in their pedagogical beliefs. In Jules's case, this social aspect of learning was notably absent in his LMS use whereas in Luke's case it was removed due to teacher workloads. These disjunctures appeared to stem from lack of experience and confidence with using technologies, and, in Jules's case, low student numbers. However the LMS technologies did not help the teachers overcome these constraints. The limited channels of communication offered by the technologies did not easily support their pedagogical approaches. Both Jules and Luke wanted to connect with their students and felt that they required a more visual communication mechanism to do so. Simon also found this a desirable feature to support his own more didactic teaching approach.

A further constraint for Jules, was his need for more tactile hands-on interaction, visual simulations and perhaps even haptic (sense of touch) feedback. A one size fits all technology solution is unable to meet such specific disciplinary needs. However, these kinds of technologies, which are now emerging (See Farley & Steel, 2009 in submission) are unlikely to be available in this kind of centralised technology model. The option for a more visual and contextual interface is also an issue for those, like Jules, Kara and Tulula, who wish to simulate a more authentic and situated learning experiences. The use of interactive visual cues can enhance immersion and believability. For example, as virtual environments become more similar to reality, the brain has to work harder to differentiate the real and virtual (Castronova, 2001). Again, this would require more customised development that is beyond the capabilities of current LMS technologies.

In fact, the case studies reported here highlight that while there are some generic tools associated with an LMS may be broadly useful, for a teacher to innovate, they require access a range of technology tools and expertise. This includes both technical (programming) type expertise as well as educational technology experts who can assist teachers to identify the affordances of different technologies that support their pedagogical and disciplinary vision. If a teacher does not perceive the technology to be supportive of their pedagogical and disciplinary approach they may choose not to use it or even use it in ways that are incongruent with their pedagogical beliefs. As Norman emphasised (1998) while design is about real affordances, it is the actor's perceived affordances that determine usability.

## Conclusion

The case studies of Jack, Jules, Kara, Luke, Simon and Tulula represented a unique expression of each individual teacher's identities and beliefs-in-practice. This is important. The internal space of teacher beliefs is an essential part of understanding how and why teachers use LMS and other technologies in the ways they do, or at least strive for. A key finding of this series of case studies is the diversity of the teachers' goals and the corresponding variation in their ambitions, internal vision and requirements from the LMS. Therefore, the extent to which the LMS meets (or does not meet) requirements will depend directly upon the individual teacher concerned. In this study, in some instances, there was a fairly close fit while in others there were mismatches that caused tensions and could only have been overcome with extensive additional programming.

Even with the limitation of a small sample, these cases illuminated a number of complex challenges that teachers routinely try to reconcile as they translate their internal tacit beliefs into LMS environments. These challenges involve teachers' pedagogical beliefs, their beliefs about the role, value and use of web technologies, their experiences, their context and the affordances and constraints they can perceive and realise in relation to these factors. Like students' learning styles, teachers' practices and visions for practise are diverse and complex. Like students, this diversity and complexity also needs to be acknowledged and accommodated. Unfortunately one size does not fit all.

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