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LMS Use and Instructor Performance: The Role of Task-technology Fit

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The introduction of learning management systems (LMS) has changed the way in which instructors work. This paper uses Goodhue and Thompson’s (1995) technology-to-performance chain (TPC) to explore the roles of task-technology fit (TTF) and level of LMS use in the performance impacts of LMS for instructors. A mixed method approach was used: an initial quantitative study followed by collection of additional in-depth data using open ended questions. The results showed that TTF directly affects instructors’ perceptions of the impacts of the LMS on their performance, indicating that the better the fit of an LMS to the skills of an instructor and the tasks that the instructor must complete, the more positive its effect on their performance is likely to be. However, level of LMS utilization by instructors is not associated in a simple linear way with TTF or performance impact. Poor fit discourages some instructors from using the LMS; in this case, poor fit is associated with low utilization. On the other hand, poor fit can result in high utilization for those instructors who spend additional time working with the system so that they can work around problems resulting from poor fit.
Introduction

The instructor plays a fundamental role in teaching and learning at university. Over the past decade, the introduction of learning management systems (LMS) has changed the way in which instructors work. Whether courses are taught entirely online or a blended approach is used, most university instructors must design and develop online materials and create and maintain course web sites (Zastrocky, Harris, & Lowendahl, 2007), and LMS have become an important means of communication with students for many instructors.

Universities and scholars have only recently begun to ask what advantages have been obtained from their investments in information and communications technology (Campbell, Oblinger, & colleagues, 2007; Laurillard, 2007) and most research has focused on the use of specific technologies within specific courses rather than the impact of LMS, which are typically used for many, if not all courses that a student takes at university. Much of the LMS research to date has been descriptive, identifying how instructors use LMS (e.g. Becker & Jokivirta, 2007) although some studies have considered why instructors use the LMS in different ways (Renzi, 2008) or what factors might inhibit instructors from using LMS(Browne, Jenkins, & Walker, 2006; Lazarus, 2003; Pajo & Wallace, 2001; Schifter, 2000; Tastle, White, & Shackleton, 2005). There has been little research on how instructors’ use of LMS (as distinct from other educational technologies) impacts teaching and learning. Some indication of this impact is, however, provided by the results of meta-studies of the impact of educational technology in individual courses: while, on average, there is “no significant difference” between the amount students learn with and without the aid of online systems, there is considerable variation in student outcomes depending on how instructors use the technology (Coates, James, & Baldwin, 2005). In addition, instructor perceptions of LMS are believed to play a role in the success of e-learning for students (Hartman, Dziuban, & Moskal, 2000; Newton, 2003).

Clearly, more research is required to investigate the performance impacts of LMS. Better understanding of this issue will benefit not just universities but also instructors, academics and professionals interested in the relationship between LMS use and teacher performance. In this paper, we use Goodhue and Thompson’s (1995) technology-to-performance chain (TPC) as a starting point to explore the performance impact of LMS. A key concept in the TPC is task-technology fit (TTF), “the degree to which a technology assists an individual in performing his or her portfolio of tasks” (Goodhue & Thompson, 1995, p216). In the case of instructor use of an LMS, we can consider TTF to be the ability of the LMS to support the instructor in the range of teaching and course administration activities they engage in whilst accommodating the range of skills instructors have with information technology. Here, we examine the role of TTF on instructors’ perceptions of the impact of the LMS using a mixed method approach in which an initial quantitative study was followed by collection of additional in-depth data using open ended questions.
The Technology-to-Performance Chain (TPC)

According to Goodhue and Thompson (1995), an understanding of information systems (IS) success needs to incorporate TTF. The TPC models the relationships between several aspects of IS success, including TTF. As shown in Figure 1, the model proposes that task characteristics, technology characteristics and individual characteristics determine TTF and TTF in turn influences performance both directly and indirectly via system utilization and its precursors.

The TPC has been used to explore the role of TTF in various domains. In a study of technology use by university librarians, Staples and Seddon (2004) found strong support for the influence of TTF on the performance impact of library management systems. Interestingly, they observed only a direct impact; utilization had no effect on the performance impacts of these systems. There has been little published research on the role of TTF in LMS performance (McGill & Klobas, 2009).

Studies of LMS Use by Instructors

LMS are widely used in universities worldwide (Browne et al., 2006). While use by individual academics is high, it is primarily confined to simple uses such as distribution of teaching materials; fewer than 10% of instructors use LMS to support active social or collaborative learning online (Becker & Jokivirta, 2007; OECD, 2005).

Research on reasons for LMS utilization have identified several inhibiting factors including: the time needed to learn to use an LMS (Pajo & Wallace, 2001), the time requirements for online teaching (Browne et al., 2006; Lazarus, 2003; Pajo & Wallace, 2001; Schifter, 2000;
Tastle et al., 2005), lack of technical support (Browne et al., 2006; Schifter, 2000), concerns about the quality of courses (Schifter, 2000) and money to support development of courses (Browne et al., 2006; Schifter, 2000). While time issues appear to be the dominant inhibiting factors, the research has not provided much insight into why time is such an important issue for instructors. Woods, baker and Hopper (2004) speculated that it may be partially due to the prevalence of blended courses. Instructors may perceive their overall level of work to be increasing as they add variety to their mode of teaching. This would account for the findings of McGill and Hobbs (2008) that instructors are less satisfied with their LMS use than are students. Renzi (2008), however, observed that instructors who are trained and experienced teachers believe that LMS use can reduce the time spent communicating with students as well as improve the quality of student learning. Thus, different teachers appear to have different expectations of LMS use. Yueh and Hsu (2008) have shown that it is possible to increase LMS usage by instructors, by focussing on appropriate design of LMS. This suggests that LMS will be used more when they fit well with the tasks performed by instructors.

Research Model

In this study, we shift the focus from LMS utilization to the performance of instructors using LMS. Nonetheless, as Figure 1 shows, utilization remains relevant because TTF is proposed to affect performance both directly, and indirectly through utilization. Given our focus on TTF, we will not model task, technology or individual differences. We assume, as does the TPC, that it is sufficient to know an instructor’s evaluation of TTF to examine the influence of TTF on utilization and performance impacts. Because we are not specifically interested in explaining the precursors to utilization, we model the indirect effect from TTF through utilization rather than precursors to utilization, consistent with Goodhue and Thompson’s (1995) own empirical work. Nonetheless, we include two other key precursors to utilization (social norms and facilitating conditions (Staples & Seddon, 2004)) to ensure that utilization is sufficiently well explained to test the relationship between utilization and LMS performance impacts. The model that guides this research is shown in Figure 2 and the associated hypotheses are discussed below.

Performance impact refers to the effect of the system on the outcomes of use for the user. For instructors, potential performance impacts can include both effectiveness of teaching and instructor efficiency or productivity. The influence of TTF on performance is a key component of the TPC, and its role has been confirmed in numerous studies by Goodhue and colleagues and others (D’Ambra & Wilson, 2004; Goodhue, 1995; Goodhue, Klein, & March, 2000; Goodhue, Littlefield, & Straub, 1997; Goodhue & Thompson, 1995; Staples & Seddon, 2004). It was therefore hypothesized that:

H1: TTF will positively influence LMS performance impacts for instructors.
The positive influence of utilization on performance is also a key component of the TPC and it too has been observed in several studies (D’Ambra & Wilson, 2004; Goodhue et al., 1997; Goodhue & Thompson, 1995). This relationship is also consistent with the DeLone and McLean model of IS success (DeLone & McLean, 1992, 2003). Thus, if the TPC applies in the context of LMS use by instructors, increased use should lead to increased LMS performance impacts. On the other hand, the importance given in the literature on instructor LMS use to the inhibiting impact of time requirements suggests that increased utilization may not lead to positive outcomes for instructors using LMS. Staples and Seddon (2004) did not find an association between level of utilization and performance when they tested for it among university librarians and student users of productivity software. To test the two alternative possibilities, we hypothesised - consistent with the TPC- that:

H2: Utilization will positively influence LMS performance impacts for instructors.

In addition to its direct effect on the work of instructors, TTF should also have an indirect effect on performance impacts via its influence on LMS utilization. Support for this theoretical relationship in the LMS domain is provided by Yueh and Hsu (2008) who showed that it is possible to increase LMS use by instructors, by focussing on appropriate design of LMS to obtain TTF that meets instructors’ needs. It was therefore hypothesized that:

H3: TTF will positively influence LMS utilization by instructors.

A key precursor to IS use according to the TPC is social norms (Goodhue & Thompson, 1995). When a university invests in an LMS, we can expect that senior academics and administrators might influence instructors to use the system. If such an influence exists, it would be reflected in social norms for LMS use, that is, instructors’ perceptions that LMS use is socially acceptable (or even expected) and using the LMS will put them in good light with people who are important to them. In general, research on the influence of social norms on IS
utilization has had mixed results. Some authors have found that social norms influence utilization (Venkatesh & Davis, 2000); others such as Davis, Bagozzi and Warshaw (1989) and Dishaw and Strong (1999) have found no relationship between social norms and IS use. In the LMS domain, van Raaij and Schepers (2008) found that social norms did affect intended use, but indirectly via perceived usefulness. We thus hypothesized, consistent with the TPC, that:

H4: Social norms will positively influence LMS utilization by instructors.

Organizational support for system use (such as ease of access to the system, training, relationship of the user with support staff etc) can influence use and performance. The importance of such facilitating conditions is reflected in DeLone and McLean’s addition of service quality to their updated model of IS success (DeLone & McLean, 2003). Although Staples and Seddon (2004) did not find that facilitating conditions influenced utilization, a positive effect was found in Chang and Cheung’s (2001) study. Given that lack of technical and financial support have been cited as important inhibitors for instructor LMS use (Browne et al., 2006; Schifter, 2000), facilitating conditions are likely to play an important role in determining levels of utilization. Consistent with the TPC it was therefore hypothesized that:

H5: Facilitating conditions will positively influence LMS utilization.

Study 1

The first study described in this paper takes a quantitative approach to exploring the roles of TTF and level of LMS utilization on instructor’s perceptions of the impacts of LMS on their performance.

Study 1 Method

Both Study 1 and Study 2 were conducted at an Australian University. The participants in Study 1 consisted of instructors from a wide range of disciplines who were using WebCT in their teaching. WebCT is one of the most commonly used LMS (Browne et al., 2006). Instructors who had been added to an email list of WebCT users provided the participant pool. They were invited by email to participate in the study by clicking on a link to a Web-based questionnaire which took approximately 10 minutes to complete. Completion of the questionnaire was voluntary and all responses anonymous. The questionnaire and completion process were pilot tested by four instructors and slight changes made to clarify some items.

The first section of the questionnaire asked about the participants and their previous training and experience with information technology and WebCT. Given that several relationships in the TPC appear to be influenced by the degree to which use is mandatory (Staples & Seddon, 2004; Venkatesh & Davis, 2000), participants were also asked to provide their perceptions of the degree to which their use of WebCT is mandatory by indicating their agreement with the
statement ‘I am required to use WebCT in my teaching’ on a 7 point Likert scale labelled from ‘strongly disagree’ to ‘strongly agree’.

The second section asked about the participants’ perceptions of WebCT, and its impact on their teaching performance. Construct measurement was based on previous studies with minor rewording to suit the e-learning domain. Unless otherwise stated, all items were measured on a 7 point Likert scale labelled from ‘strongly disagree’ to ‘strongly agree’. LMS performance impact was measured using three items from Goodhue and Thompson (1995). TTF was measured using eight items drawn from Moore and Benbasat (1991), Doll and Torkzadeh (1988), and Staples and Seddon (2004). Social norms was measured using four items from Hartwick and Barki (1994). Facilitating conditions was measured using five items drawn from Baroudi and Orlikowski (1988), Thompson, Higgins and Howell (1994) and Taylor and Todd (1995). LMS utilization was measured using four items: participants were asked how many hours a week they used WebCT, and how many hours per week they intended to use WebCT over the rest of the semester; they were also asked to assess both their current and intended use of WebCT on a 5 point scale ranging from (1) ‘light’ to (7) ‘heavy’. The items appear in the Appendix.

The relationships in the model were tested using partial least squares (PLS). PLS provides an alternative estimation approach to traditional structural equation modeling (SEM) for the analysis of small data samples (Hair, Black, Babin, Anderson, & Tatham, 2006). A two-step approach commonly used in SEM was used. The fit and construct validity of the proposed measurement model are tested first. Once a satisfactory measurement model is obtained, the measurement model is “fixed” when the structural model is estimated (Hair et al., 2006). SmartPLS version 2.0 was used for this process.

**Study 1 Results and Discussion**

**Background**

A total of 67 instructors (42.2% females and 57.8% males) participated in the study. Ages ranged from a minimum of 25 to a maximum of 65 (with an average of 46.1) and the participants covered a broad spectrum of IT experience and training. They had a wide range of usage of WebCT with the average length of use being 4.7 semesters. Participants also had a wide range of perceptions about the degree to which their use of WebCT was mandatory. Table 1 provides a summary of the background of the participants.

**Measurement Model**

The measurement model was assessed in terms of: individual item loadings, reliability of measures, convergent validity and discriminant validity. Two social norms items and two facilitating conditions items were found not to load sufficiently highly on their corresponding construct and were excluded from the analysis. All remaining items loaded significantly on
Table 1

Participant background information

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std.</th>
<th>Min.</th>
<th>Max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>63</td>
<td>60.0</td>
<td>8.7</td>
<td>25</td>
<td>65</td>
</tr>
<tr>
<td>Years of computer experience</td>
<td>64</td>
<td>20.0</td>
<td>8.7</td>
<td>8</td>
<td>40</td>
</tr>
<tr>
<td>Years of Internet experience</td>
<td>64</td>
<td>11.5</td>
<td>3.6</td>
<td>5</td>
<td>28</td>
</tr>
<tr>
<td>Perceived information technology skill</td>
<td>64</td>
<td>5.6</td>
<td>1.2</td>
<td>3</td>
<td>7</td>
</tr>
<tr>
<td>Semesters using WebCT</td>
<td>64</td>
<td>4.6</td>
<td>3.4</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Perceived skill using WebCT as a designer</td>
<td>63</td>
<td>4.1</td>
<td>1.9</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Perception that use is mandatory</td>
<td>64</td>
<td>4.6</td>
<td>2.0</td>
<td>1</td>
<td>7</td>
</tr>
</tbody>
</table>

their latent constructs (p < 0.05) and exceeded the minimum threshold of 0.70 (Chin, 1998). Reliability was assessed using composite reliability (CR). All constructs were above the minimum value of 0.70 (Hair et al., 2006). Convergent reliability was assessed using average variance extracted (AVE). All constructs met the guideline of AVE greater than 0.50 (Hair et al., 2006).

For satisfactory discriminant validity each item should load more highly on its own construct than on other constructs. In addition, the average variance shared between a construct and its measures should be greater than the variance shared by the construct and all other constructs in the model (Chin, 1998). One item measuring TTF loaded too heavily on other constructs and was dropped. The Appendix shows which items were retained. Table 2 provides a summary of the reliability and convergent validity of the final scales used in the study. Table 2 also provides the final construct inter-correlations and the square root of AVE for each construct (in bold on the diagonal). In all cases the square root of AVE exceeds the corresponding construct inter-correlations thereby demonstrating discriminant validity (Chin, 1998).

Table 2

Measurement model information

<table>
<thead>
<tr>
<th>Construct</th>
<th>CR</th>
<th>AVE</th>
<th>1.</th>
<th>2.</th>
<th>3.</th>
<th>4.</th>
<th>5.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. TTF</td>
<td>0.948</td>
<td>0.727</td>
<td>0.852</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Social norms</td>
<td>0.800</td>
<td>0.667</td>
<td>0.629</td>
<td>0.817</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Facilitating conditions</td>
<td>0.876</td>
<td>0.703</td>
<td>0.333</td>
<td>0.414</td>
<td>0.839</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. LMS utilization</td>
<td>0.946</td>
<td>0.814</td>
<td>0.221</td>
<td>0.207</td>
<td>0.232</td>
<td>0.902</td>
<td></td>
</tr>
<tr>
<td>5. LMS performance</td>
<td>0.933</td>
<td>0.823</td>
<td>0.551</td>
<td>0.531</td>
<td>0.289</td>
<td>0.236</td>
<td>0.907</td>
</tr>
</tbody>
</table>
**Structural Model**

Two criteria were used to assess structural model quality: the statistical significance of estimated model coefficients and the ability of the model to explain the variance in the dependent variables. Figure 3 shows the standardized coefficients for each hypothesized path in the model and the $R^2$ for each dependent variable. TTF had a significant positive influence on LMS performance impacts for instructors thus H1 was supported. However, level of utilization did not influence LMS performance impacts, so H2 was not supported. In addition to its direct effect on the work on instructors, TTF was also proposed to have an indirect effect via its influence on LMS utilization. TTF did not however influence LMS utilization, so H3 was not supported. Neither social norms nor facilitating conditions was found to influence LMS utilization, so H4 and H5 were not supported. The model explained 31.7% of the variability in LMS performance impacts.

In view of the unexpected results, tests of the potential for background factors to influence these relationships were conducted using graphical and correlational methods. Only two significant correlations were observed: perceived mandatoriness was correlated with social norms (0.41, $p = .001$) and perceived skill as a designer had a moderate correlation (0.28, $p = .012$) with LMS utilization. Neither of these relationships had a significant effect on the results of the structural model test.

![Figure 3. Structural model results.](image)
This analysis shows that TTF plays an important role in the success of LMS for instructors. Improvements in the TTF of LMS should lead to significant improvements in what instructors are able to achieve in their teaching, as demonstrated in a practical sense by Yueh and Hsu (2008).

Only a direct relationship between TTF and LMS performance impacts was observed in this study: TTF did not influence LMS utilization, and LMS utilization did not affect LMS performance impact. Furthermore, neither social norms nor facilitating conditions influenced LMS utilization. While these findings are inconsistent with the TPC, there are precedents in the literature. In the context of the TPC, Staples and Seddon (2004) did not find an association between level of utilization and performance, and several authors who have used the DeLone and McLean (1992) model of IS success as a framework have noted that level of utilization may not be influenced by precursors such as system quality and information quality (Livari, 2005; Landrum, Prybutok, Strutton, & Zhang, 2008; McGill, Hobbs, & Klobas, 2003) and, further, that level of utilization may not influence performance (Gelderman, 1998; McGill et al., 2003; Wu & Wang, 2006). Seddon (1997) went as far as to suggest that the causal relationship between use and individual impact proposed by DeLone and McLean may not exist.

The variety of findings suggests that the relationship between level of utilization and performance impact may be domain specific. (In their update to their model, DeLone and McLean (2003) acknowledged that the nature of relationships can vary from context to context.) For example, users may need to use a system with poor TTF more frequently to meet their needs. Alternatively, they may choose to use a system with good TTF more frequently because it meets their needs well. Given that the dominant factors inhibiting instructor adoption and use of LMS discussed in the literature relate to time (Browne et al., 2006; Lazarus, 2003; Pajo & Wallace, 2001; Schifter, 2000; Tastle et al., 2005), the relationships between TTF, utilization and performance impacts could well be more complex than hypothesized on the basis of the TPC. For example, regardless of TTF, there may be an upper threshold to the level of use that is both useful and feasible; only so much time is needed to upload teaching materials, and too much instructor time spent on online discussion may inhibit student learning as well as interfere with other uses of an instructor’s time. Thus, level of LMS utilization may be independent of TTF and performance impact may be independent of level of LMS utilization, as observed in this study. The results of this study indicate that further research is needed to understand reasons for differences in levels of utilization, as well as the relationship between utilization and LMS performance impacts.

The lack of influence of social norms and facilitating conditions on LMS utilization in this study may also reflect the context of LMS use. Previous research on the influence of social norms on usage intentions has provided mixed results and very little has been done in the e-learning domain. In the corporate context, Venkatesh and Davis (2000) found that social norms directly affected intention only when usage is mandatory and experience is in the early stages. The participants in this study varied greatly in their perceptions of how mandatory their use was and also had a wide range of experience, yet a post hoc hierarchical regression analysis showed that, although mandatoriness was associated with social norms, it did not
contribute to explanation of LMS utilization, either alone or through its interaction with social norms. This result is consistent with van Raaij and Schepers’s (2008) observation that social norms had no effect on student use of an LMS.

Although facilitating conditions are considered important for the success of e-learning (Selim, 2007), and instructors have noted lack of technical support as one of the major factors inhibiting use (Browne et al., 2006; Schifter, 2000) facilitating conditions did not influence level of LMS utilization by instructors in this study. These results are consistent with Renzi’s (2008) observation that support services have little effect on the ways in which university teachers incorporate LMS in their teaching.

**Study 2**

In order to understand the unexpected results of Study 1 better, we conducted a set of email interviews using open ended questions. Responses to the open-ended questions were examined interpretatively in order to triangulate and validate the findings of Study 1, and to gain additional insights into the nature of the relationships under consideration.

**Study 2 Method**

The participants in Study 2 were seven instructors who had used LMS in their teaching. They ranged in age from 43 to 62. They were contacted by email and invited to participate in the study. They were provided with general information about the findings of Study 1, and asked to reflect upon their own experiences using LMS. They were then asked to answer a series of open-ended questions about their perceptions of the roles that TTF, social norms and facilitating conditions play in the level of their LMS utilization and in the impacts of their LMS use on their teaching. Participation was voluntary and all responses confidential. The responses were inspected for statements that addressed the relationships contained in the research model (Figure 2). These statements were then classified into general themes representing the relationships of interest. The themes were permitted to emerge from the data. A multiple classification scheme was used so that each remark could be classified into more than one category.

**Study 2 Results and Discussion**

Table 3 summarizes the main themes that emerged from the analysis. All responses relating to the relationship between TTF and LMS performance impacts were consistent with the results of Study 1. The following is a typical comment:

Some aspects can improve efficiency eg getting students to email via LMS allows easy id of student emails and an efficient audit trail, assignment
submision is auditable … the announcement section is easier than bulk emailing etc.

Table 3

Major LMS utilization and performance impact themes grouped by relationship

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Themes</th>
</tr>
</thead>
<tbody>
<tr>
<td>TTF → LMS performance impacts</td>
<td>The LMS enhances communication and coordination</td>
</tr>
<tr>
<td></td>
<td>The LMS has the capability to improve teaching productivity</td>
</tr>
<tr>
<td></td>
<td>Poor TTF leads to inefficiency</td>
</tr>
<tr>
<td>TTF → LMS utilization</td>
<td>Aspects of the system that don’t fit our practices discourage</td>
</tr>
<tr>
<td></td>
<td>Ease of use led to increased use</td>
</tr>
<tr>
<td></td>
<td>Lack of TTF meant more time had to be spent using system to deal with problems</td>
</tr>
<tr>
<td>LMS utilization → LMS performance impacts</td>
<td>Use improves efficiency, productivity</td>
</tr>
<tr>
<td></td>
<td>Need to invest a lot of time to get returns</td>
</tr>
<tr>
<td></td>
<td>LMS creates more work</td>
</tr>
<tr>
<td>Social norms → LMS utilization</td>
<td>What students think about LMS influences me</td>
</tr>
<tr>
<td></td>
<td>Level of use doesn’t relate to social norms</td>
</tr>
<tr>
<td>Facilitating conditions → LMS utilization</td>
<td>If more support would use it more</td>
</tr>
<tr>
<td></td>
<td>Level of use doesn’t relate to facilitating conditions.</td>
</tr>
<tr>
<td></td>
<td>Wrong kinds of facilitating conditions provided?</td>
</tr>
<tr>
<td></td>
<td>Lack of support led to more work</td>
</tr>
</tbody>
</table>

Remarks relating to the influence of TTF on level of LMS utilization were more mixed. Whilst several participants noted that improved TTF led to increased utilization and poor TTF led to reluctance to use, there were also participants who felt that poor TTF requires increased utilization:

Every time I go to answer this I start grinding my teeth again......... unannounced downtime, frequent errors, inability to read Office 2007 files, and a thousand other glitches (mostly now fixed) have strongly coloured my opinion. I estimate I lost 5 - 10 full days last semester just dealing with technical faults and corresponding with students who experienced them, so the effect on my productivity was very negative.

Similarly, while some participants felt that increased utilization had positive performance impacts, others had less positive perceptions. A large investment of time was required, and while some participants found that it ultimately paid off others did not:

I have spent a lot of extra time on it but persevered and am now reaping the benefits.
One of my main gripes with WebCT is that it creates work instead of assisting.

Two themes emerged from the responses relating to social norms. While several participants did not believe that their utilization was influenced in any way by social norms, three of them commented that their use was influenced by the expectations of students:

Social norms – include students? The fact that students expect one to use WebCT/CE6 has influenced my use.

The importance of instructor perceptions of student beliefs should therefore be investigated in future research.

Only one participant commented that facilitating conditions influenced their level of utilization. The reaction that facilitating conditions did not influence use was more common. But one participant noted that the support provided was not the kind of support needed:

I believe the training and support offered in 2007 was well-intentioned but ultimately not useful due to the system’s technical shortcomings.

The findings of Study 2 emphasise the importance of TTF. While instructors recognize that LMS have the capability to improve communication, coordination and productivity, poor TTF negatively impacts performance by decreasing efficiency. Study 2 also showed that TTF affects utilization, although this effect cannot be detected by traditional linear modelling techniques. The qualitative analysis showed that poor TTF can lead to either low or high utilization. Poor fit discourages some instructors from using the LMS; in this case, poor fit is associated with low utilization. On the other hand, poor fit can result in high utilization for those instructors who spend additional time working with the system so that they can work around problems resulting from poor fit.

In order to better understand the relationship between task, TTF and performance impact, improved definition and understanding of both utilization and TTF is required. Given the myriad of reasons for different levels of utilization, it makes little sense to examine the relationship between level of utilization and performance impact or between TTF and level of utilization. Nonetheless, an instructor must use the LMS (i.e., utilization is essential) in order to obtain any performance impacts, and influencing instructors to use their organization’s LMS remains an important goal for the organizational sponsors and promoters of LMS. We therefore need to define utilization to differentiate between utilization that enables performance, enhances performance, or detracts from performance, and also need to consider more fully the elements that combine to produce TTF. While these elements can be defined generically, there is also likely to be a context-specific element to them, depending on the institution, the role of the LMS within it, the specific LMS adopted, and the needs of the instructor and the course.
Conclusion

In this study, TTF directly affected instructors’ perceptions of the impacts of the LMS on their performance, indicating that the better the fit of an LMS to the skills of an instructor and the tasks that the instructor must complete, the more positive its effect on their performance is likely to be. Level of LMS utilization by instructors is not, however, associated in a simple linear way with TTF or performance impact. Higher levels of utilization do occur when TTF is higher, but there is probably a limit on the amount of use that is both valuable and feasible. On the other hand, high levels of utilization may reflect low TTF, in which case they are not translated into improved performance (or at least not for all instructors). Indeed, poor TTF can result in instructors spending more time on use to circumvent problems, and this in turn may result in negative impacts on performance. The mixed results of IS success research in other domains suggests that this set of relationships may be observed for other types of IS. This suggests an important re-direction in the focus of IS use studies: rather than seeking explanations of levels of use (or acceptance) alone, a focus on jointly explaining use and impact and the relationship between them would challenge researchers to identify which levels of use, under which circumstances, are associated with positive, neutral and negative impacts on performance. With such a focus, TTF and other aspects of the circumstances of use, become key explanatory variables, and ideally variables that can be modified with changes of IS design and organizational policy and practice. The work of Zmud and his colleagues on differences in adoption of system features by individuals following organization level adoption of an IS (Jasperson, Carter, & Zmud, 2005) may provide a framework for more fine-grained analysis of utilization and influences on it by guiding researchers to focus on individual LMS features rather than attempting to uncover complex patterns from studies of undifferentiated LMS use.

The results of this study further suggest that it may be useful to re-think our approach to studying the role of ICT in education. Our study, and the TPC, begin with the premise that there must be a fit between task and technology. The typical approach to improving the fit is to modify the technology, or occasionally, some aspect of the task. However, educational technologists concerned with understanding the impact of technology on teaching claim that a fit between task and technology is not enough. They emphasise the ability of instructors to integrate a technology into their teaching and observe that this is a function of the instructor’s pedagogical skills rather than technology and technological skills alone. Their work suggests that good instructors can produce TTF even when the ICT and facilitating conditions are imperfect (Renzi, 2008; Van den Dool & Kirschner, 2003). Thus, we might learn more about how to improve LMS performance impacts by paying closer attention to the active process of how the instructor integrates pedagogy and technology than by focusing more passively on the fit between technology and task.
References


Appendix

Items included in the questionnaire

Note: items marked with * were retained in final scales following measurement model development

Task technology fit
• WebCT fits well with the way I like to work
• WebCT is compatible with all aspects of my work*
• WebCT is easy to use*
• WebCT is user friendly*
• It is easy to get WebCT to do what I want it to do*
• WebCT is easy to learn*
• It is easy for me to become more skillful at using WebCT*
• New features are easy to learn*

Social norms
• The university thinks it is important for me to use WebCT
• My colleagues think it is important for me to use WebCT*
• My students think it is important for me to use WebCT*
• People respect you if you use WebCT

Facilitating conditions
• The support staff make it easy to use WebCT*
• WebCT support is never available when I want it*
• Training on how to use WebCT is available to me*
• I can always access a computer to use WebCT when I need it
• Uploading and updating learning materials is fast
**LMS utilization**

- On average, how many hours per week do you use WebCT during semester?*

- How many hours a week do you expect to use WebCT (for the rest of semester)?*

- Your usage of WebCT so far this semester is: light …. heavy*

- Your expected use of WebCT for the rest of semester is: light … heavy*

**LMS performance impact**

- WebCT has a large positive impact on my effectiveness and productivity as a teacher*

- WebCT is an important and valuable aid to me in my teaching*

- I teach better with WebCT than without it*