Understanding the ways in which design features of educational websites impact upon student learning outcomes in blended learning environments

Abstract
This study investigated the effectiveness, in terms of the attainment of relevant learning outcomes, of the types of learning promoted by educational features commonly incorporated in course management systems. Twenty-one courses with significant use of the internet, but with face-to-face teaching as the predominant instructional mode, were investigated. Five hundred and ninety-five students taking these 21 courses completed a questionnaire which gave feedback on the extent of use of and quality of implementation of internet features, as well as their perception of the attainment of outcomes relating to approaches to learning, communication skills and understanding of content. A confirmatory factor analysis of scales pertinent to information-presentation and constructive-dialogue features showed a very poor fit to the data, indicating that the two types of function did not act in concert. Structural equation modelling was used to test instructional models in presage–process–product format for 'information' and 'dialogue' features. The information one showed a marginal fit to the data, but the dialogue one a very good fit. This shows that using the internet for presenting information in a blended environment does not seem to effectively help students achieve learning outcomes. Using features which promote constructive dialogue and interactive learning activities encourages a deep approach to learning, the development of communication skills and enhanced understanding of content.

Keywords
computer-mediated communication, interactive learning environments, pedagogical issues, teaching/learning strategies

1 Use of the internet in teaching

There has been a marked rise in the use of the internet in university teaching. Many instructors have dedicated websites for the courses they teach. In the United States, during the past six years, online enrollments have been growing substantially faster than overall higher education enrollments; over 4.6 million students took at least one online course during the fall 2008 term, which is a 17 percent increase over the number reported the previous year (Allen and Seaman, 2009). In Europe, eLearning is considered to have contributed to cross-border education as specified in the Bologna process (Homes et al., 2009), and a new initiative called i2010 is to further extend the benefits of technology to enhancing the quality of life of all citizens.

In this article we examine the use of websites in conventional courses taught primarily through face-to-face classes where the website is an adjunct to classroom teaching. Most commonly, the internet is introduced through the use of a CMS. Such teaching has been referred to as utilising a blended learning environment. It could also be interpreted as a form of flexible learning which Moran and Myringer (1999) described as a mix of face-to-face and distance teaching utilising information technology. In many cases, though, the use made of the internet or distance teaching may not be sufficient for the courses to be classified as flexible learning. We will not deal with courses taught primarily or entirely through the internet, such as wholly distance education or fully online courses.

As a great deal of time and resources are being devoted to developing educational websites, it seems pertinent to ask whether the outcomes justify the input. Does the quality of student learning improve as a result of supplementing face-to-face teaching with the use of a website? As there is diversity in the design of educational websites and the ways in which students are expected to use them, it is almost certainly important to distinguish types of websites when asking the question. It is likely that some forms of website do promote student learning, while others do not; just as there are marked differences between the effectiveness of forms of face-to-face teaching. There must also be differences in effectiveness between websites that use similar functions offered by CMS packages – in a similar fashion to students perceiving differences in the quality of lectures given by a range of teachers.

The question is worth asking as there is consistent evidence that use of the internet, or any new medium for that matter, does not automatically result in better learning. Johnson and Aragon (2003) reviewed "numerous" (p. 32) studies comparing face-to-face and information technology-supported instruction, to draw the conclusion that the use of technology per se has no significant impact on learning outcomes. This conclusion is consistent with a long history of educational media studies which show that new media in itself will not improve teaching quality (Clark, 1985, 1994); pedagogy and curriculum design are more influential variables.

1.1 Learning functionalities in CMS packages

Two frameworks were used to provide a more fine-grained analysis of the impact of the internet in blended environments. The first was categorising the use of the internet according to the functionalities provided by CMS packages (McNaught, 2002; McNaught, Lam and Cheng, 2008). While there would be differences between the effectiveness of websites utilising a common type of function, the categories of functionality appear to have been designed to promote quite different types of learning, and so might influence the achievement of particular learning outcomes.

The category scheme for types of features or learning functions within CMS packages was:

- Presenting content knowledge.
- Presenting course management information. In this study these first two categories were condensed into one.
- Searching for information which was recognised as a legitimate category for educational use of the internet but not used in the subsequent analysis, because its use did not seem to be facilitated through the use of a CMS. Presumably internet search engines provide better facilities for searches and students do not need additional assistance in carrying out searches.
- Facilitating discussion which was defined as interaction between students through the internet, with the aim of promoting learning through discussion.
- Engaging in learning activities which was defined as engaging with content or problems via the internet, usually in an individual capacity.

2 Active learning

A further analytical framework which was drawn upon is that of active learning. Firstly, evidence was considered for the effectiveness of forms of learning involving active student engagement in face-to-face classes. Secondly, consideration was given to the utilisation within online or distance-learning courses of instructional-design models incorporating active engagement. The design of the study itself then drew upon the active-learning framework in devising research questions to be tested in blended learning environments. These questions examine whether effective implementation of design functions promoting active engagement in learning impact upon learning outcomes.

2.1 Active learning in face-to-face teaching

Commonly used textbooks for teaching in higher education are consistent in taking a positive view of active forms of learning. Ramsden (1992) described six key principles of effective teaching in higher education, of which the fifth (p. 100) is "independence, [student] control, and active engagement". Ramsden also believed that a deep approach, interpreted as a meaningful search for understanding, is encouraged by "teaching and assessment methods that foster active and long-term engagement with learning tasks" (p. 81). Biggs (1999, p. 73) identified "learner activity" and "interaction with others" as two of four factors likely to encourage a deep approach. In a book titled *The winning trainer*, Eitington (2002) has 22 chapters devoted to forms of learning activities and one with the title "If you must lecture".

These well-known authors base their exhortations upon an abundant body of evidence attesting to the effectiveness of student-centred or active forms of learning. A compelling strand comes from the research into academics' conceptions of teaching. Kember's (1997) review divided beliefs into two broad orientations; one labelled teacher-centred/ content-oriented, and the other student-centred/ learning-oriented. Further, the review suggested that conceptions of teaching influence approaches to teaching which impact upon students' approaches to learning, and in turn affect learning outcomes (Figure 1).

[Figure 1 here]

There is good evidence for the links in the model. Gow and Kember (1993), and Kember and Gow (1994) showed, at the departmental level within universities, that teachers' beliefs about teaching influenced the approaches to learning students adopted in their courses. Trigwell, Prosser and Waterhouse (1999) found comparable results with individual teachers. Two studies have characterised approaches to teaching in higher education (Kember & Kwan, 2000; Trigwell, Prosser & Taylor, 1994) and both showed evidence that the approach adopted by teachers in the respective studies followed logically from those teachers' beliefs about teaching. The outcome of the model is that didactic teaching tends to encourage superficial learning, whereas more meaningful learning outcomes are more likely to result when a facilitative style of teaching encourages students to actively engage in learning activities. Obviously, there are other factors such as workload (Easthope & Easthope, 2000) and university or departmental culture (for example, the importance of teaching versus research; Trowler & Cooper, 2002) that influence the teaching approaches that teachers employ. This model nevertheless serves to focus attention on the strong influence teaching has on learning.

2.2 Active learning in online courses

The design of courses which operate predominantly or fully through the internet have traditionally been influenced by instructional-design models. Of these, it is not hard to find ones developed specifically for online courses which feature interaction and active student engagement, particularly if a broad interpretation of instructional design is taken so as to include influences other than a narrow behaviourist perspective.

Of many examples which might be chosen, Laurillard’s (2002) model has been influential. The book begins by rejecting as inadequate visions of university teaching couched in terms of transmitting content knowledge. Instead a conversational framework for the use of instructional technology is presented, which prominently includes interaction between students and teachers. Laurillard (2008) showed the conversational framework as a tool for examining the nature of interactions between teachers and learners. The representation of the framework is reminiscent of Jarvis’s (1995) route maps which model nine types of learning and non-learning. The essence of both representations is that the types of learning desired in higher education need adequate use of appropriate channels of communication between teachers and students, and experiential learning or active engagement with tasks.

Berge (2002) developed an instructional model for eLearning which includes learning activities, interaction and reflection. The model aims for a consistent mesh between learning goals, learning activities and feedback or evaluation. In developing these instructional-design models, the authors drew upon a wide range of literature consistent with the principle that active learning promotes the achievement of desirable learning outcomes.

The tradition has been to develop instructional-design models from theory (Laurillard, 2002). It is not common for them to have empirical evidence in their support. The models cited above are, though, consistent with the findings of empirical face-to-face studies in indicating the effectiveness of active learning. It therefore seems reasonable to accept the place of active learning as a necessary component of online courses.

2.3 Use of CMS packages in blended courses

The literature on the use of the internet, through CMS packages, in courses taught predominantly face-to-face seems to be considerably less established than that for online or distance-education courses. Even for online or distance learning, the literature is predominantly descriptive (Berge & Mrozowski, 2001; Lee, Driscoll & Nelson, 2004).

This might be interpreted as suggesting that instructional sites often lack a theoretical foundation or that technical design considerations have often predominated. Weigel (2005) noted that the current CMS packages are often modelled on the traditional features of a classroom model, and thus the CMS packages are often restrictive in their support for more creative and interactive pedagogical designs. Studies with teachers (Morgan, 2003) and students (Caruso, 2004) respectively confirmed that the most popular CMS functions are often those related to facilitating class management rather than interactivity. “Many instructors currently use CMSs simply as a delivery mechanism for the subject matter” resulting in an “underutilization” of CMS functionality (Vovides, Sanchez-Alonso, Mitropoulou & Nickmans, 2007, p. 66).

Although it is hard to make generalisations across the myriad of individual blended courses with CMS components, we suspect the limited amount of published research on their instructional design suggests there seems to be little consideration within the literature of the role of CMS functions as a complement to face-to-face teaching in a blended learning environment. There also appear to be few attempts to empirically test learning outcomes from blended learning environments. Evaluation of sites commonly focuses on soliciting feedback on technical features or seeks views on students’ satisfaction with the experience of using the site (Reeves & Hedberg, 2003).

This study attempted to provide some guidance for the design of the CMS components of blended learning environments in which face-to-face teaching makes up the major part. It did this by examining relationships between types of learning functionalities in CMS applications, the quality of their implementation, and the learning outcomes which logically ought to follow from their utilisation. This was performed by testing, with structural equation modelling (SEM), models of the impact of functions on learning outcomes. The design envisaged presage–process–product (3P) models (Biggs, 1987) in which the quality and use made of the features (designed by the teacher, and hence linked to approaches to teaching) was the presage part, approaches to learning the process, and learning outcomes the product.

3 Method

3.1 Sample

The sampling design was to select as case studies 21 courses from universities in Hong Kong where the web was a significant component of the course. In each case teaching was predominantly face-to-face with the internet component being a blended element provided through a CMS. The sample of courses was purposeful in that the selected ones intended the web to be a significant component of the teaching and learning environment – for example, more than posted material and announcements. Examples of design components included content that was more interactive or significantly enhanced for an educational purpose by the use of media, and the incorporation of active forums (McNaught, Lam & Cheng, 2008). The sample of teachers responsible for the blended courses was, therefore, not representative but biased towards innovators or early adopters (Rogers, 2003). The study did not aim to survey CMS implementation, but focused on the effect of instructional-design features on learning outcomes; so it was imperative that CMS implementations were chosen that would enable potential instructional models to be tested.

The courses covered a range of disciplines, including courses in language learning, education, science, business studies, engineering and arts. The courses were taught by 15 different teachers in four higher-education institutions in Hong Kong. A detailed description and analysis of the functions included in the teaching designs of these courses is in McNaught, Lam and Cheng (2008).

Participation by teachers and students was voluntary and all participants were notified that answering the survey was for educational research purposes only, and that the focus of the study was on relating students' experiences with their learning and not on making judgements about individual courses. Formal ethics approval from The Chinese University of Hong Kong was obtained prior to the study's commencement.

For each course selected, the sample of students was all of those enrolled in the course. Different institutions support different CMSs. For example, WebCT was the platform centrally supported at The Chinese University of Hong Kong while Blackboard was used at the City University of Hong Kong. Some teachers even had their own solutions which did not take advantage of these institutional CMSs. The focus of this paper is on the nature of the learning environment provided by these teachers, and these learning-design characteristics are relatively independent of the technical solutions used.

3.2 Development of the questionnaire

The intention of the study was to test models of how the use of learning features on websites impacted on learning outcomes related to the features in question. Data for testing the models was gathered through a questionnaire which measured students' perception of the quality and their extent of use of course-specific web functions. The web functions included presenting knowledge and information, facilitating discussion and engaging in learning activities. The learning outcomes included were ones likely to be developed through the use of these web features. These included understanding content, information-searching skills, problem solving and communication skills. The learning outcomes measures in the questionnaire were adapted from a questionnaire described in Kember and Leung (2009). The development and testing for reliability and validity is discussed in detail in that paper.

We are not using performance measures of outcomes but our perception data indicates students' confidence in their attainment of important learning outcomes. There were also items related to the quality of learning approaches, namely a deep approach and motivation. These were included as measures of learning processes so as to be able to test a 3P model.

Ensuring validity implies including all likely constructs in the learning outcomes and web environment sections of the questionnaire, with a scale for each construct. The normal compromise of keeping scales fairly short was then adopted, so as to keep the questionnaire to a reasonable length and ensure reasonable completion rates.

The questionnaire was pilot-tested in two meetings in which three students were asked to fill in the questionnaire first and then asked to comment on each section of it. Detailed notes were taken in each meeting. Five teachers also commented upon the questionnaire during the initial piloting. The questionnaire was next pilot-tested on students taking five courses. A total of 210 questionnaires were returned. Reliabilities on the 'learning outcomes' scales were acceptable to high; the factor analysis of the 'web environment' section indicated a clear distinction between information resources and 'extended' resources such as course enrichment and interactive materials. The final questionnaire took into account all qualitative and quantitative feedback. It is a 43-item questionnaire, with all items measured on a five-point Likert scale (1 = 'strongly disagree' to 5 = 'strongly agree'). Indicative items are shown in Table 1.

[Table 1 here]

Questionnaires were distributed in class near the end of the semester, when class attendance was normally high. The questionnaires were distributed to all students present in the class. A total of 668 questionnaires were collected from 879 students in 21 courses. The overall return rate for questionnaires was thus 74.4%. However, we only used questionnaire responses which were complete; 73 incomplete responses were rejected, reducing the response rate to 67.7%. Our data thus represents the views of a clear majority of students in these courses.

A sample size of 200 is usually regarded as the minimum requirement for accurate inference in SEM applications (Boomsma & Hoogland, 2001) but a larger sample is usually needed when handling a complex model (Marsh, Hau & Wen, 2004).

4 Results

4.1 Reliability

Scales within the questionnaire were first tested for reliability using SPSS (SPSS, 2007). The internal consistencies of all the scales but three were above 0.7. Schmitt (1996) discussed the value of alpha which should be acceptable and noted that a number of sources recommended the 0.7 level, but argued that values as low as 0.5 would not seriously attenuate validity. Hence, the scales in the study were considered as reliable, since all but three were in excess of the conservative level of 0.7 and the remaining three were close to it. Scores for all the 16 scales were then computed by averaging their corresponding items for the rest of the analysis (Table 2).

[Table 2 here]

4.2 Structural equation modelling

SEM has the ability to test hypothesized models of the causal relationship between measured variables. SEM makes it possible to test whether theoretically plausible models provide a good fit to collected data. The scales from the questionnaire appear in the model as indicators, which are represented in SEM models as rectangles. In addition to the variables corresponding to the questionnaire scales, models include latent variables, or higher-order factors, shown in ovals.

Model testing was performed with the EQS package (Bentler, 2006). SEM models are tested by examining the goodness of fit of the model against a collection of data measuring the variables included in the model. Following Hu & Bentler's (1998) recommendation, four model-fit indexes are reported here. They are two absolute-misfit indexes; Standardized Root Mean Square Residual (SRMR; Bentler, 2006) and Root-Mean-Square Error of Approximation (RMSEA, Browne & Cudeck, 1993), and two relative-fit indexes, Comparative Fit Index (CFI, Bentler, 1990) and Incremental Fit Index (IFI, Bollen, 1989).

It is commonly agreed that a cut-off value of 0.95 for the relative-fit indexes indicates an excellent fit while 0.9 is considered acceptable (Bentler & Bonnett, 1980; Hoyle, 1995). For RMSEA, a value less than 0.05 is indicative of a 'close fit', and values up to 0.08 represents 'fair fit' and value greater than 0.1 indicates poor fit (Browne & Cudeck, 1993). A cut-off value of 0.08 for SRMR was recommended by Hu & Bentler (1998, 1999).

A series of four models was tested. The first two tested the two sides of the models separately; firstly the web features half, or the presage part of the model, and secondly the learning outcomes part, which constituted the process and product parts of the models. Next, two models of web features impacting upon learning outcomes were tested. The series of four models constitute a series of four *a priori* hypothesised models, which are explained in sections 4.3 to 4.6. SEM and confirmatory factor analysis, which is a sub-set of SEM, were therefore appropriate statistical tests for prior hypothesised models.

The models tested were:

1. confirmatory factor analysis (CFA) of features
2. CFA of learning outcomes
3. model of dialogue affecting outcomes
4. model of information affecting outcomes.

4.3 CFA of features

The first model tested was a confirmatory factor analysis of the quality and use of the web features (Figure 2). The questionnaire incorporated eight scales measuring the extent of use and perceived quality of the features. The model, therefore, incorporates the eight scales in the form of observed variables, shown in the rectangles. Drawing upon the active-learning model which guided the design of the study, these were grouped under two higher-order latent variables, which distinguished features concerned with supplying information and those facilitating constructive dialogue or active learning. Figure 2 illustrates a possible relationship these two features of the web-based environment: that is, whether detailed information on the web is related to engaging students in active learning activities and communications for learning.

[Figure 2 here]

Overall fit statistic for the CFA model was $\chi 2$ = 269.510, df = 19 and associated p-value = 0.000. The results of the four fit indices for this model were SRMR=0.079, RMSEA=0.149, CFI=0.788 and IFI=0.789 which were all well away from the accepted cut-off values indicating a very poor fit. The conclusion is that the model is not tenable. The information-delivery features do not act in concert with features promoting constructive dialogue or active learning. It would not, therefore, be viable to test the impact of these features on learning outcomes in a single model. The tests must be conducted in separate models.

4.4 CFA of learning outcomes

The next model tested is a CFA test of the learning-outcomes model shown in Figure 3. The model has eight learning-outcomes indicators which are subsumed under three latent variables named ‘approach’, ‘communicate’ and ‘understanding’. The model in Figure 3 corresponds to the learning approaches –> learning outcomes relationship in Figure 1.

[Figure 3 here]

Overall fit statistic for the CFA model was $\chi 2$ = 39.388, df = 17 and associated p-value = 0.00158. The results of the four fit indices for this model were SRMR=0.029, RMSEA=0.047, CFI=0.989 and IFI=0.989, all of which were beyond their corresponding cut-off values. Hence, a very good approximation of the model to the data is suggested. The outcomes can, therefore, be included as a set, modelled in the form of Figure 3, in the two subsequent models, which test the impact of web features on the learning outcomes.

From the analysis, all the parameter estimates are within their corresponding feasible ranges and all the factor loadings are positive, which matches with the design of the instrument. The estimated factor loading of all the seven observed variables ranged from 0.59 to 0.86, which indicated that the extent to which the underlying latent constructs generated the observed variables is strong.

4.5 Model of dialogue affecting outcomes

As the CFA model of the combined web features had shown a very poor fit to the data, it was necessary to test the models of the effect of features on learning outcomes separately. The first model tested is a 3P model (corresponding to the teaching approaches –> learning approaches –> learning outcomes relationships in Figure 1) in which the constructive-dialogue web features are the *presage*; deep approach and motivation correspond to the learning *processes*; and the *products* are the learning outcomes under the communicate and understanding latent variables. The model tested is depicted in Figure 4, which includes the standardised solution to save space.

[Figure 4 here]

The data from the 11 observed scales were then submitted for analysis. The result of the model fit test was $\chi 2$ = 100.378 with df = 41 and associated p-value<0.00. The set of goodness-of-fit indices were beyond their cut-off values (SRMR=0.035, RMSEA=0.049, CFI=0.975 and IFI=0.975) which suggested an excellent approximation to the data.

The standardized parameter estimates of the model are displayed in Figure 4. There are two types of estimates that are of interest – the factor loadings between an observed variable and its corresponding latent variable, and the structural paths between the latent variables. In the SEM model in Figure 4, all the factor loadings except one, were greater than 0.5 which showed that the indicators represent a good manifestation of the four underlying constructs. All the structural paths between the latent variables were strong, ranging from 0.78 to 0.88, and in a positive direction.

4.6 Model of information affecting outcomes

The other 3P model was similar to the previously tested one except the dialogue latent variable was replaced by the information latent variable and its associated indicators. The model, with the resultant standardised parameters is shown in Figure 5.

[Figure 5 here]

The data from the 13 observed scales were then submitted for analysis. The result of the model fit test was $\chi 2$ = 263.752 with df = 62 and associated p-value<0.00. The set of goodness-of-fit indices were SRMR=0.050, RMSEA=0.074, CFI=0.933 and IFI=0.933, which suggested a marginal fit to the data.

5 Discussion

5.1 CFA of functionalities

The CFA model of the functionality indicators showed a very poor fit to the data. The indicators had good reliability. There was no problem with the separate use of two latent variables together with their associated indicators in the tests of models 3 and 4. This suggests, therefore, that the information functionalities do not act in concert with the dialogue or active-learning ones.

This negative finding was of interest. Instructional-design models (e.g. Laurillard, 2002) for online or distance education courses suggest that a good model of instruction, which draws upon the advantages of the internet, is one in which students engage in learning activities making use of information provided on a website or searched through the internet.

Why this has not happened effectively in the blended cases included in the sample is not clear. Possibly the predominant face-to-face teaching environment has meant that teachers have dealt with one of the learning functions in class, and so not tried to operationalise them in conjunction on the website. However, combining the two functions seems such a logical instructional use of the internet that it is surprising that pioneers would not attempt to utilise the internet in this way. Possibly developing sites which include learning activities utilising material derived from the website might take time and resources to develop, because CMS packages by themselves do not facilitate the development of such instructional functions sufficiently well (Salter, Richards & Carey, 2004) – in which case those teaching in a blended environment might feel that the time and resources needed to develop such a site could not be justified. Previous studies echo this finding about teachers' need for support and resources if they are to utilize the potential of the web (e.g. McNaught, Phillips, Rossiter & Winn, 2000).

5.2 Outcomes model

The outcomes included in the model were those which might logically be expected to result from the categories of functionalities on CMS sites. The good fit of the CFA model suggested that the learning outcomes could be promoted together through a well-designed website.

The rationale for information-presentation functions is presumably to enhance understanding of content. The understanding latent variable, therefore, included indicators for promoting the understanding of fundamental concepts and enhancing understanding through relevance. Information-literacy skills and problem solving were also subsumed under the latent variable. The standardised coefficients for the tested model indicated that each of the four indicators made similar contributions.

The communicate latent variable was a logical learning outcome for a website which made use of interactive CMS functions. The latent variable had two indicators; communication skills and group work, which made strong and roughly equal contributions to the higher-order latent variable.

The learning outcomes also included measures of the strategy and motive components of a deep approach to learning (Biggs, 1987). The inclusion of these variables served two functions. Firstly it provided a general measure of the degree to which students employed positive or meaningful approaches to learning. Secondly, it permitted models 3 and 4 to be formatted in a presage–process–product format.

5.3 Information model

As the model of information and dialogue functions acting together had shown such a poor fit to the data, it was necessary to separately test models of these features acting on the learning outcomes. Both hypothesised models were in a similar 3P format. The learning functions of the CMS were modelled as acting via the process of learning approaches on the set of learning outcomes.

The model containing the information functions failed to meet the cut-off criteria for an excellent fit under the SEM test, but could be interpreted as having a marginal fit. Presenting information on a website in a blended learning environment cannot, therefore, be seen as a highly effective means of promoting the learning outcomes included in the model. This includes outcomes, such as understanding fundamental concepts, included because of their relationship to content. The selected websites were those of pioneer teachers who had taken time and consideration over the design of their sites. If these sites were barely effective in achieving the desired outcomes, it is unlikely that teachers less enthusiastic about the use of the internet in blended teaching environments are likely to promote learning outcomes by using information-presentation features.

5.4 Dialogue–activities model

The dialogue–activities model was also in a 3P format. The process and product parts of the model were identical to the information model. The difference was that the dialogue latent variable replaced the information one in the presage part of the model. This time the model showed an excellent fit to the data, indicating that effective implementations of dialogue and active-learning features of CMS sites can promote the types of learning outcomes included in the study. It is significant that the dialogue type of features were very effective in promoting the understanding outcomes, such as understanding fundamental concepts and enhancing understanding through relevance, whereas the information functions were not.

The study thus provides empirical data to confirm the importance of dialogic interactivity in supporting students' development of desired learning outcomes. Dialogic interactivity involving interaction with content resources (e.g. with quizzes, simulations, games, interactive tutorials, etc.) and with people (e.g. with peer learners and teachers in forums, online role plays, wikis, blogs, etc.) appears to be more effective that just having access to information.

6 Conclusion

If the rationale for introducing web-based teaching through CMS functions is to improve student learning outcomes, this study suggests that the implementation ought to include features in which students engage in learning activities or discussions of content through the website. Functions which just present information do not seem to impact upon learning outcomes to any great extent.

Yet the increase in the use of internet-based teaching in blended learning environments commonly concentrates on information-presentation functions. In the university in which most cases of this study were situated there was a rise in the percentage of courses using web-assisted teaching from 45% in 2003–4 to 65% in 2006–7 (McNaught, Lam, Keing & Cheng, 2006) to >80% in 2009. However, the use of the various web functions has not greatly changed in recent years and using the web for content delivery is the most common strategy. The use of forums is the next common feature. While the number of forums has increased, the average thread length is less than three messages. This suggests that the most common use of forums is for course announcements rather than for genuine discussion. The use of the other functions on course websites is even more minimal with quizzes being used in less than 15% of WebCT sites.

It is possible that there are rationales, other than improving student learning outcomes, for using the internet in teaching. It may, for example, be a convenient and efficient way to distribute course-management information. There are universities which have policies of encouraging teachers to blend the use of the internet with their face-to-face teaching, which provide no rationale for the encouragement to use the internet. The tacit rationale may be to have an image of being technologically advanced in teaching. There then arises the perennial issue which surfaces every time new technology is developed of teachers trying to find technically advanced uses for the technology, rather than seeking ways to enhance the quality of learning by addressing existing problems. In distance education and pure online learning, the internet has permitted enhanced teacher–student and student–student interaction; so addressing a major limitation of this mode of study. However, for blended online and face-to-face learning, the problem to be solved by introducing an online component to the teaching does not seem to be so apparent.

There is a need for the development of instructional models for internet utilisation through CMS functions in blended learning environments in which face-to-face teaching predominates. It is not always clear that sufficient thought has been given to how the use of CMS-enabled features can complement face-to-face teaching. It might be thought that dialogue and learning activities are easier in class; so the use of the internet is restricted to providing information. However, this study suggests that such implementations do not to any great extent impact upon learning outcomes, which then raises the question as to whether the use of the internet is worthwhile.

It is possible that some teachers use the internet as a means of providing information because their conception of teaching is teacher-centred/ content-oriented (Kember, 1997). Such beliefs are underpinned by calling classes taught by professors 'lectures', by the design of typical classrooms or lecture theatres and by the use of the title ‘lecturer’ for university teachers. This could be further reinforced by a wide public perception of the internet as a vast repository of searchable information.

Such conceptions may well hold back the adoption of one potential strategy for effectively blending use of the internet with face-to-face teaching – namely that of presenting material via the internet and devoting time in classes for discussion and activities. This would appear to be a sensible strategy to adopt as activities and dialogue are much easier to arrange in class than they are online. Students are used to sourcing content through the internet and there is now a wide expectation that lecture notes will be available online.

Although implementation of dialogue and learning activities may be easier through face-to-face interaction, many university classes are mainly or entirely didactic. Lammers and Murphy (2002) found that the lecture was the most common type of university teaching. Lectures can include interaction, dialogue and activities, but many do not, and for those that do the interaction is often for a small minority of the time.

The strategy of using the internet for delivery and classes for dialogue and activities does not appear to be widespread. However, the converse strategy of giving a lecture and providing activities online seems to be even less common. Where classes are largely didactic, use of the internet could provide a medium for educationally beneficial dialogue and learning activities. This channel could become particularly important if the trend of rising class sizes in higher education continues. Most teachers feel constrained from interacting with students in large classes.

It is possible that a reason this strategy is not popular is that online learning activities take considerably more time and expertise to develop than posting information. Successful use of instruction through computer-mediated dialogue needs supportive mentoring, which requires facilitative and mediating skills and can be very time-consuming (Levy, 2006).

There is also evidence of some students, in Hong Kong at least, preferring online discussion (McNaught, Cheng, & Lam, 2006). The advantages over face-to-face interaction might include:

- the convenience of asynchronous discussion;
- having more time to reflect and make a telling contribution;
- shyer students being less inhibited in the presence of more confident peers; and
- students being more confident in using written communication, especially with relaxed online standards, than speaking out in front of peers.

The latter two of these reasons may reflect cultural phenomena or be affected by learning in a second language (Kember, 2009; Kember & Watkins, 2010).

There does seem to be a need to re-think the use made of CMS functions in blended learning environments in which face-to-face teaching predominates. There has been a substantial growth of such teaching in higher education, with a significant outlay of resources. Yet this study suggests that much of the internet usage may have little impact upon learning outcomes. There appears to be a need for empirically tested models of educationally effective ways to use the internet and CMS functions in blended environments in which face-to-face teaching predominates.

References

Allen, I.E., & Seaman, J. (2009). Learning on demand. Online education in the United States, 2009. Babson Survey Research Group & The Sloan Consortium. Retrieved

March 25, 2010, from http://www.sloanconsortium.org/publications/survey/pdf/learningondemand.pdf
Bentler, P.M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin, 107*, 238-246.
Bentler, P.M. (2006). *EQS structural equations program manual*. Multivariate Software, CA: Encino.
Bentler, P.M., & Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin, 88*, 588-606.
Berge, Z.L. (2002). Active, interactive, and reflective elearning. *The Quarterly Review of Distance Education, 3*(2), 181-190.
Berge, Z.L., & Mrozowski, S. (2001). Review of research in distance education, 1990-1999. *American Journal of Distance Education, 15*(3), 5-19.
Biggs, J. (1987). *Student approaches to learning and studying.* Melbourne: Australian Council for Educational Research.
Biggs, J.B. (1999). *Teaching for quality learning at university: what the student does*. Buckingham: society for Research into Higher Education and Open University Press.
Bollen, K.A. (1989). A new incremental fit index for general structural equation models. *Sociological Research and Methods, 17*, 303-316.
Boomsma, A., & Hoogland, J.J. (2001). The robustness of LISREL modeling revisited. In R. Cudeck, S. du Toit, & D. Sörbom, *Structural equation modeling: present and future: a Festschrift in honor of Karl Jöreskog* (pp. 1-25). Lincolnwood: Scientific Software International.
Browne, M.W., & Cudeck, R. (1993). Alternative ways of assessing model fit. In K.A. Bollen, & J.S. Long, *Testing structural equation models* (pp. 136-161). Newbury Park, CA: Sage.
Caruso, J.B. (2004). *ECAR study of students and information technology, 2004: convenience, connection, and control*. EDUCAUSE Center for Applied Research. Retrieved March 25, 2010, from http://www.educause.edu/ir/library/pdf/ers0405/Ekf0405.pdf
Clark, R.E. (1985). Confounding in educational computer research. *Journal of Educational Computing Research*, (*1)*2, 28-42.
Clark, R.E. (1994). Media will never influence learning. *Educational Technology Research and Development, 42*(4), 21-29.
Easthope, C. & Easthope, G. (2000). Intensification, extension and complexity of teachers' workload. *British Journal of Sociology of Education, 21*(1), 43-58.
Eitington, J.E. (2002). *The winning trainer*. Houston: Gulf.
Gow, L., & Kember, D. (1993). Conceptions of teaching and their relationship to student learning. *British Journal of Educational Psychology*, *63*, 20-33.
Holmes, B., Huet, I., Leahy, D., Gardner, J., Dolan, D., & Tavares, J. (2009). Elearning in European higher education: An analysis of present practice in Ireland, Portugal, and the UK, with lessons for the Bologna process. In J. Fegan, & M.H. Field, *Education across borders* (pp. 93-113). Netherlands: Springer.
Hu, L.T., & Bentler, P.M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Structural Equation Modeling, 6*, 1-55.
Jarvis, P. (1995). *Adult and continuing education: theory and practice* (2nd ed.). London: Routledge.

Johnson, S.D., & Aragon, S.R. (2003). An instructional strategy framework for online learning environments. *New Directions for Adult and Continuing Education, 100*, 31-43.
Kember, D. (1997). A reconcepualisation of the research into university academics' conceptions of teaching. *Learning and Instruction*, *7*(3), 255-275.
Kember, D. (2009). International students from Asia. In M. Tight, J. Huisman, K.H. Mok, & C. Morphew, *Routledge international handbook of higher education* (pp. 47-60). Abingdon, Oxfordshire: Routledge.
Kember, D., & Gow, L. (1994). Orientations to teaching and their effect on the quality of student learning. *Journal of Higher Education*, *65*(1), 58-74.
Kember, D. & Leung, D.Y.P. (2009). Development of a questionnaire for assessing students' perceptions of the teaching and learning environment and its use in quality assurance. *Learning Environments Research, 12*, 15-29.
Kember, D., & Kwan, K.P. (2000). Lecturers' approaches to teaching and their relationship to conceptions of good teaching. In N. Hativa, & P. Goodyear, *Teacher thinking, beliefs and knowledge in higher education* (pp. 219-239). Dordrecht, the Netherlands: Kluwer Academic Publishers.
Kember, D., & Watkins, D. (2010). Approaches to learning and teaching by the Chinese. In M.H. Bond, *The second Oxford handbook of Chinese psychology* (pp. 169-185). Oxford: Oxford University Press.
Lammers, L.J., & Murphy, J.J. (2002). A profile of teaching techniques used in the university classroom. *Active Learning in Higher Education, 3*(1), 54-67.
Laurillard, D. (2002). *A conversational framework for the effective use of learning technologies*. London: RoutledgeFalmer.
Laurillard, D. (2008). The teacher as action researcher: using technology to capture pedagogic form. *Studies in Higher Education, 33*(2), 139-154.
Lee, Y., Driscoll, M.P., & Nelson, D.W. (2004). The past present and future of research in distance education: Results of a content analysis. *American Journal of Distance Education*, *18*(4), 225-241.
Levy, P. (2006). Learning to learn in networked environments: A focus on 'orientation'. In H.S. Ching, P.W.T. Poon, & C. McNaught. *eLearning and digital publishing* (pp. 89-107). Dordrecht: Springer.
Marsh, H.W., Hau, K.T., & Wen, Z. (2004). In search of golden rules: comment on hypothesis-testing approaches to setting cutoff values for fit indexes and dangers in overgeneralizing Hu and Bentler's (1999) findings. *Structural Equation Modeling, 11*(3), 320-341.
McNaught, C. (2002). Adopting technology should mean adapting it to meet learning needs. *On The Horizon, 10*(4), 14-18.
McNaught, C., Cheng, K.F., & Lam, P. (2006). Developing evidence-based criteria for the design and use of online forums in higher education in Hong Kong. In N. Lambropoulos, & P. Zaphiris, *User-centered design of online learning communities* (pp. 161-184). Hershey, PA: Information Science Publishing.
McNaught, C., Phillips, P., Rossiter, D., & Winn, J. (2000). *Developing a framework for a usable and useful inventory of computer-facilitated learning and support materials in Australian universities*. Evaluations and Investigations Program report 99/11. Canberra: Higher Education Division Department of Employment, Education, Training and Youth Affairs.
McNaught, C., Lam, P., & Cheng, K.F. (2008). Using expert reviews to enhance learning designs. In L. Lockyer, S. Bennett, S. Agostinho & B. Harper, *Handbook*

of research on learning design and learning objects: Issues, applications and technologies (pp. 243-262). Hersey, PA: Information Science Publishing.
McNaught, C., Lam, P., Keing, C., & Cheng, K.F. (2006). Improving e-learning support and infrastructure: an evidence-based approach. In J. O'Donoghue, *Technology supported learning and teaching: a staff perspective* (pp. 71-90). Hershey, PA: Information Science Publishing.
Moran, L., & Myringer, B. (1999). Flexible learning and university change. In K. Harry, *Higher education through open and distance learning* (pp. 57-71). London: Routledge.
Morgan, G. (2003). *Faculty use of course management systems*. EDUCAUSE Center for Applied Research (ECAR). Retrieved March 25, 2010, from http://www.educause.edu/ir/library/pdf/ERS0302/ekf0302.pdf
Ramsden, P. (1992). *Learning to teach in higher education*. London: Routledge.
Reeves, T.C., & Hedberg, J.G. (2003). *Interactive learning systems evaluation*. New Jersey: Educational Technology Publications.
Rogers, E.M. (2003). *Diffusion of innovations* (5th ed.). New York: Free Press.
Salter, D., Richards, L., & Carey, T. (2004). The 'T5' design model: an instructional model and learning environment to support the integration of online and campus-based courses. *Educational Media International, 41*(3), 207-218.
Schmitt, M. (1996). Uses and abuses of coefficient alpha. *Psychological Assessment, 8*(4), 350-353.
SPSS 16.0 for Windows (2007). [computer software]
Trigwell, K., Prosser, M., & Taylor, P. (1994). Qualitative differences in approaches to teaching first year university science. *Higher Education*, *27*, 75-84.
Trigwell, K., Prosser, M., & Waterhouse, F. (1999). Relations between teachers' approaches to teaching and students' approaches to learning. *Higher Education, 37*, 57-70.
Trowler, P.R., & Cooper, A. (2002). Teaching and learning regimes: Implicit theories and recurrent practices in the enhancement of teaching and learning through educational development programmes. *Higher Education Research and Development, 21*(3), 221-240.
Vovides, Y., Sanchez-Alonso, S., Mitropoulou, V., & Nickmans, G. (2007). The use of e-learning course management systems to support learning strategies and to improve self-regulated learning. *Educational Research Review 2*(1), 64-74.
Weigel, V. (2005). From course management to curricular capabilities: a capabilities approach for the next-generation course management system. *EDUCAUSE Review*, May/June, 54-67.

Figure 1: Impact of conceptions of teaching on teaching and learning

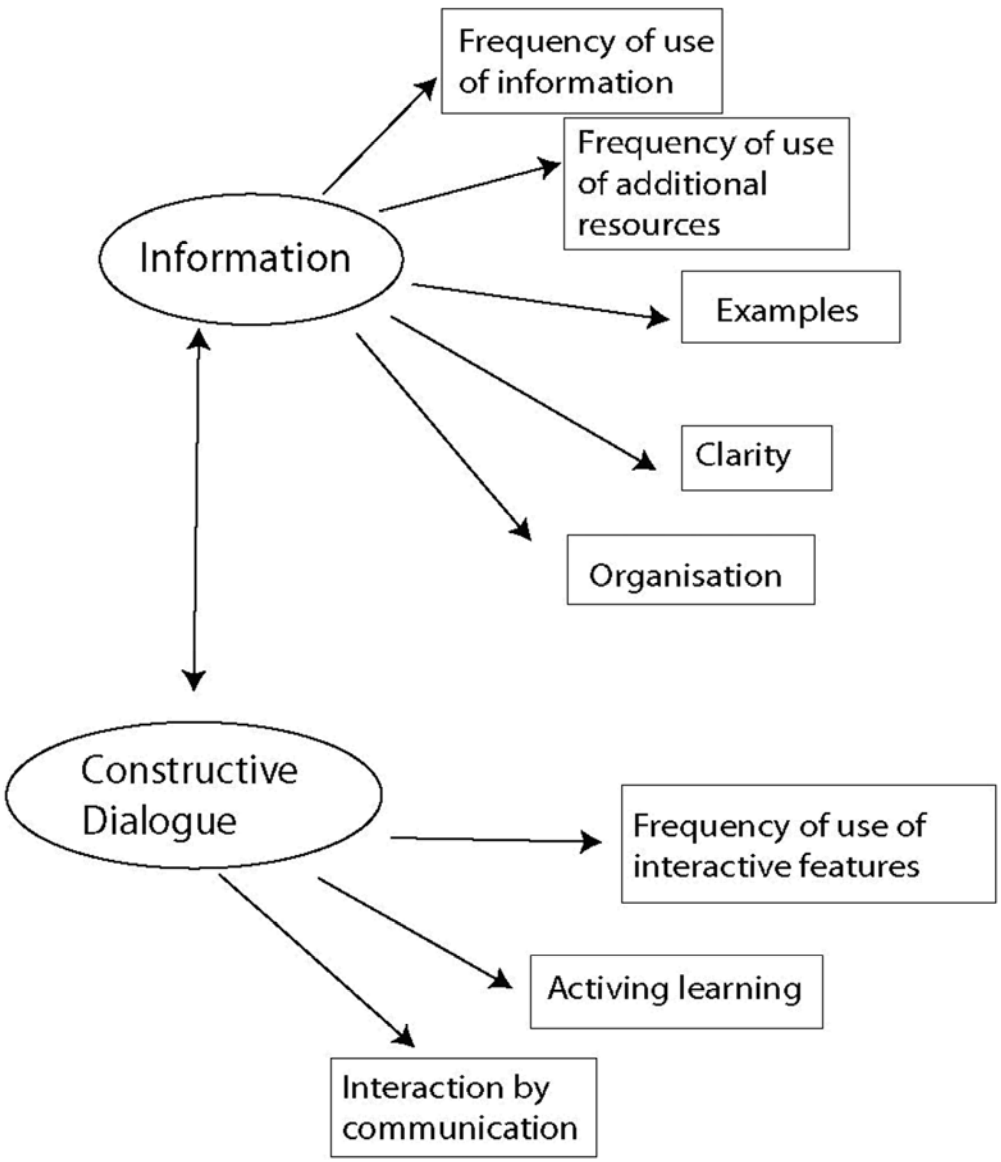

Figure 2: CFA model of the web-based learning features

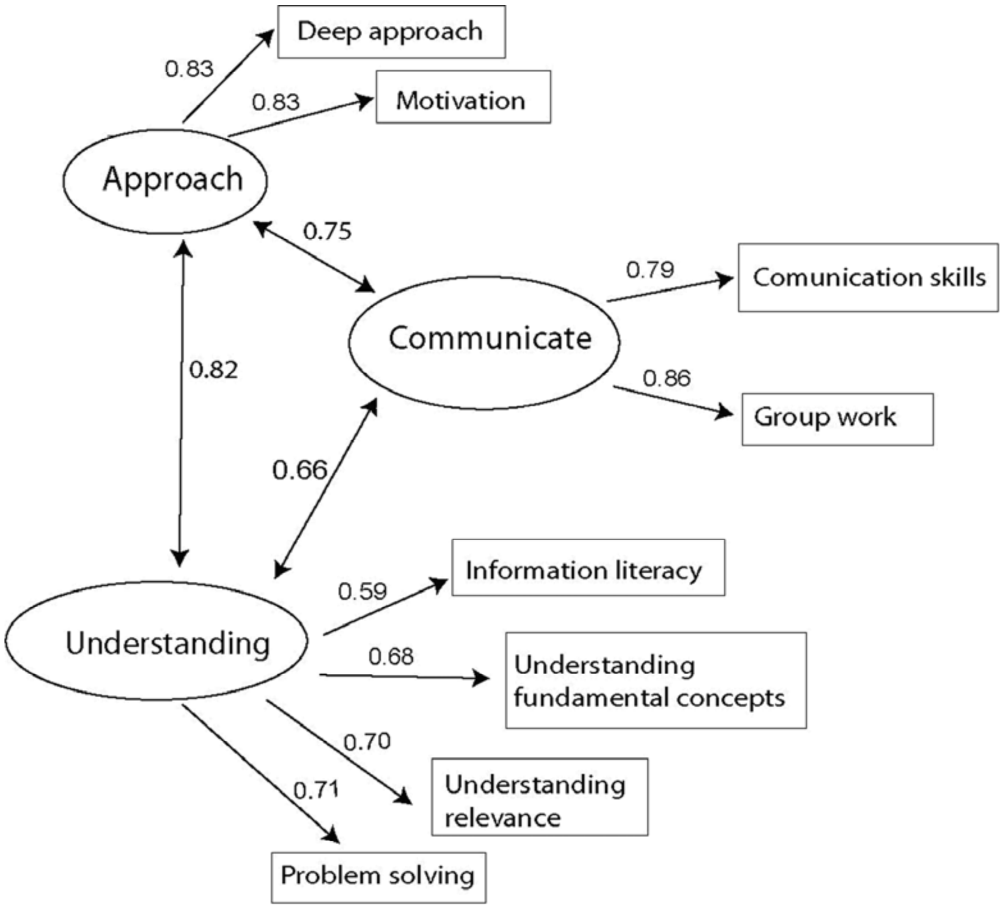

Figure 3: The standardized solution of the CFA model of learning outcomes

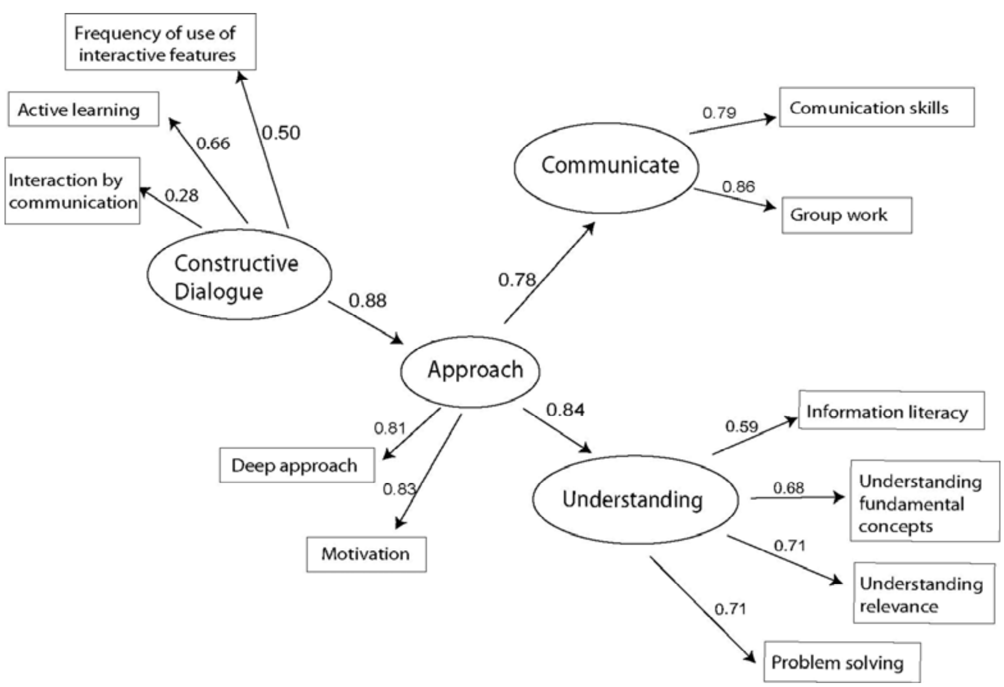

Figure 4: The standardized solution to the dialogue model

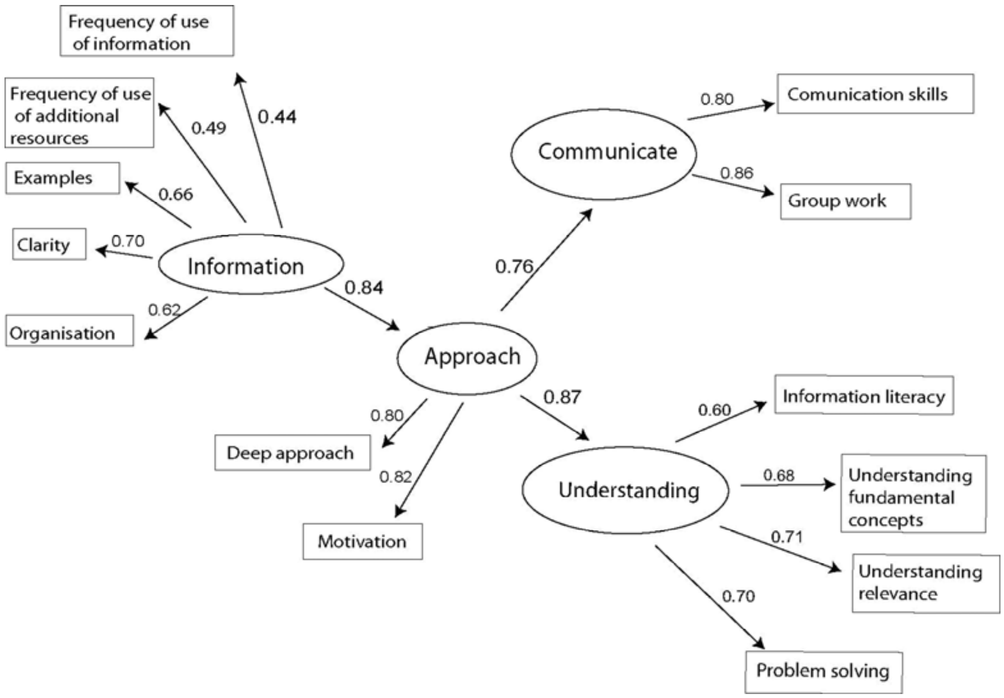

Figure 5: The standardized solution to the information model

Table 1. Structure of the questionnaire on student experience in web-supported courses

Scale	No. of items	Sample item
Part I Learning outcomes		
Information management/literacy	2	I have improved my skills in searching for relevant information.
Understanding fundamental concepts	2	The website helped me to learn key principles.
Applicability	2	The website helped me to understand the relevance of what was taught.
Problem solving	2	Use of the web has made me better able to bring information and ideas together to solve problems.
Deep approach	4	I found the new topics on the website interesting and spent extra time trying to obtain more information about them.
Motivation	3	The website was interesting.
Communication skills	2	Through using the web I have improved my ability to convey ideas.
Group work	2	I feel more confident in dealing with others because of the interactions on the web.
Part II Web environment		
A. Frequency of use		
Frequency of use of information	2	I made frequent use of lecture notes posted on the web.
Frequency of use of additional resources	4	I made frequent use of links to other web resources.
Frequency of use of interactive features	3	I made frequent use of explanations of concepts using sounds, videos or animations.
B. Perception of the website		
Relevance	3	The website gave practical examples of theories.
Clarity	3	The website is not overloaded with too many facts.
Organization	2	The objectives of learning from the website were clear.
Active learning	2	The website features a variety of learning activities.
Interaction by communication	5	There was discussion of concepts through the web.

Table 2. Internal consistencies (alpha values) of all scales

Scale (no. of items)	Alpha values
Part I Learning Outcomes	
Information management/literacy (2)	0.755
Understanding fundamental concepts (2)	0.868
Understanding relevance (2)	0.658
Problem solving (2)	0.781
Deep approach (4)	0.839
Motivation (3)	0.804
Communication skills (2)	0.839
Group work (2)	0.867
Part II Web Environment	
A. Frequency of Use	
Frequency of use of information (2)	0.622
Frequency of use of additional resources (4)	0.674
Frequency of use of interactive features (3)	0.711
Frequency of use of interactive features (2, excluding Q27)	0.719
B. Perception of the Website	
Examples (3)	0.750
Clarity (3)	0.715
Organisation (2)	0.754
Active learning (2)	0.762
Interaction by communication (5)	0.958