

Handbook of Research on Learning Design and Learning Objects: Issues, Applications, and Technologies

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Chapter XI

Using Expert Reviews to Enhance Learning Designs

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ABSTRACT

The chapter will describe an expert review process used at The Chinese University of Hong Kong. The mechanism used involves a carefully developed evaluation matrix which is used with individual teachers. This matrix records: (1) the Web functions and their use as e-learning strategies in the course Web site; (2) how completely these functions are utilized; and (3) the learning design implied by the way the functions selected are used by the course documentation and gauged from conversations with the teacher. A study of 20 course Web sites in the academic years 2005–06 and 2006–07 shows that the mechanism is practical, beneficial to individual teachers, and provides data of relevance to institutional planning for e-learning.

CLARIFYING THE FOCUS OF EXPERT REVIEWS IN E-LEARNING EVALUATION

This chapter rests on several well-known evaluation principles which fit together coherently:

- Evaluation of e-learning is best conducted with a *naturalistic approach* (Guba & Lincoln, 1981). It is difficult, if not impossible, to track the actual learning outcomes of new strategies under controlled evaluation designs because of the complicated and

contextual nature of educational settings. For example, it is unethical to split the class into two groups and provide different treatment to the two groups of students. As educational settings are highly multivariate, it is really impossible to control all the factors. Other evaluation strategies are needed. The expert reviews described in this chapter provide a strategy whereby informed views can be obtained on a complex artifact—a course Web site.

- *Authenticity*, that is, evaluation in real teaching and learning contexts, is important (Oliver, 2000). Controlled experiments are often criticised as not being representative of actual classroom situations, and conclusions made from such studies are “problematic” in “generalisability” (Kember, 2003, p. 97). Our expert reviews are of ‘working’ course Web sites and not of isolated pieces of courseware.
- *Triangulation* is essential in complex, authentic environments, and multiple sources of data are needed (Lam & McNaught, 2004). The model of evaluation that our team has developed has been used with approximately 100 educational projects in the past five years. We use data from teachers, students, and third-party reviewers in order to make judgments about educational efficiency and effectiveness. Our expert reviews are just one of a number of evaluation strategies used in the cases described.
- Both *qualitative and quantitative methods* should be considered (Jones, Scanlon, Tosunoglu, Ross, Butcher, Murphy, & Greenberg, 1996). It is important to avoid an over-reliance on qualitative opinion data garnered from surveys and focus groups. Quantitative data, for example, from assessment results or log data, can provide useful evaluation evidence. Our expert reviews are semi-quantitative in that numbers are assigned in a matrix. As we describe, this can be a

trigger to discuss other qualitative feedback and design options.

- Results from *multiple studies* provide better explanatory power (Kember, 2003). The results of a number of small studies can provide information on overall preferences and trends. One example in Hong Kong is an examination of 58 e-learning projects that indicated that glossaries, notes and PowerPoints, assessment tasks associated with grades, and exhibition of student-generated multimedia projects are considered by teachers and students in Hong Kong to be the most beneficial aspects of e-learning (McNaught & Lam, 2005). We discuss 20 Web sites in this chapter, each of which is the focus of a small-scale evaluation study.

However, it is important not to treat evaluation as a research exercise only. Another principle that underpins this chapter is that evaluation efforts should provide feedback for improvement into teaching and learning. This pragmatic focus echoes Patton’s (1997) model that evaluation should have a ‘utilization focus,’ that all stakeholders should be included in the evaluation design. Useful feedback can be provided through reports to individual teachers and also by meta-analyses across cases (Lam & McNaught, 2008; McNaught & Lam, 2005). In the work reported in this chapter both approaches are taken. In our context, therefore, the work supports individual teachers teaching their own courses and feeds into policy decision making at an institutional level.

Expert reviews are one source of evaluation data. They have the advantage of providing focused and authoritative comments on learning issues. Tory and Möller (2005) acknowledged that expert reviews are efficient in eliciting quick feedback on interface usability. They remarked that expert reviews are a very useful strategy, especially in formative evaluation, while other strategies such as peer review and user sessions can be used to collect more detailed user feedback:

“few usability experts can find a large percentage of a system’s usability problems. Compare this with up to 50 participants for a formal laboratory user study” (p. 8). Moreover, the comments can allow teachers across multiple disciplines to see how they are appraised on a common set of criteria by a common group of ‘experts.’ Tesmer (1993) also reviewed a number of common strategies for formative evaluation of instructional designs: expert review, one-to-one evaluation, small group evaluation, and field test evaluation. He commented that expert reviews have certain advantages over the other approaches; for example, the reviews “furnish information that complements the learner-based evaluations” (p. 67). Also, expert reviews tend to be comparatively inexpensive.

The type of expert review we have instituted moves beyond usability reviews—what Nielsen and Mack (1994) called a ‘heuristic evaluation,’ “the most informal method and involves having usability specialists judge whether each dialogue element conforms to established usability principles” (p. 5). Reeves, Benson, Elliott, Grant, Holshuh, Kim et al. (2002) explained ‘heuristic evaluation’ as a form of expert review where a “small set of evaluators examine the interface and judge its compliance with recognized usability principles” (p. 1615). Usability is important but the focus of the reviews to be described here is more explicitly on learning designs. We have also taken a view that expert reviews can usefully extend beyond the, again useful but contained, reviews of isolated materials in repositories of sharable learning objects, for example, as described by Nesbit and Li (2004).

This chapter examines a strategy to provide third-party expert review evaluation data on real cases of e-learning strategies with an emphasis on providing feedback on the learning designs used in the cases. The service, called ‘e+,’ was introduced to The Chinese University of Hong Kong (CUHK) in 2005. The chapter explains the design of our instrument, the procedures used in

the service, the experience with 20 reviews, and the observed benefits from such a service.

THE CONTEXT OF THE CHINESE UNIVERSITY OF HONG KONG

CUHK is a comprehensive, research-intensive university with a student population of 10,000 undergraduate and 9,000 postgraduate students, and 1,200 full-time academic teachers. CUHK started the provision of a central e-learning platform in the year 2000. Since then, e-learning has developed significantly. During the 2003–04 academic year, a study (called eL@CU) was carried out to assess the extent and nature of e-learning at the university. The eL@CU study also examined barriers to uptake of e-learning and outlined a strategy for more appropriate and comprehensive e-learning support (McNaught, Lam, Keing, & Cheng, 2006).

Hong Kong is a content-oriented and examination-focused educational environment, and this rigidity extends to a rather restricted use of the Web in teaching and learning. In 2003–04, WebCT and CUForum (an in-house platform) attained an average annual growth rate of 30% and 23% respectively in the number of courses and forums hosted. However, of the 4,637 (undergraduate and postgraduate) courses offered at CUHK in the 2003–04 year with enrolments of 10 or more students, 45% had a supplementary online course site (though this may be an underestimate as there may have been ‘undiscovered’ locally hosted Web sites). At CUHK, the Web is mostly seen as a convenient storage house for easy distribution of course materials to students. Most communications are done through online forums with simple designs—mostly teacher–student communication about course and course content. In general, most of the forums are not very active; students, on average, post only one to three messages. While there are some very keen and active e-teachers (we interviewed 26 during this study), the Web is

seen as an adjunct to face-to-face teaching and is rarely integral to the overall learning design. This study made it clear to us that evaluation feedback to teachers needed to support a range of uses of the Web and their potential value in supporting student learning.

ARTICULATING LEARNING DESIGN

In framing our work, we have tried to focus on the overall learning design of a course. To that extent, we work with teachers to see what technical functions they are using in their course Web sites, what content ‘objects’ or activities they place there, and how this all works together with their desired student learning outcomes. We therefore see learning designs as being an amalgamation of Web functionality, learning materials/objects and/or activities, all arranged with specific learning intentions. Evaluation should provide explicit feedback to teachers in a form which enables them to reflect on their current designs and make decisions about possible changes.

A brief exploration of the tension between the relative focus on ‘learning’ and ‘object’ in the ‘learning objects’ literature is useful in order to understand some of the decisions we made about our own evaluation instruments and strategies. The initial focus of the learning objects literature was overwhelmingly on delineating the concept of learning objects, their technical specifications, and their metadata—a focus on ‘objects’ rather than ‘learning’ (Agostinho, Bennett, Lockyer, & Harper, 2004; Boyle, Bradley, Chalk, Jones, Haynes, & Pickard, 2003). Similarly, Mohan and Greer (2003) remarked that “development efforts seem to be driven by available technology” but not the “pedagogical design used in conjunction with the features of the medium” (p. 263). This imbalance has led to a call for greater consideration of pedagogical purpose (Jonassen & Churchill, 2004; Wiley, 2003), and reflective practice and evaluation (Laurillard & McAndrew, 2003).

We have adapted the four-category classification of learning designs framed by Oliver, Harper, Hedberg, Wills, and Agostinho (2002) and Agostinho, Oliver, Harper, Hedberg, and Wills (2002): rule focus, incident focus, strategy focus, and role focus. Our use of these terms is simpler than the apparent intention of the researchers in the AUTC-funded Project ‘Information and Communication Technologies and Their Role in Flexible Learning’ (<http://www.learningdesigns.uow.edu.au/>). As noted earlier, CUHK teachers do not use technology widely, and we needed a classification that fit the types of teaching and learning practices used in our context. An additional category of ‘management’ was added; this is rather stretching the meaning of learning design, but it is a common use of the Web in Hong Kong courses and needed to be accommodated in some way.

This model suits the purpose neatly as the categories are simple and easy for teachers to understand, and yet they are capable of interpreting a wide range of teaching and learning strategies according to their probable learning outcomes. Because of its higher level of generalisation, it seems to be more helpful to teachers, particularly in our context, than the multifaceted IMS learning design information model which looks at dimensions such as environment, activity, role, and method, which in turn have numerous parameters. The IMS (2003) system is able to record “a countless number of possible design solutions” and would be rather overwhelming in the Hong Kong context, and we suspect elsewhere as well. The project ‘Sharing the LOAD: Learning Objectives, Activities and Designs’ (University of Cambridge, 2006–07) describes learning designs with ratings on a five-point scale in 12 key attributes which are interactivity, objective, integration, context, richness, prerequisites, support, feedback, self-direction, navigation, assessment, and alignment. Spider maps can be drawn to effectively visualise the learning designs according to their strengths and weaknesses on

Table 1. Learning design definitions used in this study

<i>Management</i>	The Web is intended to facilitate class management such as online distribution of handouts and announcement of venues and special events, etc.
<i>Rule focus</i>	The Web is intended to enhance the teaching and explanation of knowledge and concepts.
<i>Incident focus</i>	The Web is intended to display well-defined real cases and scenarios. Discussion is on the incident and understanding its context.
<i>Strategy focus</i>	The Web is intended to support students in learning how to handle ill-defined realistic problems, cases, and scenarios in the field of study. Discussion is on appropriateness of treatment and/or alternative treatments. Here, the focus is on the development of useful learning processes.
<i>Role focus</i>	The Web is intended to support students in playing the role of a professional in the field of study. Discussion relates to ill-defined real cases and scenarios in the field and the different strategies used in different professional roles. A strong focus on immersion in authentic real-life situations.
<i>Non-interactive</i>	The materials on the Web are for viewing or downloading only. The computer provides no feedback or very simple (e.g., yes/no) feedback to students' input.
<i>Interactive</i>	Students receive quite comprehensive pre-installed feedback from the computer system. This can be adaptive to students' input. Alternatively, students may receive feedback from their peers and/or teachers.

these 12 dimensions. While the visual aspect of Sharing the LOAD is appealing, the learning design categorisation method adopted in this study, however, tends to be simpler. Nevertheless, our matrix has the key strength of explicitly mapping a relationship between pedagogical intention and desired learning outcomes of the designs and the actual Web functions used for the purpose. Some working definitions are in Table 1.

THE DEVELOPMENT OF AN EVALUATION MATRIX FOR EXPERT REVIEW

The matrix we have developed to support feedback to teachers has three aspects: (1) the Web functions and their use as e-learning strategies in the course Web site; (2) how completely these functions are utilised; and (3) the learning design implied by the way the functions selected are used

by the course documentation and gauged from conversations with the teacher.

1. Concerning the nature of the Web functions/e-learning strategies, initial versions of the matrix were based on the four functions of the Web in learning listed by McNaught (2002): communicative interaction, feedback on learning progress, study program management, and content resources for students to engage with. A preliminary list of 22 Web functions for teaching and learning was documented (see Appendix for the list). The Web matrix was revised several times. The final list of common e-learning strategies was strongly influenced by the eL@CU study and by the e3Learning (enrich, extend, evaluate learning) Project (<http://e3learning.edc.polyu.edu.hk/>) which provided design, development, and evaluation services to teachers and teams in 139

Web site subprojects across three Hong Kong universities during the period 2003–05. The final Web matrix contains a list of 15 Web functions/strategies (Table 2). The list was

restricted to the strategies most commonly used in Hong Kong. The final set of four categories was described as ‘communication,’ ‘assessment,’ ‘simple resources,’ and ‘enriched resources.’

Table 2. The e+ evaluation matrix

<i>Web functions/ strategies</i>	<i>Design</i>	
	non-interactive	interactive
<p>On the RHS of the matrix, there are five columns (Management, Rule-based, Incident-based, Strategy-based, Role-based), each subdivided into ‘non-interactive’ and ‘interactive.’ These 10 columns are used for rating. In the matrix, ●s indicate the usual way in which the Web function/strategy is implemented</p>		
Communication		
Asynchronous forums. Discussion topics can range from course arrangements to discussion of cases and professional tactics.		
Synchronous such as chat-room, virtual lecturing, video-conferencing, etc. Focus on knowledge, cases, or strategies.		
Assessment		
Interactive exercises such as quizzes and tutorials. Focuses on knowledge or strategies. Various forms of feedback possible.		
Past papers and assignments. Degree of detail in answer key can vary.		
Online submission of assignments. Variation includes the use of peer review and the nature of teacher online feedback.		
Resources (simple)		
Announcements, course information, and teacher information. May be linked to follow-up online discussion.		
Lecture/laboratory notes and/or PPTs.		
Frequently Asked Questions (FAQs).		
Tools and templates.		
Resources (enriched)		
Extended self-study content/Web links.		
Glossary of terms. Can be multimedia-enhanced.		
Cases and scenarios. May be linked to follow-up online discussion.		
Role-related and problem-solving games and simulations.		
Exhibition of student work. Variation includes the use of peer review and the nature of teacher online feedback.		
Materials on learning skills. May be linked to follow-up online discussion.		

We are quite open to changing this set of Web functions and strategies. Others (such as e-portfolio) can be added as necessary. In this way, this matrix can be seen as an evolving and responsive descriptive tool.

2. We use three levels of implementation:
 - 0 – the strategy is by and large absent;
 - 1 – the strategy is implemented in a limited fashion; and
 - 2 – the strategy is well-implemented.

The judgments on the degree of implementation are necessarily qualitative. In the earlier eL@CU study, 30 ‘active’ sites at CUHK were studied. The degree of agreement between educational designers and technical staff about the degree of implementation was high (McNaught et al., 2006).

3. Decision about the learning design. All judgments about the degree of implementation and the nature of the learning design are checked in conversation with the course teacher. These conversations are in themselves valuable staff development explorations. The matrix acts as a tool for conversation about the existing design and the possibilities for modification.

THE E+ SERVICE IN OPERATION

The service we have developed using this matrix is called ‘e+’ (originally ePLUS Web, evaluating the Potential for Learning: Use and Structure of the Web). e+ was introduced to CUHK in 2005. During the second half of the 2005–06 and the first term of the 2006–07 academic years, we worked with the teachers in 20 courses.

At the end of an e+ review, the course teacher receives a report with two components: the completed matrix, about which there would have already been some discussion; and the results of a

questionnaire given to students on their perception of their learning outcomes in the course and how the Web environment might have supported this learning. We have also collected data on students’ achievements on an open-ended authentic task in the discipline area. The eventual aim is to produce a model that shows relationships between the value students place on the specific features of the educational course Web sites, students’ discipline-based learning, their approaches to learning, and their development of capabilities such as critical thinking and communication skills. However, this chapter is intended to focus, not on the whole e+ project, but rather on the value of the e+ matrix as an evaluation tool to assist teachers to articulate their current learning designs and explore other possibilities. In passing, it should be noted that the e+ matrix is just one component in the evaluation support we provide for teachers.

A total of 20 course Web sites was used as the first batch of Web sites to undergo the e+ expert reviewing service. The sites came from a relatively widespread range of disciplines. Seven of the 20 cases were from language courses, three cases from engineering courses, three from science courses, three from arts courses, two from education courses, one from a business course, and one from a social science course. As noted earlier, the final matrix decisions were discussed with the teacher. The e+ service is entirely voluntary; initially most of the teachers who used the service were approached by us as we know who the more active e-teachers on campus are. Our cases are not at all representative of CUHK as a whole. Our intention is to provide feedback to enthusiastic colleagues and also to obtain information on what learning designs work well in the Hong Kong context.

A team of five members of staff in the Centre for Learning Enhancement And Research (CLEAR) were involved in the Web function judgment—the three authors and two other educational design staff. A brief description of the review team will illustrate the need to have reviewers with a wide

range of appropriate experience. There is no clear definition of an ‘expert’; it is the synergy across the review team that can bring useful insights. Carmel McNaught is a professor of learning enhancement in CLEAR. She has over 30 years of research experience in teaching and learning. Paul Lam is an assistant professor in CLEAR and has many years of teaching experience, followed by six years of extensive research and development experience in e-learning projects. Alex Wong has seven years experience in learning, teaching, and assessment, both online and off-line; he is now an educational designer in CLEAR. Kin-Fai Cheng and Poon Wai Kei are research assistants in CLEAR who are relatively recent graduates and bring a student perspective to the review process. These professionals reviewed all the participating course Web sites and made judgments about the degree of implementation of the learning designs.

The judgment was carried out in two phases. In the first stage, four reviewers visited the course Web sites individually and jotted notes about the Web functions. Then, these four reviewers held a meeting. They looked at the course Web site

together again and discussed each item on the Web matrix until reaching a consensus. There were, as expected, disagreements among the reviewers. The reviewers discussed until consensus was reached, and they had a final set of judgments.

In the second phase of the judgment, the set of judgments made by the four reviewers was passed to the first author for cross-checking and validation. Judgments of this nature are necessarily qualitative. The final rating was based upon overall Web site reviews. The profiles are intended to be summaries of qualitative data.

Throughout the two phases, the working team discussed many issues that assisted in further clarifying the boundaries of the individual categories in the matrix. The discussions were well recorded in the form of a supplementary document for the matrix. The discussions explained and elaborated the matrix. The document further improves the practicability of the instrument as a tool to accurately measure Web designs in different contexts. Table 3 illustrates the discussions with an extract from the supplementary document.

Table 3. Extract of the supplementary document of the matrix

Functions	Issues met when considering this function	Decisions reached
Asynchronous forums	In one course, only one-way ‘discussion’ occurred: the teacher asked questions, but no one replied. How to judge the interactivity and degree of implementation.	We still treat it as interactive, because we focus on the ‘intention’ of the teacher; but we gave it a 1 for degree of implementation.
Extended self-study content/ Web links	Many links go to big sites (such as Google and sites of big organizations and projects). It’s hard to go through them all to see what learning materials they contain.	We stick to the principle of ‘directness.’ If the learning materials are not easily found by following the links, we do not count the learning materials.

FINDINGS

Across all the cases, we noticed that the e-learning designs of these 20 Web sites were quite diverse. Teachers, in general, provided high quality and rich resources on the Web. The feedback given back to individual teachers was found to be very well received and appreciated. They appreciated that the purpose of the evaluation strategies was not to put pressure on them to ‘do well—get 2s’ in all items of the matrix. We stressed that it is completely legitimate for different teachers to value some features and functions more highly than some others, based on their teaching beliefs, teaching styles, students’ learning styles, learning objectives of the course, and characteristics of the subject content. However, all teachers noted that this was an interesting and worthwhile process. They felt they had received practical data that could be used in making changes to their Web sites and other aspects of their courses.

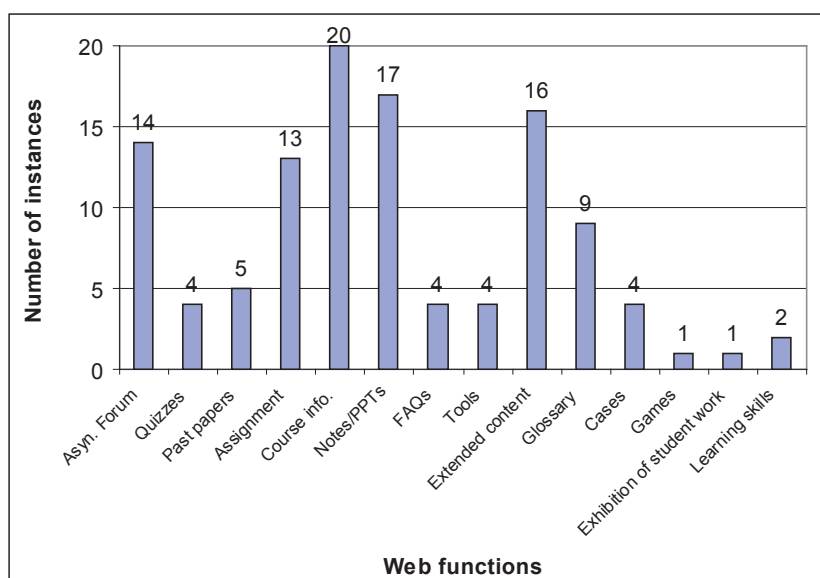
Most teachers used a number of strategies and the number of total strategies used across

the 20 Web sites (courses) was 114. Among the 114 instances of strategies, we found there was a limited set of strategies commonly used. Only one of the 15 functions was not present at all among the cases. This was the synchronous communication function such as chat-room, virtual lecturing, video-conferencing, and so forth. In our relatively small face-to-face university, this is not surprising.

As can be seen in Figure 1, six out of the remaining 14 strategies could be considered as being the more common e-learning strategies used. They were:

- Announcements, course information, and teacher information;
- Lecture/laboratory notes and/or Power-Points;
- Extended self-study content/Web links;
- The asynchronous communication function, always as forums;
- Online submission of assignments; and
- Glossary of terms.

Figure 1. Strategies used by functions



Apart from the use of forums, this list is quite consistent with the study mentioned earlier of 58 course Web sites in Hong Kong (McNaught & Lam, 2005). The content-oriented and examination-focused nature of the Hong Kong educational environment is apparent.

Figure 2 illustrates how the 114 strategies have employed the four main functions that the Web can assist teaching and learning: communication, assessment, simple, and enriched resources. Our 20 teachers largely focused on the resources functions. They most commonly used the Web as a storage place for learning materials. Some of them put up simple text-based documents such as course information, notes, and PowerPoints. Also, many of the teachers put extended materials such as links to extra readings, notes, and cases, some of which were multimedia-rich.

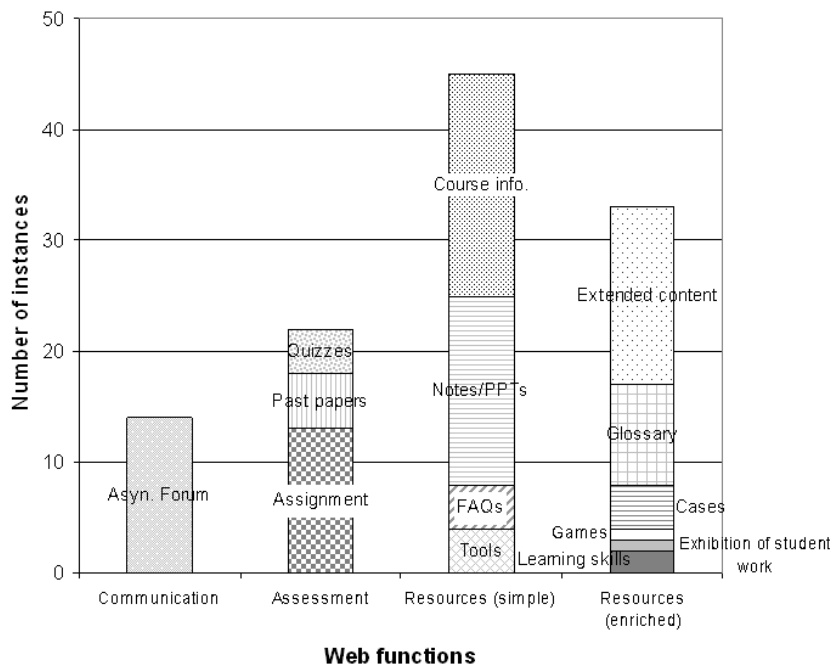
Figure 2 also illustrates that teachers viewed the Web as an assessment tool (for both forma-

tive and summative assessments). There were 22 instances where the online activities were related to self-assessments (e.g., quizzes) or course assessments (e.g., putting up past papers for examination revision, assignment submission, and online tests). The most common strategy among these was the assignment submission function.

As shown in Figure 3, the learning resources were generally non-interactive. Whether they were simple or enriched, they tended to be materials for students to view and read only. Few interactive exercises or activities were included with the materials. Eighty-four of the 114 strategies were classified as non-interactive, while the remaining 30 were interactive.

Though most forums were quite active, an example of a non-interactive instance in the communication function was a very quiet forum without student participation. In these cases, the communication tools were mainly used as places

Figure 2. Strategies used by their major functions



for teachers to disseminate ideas, while students took the role of readers. The non-interactive instances in the assessment category were cases where the quizzes did not give any feedback. The teachers in these cases did not want to disclose the correct answers to the students immediately, but by doing so, the activities were deprived of much of their learning value. Butler and Winne (1995) suggested that provision of feedback is important as it contributes to the construction of knowledge in the learning process. Hara and Kling (2000) pointed out that the lack of prompt feedback was “a major source of anxiety and frustration for students because they were concerned about their performance” (p. 567).

Figure 4 represents the reviewers’ judgments on the learning designs in each of these 20 cases. This was a somewhat complicated exercise because teachers used different parts of their Web sites in somewhat different ways. So, there could be a strong organizational (management) focus on a site that also included some good case material. Indeed, conversations with teachers showed that many of them felt that they were somewhat restricted in their designs by what they perceived to be the demands of the programmes or the expecta-

tions of the students. As a result, Figure 4 focuses on categorisation at the level of the 114 strategies used. The strategies appeared to be mainly used with management and rule-based intentions. In other words, the focus of attention was either about achieving convenience in managing the class or improving students’ understanding of the rules of the discipline. Seldom did we find strategies used that focused on situations and cases in the discipline (incident-based), learn the skills in solving problems in the discipline (strategy-based), or acquire the attitude and capabilities to be real professionals in the discipline (role-based).

Last, we looked at the degree of implementation. Most of the strategies were regarded by the reviewers as highly implemented (86 out of the 114). The rest, 28 out of 114, were regarded as having medium-level implementation. In the communication function, for example, most teachers we studied were able to facilitate meaningful and abundant online discussions on their forums. In the assessment function, either there were rich collections of quizzes or past papers (with answers), or there were recorded activities in which students participated in the online assessment activities. In the resources functions, there were on the

Figure 3. Interactive and non-interactive strategies

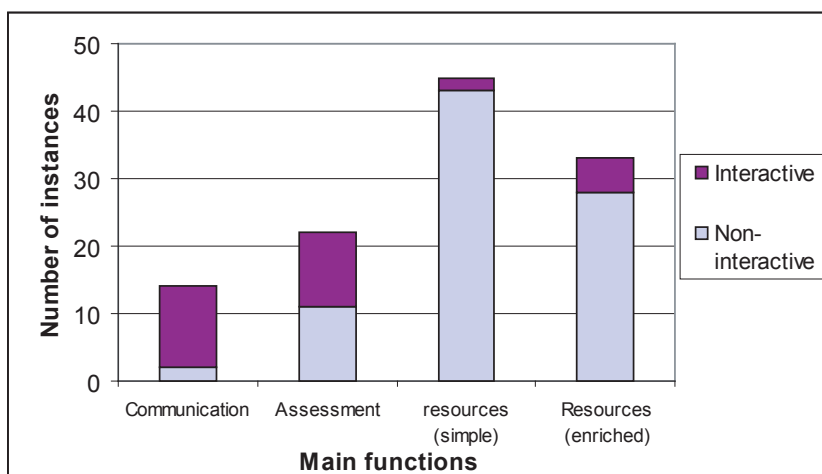
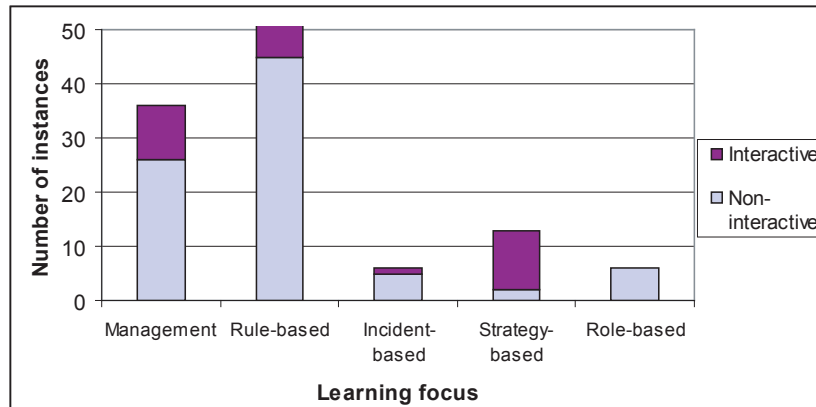


Figure 4. Strategies used by their learning focuses



whole good coverage of learning materials that generally touched upon most of the key areas of the course and could explain the course concepts well. The extended resources such as links of the other online sites were also rich.

DISCUSSION

There are many potential benefits of this expert reviewing method. We have found it to be a good tool for doing in-depth ‘spot checks’ on e-learning instances at a university. It is a good strategy for providing support to individual teachers as it supplies succinct and authoritative feedback to teachers on their e-learning designs.

Value to the Institution

Across the 20 cases described above, we noticed that the e-learning designs of these selected Web sites were quite diverse. Teachers were also in general able to put up high quality and rich resources onto the Web as the reviewers rated most of the strategies as highly implemented. However, these teacher cases were not randomly picked among all

e-learning cases at the university but were invited cases from teachers we knew were pioneers in employing e-learning strategies. We will have a clearer picture of the university-wide situation when more expert reviews are conducted.

Despite the limited scope of this study, a number of preliminary ideas on improvements can still be identified from the experiences of these teachers. First of all, teachers can be encouraged to have learning focuses that aim at more than just explaining the rules to students. Second, teachers can be introduced to some strategies which are less commonly used at the moment. Third, teachers can explore ways to make their online activities more interactive. As an education development group, we have used this information in framing some of our recent activities. Our e-learning service Web site at <http://www.cuhk.edu.hk/eLearning/> provides some information on our activities and resources.

Value to the Individual Teachers

Reports were sent to the individual teachers, together with survey results about students’ perceptions of how valuable the course Web site was for

Using Expert Reviews to Enhance Learning Designs

their learning. These reports served as triggers for discussions about the learning design of the Web site. The purpose of the report is to help teachers understand the teaching and learning potentials of their strategies.

The first part of the report was the reviewers' scores '0, 1, or 2' on the matrix, indicating what activities were found, the learning focus of the activities and their level of implementation. The second part of the feedback was the reviewers' further comments on the activities and the reasons behind their judgments. Table 4 is an extract of one such piece of extra information. The extract here, for example, explains why the rating '1' was assigned to the 'asynchronous function' and why the 'past paper and assignments' function was assigned a '2.' These entries were designed to give teachers some ideas about possible enhancements.

Teachers were also given detailed guidelines to assist them in interpreting the report data and consider what changes (if any) they wanted to

make. For example, concerning the Web strategies, the teachers were reminded that the purpose of listing 15 strategies on the report is *not* to encourage them to employ all, or anywhere near totality, of these 15 Web strategies. However, this list of strategies and functions should certainly be helpful in leading them to rethink their present e-learning design. Having a fairly complete list of the common Web strategies and functions might assist teachers in finding new Web strategies or functions that could be useful in their courses. Detailed guidelines were included in the reports to assist teachers in interpreting the reviewers' comments.

For example, the pedagogical potential of the e-learning strategies was explained:

- In general, online communicative strategies are very good strategies for teachers to build teacher–student or student–student relationships. They also offer opportunities for teachers to listen to students, to let shy

Table 4. Extract of detailed comments from reviewers to teachers

Functions available	Reviewers' judgment	Remarks
Function 1: Asynchronous forums	Management (Interactive) Level 1	<ul style="list-style-type: none"> • A channel for communication is available <ul style="list-style-type: none"> o under the 'communication' part, there is a discussion board for students to communicate o under the 'communication' part, there is an announcement session for students to discuss the new arrangement of the course • Limited usage of the function <ul style="list-style-type: none"> o in the discussion board section, only the group list is posted on the Web o in the announcements, only the news from teacher is posted in the Web
Function 4: Past paper and assignments	Rule-based (Non-interactive) Level 2	<ul style="list-style-type: none"> • Examination samples are available for students' revision <ul style="list-style-type: none"> o the past paper in 03 and 04 academic years are available on the Web o but no answer is provided • Good to have enough samples for revision <ul style="list-style-type: none"> o two years' samples are provided for students to familiarise themselves with the format of the examination

students ‘speak’ up, and to have problematic concepts identified and clarified. Many of these activities are missing in traditional classrooms because of time and space restrictions.

- Assessment strategies can be used as self-assessment tools or as mark-giving exercises for students. In general, they tend to engage students in learning. Also, quizzes that are multimedia-enabled are often better alternatives than traditional paper-and-pen exercises.
- The various strategies to provide learning resources such as text-based readings or multimedia-enriched materials can also serve to engage students in prelecture preparations or postlecture revisions. Well-written and designed resources sometimes can explain facts and concepts really well as students are given the opportunity to unlimited access of these materials in the online space.

Learning designs were also explained. The ‘management,’ ‘rule-based,’ ‘incident-based,’ ‘strategy-based,’ and ‘role-based’ dimensions can assist teachers to rethink what they want the technology to do for them.

- Do they want the Web to facilitate class management (management)? This can be achieved by strategies such as online distribution of handouts and announcement of venues and special events.
- Do they want the Web to assist the explanation of knowledge and concepts (rule-based)? If yes, putting well-designed explanatory notes, exercises, or links to good Web resources or further readings may be what they want.
- Do they want students to see how concepts and theories can be applied (incident-based)? Perhaps they can think of displaying well-defined real cases and scenarios. Discussions of these stories may further enhance students’ understanding.

- Or, do teachers wish to support students in learning how to handle ill-defined realistic problems and use knowledge in real situations (strategy-based)? They may then consider putting up more cases and scenarios in the field of study, followed by discussions on the appropriateness of treatment and/or alternative treatments.
- Finally, if they want to support students in playing the role of a professional in the field of study (role-based), they may need online activities that have a strong focus on immersion in authentic real-life situations. Students can then experience the feelings and decision-making processes of actual professional situations.

There were also explanations of the judgments on the degree of implementation, that is, the ratings 0 (blank row) – absent, 1 – implemented in a limited fashion, and 2 – well-implemented. Teachers had the chance to reflect on the practice and plan for improvements.

- In general, online resources can be enriched through linkage to good external sources of information, appropriate uses of multimedia, and a wider coverage so that the resources cover the most important or difficult, if not all, the topics in the course.
- The assessment strategies can be enhanced through well-designed questions which are designed not only for assessing students but also for assisting students to master the knowledge through errors. Online quizzes that provide feedback such as common misconceptions or learning tips on students’ mistakes, for example, are better than questions that just inform students that their answers are wrong.
- Finally, higher quality communication strategies can be achieved through higher level of engagement of both teachers and students. These can be achieved, for example,

through effectively motivating students to discuss online (giving marks for online participation can be a good ice-breaking strategy here). Heated online discussions can also be a result of well-planned discussion procedures. In general, provision of clear discussion topics and clear indications about when the discussion periods begin and end are needed. Splitting the class into groups with or without prespecified positions on the topics may also help to engage students in the discussions.

Teachers were reminded that the feedback from the ‘experts’ is at best only indicative rather than conclusive, as we admit that there are obvious limitations. It is completely legitimate for different teachers to use only some features and functions. We are hopeful that our feedback will encourage teachers to be reflective about the learning designs they are using and consider how they might continuously enhance the work they do.

Although we have not obtained concrete evidence that the expert reviews changed our teachers’ actual teaching and learning practice as the project is still ongoing, the initial perception is promising. We received positive comments from teachers who were sent the reports and below are some quotes:

“I’ll study it and look for ways to improve my Web-based course delivery in future.”

“Thanks for the effort. I shall read the report and see how to further improvement the website.”

“The report is excellent, and I have learnt from its structure and organisation.”

“The report is both affirming and informative.”

There were challenges, however, in following up these teacher cases and in supporting the teachers in reworking their e-learning strategies. The

reviews pointed out ideas for improvement but perhaps did not provide practical advice on how to implement changes. Nor did the project team have resources to assist teachers in changing their Web sites (though recent funding improvements have changed this situation).

Also, as the teaching and learning culture in the Hong Kong context is largely content-oriented and examination-focused, teachers in general are not able to immediately comprehend the importance and benefits of the strategy-based and role-based learning designs. Ongoing efforts are needed on the part of the project team to explain and demonstrate new e-learning options to teachers. Follow-up meetings, seminars, and showcases (e.g., see <http://www.cuhk.edu.hk/eLearning/resources/showcases.htm>) occur, but this type of professional development is a long-term process and requires sustained enthusiasm. In a context where the pedagogy is less content-focused, the ‘higher level’ strategy-based and role-based learning designs may be more common. Having a matrix with a range of learning designs provides a flexibility that should make it useful in a range of contexts.

As mentioned earlier, the e+ matrix is one component of the e+ service project. The overall objectives of this project are to characterise the ways in which educational Web sites used in courses in higher education can support student learning, to develop guidelines for how the use of the Web can support student learning, and to understand whether the design features of the Web that are now widely advocated are perceived by students as having a positive impact. In order to achieve this, extensive survey and assessment data have been collected. The matrices will be used as illustrative material (vignettes) to describe the relationships between the value students place on the specific features of the educational course Web sites, students’ discipline-based learning, their approaches to learning, and their development of capabilities such as critical thinking and communication skills.

Having a model based on local evidence has been very persuasive in other work at CUHK. For example, a set of principles of excellent teaching derived from interviews with 18 award-winning teachers at CUHK is used to frame professional development for all new teachers and teaching assistants (Kember, Ma, McNaught, & 18 exemplary teachers, 2006), and a model of the relationship between the development of capabilities and factors in the teaching and learning environment is used to explain students' feedback on programme-level questionnaires (Kember & Leung, 2005; McNaught, 2005). These grounded models have resulted in greater take-up of services. We are hopeful that our research will do the same for e-learning.

CONCLUSION

This chapter describes a project on providing expert reviews on e-learning strategies in active courses. The mechanism used involves a carefully established evaluation matrix. The matrix allows reviewers to judge e-learning practices on aspects regarding their level of implementation, the nature of the strategies used, and their learning focuses through engaging student in these online activities. The first study of looking at 20 course Web sites at The Chinese University of Hong Kong in the academic years 2005–06 and 2006–07 shows that the mechanism is both practical and beneficial. Despite the limited scope of this initial study, a number of preliminary ideas on improvements can still be identified from the experiences of these teachers. The feedback given back to individual teachers was well received.

As in most staff development work, teachers who have found an activity valuable are our best advertisement. It will be valuable to see whether the pattern of use shown by this first set of 20 cases remains the same or shifts over time. The Hong Kong government is requiring evidence of student learning outcomes at an institutional level. The

e+ matrix provides snapshot data of individual courses but it could be used to exemplify and correspond with overall claims that programmes make about the student-centred nature of their designs. The data from the eL@CU study resulted in funding for an expanded e-learning support service. The data from the e+ matrix will be part of the data used in the production of the next institutional report at the end of 2007.

We are hopeful that the matrix is flexible enough to be able to support teachers in other contexts. Presentations in other countries (Singapore, Malaysia, and South Africa) have been well received with follow-up discussions taking place. As in much academic work, disseminating one's own ideas enables new strategies to be developed.

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REFERENCES

- Agostinho, S., Bennett, S., Lockyer, L., & Harper, B. (2004). Developing a learning object metadata application profile based on LOM suitable for the Australian higher education context. *Australasian Journal of Educational Technology*, 20(2), 191–208. Retrieved April 1, 2008, from <http://www.ascilite.org.au/ajet/ajet20/agostinho.html>
- Agostinho, S., Oliver, R., Harper, B., Hedberg, J., & Wills, S. (2002). A tool to evaluate the potential for an ICT-based learning design to foster 'high-quality learning.' In A. Williamson, C. Gunn,

- A. Young, & T. Clear (Eds.), *Winds of change in the sea of learning: Proceedings of the 19th Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education* (pp. 29–38). Auckland, New Zealand: UNITEC Institute of Technology. Retrieved April 1, 2008, from <http://www.ascilite.org.au/conferences/auckland02/proceedings/papers/164.pdf>
- Boyle, T., Bradley, C., Chalk, P., Jones, R., Haynes, R., & Pickard, P. (2003, April). *Can learning objects contribute to pedagogical improvement in higher education: Lessons from a case study?* Paper based on presentation given at CAL 2003, April 2003. Retrieved April 1, 2008, from http://www.londonmet.ac.uk/ltri/learningobjects/papers_pres/CAL_Objects_paper.doc
- Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research*, 65(3), 245–281.
- Guba, E., & Lincoln, Y. (1981). *Effective evaluation: Improving the usefulness of evaluation results through responsive and naturalistic approaches*. London: Jossey-Bass.
- Hara, N., & Kling, R. (2000). Student distress in a Web-based distance education course. *Information, Communication & Society*, 3(4), 557–579.
- IMS Global Learning Consortium, Inc. (2003). IMS learning design information model, version 1.0 final specification. Retrieved April 1, 2008, from http://www.imsglobal.org/learningdesign/ldv1p0/imslid_infov1p0.html
- Jonassen, D., & Churchill, D. (2004). Is there a learning orientation in learning objects? *International Journal on E-Learning*, 3(2), 32–41.
- Jones, A., Scanlon, E., Tosunoglu, C., Ross, S., Butcher, P., Murphy, P., & Greenberg, J. (1996). Evaluating CAL at the Open University: 15 years on. *Computers in Education*, 26(1:3), 5–15.
- Kember, D. (2003). To control or not to control: The question of whether experimental designs are appropriate for evaluating teaching innovations in higher education. *Assessment & Evaluation in Higher Education*, 28(1), 89–101.
- Kember, D., & Leung, D. Y. P. (2005). The impact of the teaching and learning environment on the development of generic capabilities needed for a knowledge-based society. *Learning Environments Research*, 8, 245–266.
- Kember, D., Ma, R., McNaught, C., & 18 exemplary teachers. (2006). *Excellent university teaching*. Hong Kong: Chinese University Press.
- Lam, P., & McNaught, C. (2004, June 21–26). Evaluating educational Websites: A system for multiple Websites at multiple universities. In L. Cantoni & C. McLoughlin (Eds.), *ED-MEDIA 2004: Proceedings of the 16th annual World Conference on Educational Multimedia, Hypermedia & Telecommunications*, Lugano, Switzerland (pp. 1066–1073). Norfolk VA: Association for the Advancement of Computers in Education.
- Lam, P., & McNaught, C. (2008). A three-layered cyclic model of eLearning development and evaluation. *Journal of Interactive Learning Research*, 19(2), 313–329.
- Laurillard, D., & McAndrew, P. (2003). Reuseable educational software: A basis for generic learning activities. In A. Littlejohn (Ed.). *Reusing online resources: A sustainable approach to e-learning* (pp. 81–93). London: Kogan Page.
- McNaught, C. (2002). Adopting technology should mean adapting it to meet learning needs. *On The Horizon*, 10(4), 14–18.
- McNaught, C. (2005, November 24–25). From diagnostic feedback to university policy: Programme-level evaluation at a Hong Kong university. In C. S. Nair (Ed.), *Communicating evaluation outcomes: Issues and approaches: Proceedings of the 2004 Evaluation Forum*, Melbourne (pp. 96–106).

McNaught, C., & Lam, P. (2005). Building an evaluation culture and evidence base for e-learning in three Hong Kong universities. *British Journal of Educational Technology*, 36(4), 599–614.

McNaught, C., Lam, P., Keing, C., & Cheng, K. F. (2006). Improving eLearning support and infrastructure: An evidence-based approach. In J. O'Donoghue (Ed.), *Technology supported learning and teaching: A staff perspective* (pp. 70–89). Hershey, PA: Information Science Publishing.

Mohan, P., & Greer, J. (2003, June 23–28). Reusable learning objects: Current status and future directions. In D. Lassner & C. McNaught (Eds.), *ED-MEDIA 2003: Proceedings of the 15th Annual World Conference on Educational Multimedia, Hypermedia & Telecommunications*, Honolulu, Hawaii (pp. 257–264). Norfolk VA: Association for the Advancement of Computers in Education.

Nesbit, J. C., & Li, J. (2004, July 21–25). *Web-based tools for learning object evaluation*. Paper presented at the International Conference on Education and Information Systems: Technologies and Applications, Orlando, Florida. Retrieved April 1, 2008, from http://www.sfu.ca/~jzli/publications/Nesbit_Li_2004.pdf

Nielsen, J., & Mack, R. L. (1994). *Usability inspection methods*. New York: John Wiley & Sons.

Oliver, M. (2000). An introduction to the evaluation of learning technology. *Educational Technology & Society*, 3(4), 20–30.

Oliver, R., Harper, B., Hedberg, J., Wills, S., & Agostinho, S. (2002). Formalising the description of learning designs. In A. Goody, J. Herrington, & M. Northcote (Eds.), *Quality conversations: Research and development in higher education. Proceedings of the Annual International Conference of the Higher Education Research and Development Society of Australasia*, 25, 496–504. Jamison, ACT: HERDSA. Retrieved April 1, 2008, from <http://www.ecu.edu.au/conferences/herdsa/main/papers/ref/pdf/Oliver.pdf>

Patton M. (1997). *Utilization-focused evaluation: The new century text*. (3rd ed.). Thousand Oaks, CA: Sage.

Reeves, T. C., Benson, L., Elliott, D., Grant, M., Holshuh, D., Kim, B., Kim, H., Lauber, E., & Loh, S. (2002, June 24–29). Usability and instructional design heuristics for e-learning evaluation. In P. Barker & S. Rebelsky (Eds.), *ED-MEDIA 2002: Proceedings of the 14th annual World Conference on Educational Multimedia, Hypermedia & Telecommunications*, Denver (pp. 1615–1622). Norfolk, VA: Association for the Advancement of Computers in Education (AACE).

Tessmer, M. (1993). *Planning and conducting formative evaluations: Improving the quality of education and training*. London: Kogan Page.

Tory, M., & Möller, T. (2005). Evaluating visualizations: Do expert reviews work? *IEEE Computer Graphics and Applications*, 25(5), 8–11.

University of Cambridge. (2006–07). *Sharing the LOAD: Learning design taxonomies*. Retrieved April 1, 2008, from <http://www.ucel.ac.uk/load/taxonomies.html>

Wiley, D. A. (2003). *Learning objects: Difficulties and opportunities* (Academic ADL Co-Lab News Rep. No. 152- 030406). Retrieved April 1, 2008, from http://opencontent.org/docs/lo_do.pdf

KEY TERMS

Incident Focus: The Web is intended to display well-defined real cases and scenarios. Discussion is on the incident and understanding its context.

Interactive: Students receive quite comprehensive pre-installed feedback from the computer system. This can be adaptive to students' input. Alternatively, students may receive feedback from their peers and/or teachers.

Learning Designs: Learning designs are an amalgamation of Web functionality, learning materials/objects and/or activities, all arranged with specific learning intentions.

Management: The Web is intended to facilitate class management such as online distribution of handouts and announcement of venues, special events, and so on.

Non-interactive: The materials on the Web are for viewing or downloading only. The computer provides no feedback or very simple (e.g., yes/no) feedback to students' input.

Role Focus: The Web is intended to support students in playing the role of a professional in the field of study. Discussion relates to ill-defined real cases and scenarios in the field and the different strategies used in different professional roles. A strong focus on immersion in authentic real-life situations.

Rule Focus: The Web is intended to enhance the teaching and explanation of knowledge and concepts.

Strategy Focus: The Web is intended to support students in learning how to handle ill-defined realistic problems, cases, and scenarios in the field of study. Discussion is on appropriateness of treatment and/or alternative treatments. Here, the focus is on the development of useful learning processes.

APPENDIX

Original List of 22 Web Functions with Descriptions

A. Communication

Asynchronous

1. *Forum.* A virtual space for displaying of the written message exchanges for the whole

class or selected groups of students in the class. **Online forums** and **newsgroups** are the two most common ways to realize this function.

Synchronous (can be reviewed when the exchanges are archived)

2. *Chat-room.* **Real-time text-based** message exchanges usually between more than two parties over the Web. Messages are viewable by all members participating the chat-room session.
3. *Graphic-enabled Chat.* Extended chat-room that enables exchanges of messages that **contain graphics** as well as text.
4. *E-lecturing.* **Virtual lectures** in which the students listen to and often also view teachers instructing online real-time. In some advanced system, the e-lecturers may also show PowerPoints while they teach and/or accept questions from the floor raised by the learners.
5. *Video-conferencing.* **Virtual conferences** in which the participants (two or more) view and chat with each other real-time in front of their video-enabled and broadband-connected computers.

Time-independent

6. *Role-play.* Students play certain **roles** relevant to their areas of study and do online activities using the forum or other Web communication tools.

B. Assessment and Feedback to Learners

7. *Quizzes.* Online exercises that give immediate feedback to learners. Questions may take many different formats: for example, **true/false (T/F) questions, multiple choice (MC) questions, open-ended questions, or even exploratory-type simulations.** Feedback may take the form of giving some

hints, giving the suggested answers, or giving both the answers and the explanations to learners.

8. *Online feedback on assignments.* **Uploading** of assignments to the Web site by students as an official way of work submission. The functions usually go with an **online marking system** in which the students can view their teachers' comments and the grades given to their work online.
9. *Peer review.* Students **view** their peers' work online and then give their **comments** on each other's work. The comments can be viewed on the Web site.

C. Study Management and Skills Support

10. *Course information.* Description of the course, its **objectives**, **schedule**, **mark allocations**, and/or **assignment and examination** specifications.
11. *Teacher's information.* Information about the teachers and tutors. It may include teachers' and/or tutors' **background**, **research interests**, **office hours**, **e-mail addresses**, and/or links to **personal homepages**.
12. *Lecture notes and/or PPTs.* **Storage** of lecture notes and/or ppts the students may need before or after the lectures. Some teachers may add a time-release function to these **downloadable materials** so that the students do not get the things earlier than teachers think they should.
13. *Lab notes/Lab handbooks/Tutorial questions.* **Storage** of laboratory notes and/or tutorial question sheets that students may need before or after laboratory or tutorial sessions.

14. *Learning skills (tips, links, inventories).* **Self-learning materials** on improving learning skills which the teachers think are important to the course. The skills may include reading skills, information-searching skills, and presentation skills.

D. Enrichment

15. *Online learning resources.* **Learning materials** that can be **text-based**, **graphically-rich**, or even **multimedia-enabled** built by the teachers to enhance the students' learning of the course.
16. *Past papers and assignments.* **Archived** past assessments (exam papers and/or selected work of the students) to give students a better understanding of the course and the subject matter.
17. *Glossary.* **Explanations of terms** commonly used in the course (prepared by the teachers or linked to external sites).
18. *FAQ on content.* Collections of **answers to commonly-asked questions** concerning the course content.
19. *Cases and scenarios.* **Stories of real cases** in the field of study to give students greater understanding about the professional life of the discipline and the application of the knowledge in real situations.
20. *Students' work/presentations as resources.* **Online exhibition** of selected work or presentations of students.
21. *Role-related games.* **Game-like activities** designed to enable students to learn while they play certain roles in their field of study.
22. *Tools.* Provision of **practical tools** essential to the subject. For example, a teacher may put up software for typing formulae for students to download so that they can type in formulae in their assignments more easily.