A Three-Layered Cyclic Model of E-Learning Development and Evaluation

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Evaluation is often depicted as being in a cyclic relationship, together with the planning, development, and implementation aspects of e-learning in higher education. This article supports this view and elaborates the multiple roles evaluation can have. We present a three-layered cyclic model developed during an e-learning support project: e3Learning (e3L). Formative evaluation can refine e-learning planning and development before implementation; however, the emphasis of this article is on the contributions of summative evaluation. Experiences during the e3L project reveal two key roles of evaluation from summative data: (a) Evaluation assists teachers in improving their e-learning strategies in further rounds of planning and development; and (b) evaluation can also provide evidence through meta-analyses across projects, which can feed into overall e-learning planning, development and evaluation strategies.

THE ROLE OF EVALUATION IN E-LEARNING PROJECTS

E-Learning projects can greatly benefit from evaluation. Reeves and Hedberg (2003) suggested that the integration of evaluation into all technology-enhanced interactive learning systems is essential. Kennedy (1998) commented that formative and summative evaluation addresses a broad range of issues from interface design to student learning outcomes and is thus "fundamental in courseware development" (p. 375). There is a cyclic relationship (Phillips, 1997) between evaluation and the other planning and implementation stages of an e-learning project: planning and implementation lead to evaluation, but evaluation also loops back into the planning and implementa-

tion stages by providing feedback and data for reflection. In this article we wish to elaborate these cyclic relationships by looking closely at the benefits resulting from a range of e-learning evaluation strategies. We will do this using evidence collected from evaluation of 70 e-learning projects under the auspices of the e3Learning project which operated in three Hong Kong universities during the period 2003-2005. The data from these 70 projects led to a three-layered cyclic model of e-learning development and evaluation.

E-Learning evaluation takes place in different stages of the development and implementation of e-learning projects, usually with different purposes. Evaluation can be roughly distinguished into two main types of evaluation, formative and summative. Formative evaluation often co-occurs with development so that the e-learning product can be improved as it is being developed (Khan, 2005). Summative evaluation, on the other hand, is usually conducted as the final assessment of the material or strategy. The distinction, however, should not be taken as a clear-cut dichotomy. Mandinach (2005) explained that supposedly summative evaluations can be formative, especially if the goal of evaluation is to provide constructive feedback and is linked into a model of evaluation based on continuous cycles of improvements and redevelopment.

There are diverse evaluation strategies involving both qualitative and quantitative methods. Very often multiple strategies are used in a single case to "triangulate results" and "enhance creditability" (Oliver, 2000, p. 1437). Evaluation strategies for formative e-learning evaluation can include strategies such as checklists to confirm functions and accuracy, carrying out usability trials of product prototypes, or conducting pilot tests with a smaller number of subjects before using the online component in full scale. Summative evaluation strategies can range across open-ended comments from participants, structured closed surveys, focus-group meetings, investigation of the engagement in online activities through the web activity logs, and/or analyses of students' learning outcomes through monitoring, comparing, and contrasting students' various forms of performance.

With such a diversity of evaluation purposes and strategies, benefits from evaluation are naturally also varied. For example, formative evaluation, of course, can assist the further improvement of learning materials before their actual use. A classic design for formative evaluation is that of Tschirner, Muller, Pfeiffer, and Thomsen (2006) who did three pilot tests with small groups of students (<30) focusing on usability issues in online multimedia examinations in preparation for a later implementation on a larger scale. A valuable approach to summative evaluation is exemplified by McPherson (2004) and Levy (2003) who carried out evaluation studies as action research studies or practice-based research. Such studies are capable of providing rich descriptions of what works well in particular contexts.

Benefits from evaluation can also extend further than single individual e-

learning projects. One example is the evaluation of learning object repositories. Nesbit and Li (2004), for example, proposed a system to evaluate a pool of learning objects in a repository. The learning materials were examined for content quality, learning goal alignment, feedback (perhaps in an adaptive form), motivation, and presentation designs. The evaluation of individual learning objects should benefit future users in selecting the most appropriate learning objects. However, as Jones and McNaught (2005) demonstrated, developing a robust and pragmatic evaluation system for learning objects does not ensure it will be used by other developers. Other broad evaluation designs include meta-analytic studies such as McNaught and Lam's (2005a) examination of 58 e-learning cases in Hong Kong universities in order to deduce the most popular e-learning strategies at use in Hong Kong. (In this study, sadly from our point of view, fixed learning resources such as glossaries, notes, and PowerPoints were the most popular).

CONTEXT OF THIS STUDY

The e3Learning (e3L) project (enrich, extend, evaluate learning; e3L), which was designed to assist teachers in web-assisted teaching and learning, conducted a wide range of e-learning evaluations. The project offered a range of design, development and evaluation services. For each subproject or case, a team was formed whereby teachers had access to educational and technical support. Full details of the design of this project are in James, McNaught, Csete, Hodgson, and Vogel (2003) and the project website. The e3L project operated across three universities, the Hong Kong Polytechnic University, the City University of Hong Kong, and The Chinese University of Hong Kong. Over a 30-month period, the e3L project supported the web development of 139 subprojects designed to actively assist teaching and learning in courses. Evaluations of 70 sites in use within authentic course contexts were completed. The project had an evaluation officer (first author) who actively assisted teachers with evaluation of the websites developed under the auspices of the e3L project. The project formally ended early in 2006, and has been replaced by other e-learning service projects in each of the three e3L universities.

The rationale and the benefits of designing a flexible evaluation mechanism that can handle a wide variety of e-learning developments are reported in an earlier paper, Lam and McNaught (2004). The evaluation system can account for the individual preferences of each teacher and the specifics of each course design. The evaluation procedure assisted teachers to articulate their objectives in using the technology, and then the evaluation officer worked with teachers to design evaluation strategies and instruments to answer the evaluation questions the teachers had formulated about their websites and their students' learning. The strategies used by the evaluation

research team to effectively carry out a diverse range of investigations using this flexible mechanism are explained in Lam and McNaught (2005). These strategies include systematic procedures to foster communication between teachers and the evaluation research team; and internal workflow processes within the evaluation team which ensured within-team mutual understanding, staff development and team spirit.

The focus of this article is a consideration of how the experience of all these evaluation studies feeds into our understanding of how evaluation can enhance teaching and learning at the level of the individual teacher and courses, and also at a broader level of informing the local and global e-learning communities. In addition, we will outline how our understanding of how to carry out e-learning evaluations has been enhanced. The actual data from and evaluation "stories" of many of these evaluation studies can be found in the papers and articles recorded in the references. An overview of the nature of these is given in the discussion of cycle c1 on p. 320 below. The intention in this article is to look more globally at the whole e3Learning experience and illustrate with evidence the claims that are frequently made about how "good" evaluation is.

THE CYCLICAL NATURE OF E-LEARNING PROJECTS

The experiences of the e3L project have provided the data in this article to enable the analysis of the various contributions of e-learning evaluation. Phillips (1997), in his description of the incremental prototyping interactive multimedia development model, pictured the development process as having a cyclic relationship with evaluation (formative) serving to perfect the multimedia products: "production proceeds through a cycle consisting of design, develop, evaluate, until the project is finished and implemented or installed" (p. 38). Phillips's graphical representation of the cyclic process is adapted and significantly extended in Figure 1 to cover also two major contributions of summative evaluation during the implementation stage.

Figure 1 illustrates the multiple contributions that evaluation can make:

   a. First of all, formative evaluation assists the process of refining materials and activities during development before implementation.

This article, however, concentrates on the contributions of summative evaluation in the implementation phase.

   b. The contributions evaluation can make towards the planning, development, and even the implementation stages of the original subproject or case (the middle circle in Figure 1). Summative evaluation provides evidence of the strengths and weaknesses of the e-learning strategies adopted in the specific case. This can assist individual teachers to improve their original e-learning designs.
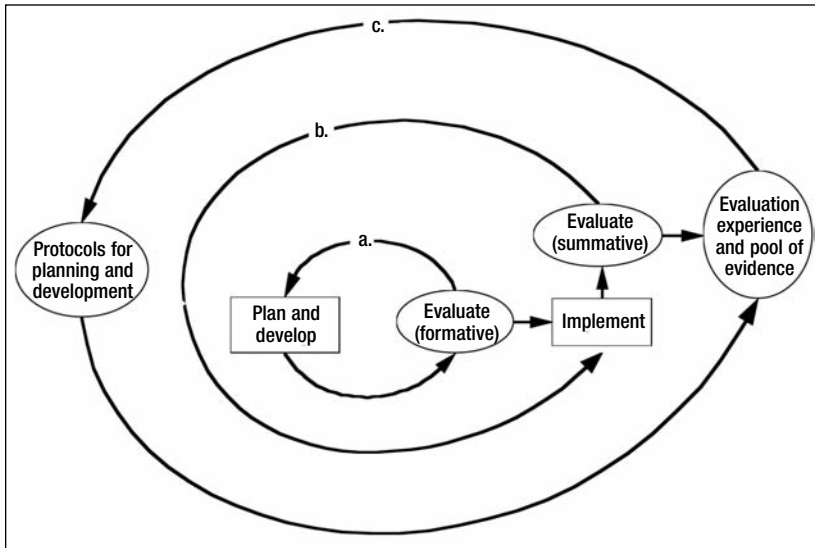
Figure 1. E-Learning development cycles with three layers of circles
        (a, b and c explained in text)

    c. The contributions towards overall approaches to development and evaluation. This can affect future subprojects (the outer circle in Figure 1). Summative evaluation can lead to:

      c1 new ideas on more effective e-learning strategies, which are then available for all teachers; and

      c2 refinement of the evaluation strategies used in future studies. Accumulation of evaluation experiences and reflection of these experiences can contribute to the advancement of evaluation methodologies, and the tools and strategies used.

As the e3L project came to closure, we were able to provide evidence about the nature of the loops in the cycles of Figure 1.

CYCLE B: ASSISTANCE FOR THE PLANNING, DEVELOPMENT, AND IMPLEMENTATION OF THE ORIGINAL CASE

The overall design of the e3L evaluation process can be considered as a reflection–improvement model in which the findings of the evaluation contribute to further improvements in each of the web-assisted courses under

investigation. For example, one of the e3L subprojects involved a set of innovative (for Hong Kong) online peer-review activities. The experience was carefully documented (Mohan & Lam, 2005), and these reflections of the approach's strengths and weaknesses have been used by Mohan and also by other individual teachers in Hong Kong.

Improvements made by individual teachers to their courses can be seen in an investigation of the 13 "repeat" teachers who revisited the project for further services after the first round of implementation and evaluation of their e-learning strategies. Project records show that all of these teachers had already made modifications to their e-learning strategies based on the evaluation data they had received by the second time they came to our project. For example, one teacher used the forum for free discussion of subject-related news. Evaluation, however, revealed that postings by the students were infrequent and the students perceived the forum activity as not very helpful. In the following year, the teacher gave the forum a more organized structure with fixed discussion topics for students to express their opinions in groups.

Each e3L case had a formal evaluation plan with the evaluation questions being formally noted. The template for the evaluation plan can be seen at http://e3learning.edc.polyu.edu.hk/Eval/ evaluationPlanTemplate.doc; actual examples of evaluation plans can be seen in the four evaluation cases on the project website. At the beginning of each subproject, the evaluation team had discussions with the teacher(s) concerned in each of the cases to decide on the evaluation questions. These evaluation questions were clearly recorded in each case's evaluation plan, which also documented the evaluation strategies used to best answer the questions.

McNaught and Lam (2005b) studied the evaluation questions asked in all 70 cases of the project. The 13 "repeat" teachers were involved in 26 cases. It is interesting to examine how the evaluation questions of these 13 teachers changed. Eleven of the 13 teachers had different evaluation questions the second time round. Major changes in the teachers' evaluation interests in their subsequent attempts of e-learning strategies are noted in Table 1, which shows the evaluation questions added or dropped by this group of 13 teachers. Comparing the second round of e-learning evaluation with the first round indicates how the teachers' concerns have changed. In general, in the second evaluation, teachers were less interested in learning about students' opinions on the e-learning materials and their ideas to further improve them; this may be because the teachers felt they had enough understanding of the materials and had already dealt with improvements. Teachers' attention had shifted to identifying learning outcomes. These changes between evaluation of the first and second rounds of a teacher's course thus indirectly support evaluation contributing to better planning, development and implementation when teachers are given feedback so they can learn from their previous experiences.

Table 1
Changes of Evaluation Questions in Cases Where Teachers Asked
for Repeated Services

Common evaluation questions to <u>add</u> in the second round	Common evaluation questions to <u>drop</u> in the second round
learning outcome: remember or understand concepts (6)	usability of the e-learning environment (4)
general feelings towards e-learning (4)	ideas for improvement (3)
learning outcome: apply knowledge and analyze situations (2)	quality of content of the e-learning environment (3)
learning outcome: evaluate and create knowledge (2)	pattern of student use during implementation (2)
general benefits to learning (2)	technical problems met during implementation (2)
enhancement on motivation to learn (1)	

Note: the numbers in brackets indicate the instances the specific evaluation question was added or dropped from the subsequent evaluation plans

Benefits of evaluation to individual teachers can also be seen in email messages such as:

> I wanted to acknowledge what a first-rate job you have done (and please convey to others should they have assisted), on compiling a rather daunting data set (mixed quantitative and qualitative aspects). Your masterful compilation of the feedback will enable us to design Phase II even better, as well as enhance the quality of this innovative professional education project in physical therapy.

> Thanks for your report which I have already read with interest! I have gone through all of it…I really appreciate your efforts to enhance the course…I'm cc'ing this to <another teacher of the course>, in case she sees it while she's on leave or else early Monday before our meeting, as she was also quite involved in teaching the course.

> All comments are very valid and will definitely help us to improve not only the way we will run our video-linked sessions next year but also our teaching.

So, we can see that the flexible evaluation services we provided for teachers had significant impact on the teachers' e-learning strategies. Evaluation thus can provide helpful answers to teachers' queries through the use tailor-made evaluation plans, strategies and instruments. There is a feedback

mechanism operating whereby the results of these customized evaluations feed into teachers' actual e-learning strategies because teachers can develop a clear rationale for the decisions they make about which e-learning strategies are most appropriate for their context and their students. As they become more confident about their e-learning strategies, issues about technology may become less important, enabling teachers to pay more attention to pedagogical issues.

CYCLE C: REFINEMENT OF E-LEARNING APPROACHES

c1 More Effective E-Learning Strategies

As the b arrow on Figure 1 shows, evaluation benefited teachers even the first time they came for e-learning support because the project staff had continually acquired knowledge from the planning, development, and evaluation of previous e-learning subprojects. As the e3L project progressed, we accumulated more and more experience on e-learning through the evaluation studies we conducted. This experience was disseminated in four main ways:

1. Suggestions about e-learning strategies were generated through meta-analyses across numerous e-learning cases. Many of these studies have been published. For example, Lam, Csete, and Hodgson (2005) summarized ways to improve e-learning strategies by enhancing three forms of interaction: learner–content, learner–instructor, and learner–learner. Lam, Cheng, and McNaught (2005) reviewed 13 educational online forums to identify relationships between the levels of teacher involvement, the designs of the discussion activities and the quality of discussion. McNaught and Lam (2005a) discussed the perceived usefulness of 17 common e-learning strategies and deduced some factors that influence these perceptions. Lam and McNaught (2006b) examined three sets of online strategies for facilitating peer and group assessment utilizing eResources, eDisplay, and eCommunication. Lam and McNaught (2006a) examined the role of media elements in online courses. The difficulties of developing complex online learning materials was examined and common challenges noted, such as miscommunication, and limitations in resources and expertise (McNaught, Lam, Cheng, Kennedy, & Mohan, in press). All of this accumulated experience is in the public domain.

2. One of the outcomes of the e3L project was an ePlanning matrix which was developed during the project to streamline the planning stage of new e-learning endeavours. This matrix lists the nature and purpose of e-learning strategies (Table 2) and is designed to be a

checklist for planning. The purposes (columns) represent the common reasons why teachers use the Web to assist teaching; this list is based on the experience of the meetings the evaluation team had with teachers in setting up evaluation plans. This matrix has the advantage of being a summary of a plethora of benefits web-assisted teaching might be able to bring, enabling teachers to focus on the specific purposes they might have in mind, and then assisting them in the selection of the appropriate e-learning strategies to match the purposes. More details about strategy planning can be found in Lam, Csete, and Wong (2005).

3. Six workshops, showcasing the project's experiences on e-learning support and suggestions for e-learning strategies, have taken place locally in our three universities in Hong Kong. In addition, there have been presentations externally in international conferences (see reference list) and at universities across Australasia.

4. The e3Learning experience was invaluable in a subsequent study of e-learning at The Chinese University of Hong Kong (McNaught, Lam, Keing, & Cheng, 2006) that has led to continued funding for e-learning support services. Without the evidence base generated by carefully evaluated studies, it is difficult to persuade university administrations that investment in e-learning has real benefits.

c2 Refined Evaluation Strategies

The next major contribution of evaluation is its feedback to the evaluation mechanism itself, resulting in refined and improved evaluation strategies. The evaluation strategies that were used to provide answers for different evaluation questions in the 70 evaluated e3L subprojects were examined. The evaluation plans recorded this level of detail. The evaluation strategies selected for the most frequently selected 12 evaluation questions are listed in Table 3. It should be noted that course-end surveys were conducted in 60 of the e3L subprojects.

A few general trends can be observed and explained as follows. First of all, questions concerning learning outcomes were less often asked in surveys because questions on these aspects recorded students' perceptions about learning only; further, they are sometimes difficult to answer in a questionnaire and the answers may not be reliable. The researchers were able to employ other means, such as the analysis of forum postings, assignments, examination performance, or through asking students' more detailed comments in focus-group meetings. Similarly, the question about e-learning usage patterns that students adopt is better recorded by the more objective log data than through students self-reporting in surveys. Lastly, questions

Table 2
ePlanning Matrix Showing the Nature and Purpose of Possible
E-Learning Strategies

Nature of e-learning strategy	Class management	Learning remember/understand	Learning apply/analyze	Learning	Motivation and affect	Approaches to learning	Engagement	Generic learning skills	Communication	Others
Content *Tend to enable simple interaction only* ❏ Course background ❏ Notes & PowerPoints ❏ Teachers' information ❏ Past papers ❏ Announcements ❏ Archives of student work ❏ Others…										
Content *Enriched interaction possible* ❏ Multimedia-rich explanations of concepts ❏ Cases & issues ❏ Simulations ❏ Extended readings ❏ Online quizzes Cases & stories in the field ❏ Concept mapping of subject topics ❏ Others… ❏ Linkage to other web resources ❏ Readings on learning skills										
Interaction with tutors ❏ Online discussion using forum/ email/ icq/ chatroom/ video conference, etc. ❏ Feedback on assignments ❏ Online community ❏ Others…										
Interaction with peers ❏ Online discussion using forum/ email/ icq/ chatroom/ video conference, etc. ❏ Web-based group projects ❏ Online community ❏ Others…										

Purpose of e-learning strategy

about usability and improvement ideas are not regularly handled by surveys as the researchers found students unwilling to write lengthy feedback. Focus-group meetings became the major alternative method to collect students' ideas on these aspects. Throughout the project, the e3L project staff became more experienced in designing appropriate evaluation strategies.

Apart from the trend of using a variety of evaluation strategies, there was also a refinement of the most commonly used strategy: the survey. First of all, the flexible nature of our evaluation process produced a range of questionnaires to cater for the diverse evaluation needs of the individual cases. The questionnaire items were kept to facilitate future evaluation processes. The latest version of this question pool can be viewed at the evaluation resources section of the e3L project site at http://e3learning.edc.polyu.edu.hk/Qdb.htm

We analyzed the questionnaire items used in each of the evaluation cases to show how our survey strategy underwent continuous refinement as evaluation experiences accumulated and the lessons learnt provided feedback back into the system. For example, as the project proceeded, more questionnaire items focused on predevelopment issues such as learners' needs and expectations of the web component. As a result the evaluation took on a more comprehensive function which assisted the planning stage. The shift of attention to include the predevelopment aspects can be seen in Figure 2 in which the questionnaire items are classified into those that seek comments or data on the following four areas: (a) predevelopment (aspects that concern students' needs and habits before the web development), (b) environment (concerning
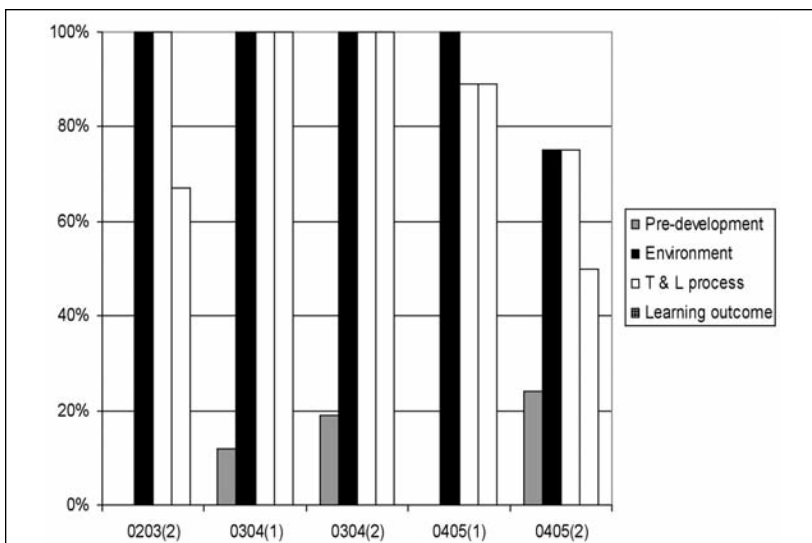

Figure 2. Main types of questionnaire items for each semester

Table 3
Matching Evaluation Questions With Appropriate Evaluation Strategies

Evaluation questions recorded in evaluation plan	No. of cases with evaluation question	Cases where question asked using surveys		Cases where question tackled by other strategies		The other strategies used
		No.	%	No.	%	
learning outcome: evaluate and create knowledge	5	0	0.0	5	100.0	content analysis of postings, assignments and exams, focus-group meetings
learning of subject-specific skills	6	1	16.7	5	83.3	assignments, lab sessions, focus-group meetings
ability to reflect on own learning	5	1	20.0	4	80.0	focus-group meetings
enjoyment of the online activities	8	2	25.0	6	75.0	focus-group meetings
learning outcome: apply knowledge and analyse situations	13	4	30.8	9	69.2	content analysis of postings, assignments and exams, focus-group meetings
learning outcome: remember or understand concepts	20	8	40.0	12	60.0	content analysis of postings, assignments and exams, focus-group meetings
general feelings towards e-learning	25	13	52.0	12	48.0	focus-group meetings
usability of the e-learning environment	20	12	60.0	8	40.0	user tryout sessions, focus-group meetings
general benefits to learning	43	26	60.5	17	39.5	content analysis of postings, assignments and exams, focus-group meetings
ideas for improvement	40	26	65.0	14	35.0	user tryout sessions, focus-group meetings
quality of content of the e-learning environment	40	26	65.0	14	35.0	user tryout sessions, focus-group meetings
pattern of student use during implementation	47	35	74.5	12	25.5	site logs

the usability and quality of the web development), (c) teaching and learning process (concerning opinions and feelings towards participating in the web activities), and (d) learning outcome (concerning benefits to learning).

There was also a trend for the questionnaire items to become more refined and specific during the later part of the project. They were thus able to tap into feedback on more detailed subareas within each of these four main themes. For example, as Table 4 shows, questionnaire items on "difficulty," "improvements," "class management," and "workload" gradually appeared in the later surveys of the project, allowing the evaluation strategy to obtain more detailed evidence about the teaching and learning process.

Table 5 shows a similar trend in the "learning outcome" type of questionnaire items: the evaluation strategy improved progressively as new questions were used to ask about more specific areas in learning outcomes. That is, not only were we interested in the general benefits to learning which were represented in surveys by questions like "Did you find the materials helpful to learning?," but we became more conscious about how to differentiate potential learning benefits: "confidence," "generic learning skills," "building of a sense of community," and change to the "approaches taken to learning," and so forth.

In summary, the lessons learned through reflections on the evaluation strategies themselves can lead to enhanced processes for evaluation. We have refined our understanding of how to use a wider range of evaluation instruments and developed skills in the implementation of these strategies. For example, in the use of surveys, questions become more refined through the constant revision and reuse of previous items.

Table 4
Percentage of Questionnaire Items Concerning Various Aspects of
the Teaching and Learning Process

Focus of questionnaire item	0203(2) %	0304(1) %	0304(2) %	0405(1) %	0405(2) %
Nonweb course arrangement	16.7	11.8	0.0	0.0	25.0
Meaningful/effective communication	16.7	23.5	75.0	29.4	0.0
Difficulty	0.0	*5.9*	*12.5*	*17.6*	0.0
Enjoyment	16.7	41.2	87.5	29.4	25.0
Improvements	0.0	*11.8*	*37.5*	*11.8*	0.0
Class management	0.0	*17.6*	*6.3*	*11.8*	0.0
Technicality	0.0	5.9	0.0	0.0	0.0
Usage pattern and engagement	83.3	88.2	75.0	64.7	50.0
Workload	0.0	0.0	*31.3*	*17.6*	*50.0*

Table 5
Questionnaire Items About Different Learning Outcomess

Aspect of learning outcome	0203(2) %	0304(1) %	0304(2) %	0405(1) %	0405(2) %
Confidence	0.0	*17.6*	*12.5*	*23.5*	0.0
Generic learning skills	16.7	*23.5*	*81.3*	11.8	0.0
Motivation	16.7	23.5	6.3	23.5	50.0
Preparation	0.0	5.9	18.8	5.9	25.0
Reflective learning	0.0	0.0	37.5	11.8	0.0
Relationship/sense of community	0.0	0.0	*25.0*	*11.8*	0.0
Revision of taught topic	0.0	0.0	0.0	17.6	25.0
Scope of learning	0.0	5.9	0.0	0.0	0.0
Self-study on content	16.7	11.8	37.5	5.9	0.0
Subject-specific skills	0.0	11.8	12.5	17.6	0.0
Approaches to learning/ learning styles	0.0	*17.6*	*6.3*	*23.5*	0.0

CONCLUSION

In the e-learning development cycles, evaluation contributes to improvement of existing materials, and the better planning, development, implementation, and evaluation strategies of overall e-learning practice. The article has presented the details of these contributions using data from 70 subprojects in the e3L project. Formative evaluation is able to refine e-learning planning and development before implementation. In the e3L project, there were two main areas of benefit from summative evaluation:

• first of all, it benefits planning, development, and implementation by providing feedback to teachers to improve their e-learning strategies. Our experience has shown that teachers' use of e-learning strategies became more mature as evaluation supplied the data for reflecting on their previous practices. Teachers became more skillful in planning their evaluation strategies. Their evaluation questions also shifted from the earlier ones that were about look and feel of the materials, to the ones that focused on core issues such as the benefits to teaching and learning.

• second, evaluation experiences can accumulate and be transferred into refinement of e-learning planning tactics for future requests for development and evaluation support. For example, teachers who are new to e-learning can gain e-learning ideas through papers and workshops. The

ePlanning matrix is one tool which we developed based on empirical data. This matrix assisted us to better understand the various web functions and the educational intentions behind the various ways the Web can be used. The matrix serves as a useful tool to assist teachers in positioning their e-learning strategies during the planning stage. The matrix, in the present or in a simplified format, has been used in many occasions of our subsequent e-learning projects with teachers. Also, apart from advances in describing e-learning strategies, our evaluation experiences provide the grounds for continuous refinement of the evaluation mechanism as well. For example, accurate questions have been devised to ask for the more specific aspects of the e-learning context under investigation, and evaluation instruments (such as the question pool) allow reuse of good items.

The findings illustrate the three-layer cyclic representation depicted in Figure 1. Furthermore, they clearly confirm the indispensable role evaluation has in e-learning development and implementation. We have provided an evidence base for the often-made claims that evaluation can inform teaching and learning for individual teachers and also for the whole e-learning community.

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