Developing a Standardised Evaluation Methodology for Computer Based Learning Materials

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Abstract

The UK-based EASEIT-Eng project (http://www.easeit-eng.ac.uk/) aims to encourage or enhance the usage of existing engineering computer-based learning materials by enabling an academic tutor to make an informed choice from a range of evaluated software. This is being achieved through: (1) establishing standardised evaluation criteria and hence an evaluation methodology, (2) conducting evaluations, focusing primarily on producing case studies of actual implementations of software and (3) providing web access to these evaluations through a dedicated, fully searchable database. The evaluation methodology described in this paper was developed with the intention that the resource demanded by an evaluation would be: (1) manageable from the perspective of the evaluator, (2) acceptable from the perspective of the academic tutor delivering the software and (3) sustainable in the sense that further evaluations could be conducted with minimal funding beyond the life of the project. The development of this unique methodology also drew on established good practice and procedures, including particularly the ANSI Dental Informatics Guidelines [1] and the NEEDS database [2]. The resulting Evaluation Manual, which has been in use since September 2000, offers full guidance on the principles behind the approach to evaluation, details on how to conduct each part of the evaluation and access to the evaluation tools. The Manual should enable new evaluators to train themselves to conduct evaluations and use the tools developed. To date, EASEIT-Eng has 42 case studies and 39 reviews covering 53 different software implementations (over 40 different products) in all the major Engineering subject areas, either completed or in progress. Academics from over 20 different UK universities have participated in the project.

Introduction

While the use of computer-based learning in higher education is continuing to grow, there are still obstacles in the way of its uptake that need to be overcome. The process of selecting a suitable piece of software from an increasing wealth of such packages can be an arduous task for a busy academic tutor. The difficulty of comparing resources increase when various criteria, e.g. cost-effectiveness, ease of use and quality of support, student learning gain and student motivation come into play. Having made the decision to use computer based learning

(CBL) tools, it is often difficult to identify software that will best deliver the subject material being taught while meeting the students' learning needs. This paper describes how the UK-based EASEIT-Eng (Evaluative and Advisory Support to Encourage Innovative Teaching in Engineering) project aims to address the issues surrounding the choice and implementation of CBL software in Engineering Higher Education and to enhance the existing usage of such software. By evaluating a range of Engineering teaching software using the project's standardised evaluation process and creating a fully-searchable database of software reviews and evaluation case studies, EASEIT-Eng seeks to make the task of choosing and implementing such software an easier one. These reviews and evaluation case studies indicate strengths and weaknesses of a particular application of the CBL software as well as the software itself. In addition to offering an introduction to an evaluation methodology with potential for wide-spread applicability, this paper will be of interest to the many projects and services in the field of Learning Technology that rely on securing practitioner involvement for their success.

The Project

The main aim of EASEIT-Eng is to enable engineering academics to make an informed choice from a range of evaluated CBL materials through the development and use of a standardised evaluation methodology.

For the purpose of the project, the software resources of interest were defined as those whose primary purpose or contextual use has a declared pedagogical intent within Engineering higher education. Software tools such as computer aided design software or data analysis packages are, therefore, excluded by this definition.

Engineering academics from 5 universities were initially involved in this consortium project. These academics had experience in the use of learning technology resources for their own courses and in some cases had also been involved in the development of such resources. Their involvement in the project ensured that the decisions EASEIT-Eng made were dictated by the needs and views of the people at whom the project was aimed, rather than by what others thought engineering academics would want. Feedback from the academics who took part in evaluations confirmed and expanded on the views which had been instrumental in the development of the evaluation methodology.

The first stage of the project established standardised software evaluation criteria and hence an evaluation methodology. The development of this unique methodology drew on established good practice and procedures, including particularly the ANSI Dental Informatics Guidelines [1] and the NEEDS database [2]. The methodology was further tuned as the project progressed. Based on this methodology, software evaluations have been conducted, focusing primarily on producing case studies of real implementations of software use. The findings from these evaluations are in a fully searchable dedicated database, freely accessible through world wide web.

The evaluation process also examines the users' views of the software implementation, suggesting improvements to the software and the way it is used. This provides the academic tutor with an opportunity to reconsider good practice in using CBL resources: an outcome which has been instrumental in persuading many academics to devote time to EASEIT-Eng evaluations.

The Aspects for Evaluation

An extensive list of aspects of software that would be of interest in the evaluation of CBL software has been generated. These aspects are important factors or information for an academic tutor considering using CBL resources or expecting to enhance an application of CBL.

Aspects of Evaluation	Review		Case Study				
	E-E	Qu	P-EQu	Int	Obs	F/b	Wrap-up
4b: Evaluating the package: Is the material written in a third party authoring package?							
Is CBL package written in a third party authoring package e.g. Question Mark, Authorware, web-authoring? Which one?	✓						
Comment on authoring skill of author e.g. enthusiastic academic, professional technical author				✓			
Comment from author on ease with which CBL package was prepared inside chosen authoring package				✓			
4c: Evaluating the package: What technical considerations are associated with the CBL package?							
Delivery medium: web, CD-ROM etc.	✓						

The table above is a small excerpt from the evaluation overview matrix, showing some questions and the mechanisms to be used for evaluation. The individual aspects are not themselves intended to be read as questions but were intended to promote development of the evaluation tools. These tools may be in the form of questions or issues to be probed. The design of the tools must be in an appropriate form for interviews, questionnaires, observations, feedback sessions or focus groups. A full list of the aspects is available in the EASEIT-Eng Evaluation Manual [3]

Evaluation Methodology

As the next step, a methodology was selected to achieve best coverage of the range of aspects with as few instruments as possible and appropriate data analysis leading to a report. The EASEIT-Eng methodology was developed with the intention that an evaluation should be manageable from the perspective of the evaluator, acceptable from the perspective of the academic tutor delivering the software and sustainable in the sense that further evaluations could be conducted with minimal funding beyond the life of the project.

Several frameworks and toolkits for evaluation have been published. e.g. TILT-E [4], the CTI Accounting CERT [5], ELT Evaluation Toolkit [6], the OU CIAO framework [7], the ASCILITE handbook [8] and the ILRT Evaluation Toolkit [9]. These frameworks seek to formalise and document the evaluation process in a way that brings out the underlying pedagogical principles and/or allows the relatively inexperienced to perform evaluations with a certain amount of quality assurance. Usually, this approach creates an evaluation strategy individually tailored to the educational issues relevant to the learning innovation being investigated. However, the ultimate aim of facilitating a choice from different CBL resources dictates that the evaluations must be standardised to the extent that, where appropriate and possible, they yield comparable information. This is not normally an issue relevant to the approaches mentioned above.

There are some examples where software evaluations have been carried out with the explicit aim of facilitating choice, e.g. WAMMI [10] and W3LS [11]. In each of these, users of different resources are asked more or less similar questions and the data from these questions yield a comparison of the resources used. Such an approach is most frequently applied to evaluating software aspects which vary least with context (such as navigability and other human-computer interaction issues as in the case of WAMMI) or using similar software in similar contexts (such as virtual learning environments in distance learning).

Input from engineering academics in the project team strongly suggested that the information on *how* a particular piece of software was used in a real context would be extremely valuable. This reflects current thinking in evaluation that the context of use of learning resources is critically important to its efficacy. The range of software and contexts that EASEIT-Eng evaluations have to deal with prompted the development of an approach which is more flexible than that taken by WAMMI and W3LS.

The methodology was designed to be flexible enough to fit individual situations with the aim of documenting the context of the software use and the opinion of the users (staff and students) regarding the performance and usability of the software against the criteria used. By following this methodology, different authors can produce comparable reports on the resources they evaluate.

EASEIT-Eng evaluations are conducted in two key stages. These separate the factual description of a software product from its actual use in an educational setting. A software review concentrates on factual information about a software product, examining context-independent features, such as technical content, user support, available documentation, installation issues and hardware requirements. An academic expert in an appropriate subject area performs this software review, completing a structured web-based questionnaire. Peer-review of the work of other academics is a well-established approach in academic research and one that academics trust. It is hoped that applying a similar principle to learning resources will encourage academics to trust the validity of material which they did not themselves author and thus encourage them to use it in their own courses. In turn, this will broaden ownership and further diminish the prominence of the "not-invented-here" label while, at the same time, generating a wealth of documented and reliable information of benefit to the creation of new or revised computer-based materials in the future.

The appraisal of the remaining aspects requires soliciting the opinion of students, academic tutors and other staff (e.g. technical support) involved in a specific software implementation. This is done in the second stage of the evaluation, where a case study of the actual implementation of the software is conducted by one of the project's trained Evaluators. This evaluation stage includes the following five key elements

1. Pre-evaluation interview to elicit the tutor's expectations of the software and acquire factual information required to customise evaluation instruments.
2. Observation of students' use of the software.
3. Feedback by means of student questionnaire.
4. Feedback by means of a student focus group.
5. Interview with the academic tutor to explore their conclusions on the value of the software and the success of its delivery.

The success of a software implementation is enormously dependent on the appropriateness of the delivery to the particular group of students involved. For this reason, a single piece of software for which there is a single software review may merit multiple case studies of implementations with different contexts.

Semi-automated analysis of questionnaire responses enables the Evaluator to prepare the case study report, which is the main output from the evaluation to describe how the software was actually used and how it was perceived by staff and students. Feedback can then be given to the academic concerned and comments on this report are invited from both the academic tutor and the author/publisher of the software. These comments are appended to the case study report, which is made available through the EASEIT-Eng evaluation database.

Making the information accessible and comparable

Access to the EASEIT-Eng reviews and case studies as well as reviews or evaluations from other sources is provided by a fully searchable database, accessible through the project web site (http://www.easeit-eng.ac.uk/). The EASEIT-Eng project team also work with other services in the UK with an interest in resource discovery for Engineering education to embed this information into a catalogue of electronic teaching and learning resources with a wider coverage of available material. Having found a resource for which EASEIT-Eng has gathered material, the user can choose to view the software review, case study reports or any other included non-EASEIT-Eng information. In order to facilitate comparison of software highlighted by a particular search, EASEIT-Eng reviews and case studies employ a standard format. Consequently, the user is presented with information on each software package of interest, in a format that is easy to assimilate and compare with data on other packages.

EASEIT-Eng evaluations do not set out to answer all questions to all academic users. Having identified a suitable piece of software, the user may then wish to seek further information from the software publisher and/or the academic involved in the evaluation on which the case study reports and information is made available for this purpose.

EASEIT-Eng compared with NEEDS

The aims of EASEIT-Eng are broadly similar to those of the NEEDS project [2], and so it is interesting to compare their approaches. The NEEDS database contains descriptions of a large number of computer based learning resources, and "NEEDS supports a multi-tier courseware evaluation system". In an early paper describing how this evaluation system had evolved [12], the Editor of the NEEDS database expressed the opinion that gathering information on the opinions and experience of students who used the software has greater potential to provide information on the suitability of that software for education than other evaluation models. This model of contextual evaluations was not, however, deemed suitable for the purposes of NEEDS due to it being very time intensive.

The EASEIT-Eng methodology is based on a model which elicits the opinions of students and staff, who are using the software on a real course. Partly our choice of a more time-intensive method may be due to our aiming to evaluate fewer software packages, or our having more resource to perform these evaluations. Also we have simplified the model for performing this type of contextual evaluation. Rather than start from scratch and try to design an evaluation that matches the aims of the software and the person using it, we evaluate against aims which are common to many Engineering academics in UK Higher Education. This is not to say that the methodology is a "one-size fits all" model: the aspects of the software which may be evaluated cover many possibilities, and those which are

irrelevant to a particular piece of software can be ignored. This simplification is a necessary consequence of wanting to compare the results of different evaluations and therefore we cannot design each evaluation entirely to suit the way in which the software is being used. The EASEIT-Eng methodology acts as a framework or toolkit which facilitates contextual evaluations aimed at comparing implementation of educational software. Feedback from academics confirms that the information gathered is useful and helpful.

The NEEDS peer review has also been designed to require less time from the reviewer than the EASEIT-Eng methodology requires from its evaluation hosts. This was in response to feedback from piloting their questionnaire [12] which suggested that it would be difficult to find reviewers willing to put in the time required for the original detailed version. This academic involvement has partly been secured by paying the tutors who host our evaluations a small sum, but we have also attempted to show that the evaluation process can be of mutual benefit; this is explored further in the next section.

Academic involvement

EASEIT-Eng evaluations greatly rely on the involvement of end users i.e. engineering academic tutors and students. The evaluation methodology requires some of their time (about half a day) and, to some extent, entails minimal interference with their teaching and learning process. In common with current practice in evaluation, evaluations have to be carried out in the context in which the resource will be used [13]. An EASEIT-Eng evaluation is therefore based on software being used by a real tutor and real students in a real course. This parallels Laurillard's judgement that "New technologies are too frequently introduced to students on an experimental, pilot basis without being properly integrated into their teaching. Students therefore see them as peripheral to the real teaching and invest less effort in them than they otherwise would. The only real test of any learning material is its use under normal course conditions" [14, p217].

Such a 'live' evaluation requires a degree of commitment from the academic tutor and a certain amount of intrusion into the classroom. The academic tutor is required to spend some time providing the information necessary to adapt the evaluation instruments and in contributing their opinion about the software and its usage. The evaluation methodology has been designed to minimise intrusion into the academic's teaching. The Evaluator does as much of the work as possible, reducing the time required from the academic hosting the evaluation.

It was found that it is important to publish barriers and difficulties related to hosting an evaluation along with benefits so an academic tutor who is willing to have an evaluation conducted understands the commitment expected. By being open about this from the outset, the situation where academics back out when some of the barriers and difficulties become clear, could be avoided.

On the positive side, focus groups identified the following benefits that the academics who had participated in an evaluation had enjoyed

1. Recognition: the case studies published by EASEIT-Eng conferred some form of recognition for academics who had put effort into thinking about their teaching.
2. Networking Opportunities: EASEIT-Eng evaluations brought academics interested in the use of CBL resources into contact with others with the same interests .

3. Support: the EASEIT-Eng Evaluator was able to provide some support and more was offered through the networking opportunities identified above.
4. Confidence: Several academics felt that the fact that their use of Learning Technology had been given the 'once over' by the external Evaluator and gave them (and their Head of Department) more confidence in its suitability

When involved, academics found the evaluation process was not onerous and was well worth undertaking; *'Didn't take a lot of effort', 'Got more out of it than I put in'* were typical of the comments made by them. Being involved in the EASEIT-Eng evaluation process gave academics more confidence in using novel teaching approaches, especially when presented with encouraging feedback from their students. On the whole, it was found that this degree of commitment is something that academics are willing to give on the basis that there are some benefits for them and as part of "doing their bit" for the Engineering HE community.

Evaluation Manual

The Evaluation Manual, which has been in use since September 2000, guides the evaluator through all aspects of the evaluation process, from initial contact with software users, observation of software use, techniques for obtaining useful feedback from users to writing an evaluation case study. The manual has attracted interest from diverse parties and should enable new evaluators to train themselves to conduct evaluations and use the tools developed.

In addition to the instructive text, the manual also contains a complete set of the practical tools required in carrying out an EASEIT-Eng evaluation. For reference, detailed flow charts outlining the entire evaluation process are included.

What the future holds

EASEIT-Eng is now in its fourth year. The first year was spent developing the methodology and evaluation tools. These were piloted in the second year, before their widespread use in the third year. To date, EASEIT-Eng has 42 case studies and 39 reviews covering 53 different software implementations (over 40 different products) either completed or in progress in all the major Engineering subject areas. Academics from over 20 different UK universities have participated in the project. As a result, the database has an extensive range of software reviews and case studies, with entries that should be of value to all engineering academics in higher education sector.

The fourth year of EASEIT-Eng will concentrate on further dissemination of the key generic outcomes to a larger group of end users and the embedding of EASEIT-Eng structures and data into existing, more permanent, dissemination resource. This will produce the following

1. Evaluator training workshops to disseminate the methodology to diverse groups (both within and beyond engineering).
2. Final publication of the Evaluation Manual.
3. Transfer of EASEIT-Eng to become a service of the UK's Learning and Teaching Support Network Centre for Engineering (LTSN Engineering) [15]. This Centre provides subject based support for the UK higher education engineering community in the area of learning and teaching.

Other activities ongoing in the fourth year include carrying out additional evaluations and updating the web-based database. In all, these activities will help to maintain the currency and vitality of the project.

Conclusions

Identifying the most appropriate CBL software for a particular situation often becomes difficult when a meaningful comparison of available software can not be made. EASEIT-Eng provides an efficient and independent means of evaluating software in the context of use. The evaluations do not make judgements about how software *might* perform, but report on *how* they actually performed in the real delivery of real Engineering content to real students.

The primary aim of EASEIT-Eng is to facilitate the widespread implementation of teaching software within Engineering higher education and this aim has been achieved by

1. developing and thoroughly testing a standardised method of evaluating CBL resources,
2. performing standardised reviews and case studies of many commonly used engineering CBL software packages and making them available via the web in a fully searchable database.

This database enables its users quickly to locate reviews, implementation based case studies and other information on software for use in the teaching of their particular field. Use of this database enables Engineering academics to make an informed choice of CBL software suitable for use with their students.

Feedback from these evaluations and the experience of EASEIT-Eng evaluators prove that the methodology is not too onerous on either the academic hosting the evaluation or on the evaluator. Many academics who hosted EASEIT-Eng evaluations have found that doing so was helping them rather than imposing on them and a positive evaluation gave them confidence in what they were doing. It has also provided academics with a valued opportunity for networking with others with a similar interest.

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