EVALUATING FLEXIBLE LEARNING MATERIALS

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ABSTRACT

Much effort is currently devoted to developing flexible learning materials. However, not nearly as much attention is given to evaluating them once they are delivered. Few evaluations gather objective research evidence about how and why particular materials work well. This paper will suggest a framework for evaluating flexible learning materials.

Evaluation

Evaluation studies vary along a continuum from experimental research (random assignment of subjects to experimental and control groups) to descriptive studies. Various classifications of evaluation models and approaches have been proposed, beginning in the early 70s (for example, Stake 1973, Worthen and Sanders 1973, Popham 1975, House 1978, Stufflebeam and Webster 1980). By 1987 more than 50 different models had been identified (Worthen and Sanders 1987).

Benson and Michael (1990) provide a broader classification for evaluation designs comprising four categories: experimental, quasi-experimental, survey and naturalistic. Campbell and Stanley (1966) provide detailed evaluation designs for the experimental and quasi-experimental categories. Quasi-experimental designs arose as experimental designs were not flexible enough to encompass all aspects of a particular program in the field. Survey designs are often used for programs implemented at many sites, involving a large number of participants. Quasi-experimental and naturalistic designs may be combined to evaluate both the implementation and the impact of programs (Benson and Michael 1990, 545-546). More recently, Smith (1996) classifies models and approaches to evaluation into seven categories, some of which overlap with the designs above.

A prime aim of evaluation is to present decision makers with information for their objective management of educational programs (Stufflebeam and others 1971). However, once the evaluation has been finalised and reported on, it is eminently possible that managerial practices will not be affected (McAnany and others 1990). This makes the 'selling' of the evaluation process and products to those managers making the decisions vital. The inclusion of management early in the evaluation is crucial.

Smith (1996) describes evaluation models as 'methodological advocacies' (238) in that they tend not to describe procedures in detail, are subject to varying interpretations and many decisions are left to the evaluator's professional judgement. By implication, evaluators usually have freedom to tailor their evaluation to the needs of the program. Thus Levine (1996, 266) recommends that meaningful evaluation

> can and should use an eclectic approach ... grounded within a defined conceptual framework ... An eclectic approach requires the integration of various methodologies ... to be implemented in different educational settings ... to gather significant and relevant data ... for different purposes ... using different instruments ... from different users.

Flexible learning

Flexible learning is facilitated when learners are provided with programs (subjects or courses) delivered flexibly. Flexible delivery has been defined by the Australian National Training Authority (ANTA 1996, 1) as

> a way of providing what the learner wants, making sure that what they want is clearly specified in terms of *what* (content), *how* (mode), *when* (timing and sequencing), and *where* (location).

Learners may potentially use the flexibility provided by the deliverer to

(use) a range of learning strategies in a variety of learning environments ... (which cater) for differences in learning styles, learning interests and needs, and variations in learning opportunities (Flexible Delivery Working Party 1992, 5).

To facilitate this flexibility, support materials of various types are produced. Flexible learning materials will vary according to the delivery method chosen and the learner. For instance, primary school distance learners require different materials to tertiary students using the internet. For examples of flexible delivery in TAFE NSW, see Planning and Evaluation Unit (1995, 4–48).

Flexible learning materials may include various combinations of multiple media - print, audio, video or broadcast television, computer software or other resources. Alternatively, the whole program may be delivered using some or all of the previous resources, integrated through a computer, referred to as multimedia.

Evaluation of flexible learning materials

There are a number of aspects of flexible learning materials to note when conducting evaluations. It is anticipated that flexible learning materials will increasingly use multimedia. The integration of various media into a logical and user-friendly multimedia learning material is complex and challenging. Some multimedia projects can be time and resource intensive, requiring hundreds of thousands of dollars (Hoekema 1992) or taking several years (Jones 1990). Similar considerations can apply to video projects. These time and cost considerations impact on the evaluation methodology.

The content of flexible learning materials needs to be current, as does the software and hardware used. In some areas, content changes frequently, and development teams need to consider this in the design of their materials. Students and institutions continually upgrade their equipment in line with software and hardware developments. Development teams need to ensure that their software remains current as long as possible.

Flexible delivery using stand alone materials may mean that learners have less opportunity to interact with teachers or tutors. Flexible learning materials need to provide greater learner support. Distance materials and programs delivered with minimal teacher interaction are the most complex and challenging to develop. The distinction between distance and face-to-face materials is blurring, as distance materials are now used more frequently in classrooms. However, materials developed specifically for classroom use are generally not suitable for distance learners due to their lack of complete content coverage and inbuilt support.

Flexible learning materials need to include all possible groups of learners, both those with learning difficulties and those with various types of disability, as such learners may be more likely to study flexibly. MacCann (1997) and MacCann and Downie (1998, in press) suggest guidelines for designing learning materials which allow for learners with visual disabilities to access internet sites using text readers, and for learners with all types of disability to use any of the wide variety of media currently available. The needs of all learners should be considered both in evaluating existing learning materials, and in designing new materials.

Strategies for learners to acquire metacognitive skills should also be included in flexible learning materials. These skills assist learners in analysing and improving their own learning. Tessmer (1996, 190) includes this as an element of front-end evaluation, but they should also be considered when selecting existing materials and developing new ones. See Schmeck (1988) for information on how to teach metacognitive strategies. For a discussion of flexible learning and metacognition, see Boote (1998).

A suggested evaluation framework

Three possible evaluation frameworks were located. Wolf (1990) includes all learner groups across a range of learning environments. He separates information into five classes: initial status of learners, learner performance after a period of instruction, execution of treatment, costs and supplemental information. A framework for the evaluation of telecommunications-based distance education is presented by Dillon and Gunawardena (1995). Their framework classifies distance education into types of interaction; timing of interaction, and social presence. In the multimedia area, Pham also provides an evaluation framework (1998, 109). Wolf's framework is very broad, while Pham and Dillon and Gunawardena deal with particular types of materials.

In this paper, a framework is proposed which follows the chronological stages of materials development, summarised in Table 1. This framework suggests evaluation stages and their outcome, with possible evaluation tools and techniques, at various stages in the process of materials development and implementation. It could apply to a wide variety of projects in developing flexible learning materials. The evaluation approach or design selected varies, depending on the purpose of the evaluation and its intended outcomes.

FRONT END OR FEASIBILITY EVALUATION

The term 'front-end analysis' was used by Harless (1973) to describe activities which contributed to decisions about program installation. Front-end or feasibility evaluation is suggested by Tessmer (1996, 187) as the first step in the development process. Feasibility evaluation occurs in the planning stage and is particularly appropriate for any projects which require a large expenditure of both time and money. Before starting the project, developers make decisions about content, costs, media, resources, timelines and both student and teacher training.

The first step is to map out the general content. Once this has been completed, a search for existing materials can be carried out. Existing materials research is an essential step in the process prior to the decision to go ahead with developing materials. These materials can assist the developer by providing either part or all of the content. It is a waste of time and money to re-invent the wheel - to develop, yet again, materials that are already available. A team of experts in flexible learning and curriculum analyses the materials and matches them to the content. For example, at the Open University in the UK, the opinions of course team members, external assessors and developmental testers were obtained (Hawkridge 1995, 85). At the Open Training and Education Network (OTEN), content experts and instructional designers are used.

Checklists for evaluating materials as they are developed can also be used for evaluating existing materials (OTEN, 1994; Parer 1995, 171). Rating scales should also be considered. Where available, students can be included as evaluators to provide a learner's perspective. There is a useful discussion of techniques and issues in Eraut (1990, 210-212). When considering evaluation issues, techniques and tools, Anderson and Ball (1978) is an excellent and practical source of information with many useful tables and matrices.

The decision whether to use an internal or external evaluator would be made at this point. If an external evaluator is selected, they should participate in the project from an early stage, so they can assist the team in deciding what information to collect, at what points, and how to collect it. Evaluators could consider using the *Standards for Evaluations of Educational Programs, Projects and Materials* (Joint Committee on Standards for Educational Evaluation, JCSEE, 1981) to plan their evaluations. This includes a form for evaluators to check which of the standards they have used in their evaluation (JCSEE 1981, 148).

Once existing materials have been researched, the next step in the feasibility evaluation is to select the remaining elements of the program and refine content detail. The developer outlines the intended learning experiences, learners' expectations of the media, and instructors' intended use of the media. Bates (1991) analyses some of the issues involved in the selection of media and its use. Concept testing can be carried out to ensure that there is a need for this material, in this form, and that an appropriate market exists (Pham 1998, 109).

Although multimedia is currently becoming more fashionable, some projects can be styled as solutions in search of a problem. Clients interested in multimedia development may want to be on the cutting edge, rather than selecting the design for its fit to the content and learners (Tessmer 1996, 187). An interesting example of the analysis of learning needs leading to a change in the media chosen is described (190).

Finally, developers should consider whether there is management support for projected costs, timelines, staff and user training. Tessmer suggests techniques and tools which can be used for this stage (1996, 191-196). Once these issues have been satisfactorily analysed and documented, the flexible materials development project begins and the formative evaluation stage commences.

FORMATIVE EVALUATION

Formative evaluation provides information for developers to improve the flexible learning material. De Wolf (1996, 380) distinguishes between first and final draft stages, while Eraut (1990) advocates small-scale field testing at prototype stage then large scale field testing in the final stages of

development (213). This is very much an issue with multimedia projects, where a mock up may initially be used to structure the program, while at final draft stage, it is very close to a finished product. The development process at the German Distance University includes testing at first draft stage and field testing at the final draft evaluation stage (Laaser 1993, 292).

If possible, the drafts should be discussed with the potential learner group at both these stages, initially to validate a particular approach then, in final draft ,to iron out any problems that may have crept in. In this final stage, the development team may have difficulty anticipating learner problems. They have spent time and effort on the materials, and may be so familiar with them that they see what they expect, rather than what is actually present.

Multimedia projects have their own special features. For example, learners should be able to navigate around the materials easily, choosing their own unique path. Learners should never be caught in a loop, making it difficult to exit. Formative evaluation is crucial for sorting out problems before they become far more expensive and difficult to change.

The Delphi technique (Uhl 1990) could be used where the materials development team are distant from each other. An action research methodology could be considered for a small-scale, local evaluation study (Carr and Kemmis 1988).

SUMMATIVE EVALUATION

By this stage, the flexible learning materials are now with the learners. Information gathered from this point on can still be fed back into a revision cycle, but it also can be used in a summative way, to present information to those who approved the funding and to those who make decisions about funding similar projects. For costly materials development projects, a large-scale study using external evaluators is sometimes used.

A clear evaluation plan is immensely valuable at this stage, as it specifies what information is to be collected, how, from whom, for what purpose, and how the information will be used. The plan would have been written during feasibility evaluation. Internal evaluators frequently collect information in the wrong format for analysis, from a restricted audience, without really knowing what the information will be used for. It is at this point that careful planning pays off.

Techniques such as cost-benefit analyses (Ross 1995) would be useful here. Analyses of the intentions of designers, mapped against the student outcomes, are also useful to see whether designers' assumptions are borne out by the learners' use of the materials. Measures of student performance indicators such as student dropout, average pass rates and levels of student achievement on assignments and in examinations (Hawkridge 1995, 85) are frequently gathered. However difficulties with using these measures occur as there are too many other confounding variables, apart from the learning materials, that influence these factors (Woodley and Parlett 1983).

For materials using group pacing strategies, evaluation should assess how pacing strategies are monitored to assure that the rate of progress through the program is appropriate (Dillon and Gunawardena 1995, 348). Where social interaction is important, it should be investigated in an evaluation (350). For individualised materials, the quality of the interaction between learner and content, as well as the feedback and motivational support provided, should be evaluated (Parer 1995). Since a frequent claim for the superiority of flexible learning materials is the learners' ability to study at their own pace, the above considerations are very important.

A range of techniques has been suggested for evaluating multimedia learning materials, some of which are also suitable for other materials. Webster (1995, 482) mentions computer modelling to explore the relationship between specified variables, which are identified by multiple regression. He also mentions navigation patterns through the material by learners, times spent at various nodes of information, patterns of user interaction, use of help facilities and tools (483).

Observational studies can involve video, logs, path tracking, interview and think aloud techniques. In think aloud techniques, learners verbalise their thinking at the times when decisions need to be made. When materials are computer based, video can be recorded in three views: keyboard and mouse; trunk, head and shoulders of the learner and computer screen. To make analysis easier, these can be recorded on a split screen with a time signal superimposed.

Computer-based log files can record what commands are used, screen and time data, along with path history. These can be recorded on computer as the learner is using the materials. Path algebras, directed graphs and social interaction methods are also mentioned (Webster 1995, 483) as tools for

multimedia evaluation. In addition, further data can be collected in follow up interviews of students. Webster (1995) mentions verbal reporting, interviews, path tracking combined with constant-comparative analysis, data reduction and discrepant case analysis.

There are a number of disadvantages for these techniques being used together in a 'combinational' way in a naturalistic design (Webster 1995). It is not clear how all the information can be combined to provide an overall picture of the learning environment. Analysis of the wealth of data is difficult: the cost is prohibitive, the storage capacity required is enormous, and the cost versus the benefit is questionable (Webster 1995, 483). It is also difficult to triangulate the data - to verify different themes or elements in the study from a number of differing data sources - as the data is in differing forms. Webster suggests that a new interface may need to be designed for the evaluator handling multifaceted data.

Ultimately, a summative evaluation study will be judged by its adequacy for the purpose it was designed for. A clear statement of its purpose and methodological basis should be given in the documentation both in the planning stage and the final report.

Obtaining multiple judgements

The judgements of content experts are often used throughout the process of developing flexible learning materials. However their judgements are sometimes inconsistent with the learners' opinions about the quality of instructional software - students are often more critical than teachers. In addition, experts may not correctly predict learners' performance after using the materials. Software rated highly using subjective evaluation techniques proved not to be highly effective when used by learners (Reiser and Kegelmann 1996).

Furthermore, the reliability of ratings of materials can vary considerably across different expert groups, (Reiser and Kegelmann 1996, 259). Content specialists tend to rate computer software differently to computer specialists, who look more at the technical than the content area. This may also happen in the video area, where technical specialists may rate the technical aspects more highly than content specialists.

To counteract these difficulties, evaluations should obtain multiple ratings from different groups: professional educators, external experts and students. Where discrepancies occur, these areas should be further investigated with each of the groups. Where materials deal with different ethnic groups, or are to be used by students of particular ethnic groups, a representative of those groups could be included in a panel of content experts.

Concluding comments

Flexible learning materials are developed for a wide range of learner groups, across a variety of educational settings. An evaluation framework needs to encompass the wide variety of models, designs, tools and techniques which are appropriate for different projects, at different stages of development. For small-scale projects, evaluation design could include an action research methodology with an emphasis on formative evaluation to improve the learning materials.

For major projects, it is essential to have a carefully planned, costed and approved evaluation study before the project actually starts. Funding bodies could allocate additional funding, where considered necessary, for an outside evaluator to be involved in the project throughout. There is much to be gained in a major study from an external evaluator who is more able to see the materials from an external perspective.

Many learning materials developers never see the learners using their materials, as development is often carried out at a distance from the intended learners, and information is rarely provided to development teams about how their products are being used by learners. Assumptions may be made by development teams about how learners use materials, without any evidence having been collected to verify these assumptions. This information is essential in large-scale, costly projects to allow future products to benefit from hindsight.

The importance of the final report, and reporting results of the evaluation to all parties concerned, is stressed in Passow (1990). While a great deal of time and effort may have gone into the evaluation,

there is no necessary relationship to the decisions made following the study, unless the results of the evaluation have been communicated in a timely and relevant way to those making the decisions.

Evaluations should themselves be evaluated to build up meta-evaluation information (Straw and Cook 1990) and improve the quality of this field of research. There have been repeated calls for increased empirical study of evaluation practice (Worthen 1990, Scriven 1991) to compare the effectiveness of different methods and models in informing practice.

Table 1: A suggested framework for evaluating flexible learning materials

Evaluation stage	Outcome	Evaluation tools/techniques
Front-end or feasibility evaluation	Determine content; evaluate existing materials; determine available resources, suitable media, staff, timelines, management support; develop project and evaluation plan.	Expert opinion and student evaluation; focus group; interview; questionnaire; training needs survey; concept testing (examine needs and markets); rating scale or checklist.
Formative evaluation: First draft development	Improve first draft and development process.	Expert opinion; checklists; rating scales; possibly Delphi; field testing with intended learners; naturalistic studies, action research.
Final draft development	Improve final draft and development process.	Field trialling: observation, questionnaire, interview, social interaction methods.
Summative evaluation	Outcomes may vary, depending on size of project and funding for evaluation; provide decision makers with information about the success of the program.	Observation; questionnaire; interview; social interaction methods; case studies. For multimedia: audit trail; navigational patterns; time spent at various information nodes; patterns of user interaction, use of help facilities and tools, path algebra's and directed graphs. For smaller projects: action research may be appropriate. For larger projects a number of designs are available.

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