A DEVELOPMENT STRATEGY FOR SUBJECTS DELIVERED IN A FLEXIBLE LEARNING MODE

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ABSTRACT

In a tertiary educational environment where emphasis is placed on the development of flexible learning using technology, there is a need to assist academics to move from the traditional lecture/tutorial approach (i.e. a didactic, linear, information presentation form) to a flexible learning milieu (a multidimensional, interactive, non-linear approach). Many academics lack appropriate knowledge of the domain analysis process to achieve a suitable solution in a flexible learning environment, where a multi-dimensional, non-linear approach is required.

This paper presents a strategy that assists the academic in this transition with emphasis on insight and development of student learning objectives and effective employment of technology to support them. The strategy describes a four step process, providing examples from the development of "Healthcare Information Systems", part of the Graduate Certificate in Health Informatics.

Step one concentrates on content, emphasizing a non-linear approach to topic development, specification of detailed student learning objectives based on Bloom's taxonomy, educational methods of implementation to support the objectives, as well as a topic linkage map showing the integration of the topic areas. A set of educational methods developed for the sample subject is also detailed.

Step two discusses project management, the effective use of technology where appropriate and the determination of in-house development versus outsourcing requirements.

Step three covers the development of technology requirements in-house, focussing on issues such as testing, documentation and standards.

Step four concentrates on outsourcing, with particular emphasis on the cost-benefit analysis of this area.

The paper promotes this strategy of principled design based on understanding the educational objectives in the pursuit of an educationally satisfactory design as opposed to a technology driven solution. It also highlights the potential of the use of initial flexible learning environment development as a training ground for subsequent growth.

KEY WORDS

Flexible learning mode, student-centered learning, Bloom's taxonomy of learning objectives.

1. INTRODUCTION

Academics faced with moving from traditional lecture/tutorial domain development to technology supported flexible learning environments (multimedia and Web-based materials), experience difficulty in determining what, where and how to use technology to support this development. Because of the linear information presentation of didactic lectures, development occurs through the generation of a series of linear lecture slides that convey content, but pay little attention to the objectives of the learner except in broad subject terms (often a mandatory requirement for the faculty handbook). For many academics this transition to flexible learning where a multi-dimensional, non-linear approach is required, presents them with difficulty, namely how to analyse the subject domain to achieve an effective solution.

Laurillard (1994) discusses the conversion of the narrative material to adaptive media with an emphasis on a guided discovery mode of delivery. She describes a multiply-linked audio-visual database, indicating that this is an "impressive resource for the scholar-researcher", yet indicates that for it to be effective for the student "the teacher's role has been to make the linked database available (the 'teacher constructed world') and perhaps to set the task as part of the interaction" p.23. She discusses the conflict of giving control to the learner (the intention with flexible delivery) and the ability of the learner to utilise the material to achieve his / her objectives. She states that "The basic design principle must be to think in terms of what the learner must do for their part, and how the 'teacher' (ie. the multimedia program) should support them in that" (p.24).

Similarly, Parker (1997), in her article on distance education (also part of the flexible delivery mode) indicates that the learning emphasis should be on what the students do rather than what the teacher does, and that the 'subject syllabus' "poses an ever-present threat to the transition of students from instructor-directed to self-directed" learning (p.9). Both Laurillard and Parker agree on an educationally driven solution. Lecturers new to developing in such media may be seduced by its pizzazz and arrive at a technology driven soltion. But in what way does this support the educational goals of the learner?

This paper promotes a strategy of principled design which analyses the educational objectives that assist the academic in the transition from traditional lecture/tutorial mode to a technology supported flexible learning environment. It provides examples from the development of a course in the Health Informatics Graduate Certificate. The students are health professionals requiring knowledge of the application of computers and information systems in the health environment. Each subject will have two compulsory residential weekends.

2. FLEXIBLE LEARNING MODE

Before describing the strategy used to produce subjects in a flexible learning environment, a definition is required. This incorporates two aspects of flexibility – the learning and the delivery.

2.1 LEARNING MODE

Flexibility must be considered in the approach to learning. A large part, if not all, of the learning will take place away from the usual face-to-face context of the lecture or tutorial as student directed learning. It is necessary, therefore, to provide a variety of approaches to learning so that students can adapt the materials to suit their learning style.

Examination of Kolb (1984) and McCarthy's (1987) learning theory indicates that students have a number of different approaches to learning depending on what is referred to as a 'preferred learning style'. These approaches should be included in the design of flexible learning materials. For example, different learning styles could be supported in the following ways:-

- **Reflective learners**: linear content, with hyperlinking for more detailed explanations, could be used.
- **Sensing/feeling learners** (who prefer personal interaction): discussion groups and one-to-one communication would be essential, whether by using technology such as asynchronous discussion groups, chat sessions, email and the telephone, or through face-to-face contact.

- **Concrete learners**: experiential form of learning, interactive simulations would be appropriate.
- **Theoretical learners**: a framework and an abstract style of learning, references and links to theoretical explanations and further detail in these areas could be developed.

Issues of control and provision of directions should also be considered. Often a problem-based learning approach is suitable for the flexible learning environment as a real-life problem or scenario can become the central focus of the subject, with detailed explanations, examples, exercises, group work and assignments providing extensions to the thematic problem central to the subject. Students can be directed to materials when the need arises during the learning process. Consideration of the student profile is also important in determining the learning approach and the amount of direction and guidance through the materials required.

2.2 DELIVERY OR ACCESS

Flexible delivery in terms of access includes the use of a variety of media and delivery mechanisms as well as a flexible approach to access from the user's point of view. For a subject in this environment, paper materials, interactive CD-ROM and the use of the Internet may all be incorporated into the subject as well as some human interaction components such as discussion groups, chat sessions and face-to-face workshops. Which of these are selected will depend on the objectives of the subject, the main access mode of the students (e.g. distance education, on-campus) as well as the nature of the recipients. The aim is to integrate new technology appropriately into the course, balancing its innovative use with existing practice to achieve an overall improvement and support the student in a 'community of learning' (Thomas et. al, 1998).

For example, if students are enrolling from an overseas base and will be doing the course from their own countries, face-to-face workshops and synchronous sessions would very likely be impractical or impossible. Subjects that are distance education with a residential component would lend themselves well to face-to-face components during the residentials, but may concentrate on stand-alone materials for the rest of the course. If an essential component of the subject is group work, the use of asynchronous discussion groups and email may be the best approach to allow for flexible access, yet achieve direct communication.

3. THE DEVELOPMENT STRATEGY

The main aim of the development strategy is an educationally driven approach that aims to meet the needs of the learners while supporting the lecturer in this embryonic transitional phase. It concentrates on the role of the academic as content expert and, to some extent, educational expert. The amount of educational expertise for the tertiary academic may vary from the limited experience of delivery of information through a lecture with no formal education training, to those who have spent many years researching and applying educational techniques as part of their 'teaching' with some even holding a tertiary qualification in this area.

For the flexible delivery mode, "those faculty accustomed to more conventional teaching modes will have to acquire new skills to assume expanded roles not only to teach distance (flexible) learners, but also to organise instructional resources suitable in content and format for independent study" (Beaudoin 1990, p. 21). The purpose here, is to provide an approach that assists those whose main form of 'teaching' is that of information presentation within a lecture, to consider learning objectives as the major guide to subject development in order to develop subject materials that meet the flexible learning mode requirements, both from a learning and delivery perspective.

3.1 STEP 1 – CONTENT

The first step is to concentrate on the content. This is the area the academic is most familiar with, and may already have linearly produced content for the subject in the form of 'lecture slides'.

3.1.1 Topic development

What is important here is to move away from the idea of linear presentation to a series of topic areas that, when integrated and interlinked, form a coherent package of information that comprises the content of the subject. Once major topic areas have been identified, each topic area should be broken down further into detailed knowledge items.

For example, 'Topic 1.2 Impact of computers on business and society' for the Health Informatics subject 'Healthcare Information Systems' is broken down as follows:

- doing things faster and more accurately
- replacing people in the workplace
- data interchange and privacy
- manufacturing
- file sharing
- the paperless office
- new products
- games
- home computers

These items form the major knowledge or issue areas for this topic. Some consideration of order may be necessary if comprehension of certain aspects of a topic must precede other areas. The intention is to concentrate on separate topic content at this stage, with the integration and ordering considered more fully once detailed learning objectives have been established.

3.1.2 Learning Objectives

For this detailed content, a set of learning objectives will be developed. The purpose of this is to encourage the content expert to think of the material from the student domain rather than the teacher domain. If, for each topic area, it is known what the learning objective of the student is, it is much easier to determine the delivery approach that will suit the material in terms of those objectives, and which of those objectives information technology is likely to be able to support.

The learning objectives described here are taken from Bloom's Taxonomy of Educational Objectives (1956) and are as follows:

- Knowledge requirements – includes knowledge of terminology, specific facts, conventions, trends associated with the field, classifications or categorisations and specific criteria used in the area.
- Comprehension and understanding requirements – an understanding of concepts such that they can be presented in a different form and still understood, interpreted, and used for extrapolation purposes.
- Application requirements – the ability to apply concepts in specific and concrete situations.
- Analysis skill requirements – the analysis of specific elements, their relationship to one another and the analysis of the underlying principles that combine these elements.
- Synthesis requirements – the assimilation of separate knowledge and concepts to form a new structure.
- Evaluation requirements – the use of the domain content to enable judgements about the appropriateness of materials and methods for particular purposes.

It is quite possible that the academic has never previously considered objectives at this level of detail. Subsequently, the emphasis is often on lower level objectives of knowledge requirements and comprehension, but rarely on higher objectives of synthesis and evaluation. Hence, while all these objectives may not be present for each topic or sub-topic, each should be carefully considered as it is possible they have been overlooked. Also, objectives that link groups of topics and integrate them are important and often involve synthesis and evaluation.

Using our above example, Topic 1.2 has the learning objectives as shown in Table 1. Note that for this topic, no synthesis component was identified.

Table 1

Learning Objectives for the Topic Area

Learning Objective	Detail
Knowledge	The impacts of computers on society
	The areas of society that have been affected
Comprehension	Understand how computers have impacted on society
	Understand what changes have occurred
Application	Indicate ways in which computers have changed business and day-to-day life for the student's environment
Analysis	Look at a business to investigate the use of computerisation
Synthesis	
Evaluation	What aspects of a business have been supported by computers and what problems are encountered - Pros and cons of computerisation

3.1.3 Educational Method Development

Once the content has been specified and appropriate learning objectives identified, domain specific educational strategies can be developed (eg. explanatory notes, diagrams, exercises, quizzes, demonstrations, simulations, discussion groups, field trips, etc). The important question for the academic is 'What strategy best achieves the learning objective?', not 'What learning objective can be used for this technology?' No specific technology should be considered at this stage. How to effectively meet the objectives is more important at this stage than what technology might be available. The learner, not the technology, is central to the design. This leads to an educationally satisfactory design rather than a technology driven solution, often less satisfactory for the student (Carswell, 1998). Also, restrictions in terms of money and time should not be considered here. It is easy to cut back if necessary, but it is very hard to extend options once the design and development of materials has begun. Where topic areas form an integrated unit, or are dependent upon an integrated educational approach (eg. a simulation or a case study) these should be considered concurrently, with appropriate information documented to show the connection.

The development of a 'topic linkage map' can be used here, where topic items are linked together to show their inter-relationships and connectivity. This is particularly useful where topics may be approached from different perspectives in a number of subjects, yet there is a need to delineate separate subjects while showing the interconnectivity between the topic areas.

For our topic used in the example above, the methods shown in table 2 could be employed.

Table 2

Educational Methods for the Learning Objectives

Learning	Detail Objective	Method
Knowledge	The impacts of computers on society. The areas of society that have been affected	A series of visual and text supported views of use of computers today
Comprehension	Understand how computers have impacted on society and what changes have occurred	Guided discussion – some of the major knowledge areas listed as a starting point
Application	Indicate ways in which computers have changed business and day-to-day life for the student's environment	Practical exercise involving an investigation using the student's experiences
Analysis	Look at a business to investigate the use of computerisation	Field trip or investigation of an actual business with students reporting on findings in a followup discussion
Synthesis Evaluation	What aspects of a business have been supported by computers and the problems encountered. Pros and cons of computerisation	A written report as an assessment portion of the subject.

The development of a formalised set of "Educational methods of Implementation" can be useful at this stage to assist in this process. The set of educational methods developed for these Health Informatics subjects included the following:

- Test items – this may be displayed questions and answers, or interactive quizzes (where students may or may not access the correct answer). Methods include frequently asked questions and quiz items.
- Practicals – this is where the student is required to carry out some practical exercise. Where possible, these should have direct relevance to assessible assignment work. They may even be the assessment items themselves. Methods include practice problems, research exercises, investigation exercises and the construction of diagrams.
- Discussions – this is where the student participates in an interchange of knowledge, concepts and ideas. Methods include group discussions led by the staff member, student only group discussions and one-to-one staff-student interchange.
- Explanations – this is where a more detailed explanation of a topic can be gained. Methods include animated demonstrations to provide explanations, static explanations (may be textual, verbal and/or visual) that can be viewed by the student with further detail provided on request (eg. a glossary of terms), and interactive explanations where the learner provides input into the process.
- Case study/scenarios – This is a special method that will probably permeate through a large number of topic areas and many involve the other methods described above. If used, a detailed description of the case study should be specified and its appropriate use indicated in terms of the other methods employed.

3.1.4 The storybook map

This is the stage where the integration of topics takes place, showing the linkages and possible ordering of the areas covered. The aim here is to provide the sign-post scaffolding upon which the students can base their learning within the course.

3.2 STEP 2 – DESIGN OF THE TOPICS FOR THE CONTENT AND EDUCATIONAL APPROACH

3.2.1 Selection of areas for IT development

At this stage each topic and its educational strategies are considered in light of the technology available, to determine the most effective presentation technique. If we consider the learning objectives, it becomes apparent that technology best supports lower level educational objectives (knowledge, comprehension, application and, to a certain extent, analysis) while higher level objectives of analysis, synthesis and evaluation require human interaction. It should not be the intention to have all parts of the course developed using information technology on a computer. Other technology may be more appropriate such as print based materials, cassette or video tapes. It is also necessary to consider likely student computing specifications as this will influence what technology can practicably be used.

In order to do this successfully, consultation with a commercial expert in multimedia and internet technology may be required. Flexible delivery mode subjects will ultimately be available in a much wider domain than the student pool from local areas. If such courses are intended to attract the international market, and have to compete with other affluently funded courses, it is critical that a high commercial quality commodity is produced. With the academics now supplying high quality content, educational objectives and delivery mechanisms, an in-house technically amateurish manifestation as opposed to an outsourced expert production is unlikely to yield the required quality.

3.2.2 Determination for in-house development / outsourcing requirements

This is where those areas selected for potential IT development are viewed to determine what is possible in terms of budgetary and time constraints, and, in light of these constraints, which parts should be developed in-house and which parts should be outsourced. Note that outsourcing here refers to anything outside the department or school that has the academic responsibility for the subject content.

Further considerations such as:

- availability of staff for the development of the materials (development time versus time available);
- cost of software/hardware requirements for a quality development (current facilities and extra purchases versus outsourced cost);
- training required and length and steepness of learning curve required for the particular software/hardware products needed (cost of learning time and development versus cost of outsourcing);
- skill base of the in-house staff; and
- reuse of knowledge, software and hardware for future projects should be included.

It is important to cost the academic's time in determining whether in-house development or outsourcing occurs. This gives a more realistic valuation of the costs incurred. It may be that the time and budgetary constraints prohibit the use of technology for the preferred educational approach, and that an alternative medium may have to be used at this stage (eg. A computer simulation may not be able to be implemented within the current time constraints, so perhaps a paper version can be used and presented when students will be able to get together physically (ie. at a residential), with a computer version developed for future delivery).

3.2.3 Project Management

Once a realistic determination of what can be done and who is to do it (in-house or outsourced) has been determined, a detailed project plan for the design and development of the technology areas of the course must be developed. Once again, outside expert consultation can benefit this process.

3.3 STEP 3 – DEVELOPMENT OF TECHNOLOGY BASED AREAS IN-HOUSE

An approach to this should consider some form of multimedia development lifecycle approach (Ellis, 1996; Phillips, 1997). Important issues relating to the design and development of materials have been highlighted here.

3.3.1 Design

Design tools such as storyboards, object-hierarchy diagrams, navigation maps and object descriptions (Faraday and Sutcliffe, 1994) all aid in the documenting of the design process.

3.3.2 Testing

Too often testing for technology based materials is done in a rather ad hoc and arbitrary manner.

As Ellis (1996) states “What is important here is that a formal testing strategy is employed for each functional task, and the application as a whole. Testing should be oriented around the tasks to be completed by the user, as well as testing for all objects of an interactive nature (ie. an object that has a handler associated with it)” (p.121).

3.3.3 Documentation

Documentation is an area that is often overlooked or done poorly. As Ellis and Browne (1996) comment, “[the developers] get involved in the fascinating task of multimedia development and there is a danger that the documentation might become rudimentary at best and non-existent at worst” (p.186). The academic staff doing the development should be aware that documentation can facilitate the design, development and implementation processes and will provide information for future maintenance of the subject and development of further subjects.

3.3.4 Standards Development

Particularly if the subject under development is part of a course where future subjects will be developed using a flexible learning mode, or involve staff from other faculties, it is worthwhile considering the development of a set of standards in relation to interface design and user documentation to reduce the student’s learning curve in relation to the technology aspects of the various subjects. It is far easier to develop a set of standards at the start than to try and implement them later. The standards should be flexible enough to allow for some individual creativity, yet be extensive enough to aid in providing an appropriate and consistent framework for the subjects being developed.

Standards for such areas as :

- use of Logos (university, school or department, external logos);
- colour schemes;
- object placement;
- use of icons and metaphors;
- navigation approaches including menu approaches and hyperlinking;
- use of text formats and styles; and
- help system design and approaches;

should all be considered when developing standards. If standards relating to the subject area already exist (eg. the health environment has standards relating to system development that impact on some of the content of the Health Informatics subjects), these should be consulted, as appropriate approaches for some of these areas may already exist and be familiar to the student.

3.3.5 Overlap with outsourced areas

Some of the in-house development may involve the preparation of content that will subsequently be converted to a technology based form through an outsourcing stage (eg. voice scripts for audio material, document preparation and collection for or word-processed documents that will be converted to a help system). These areas should be clearly documented with the outsourced requirements.

3.4 STEP 4 – OUTSOURCING OF TECHNOLOGY BASED AREAS

Two areas should be considered when determining what areas should be outsourced - the cost of specialised equipment for the development of the materials and the time and effort involved in producing the materials.

For production of areas such as video, graphics and sound, expensive specialised equipment and specific skills are required to produce these materials. While it is tempting for the enthusiastic academic to attempt producing these materials, it is usually impractical in terms of the cost of equipment and also in terms of academic time. For example, the quality of a digital image produced by a $600 digital camera will be vastly inferior to that produced by an $80,000 digital camera. While it may seem expensive to pay $100 per hour for an expert to digitise images, the finished product will be high quality and the time taken to produce it will likely be one tenth of inexperienced academic time. In general management fail to properly cost academic time and the large numbers of hours spent are not seen as a ‘real cost’. This raises other issues such as what academic work is not being completed or is this increasing the stress on an already over-stretched work force? This also assumes that the academic has the appropriate visual skills to produce these materials, and in-house materials may not have the commercial look and feel that enables these subjects to compete in the international educational market, an area of consideration for most universities in the current economic climate.

With regard to the use of products such as authoring software, if the academic is likely to be using the product frequently (at least for 15% of their work) and will be making use of that product for subsequent development, it is probably appropriate for the academic to spend the time learning to use that software and to develop the materials in-house. One has to remember the rapidity of change occurring to this type of software, and whether the academic has the time to keep abreast of these changes. Content in terms of basic word processed documents coupled with appropriate storyboards may be a more efficient use of the academic’s time rather than direct development of the finished product.

Outsourcing does not necessarily mean external commercial development. It may mean the employment of a multimedia programmer by the department or the use of a university multimedia development unit. Various alternatives should be considered when determining what is to be outsourced and to whom.

4. SUBSEQUENT SUBJECT DEVELOPMENT – TRAINING ISSUES

Any development of flexible learning subjects should keep in mind the issue of development of further subjects. If it is possible for the staff to use the development of initial subjects as a training ground for subsequent development then this should be encouraged.

Two ways in which this can be achieved are:

- Making the development process a group exercise. This allows those involved in the process to become experienced members of new teams and as such pass on advice and expertise about the development process.

- Using the consulting advice as a component of staff development for subsequent subjects. This means working in parallel with the expert consultants to enable the academics to take on the processes themselves in the future. Particularly those areas such as project management, and the determination of in-house versus outsourcing requirements should ultimately be able to handled entirely by the academics involved.

5. CONCLUSION

This strategy promotes a domain analysis approach that identifies the educational objectives in the pursuit of a learner-centred approach to the design of a flexible learning environment. It also seeks to support the lecturer in the difficult transition from a traditional didactic lecture mode to that of dynamic flexible learning. This approach is favoured over the *try-it-and-analyse-later* method which often leads to a technology driven approach, less appropriate for the learner (Petre et al, 1998). It enables academics to develop detailed domain learning objectives by applying appropriate educational implementation methods, and then matching technology for the effective support of these objectives. By placing the emphasis on the learner, and developing the subject using an integrated topic approach, we avoid the didactic, linear presentation mode common to traditional lectures. This *back-to-basics* approach of analysing the educational objectives provides a principled approach with clear goals for development, which help promote a learner-driven solution where education, and not technology, drives the process.

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