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# An evolving methodology for managing multimedia courseware production

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It is often claimed that techniques such as 'multimedia' and the use of blended learning environments can be used to achieve powerful interactive pedagogies. Indeed, the advent of easy-to-use multimedia technologies has meant that a plethora of digital learning products is now becoming available. Despite the relative ease-of-use of these new technologies, managing large-scale multimedia courseware development projects is still very problematic. This paper discusses some of the issues involved and outlines an emerging methodology for managing such projects.

## Introduction

In its simplest of forms, a (digital) multimedia learning product is one which combines 'text', 'audio' and various forms of 'image' (along with suitable pedagogic strategies) in order to create an effective and 'pleasant-to-use' learning experience for a given cohort of students (Barker, 1989, 1994, 1995, 2006). Techniques and strategies for developing and managing the production of different types of multimedia artefact are well documented in the literature (England & Finney, 1999; Alessi & Trollip, 2001; Vaughan, 2004; Chapman & Chapman, 2005). However, despite the experience and knowledge that is available, many large projects still often 'flounder'. Sometimes, the reason for this is that multimedia products often employ some of the latest 'cutting-edge' technologies (such as WiFi networks and iPod devices)—often before suitable pedagogic models and techniques for using them have emerged and become established. Obviously, in some cases, projects also fail because of their sheer complexity—involving many different people and a variety of diverse learning technologies.

For almost a decade, we have been researching various approaches to developing multimedia learning products with a view to documenting relevant models and methodologies that will enable the production of effective multimedia courseware that is delivered on time and within budget (Barker & Giller, 2001). In general, there are two basic approaches to designing multimedia courseware. These are often referred to as the '*trial and error*' and the '*theoretical*'

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approaches. The first method simply involves putting together various components and then testing them 'in the field'; various combinations can be tried until a successful combination is found. Naturally, as well as being unscientific, this approach is both time consuming and costly. The second approach to courseware development is less 'hit and miss' and depends upon bringing to bear appropriate theoretical knowledge (from a variety of relevant disciplines) that will enable the 'trial and error' processes to be removed. Fundamental to the theoretical approach to courseware development is the identification of appropriate 'models and methodologies' that can be used to steer the design and product management processes from conception through to completion (Barker & Giller, 2001).

In this paper we describe our 'evolving methodology' for managing multimedia courseware development projects. We refer to our approach as 'emerging' because, as new software-development management tools and techniques become available, we incrementally augment our underlying model in order to accommodate the best features of these new approaches. Naturally, our approach is also significantly influenced by our own experiences and the new product-development situations in which we often find ourselves. Bearing in mind what has been said above, the remaining sections of this paper are intended to 'set the scene' (by describing some of the problem areas that we have encountered), briefly outline the methodology and indicate how we have been attempting to evaluate and verify the underlying model and the associated methodology.

## Problem areas

The production of multimedia learning products is a complex process that often involves the investment of considerable resources. During the development process itself, various problems can occur that can affect the management of the project, the development process itself, the interface design and the choice of delivery methods. Ultimately, each of these problems may compromise the quality of the final product—especially in situations where cost constraints are imposed.

Most production processes (such as house building or making beer) follow some form of established life-cycle strategies, but there are very few generally accepted rules or guidelines for the development of multimedia learning products. Courseware development projects vary according to the content (both extent and complexity) and the expertise available within the development team. Projects follow a life-cycle that includes several phases, such as planning and design, content specification, materials production, development and dissemination. Naturally, problems can occur in each of these phases. Without proper planning, control, and project development strategies, the final product may deviate from the intended design, exceed the budget allowance, be delivered late or, in the worst cases, be abandoned.

In order to throw further light on the issues involved, an investigation was conducted to identify common problems that occurred during multimedia production projects, and to determine their probable causes (Giller, 2006). The investigation revealed 81 commonly occurring problems and indicated 14 identifiable causes as shown in Table 1. (Note that some of the problems have more than one identifiable cause.)

Many of the problems were caused by disorganised project management strategies, a lack of suitable guidelines and failure to apply a structured approach. The two major issues underlying

Table 1. Identifiable causes of multimedia project failure

| Probable causes | No. of occurrences |
|---|---|
| 1. Poor project management policies | 17 |
| 2. Inefficient quality control strategies | 12 |
| 3. Ineffective communication strategies | 11 |
| 4. Inadequate analysis | 10 |
| 5. Lack of set procedures for product development | 9 |
| 6. Lack of instructional design input | 7 |
| 7. Defective content scripts | 5 |
| 8. Lack of backup and file transfer strategies | 5 |
| 9. Insufficient design specification | 4 |
| 10. Poor evaluation strategies | 3 |
| 11. Inadequate preparation | 3 |
| 12. Unsatisfactory production techniques | 3 |
| 13. Poor or non-existent file-naming strategies | 1 |
| 14. Lack of resource-planning strategies | 1 |

these causes appear to be a lack of effective co-ordination and poor communication. In order to solve or alleviate some of the recurring problems listed in Table 1, an important outcome from the investigation was a list of project management strategies which, if adhered to, could help solve some, if not all, of the difficulties that were being encountered. The suggested list of strategies is presented in Table 2.

Each of these 14 strategies is fundamental to the efficient management and control of multimedia development projects and, ultimately, to the production of successful quality learning products. The application of a suitable methodology could provide a firm foundation for the development of multimedia learning products by establishing a structured approach to the production process.

Table 2. Strategies for avoiding multimedia project failure

| |
|---|
| 1. Appropriate project management policies |
| 2. Efficient communication strategies |
| 3. Effective quality control strategies |
| 4. Reliable procedures for product development |
| 5. Thorough analysis of client, content, delivery and users |
| 6. Sufficient instructional design input |
| 7. Comprehensive content scripts |
| 8. Explicit design specification |
| 9. Meticulous evaluation strategies |
| 10. Adequate preparation |
| 11. Detailed production techniques |
| 12. Sensible file-naming strategies |
| 13. Practical resource-planning strategies |
| 14. Logically organised backup and file transfer strategies |

## The methodology

Models and methodologies for the development of conventional software products are well documented in the literature of software engineering—see, for example, Sommerville (2004) who describes the more well-known and prominent ones. As valuable as these tools are, they have limited applicability to the development of some of the more advanced multimedia products such as interactive media-rich web pages and CD-ROM learning resources. Bearing this in mind, this section of the paper outlines our development methodology. This has been established as a result of the work we have undertaken on a wide variety of multimedia projects. Based on our findings to date, we define a typical project life-cycle in terms of a number of phases—as depicted schematically in Figure 1.

Each of the phases shown in Figure 1 includes several stages that are composed of specific tasks. The proposed methodology includes procedural guidelines, sample documentation, training strategies and structured work-flow diagrams for each of the recommended tasks.

### *Phase 1—preparation*

Phase 1 is the initiation and preparation of the project. A preliminary analysis is carried out and a formal proposal is prepared based on the results of the analysis and consultation with the clients and the developers. The proposal should include an outline of the product, a budget limit and an expected delivery date. Once the proposal is accepted and the project approved, clients, subject-matter experts (SMEs) and new team members are trained by introducing them to the multimedia production life-cycle and the use of script documents. Project research includes a feasibility study, cost analysis, resource allocation, schedule estimation and an in-depth study of the scope of the contents. Team members are appointed, management and evaluation strategies are formulated, and appropriate equipment and tools are designated.

### *Phase 2—design*

An outline script is prepared from the information obtained from the research. This is followed by the development of a prototype, which should be thoroughly tested by all team members, the clients and representatives of the user group. A master script is prepared based on the information derived from the research. This script is then thoroughly checked by the SMEs and any changes or amendments are made to the document. It is far easier to make major changes at this stage rather than later when the development process is under way. Audio scripts, video and animation storyboards and graphics listings are then easily derived from the master script. Textual content can also be produced from the master script—this saves time when programming the product and also ensures that textual content is correct and free from errors. Phase 2 culminates in the acceptance of the master script and the production of resource documents for the preparation of graphics, audio, video and animation.

### *Phase 3—development*

Most of the development process occurs in Phase 3. A new program is constructed based on the results of the prototype. Following the steps in the master script, programming and resource

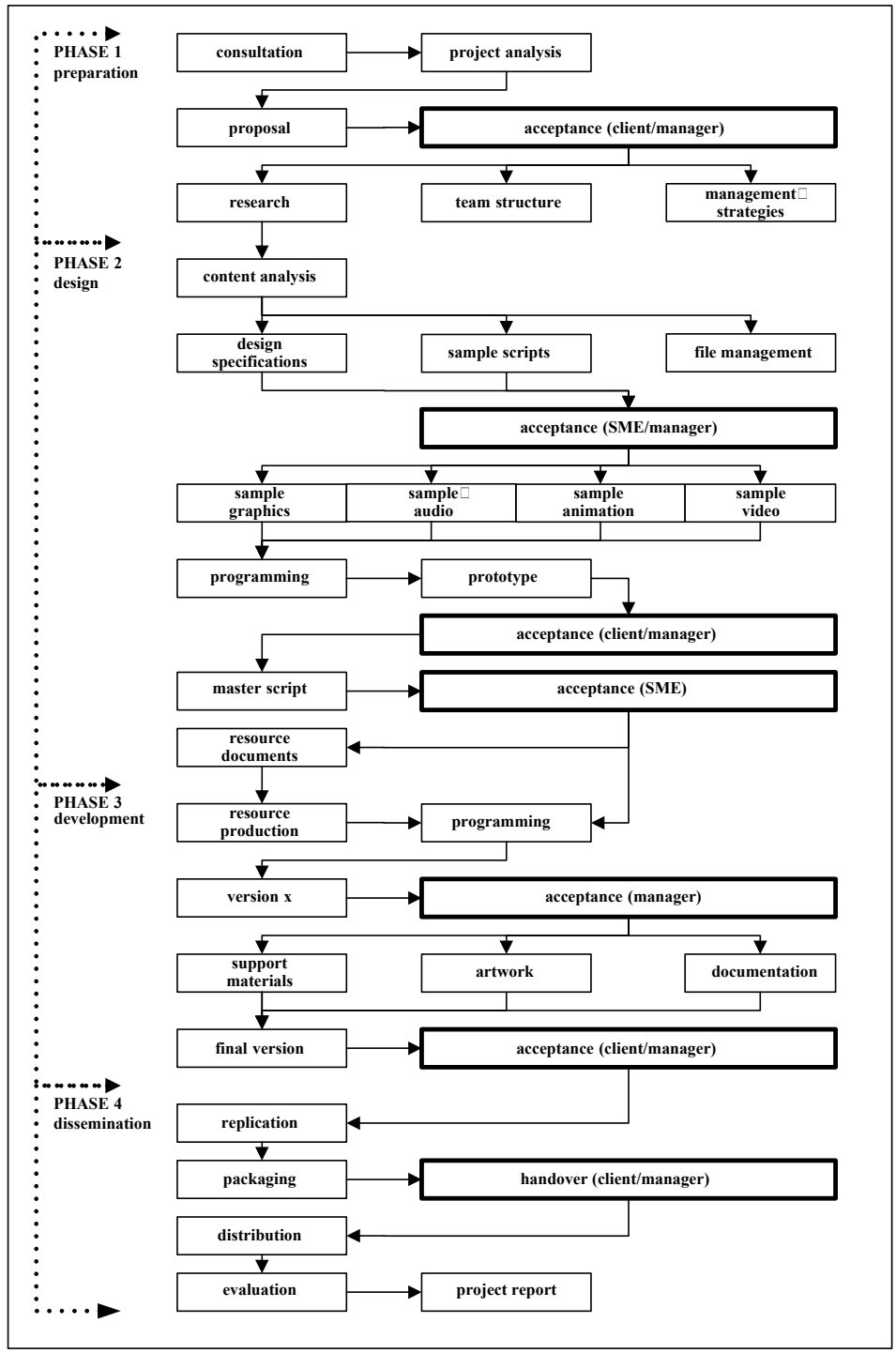


Figure 1. Project life-cycle for courseware production

production are carried out simultaneously and elements incorporated into the program as they become available. This is an iterative process and testing is carried out using various methods of quality control. These include: content checks, system testing and program testing. During the iterative development, several versions of the product may be produced until a final version is perfected. If the learning product is to be delivered on CD-ROM or other portable storage media, artwork is designed and developed and appropriate arrangements are made for replication. Learning products intended for delivery via the Internet or internal network systems require server access to be made available. Multimedia learning products that form part of a larger learning package or are a component of a blended learning facility (Bielawski & Metcalf, 2005; Bonk & Graham, 2005; Barker, 2006) may need to be supplemented by support materials, such as printed workbooks.

*Phase 4—dissemination*

The dissemination phase depends very much on the chosen delivery method. The official handover of the product to the clients is followed by its distribution. This may be achieved by transferring the replicated products to the client, publishing the product on the Internet or launching it on a network. An important stage in the final phase is the summative evaluation whereby the product is assessed according to its usefulness to both the client and the users. The most effective product evaluations are those that are carried out in stages, for example, immediately following the launch, a few weeks afterwards and the following year. The resulting feedback should be made available to the development team and analysed accordingly so that any recommendations can be incorporated into later projects. The project itself should also be evaluated to consider problems that may have occurred during the life-cycle so that these can be rectified or avoided in future projects. Any changes may also be incorporated into the evolving methodology.

## System appraisal

In order to assess the effectiveness of the methodology, two similar multimedia courseware production projects were compared. Information related to the product development was collated, analysed and presented as a series of graphs representing the amount of work time spent by various team members and the number of errors recorded in the product. The results of this comparison indicated that the application of the methodology can assist in the production of successful courseware.

The proposed methodology is able to improve the efficiency and effectiveness of a courseware development project and can increase the possibility of creating a successful product by addressing each of the 14 key strategies that were previously identified in Table 2. The ways in which this can happen are briefly discussed below.

*Appropriate project management policies*

Project management should be carried out efficiently and effectively throughout the project life-cycle. The methodology includes practical suggestions for establishing a workable project

life-cycle, formulating effective evaluation plans, establishing and managing a development team, project preparation and examples of documentation.

*Efficient communication*

Communication relies to a great extent on the availability of good documentation. The main types of documentation necessary for the production of courseware include: a project proposal, design specifications, scripts and storyboards, and progress reports. It is also important that team members have opportunities to discuss the project and the methodology provides examples of how such discussions can be conducted.

*Effective quality control*

Many errors can be detected and rectified at an early stage by conducting effective quality control procedures from the outset. Practical suggestions for conducting quality control and testing are included in the methodology along with examples of documents that are useful for controlling the detection and amendment of errors.

*Reliable production procedures*

The methodology provides a comprehensive set of guidelines to enable successful courseware to be developed efficiently and effectively by providing a series of practical solutions to ensure that all aspects of the project life-cycle, script creation, quality control and evaluation are adequately addressed.

*Thorough analysis of requirements*

The methodology provides details of the various aspects of analysis that should be carried out in order to produce learning products that meet the needs of the client and the user and to ensure acceptable learning outcomes.

*Instructional design input*

For courseware to be effective it is imperative that learning requirements are properly met. The methodology stresses the need for good instructional design principles and discusses the issues surrounding instructional design.

*Explicit design specification*

All elements of a learning product must be properly documented to ensure that every aspect is adequately described. Resources should integrate well within the content, navigation should be smooth and presentation should be consistent. The methodology explains how this information can be collated to produce a design specification document that provides essential information for team members.

*Meticulous evaluation strategies*

Evaluation is used to assess many aspects of a courseware development project, such as its usefulness as a learning tool, the efficiency of the production process and the cost effectiveness of the project. Evaluation results are analysed carefully and recommendations applied to improve both the existing product and future projects. The methodology describes three types of evaluation that can be applied to courseware production.

*Adequate preparation*

Good preparation is essential to the production of successful courseware. The methodology provides information and guidance on the preparation phase. Elements that should be considered include: training of team members, achieving a balanced project, thorough project analysis, conducting user profiles and content analysis.

*Detailed production techniques*

Technical production techniques must be described fully so that programmers and resource producers are provided with presentation specifications and are aware of any constraints from the outset. The methodology includes most of the considerations that should be provided for the development phase to take place as smoothly as possible.

*Sensible file-naming strategies*

Multimedia products contain a selection of resources (graphics, audio, video and animation). Most of these resources are produced by individual team members who then pass them to the programmer. A systematic approach to file naming enables team members to integrate the files correctly, assists in error management and enables a project manager to keep a tally of completed files. A suggested file-naming strategy is provided in the methodology.

*Practical resource-planning strategies*

Practical resource-planning strategies must be available for team members to refer to, especially if they are novices. The methodology includes explanations of how resource production can be improved and provides examples of technical considerations and guidelines for the production of various resources.

*Logical file management strategies*

The adoption of logical file management strategies assists greatly in the production process. The methodology offers guidelines for the provision of efficient systematic storage and coherent content checks that help to eliminate errors and contribute to an effective and efficient production life-cycle.

*Comprehensive content scripts*

A comprehensive master script is the key to developing courseware effectively and efficiently as it provides a 'blue print' for the product. The master script enables the development phase to proceed smoothly by eliminating content errors and ensuring that navigation and interactive events are properly structured.

## Conclusion

Over the last decade there has been a substantial increase in the use of computers for educational purposes at all levels of endeavour—schools, universities and colleges, and commercial organisations. Indeed, as the number of potential learners using computer-based learning techniques increases, the demand for high-quality, effective multimedia learning products intensifies. Multimedia learning products can now be used to deliver a wide range of topics for distribution in many different formats. Despite the availability of sophisticated development tools and equipment, many projects fail to produce good-quality courseware.

The application of a structured methodology can assist in the production of successful multimedia learning products by increasing the efficiency and effectiveness of activities throughout all phases in a project life-cycle. A number of methodologies exist that may be used to assist in courseware production, but many of these are intended for the development of other types of application and may be unsuitable for the development of multimedia learning products.

The methodology has been applied to a wide range of courseware development projects. Each project has contributed recommendations and new features that improve the application of the methodology. In this way the methodology evolves to suit the purpose, resources and organisation.

Rapid advances in technology over the last decade have resulted in the convergence of three major components: telecommunications, computer technology and television. Multimedia learning products may not only benefit from these advances, but also have a major role to play in their evolution. These new technologies offer exciting possibilities for the production of sophisticated learning products. However, the production processes could be more complex, resulting in a greater need for a structured approach. The evolving methodology introduced in this paper offers the flexibility and reliability that will be required by projects for the design and creation of future multimedia learning products.

## Notes on contributors

Susan Giller is an independent multimedia consultant based in Ashburton, New Zealand. She has worked on a large number of multi-disciplinary multimedia projects for a range of international organisations. As well as her interests in multimedia learning products, Susan has also undertaken significant research projects in relation to electronic book production and the application of e-learning techniques within a range of different contexts.

Philip Barker is Professor of Applied Computing within the School of Computing at the University of Teesside. His research group conducts studies into various aspects of human–computer interaction—particularly those relating to the use of computer-based

technologies for the support of teaching, learning and training. He is currently interested in combining knowledge management, e-learning and electronic performance support systems for the creation of online blended learning systems. As a recently elected Fellow of the Royal Society of Arts (FRSA), he is particularly interested in the goal of 'Developing a Capable Population'. In 2005, Professor Barker was awarded a National Teaching Fellowship by the UK's Higher Education Academy; the funds provided by this award will be used to continue his studies into the use of electronic performance support techniques in both conventional and digital library systems.

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