DIVISION OF COMPUTER SCIENCE

Creating Multimedia Learning Applications in a Further Education Environment

Trevor Barker
Sara Jones
Carol Britton
David Messer

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Contents

Abstract.

This report describes the development of a large multimedia learning application within a Further Education environment. It looks primarily at the underlying processes used in the design, implementation and evaluation. The requirements of large scale material production within a working educational environment are necessarily different from those of commercial organisation and some of these requirements are explained. The report details some of the limitations of the materials creation process and describes the compromises that were made due to external and other constraints.

1.0 Introduction:

The use of high quality multimedia learning materials is likely to become increasingly important to Further Education colleges in the coming years (Gray and Warrender 1995). This is due to several influences within the sector, notably the need to lower the per capita costs of providing learning and the idea that it is possible to deliver higher quality learning in a flexible and interactive way by using multimedia. To support this move towards multimedia based computer assisted learning, there has been a large investment in flexible learning centres in colleges. Students have access to large numbers of powerful multimedia computers, often networked. This, as much as anything, is driving the need for multimedia learning materials.

It has been reported that high quality multimedia learning material suitable for use in the FE sector, does not exist in sufficiently large quantities. (Further Education Funding Council 1996). Moreover there are several additional requirements that need to be satisfied before material can be used effectively: for example there is a need to record and track students as they work on material or through courses; there is a need to integrate material into current courses with regard to existing materials in other formats and there is also a need to provide direct accreditation as students

work through courses. This last requirement is important because not only does it reduce the labour of tutors, but also it provides direct motivation for users of the software.

There is plenty of evidence from other sectors that multimedia can enhance learning. (National Council for Educational Technology 1995) The results of some of these findings need to be applied to FE Colleges with the greatest care for several reasons. The problems of software use for students in the FE sector are not the same as problems in schools or in universities. Courses are often vocational and involve a wide range of individuals with vastly different educational and cultural backgrounds. The set of learning skills that arrive with the individual cannot be taken for granted. Additional problems relate to the fact that much of the evaluation of such material is based on work that has taken place in the USA, (Kenworth 1993), (Barron and Atkins 1994), (Barron and Kysilka 1993) for example. Experiences of multimedia software evaluation in the FE sector in the United Kingdom are scarce. Evaluation of software is central to its development for several reasons, including the necessity of cost benefit analysis. It is also important to make sure that the software is useful in learning in some way. This implies that we include user evaluation as well as testing in the overall consideration of any package. Comparisons between different media types and delivery methods are not seen as being very important. The evaluation of multimedia learning applications developed will be discussed later.

There is a need for large quantities of high quality open, flexible and distance learning materials for use in Further Education. Multimedia learning materials are seen as a potential solution to this problem. The possibility of collaboration with external commercial organisations has been made. The recent *'Higginson'* report for example, from the Further Education Funding Council (FEFC) Learning and Technology Committee recommends this as a way forward. (FEFC 1996). Others however urge caution and question the profit motive as a major driving force for learning materials development. (Barker 1996). The development of

multimedia materials involves high investment in time, money and human effort and implies the moving of resources away from traditional methods of delivery. It is important therefore that the highest standards of project management and control are applied to the development of multimedia learning materials.

2.0 The development process.

The complex process of multimedia development has been described by several authors, for example

Howles and Pentergill describe a simplified seven step process for producing multimedia presentations as follows:

- Select potential lesson or topic

- Describe specific learning outcomes or goals

- Create scope and sequence outline for lesson content

- Identify and list specific multimedia resources to use in the presentation.

- Explore technology for presenting lesson content

- Develop a storyboard for the presentation

- Produce the lesson using authoring software.

(Howles and Pentergill 1993)

Other authors suggest that the process is more complex than the seven steps described above. McAteer and Shaw have reviewed the process of planning, developing and evaluating software for use in Higher Education at the University of Glasgow (McAteer and Shaw, 1994). They provide guidelines for the development of multimedia applications in the HE context, including the composition of project teams which is seen by them

to be important. Arnold and colleagues also describe the construction and implementation of multimedia teaching packages in a Higher Education environment. (Arnold et al 1995).

Any process that is used will need to justify itself in terms of cost and benefit. Excessively complex methods may be expensive to implement, or be unworkable for small development teams and thus defeat the object of employing them. The method used at Waltham Forest College and presented here is fairly simple and was designed to facilitate the production of material of good quality in a reasonable time at reasonable cost. The process followed in the implementation of projects is described below:

- Formal proposal and needs analysis
- Development team formed
- Subject specialist specifies material for inclusion in course
- Material passed to development team who storyboard the material for multimedia production
- Material modified for interactive presentation
- Story board discussed and modified
- Design / layout specialists involved at early stage.
- Media created.
- Material produced as a prototype
- Material tested against technical standards
- Material evaluated by user according to specific usability requirements.
- Final versions of the materials produced.
- Material used by staff and students with ongoing evaluation.
- Results fed back to team and formal report written.

2.1 Formal proposal and needs analysis.

All multimedia learning material projects start from a formal project proposal which will include a needs analysis. Proposals are considered by a project management group whose role is to consider the project in the wider context of strategic development.

If the material is not really required or already exists in a suitable alternative form, then the project will not be approved. The proposal is required to include reference to learning and other objectives and should also include details of how the material is to be used and integrated into existing work. Good project proposals will also include information on how material is to be assessed and accredited, and how student tracking and recording is to take place. Projects should be costed and funding considered at this stage.

2.2 Development team formed.

Once approved, a project team is formed which is comprised of:

- Subject specialist team
- Project manager with computer science background
- Computer support staff
- Programmers
- Designers
- Other specialists (Language, Learning Difficulties, educationalists etc.)

Often team members may take on more than a single role and in larger projects several persons may undertake a single function, for example there may be two or more programmers working on a project. As the project progresses, some members are required less and others more, depending on the stage of the project. We have found it important to hold regular meetings, and to record both formal and informal meetings. The team works to deadlines and partial objectives. The role of the project manager is to ensure that the team members achieve their actions by the required deadlines and to keep the whole complex project process on line. The project manager will assist in setting partial objectives and deadlines which must be by agreement. The project must be fully documented at all stages of the process. This not only assists in recording the financial and formal aspects of the project, but also assists in communication between team

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members. Documentation will include details of time, money spent on purchases, dates and records of all meetings. There is also a requirement that the software development process be fully documented. This will include records of storyboards, flow diagrams and course structures used in the course. It is also important that media assets are documented, for example the creation and modification dates of the asset, who it was created by, copyright information or evidence, file format, location etc.

2.3 Subject specialist specifies material for inclusion in course

Quite often subject specialists have already produced much of the learning material for the project, or want to convert an existing course from another format, video or text for example, into a multimedia course. Subject specialists soon become expert at what is good and bad practice in designing multimedia presentations and quite sophisticated specifications are often the case. It is always better if subject specialists have a good conception of the multimedia authoring process. It is often difficult to convert existing passive materials into interactive learning materials.   Barker describes a multimedia authoring project that involved lecturers in six academic areas of a large FE College. (Barker, 1995). Subject specialists underwent an initial training course in multimedia authoring and then wrote and delivered a multimedia authoring course to students in their respective subject areas. In this way authoring skills were passed into the hands of non-IT subject specialists and from there to students. Initiatives such as this allow the subject specialist to influence significantly the development of multimedia learning materials.

The materials produced include the knowledge that underpins learning and that links to specific learning objectives. Project teams have found it far easier if this linkage is made explicit at this stage. Assessment and tasks for the presentation are given an initial consideration at the time the material is specified. In this way each objective can be tested by the application.

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2.4 Material passed to development team who storyboard the material for multimedia production

The storyboarding process has been described by several authors (McAteer and Shaw 1994) and (Allessi and Trollip 1991) for example. Both describe a common representation of the storyboard as a succession of thumbnail sketches or cartoons. This is often the case within our own projects, but on occasions other methods are used, including fairly detailed written descriptions with images and flow diagrams. What is important at this stage is to create an underlying structure for the course. Material can be made linear or non-linear, differentiated or non-differentiated, interactive or passive. The final structure for the material is the end result of a long process involving many discussions between team members. Compromises are usually made, as the structure of the material will be influenced by the pedagogy, learning theories employed by the subject specialists and the learning objectives to be satisfied. The structure employed by the team for the application also has an influence on and will be influenced by many other factors, for example the delivery hardware required for the final application, technical details of the implementation and the choice of authoring software. Templates, (sections of bare code to which text, graphics and other media can be added), are used in the development of courses if possible. The benefits of templates include speed of production, application of house style to new work and re-use of good ideas without duplication of effort.

Initial decisions about the type and format of media to be used in the presentation are begun to be made at this stage.

2.5 Material modified for interactive presentation

Once a storyboard has been developed, the team look again at the material for the course and modify it in the light of the storyboard. The *final* script for the material is generated at this stage and interactivity issues considered. Scripts are usually

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written in English without any special notation. In some cases detailed scripts are created before initial storyboarding by the subject specialist, and later modified after the storyboarding process. In the next stage of the method, the final version of the script is mapped onto the storyboard.

2.6 Story board discussed and modified

The term 'storyboard' is used in house to refer to the detailed software specification for the application. In a cyclic process of discussion and modification a final version of the storyboard / specification is created. This will specify the following.

- All learning objectives and the material specified to underpin them.
- Full final script for the material.
- All assessments and interactive tasks explained
- Overall structure of the course
- Orientation, Navigation tools to be used
- Issues of linearity, differentiation and interaction specified.
- Pedagogical factors linked to presentation specified.
- LD&D factors taken into account.
- Screen design and layouts drafted.
- Text, sound and video files to be created and their location in the course.
- Additional support required (for example language).
- Student recording and tracking details specified.
- Authoring software specified.

2.7 Design / layout specialists involved at early stage.

Initial ideas about screen design and layout that were identified in the storyboarding process are put into effect. The team is involved in modifying screen design at all stages. It is important that design specialists are used to create high quality screen layouts; it is also important however that the whole team is

involved in the look and feel of the presentation. The team considers the academic level of the material being created and the final use to which it is to be put. This information is then fed back to designers.

Consideration about specific components of the media are made at this stage. These range from the colour, size, font and amount of text presented on the screen at any time to the use of images sound, animation and video to emphasise or deliver content.

2.8 Media created.

The text, images, sound, animation and video files for the course are created. The format of the media will determine the file size and thus reflect on the final size of the course. Quality issues are also related to media file format, for example decisions about image depth, sound sampling rate and video format need to be taken relatively early in the production of the course and relate to the aims and objectives of the course. These decisions will determine whether material is suitable for release on CD ROM, suitable for distribution over a network, or capable of being delivered on hardware with standard VGA video adapters and mono sound cards. In general, the higher the quality of the media, the more constraints are placed on its use, at least for the present.

2.9 Material produced as a prototype

Early versions of the course are produced; these are often cut down and not fully functional. These are used for user and expert evaluation and for testing.

2.10 Material tested against technical standards

This process is intended to remove hardware and operating system bugs. All file handling, external DDE calls, multimedia files and multimedia operations are tested. Performance of the software on different hardware systems is tested and

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improvements in program efficiency are made. For example any remaining palette clashes and image problems are eliminated at this stage. Improvements are also made in the presentation of animation and video files. Jerkiness and problems with faltering sound are removed as much as possible.

2.11 Material evaluated by user according to specific usability requirements.

The material is subjected to a testing and evaluation procedure. This is described in more detail later for an example multimedia learning application.

2.12 Final versions of the materials produced.

This stage also involves the creation of a staff / user manual and a robust and simple installation procedure that will also include installation of the final versions of student tracking and recording systems. Issues and problems of final distribution are solved, for example CD ROMs created or network installation undertaken.

Material is then used by staff and students with ongoing evaluation. It is important to make sure as much as possible that evaluations are performed with the student and the final objectives in mind. Too often the media is evaluated and not the learning taking place.

The final stage of any project involves feedback and de-briefing with a formal written report.

3.0 Development of the Horizon material.

The development of multimedia applications is a complex process which involves large teams of developers and may occupy many months or years of development time. Arnold states that project management is important in the development of multimedia

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learning applications. There is a need to follow conventional software development project phases to ensure adequate control. (Arnold S et al 1995).

3.1 Horizon Project.

The Horizon project involves the staffing of a cafe with students who have learning difficulties and disabilities. It has as one of its deliverables, the creation of interactive multimedia learning material to support the training of the cafe staff. It is intended that the material produced be directly related to National Vocational Qualification (NVQ) units in catering and business studies.

This work was undertaken by a project team consisting of computing and design specialists, subject specialists, learning difficulty & disability specialists (LD&D) from FE and outside and foreign language specialists. All the catering units produced for the project were also produced in Spanish.

3.1.1 Production of Horizon multimedia learning material.

Material is produced in essentially the same stages as detailed above although several additional complications had to be considered.

- There is a large specialist component in terms of learning difficulties and disabilities (LD&D).

- There is the need to produce foreign language versions

- There is a requirement for extensive international use of the material. This involves trans-national meetings between the software design team and partners with additional issues relating to distribution, installation and evaluation of the software.

3.1.2 Specifications for the material

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The production of large quantities of multimedia material in such a short time, by such a small team (and for such a small cost) did not mean that the material was to be of low quality. It was intended that extensive formal evaluation of the material produced by users and experts would ensure that it was of the highest quality. The following guidelines for the initial production of the software were adopted after lengthy research and discussions. Results of previous evaluation studies were also used in agreeing this initial specification.

- Level of the material produced to be determined by the subject specialist.
- Learning Objectives specified by subject specialists
- Differentiated paths to be available to provide:
    Language support
    Extra subject support
    Fast routes
    Additional support for students with learning difficulties
- Cognitive overhead to be avoided
- Touch screen technology to be included
- Hierarchical structure to material with navigational and orientation tools
- Clear text, with bold, simple fonts
- Simple colours
- High design quality of images
- A mixture of realism and cartoon to be used, producing an entertaining presentation
- Amount of information presented at any time to be limited
- Four screen model, Delivery, Task, Question, Review.
- Video used to add interest and extra realism
- Sound configurable by user / tutor
- Colours configurable by user / tutor
- Standard user interfaces for all applications
- Student tracking built in
- Individual user configuration files to be provided
- Stand alone applications where possible

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- Assessment to be built in.

Most of these of these guidelines were implemented in the initial release of the material, although some were omitted, because of time limitations. These, though, will be implemented in the near future. The creation of this material has involved a continual process of production, evaluation and modification of the material, mostly at the technical and theoretical level at present. It is hoped that this can be broadened to include the results of user and expert evaluation now taking place, including that of partners. Partners involved in the project include colleges and institutions from Britain, Spain, Ireland, Italy, Germany and Denmark. Ongoing evaluations are taking place in all those countries in the areas of learning difficulties and disability, pedagogy and multimedia, according to guidelines developed by the materials development team. Some example screens from Horizon are shown below:
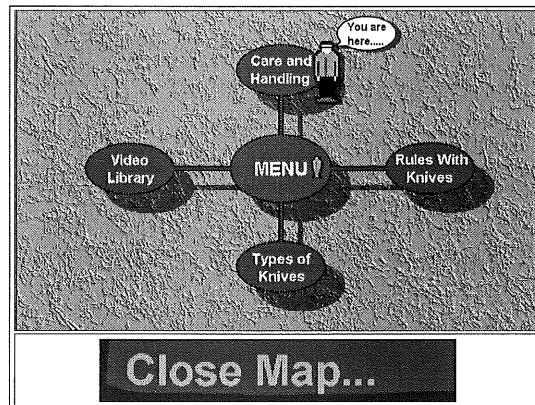

Figure 1: Horizon Visual ID Login Screen

Students log in to the system by selecting their face or picture from the users in their group. The user picture file can hold up to 16 users and is accessed from the hard drive, not the CD ROM

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drive. In this way it can be set up by editing the template provided.

Figure 2: Navigation and orientation tool.

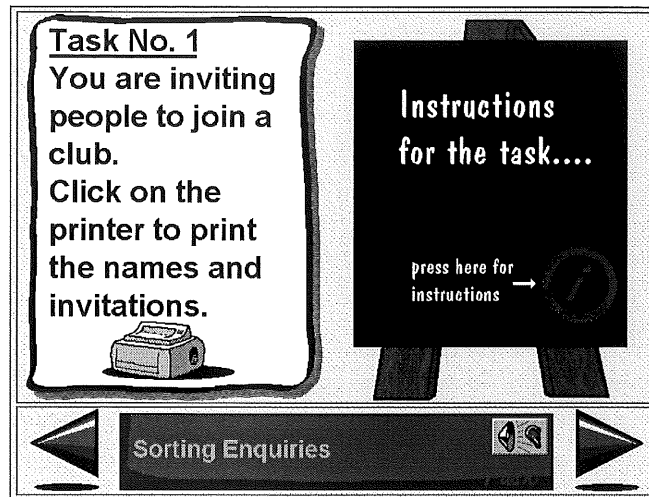A simple navigational and orientation tool is provided as shown in figure 2. The user can navigate to areas of the course by selecting from the map. Places already visited have a small grey person drawn on them. The place where they are at present has a larger figure displayed. Students soon learn to use the map to see where they've been.

Figure 3: Presentation Screen

A simple presentation screen is displayed above. Users may move to the next screen using the forward arrow button. Clicking the repeat sound button will play the sound again. Text is displayed clearly and boldly in a simple font. The amount of information displayed at any one time is limited.

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Figure 4: Task Screen

This screen presents instructions for performing a task away from the computer, as shown in figure 4 above. It allows the student to print out material necessary for doing the task

3.1.3 Evaluation of the Horizon Material.

The rapid development of multimedia learning materials relies heavily on the ability to determine what aspects of the prototype are good and what bad. This is especially important in the Horizon project when quite large amounts of materials need to be produced in a short time to strictly defined specifications and targets. The project is producing multimedia learning material for students with special learning difficulties and / or disabilities. This adds an extra dimension to the evaluation of the materials. The following five methods of evaluation have been used at various stages of the project:

- Questionnaire (individual and group and on-line)
- Taped Interview
- Group video
- Individual video
- Logged data

All of these methods have been shown to have limitations. Henderson and colleagues for example discuss the use of logged data, questionnaire, interviews and verbal protocol analyses used

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in software evaluation. Weaknesses were found in all methods. For example questionnaires often rated attributes highly that did not exist in an application. **(Henderson et al 1995)** This corresponds closely with our experiences in evaluating the Horizon material. For example, some users rated the video components in the course as very useful, when their tracking files indicated that they had not used them in any previous session. Responses to open ended questions were found to be useful. Henderson looked at the effect of combining evaluation methods and found this to be the most useful approach where each method contributes something different to the evaluation.

The use of video analysis in evaluation studies has been approached by Laws and Barber. They consider video to provide a rich data source for evaluation, though there are problems of translation from the low level data of the result to the high level aims of the investigation. They consider that video analysis has the following benefits:

- Able to evaluate all aspects of human behaviour including facial expression and gesture.
- Provides informal and anecdotal evidence for designers.
- User behaviour may be assessed on rating scales by observers.
- Users may rate reaction to tasks and performance themselves.
- May form the basis of formal comparisons between HCI designs

(Laws and Barber 1989)

Law and Barber recommend that the high level goals do indeed map to the specific observable behaviours in the first place so that higher level interpretation may take place.   The goals for the Horizon evaluation are restricted to how easily material is accessed by users with learning difficulties and whether or not they find the material enjoyable to use, interesting and useful in their studies. The video component of the evaluation was found to be extremely useful to this end.

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Evaluation issues in computer based instruction have been covered in some detail (Allessi and Trollip 1988). Their discussion includes the testing of learning material in terms of quality, questions and menus, feedback, issues of pedagogy, student control and interaction and subject matter. Reeves considers it essential that we distinguish between testing software and evaluation of software. This distinction is not always made in studies. (Reeves, 1991).

The nature of the users of this software has made it essential to consider individual evaluation rather than statistical analyses of large groups of users. Evaluation sessions then involve small numbers of students and typically large numbers of evaluators. A detailed analysis of such a session is given below.

3.1.3.1 Introduction session

The session started with a formal introduction to the material which was presented to users as a group. Features of the software were demonstrated. The introduction session was captured on video and examined later. A formal script was prepared and used for all introduction sessions to make sure that all important points were covered for all users.

3.1.3.2 Main Session

Students were than recorded using the Horizon applications. Each student was recorded by means of an individual tracking file. Video recordings were made in two ways. Individuals within the group were followed as they worked through sections of the material. Several usability problems were readily identified in this way, for example it was possible to tell whether long time delays recorded in the tracking files were due to problems with subject content, hardware problems (mouse etc.) or problems of navigation or orientation. It was also possible to compare user questionnaire results to the ways the course was followed; for example one user who said they found the mouse easy to use,

actually required a helper to manipulate the mouse for them. It was also possible to identify users who were having very few problems at all with the interface and the subject content. These users need to be provided with suitable challenges. It is important that material is created at a suitable level for all users in such a diverse group. The use of video allowed rapid identification of users with problems and those that were not being challenged sufficiently.

Video was also used to record how users performed specific functions within the material; for example each user was recorded logging in and out, accessing navigation and orientation tools, performing specific mouse and other operations. These were identified by the project team as being important.

3.1.3.3 Questionnaire (individual and group and on-line)

Three methods of undertaking questionnaires were available. Some users with learning difficulties were led through a questionnaire as a group by an expert evaluator who answered questions and assisted users in filling in the evaluation. Other users in the same group were able to undertake filling in a questionnaire on their own. There is also an evaluation questionnaire available presented on the computer. Table one below summarises the results of this evaluation.

Table One
HORIZON multimedia application.
Summary of Evaluation Sheets for 4 users.

1) Have you previously taken a multimedia Course?
                                    Y / N
Y, Y, N, N
Rank the following questions about the course you have just taken, on a score of 1 to 5, where 1 is poor and 5 exceptional

2) How interesting did you find the course?
5, 5, 5, 5

3) How easy was the course to follow?
5, 5, 1, 5

4) How enjoyable was the course?
5, 5, 5, 5

5) Do you think that you learned anything from the course?
5, 5, 5, 5

6) Did you feel the course was too slow, too fast or about right in its pace?
3, 3, 3,2,

7) Were the following items useful or not useful to you in the course?
Video clips
5, 5, 5, 4
Pictures
5, 5, 3, 4
Text
5, 5, 5, 5
Sound
5, 5, 3, 5
Course book (if used)

NOT USED -, 5, -, -
Help screens
NOT USED -, 5, -, -
Tests
5, 5, 2, 5
Task Screens.
5, 5, 2, 5
Review Screens.
5, 5, 4, 5
Question Screens.
5, 5, 5, 5
8) How worried were you by the following?

Not Worried   **Very Worried**

Using a computer
5, 5, 5, 5
Using headphones or speakers
5, 5, 5
Taking exam on a computer
5, 5,-,-
Using a mouse
2, 5, 3, 5
9) How difficult was it to log in to the course?
3, 5, 5, 1
10) How difficult was it to exit the course.
1, 5, 5, 1
11) Did you find it easy to move about to different sections   in the course
3, 5, 4, 5
12) How often did you need a break from the course?
- **Less than half hourly.**
- **About half an hour.**
- **More than half hourly.**

No break: (One student records this as Less than half hourly all others ignore or say no break)
13) Would you like to take similar courses in other subjects?
Y / N
Y, Y, Y,Y

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3.1.3.4 Taped Interview

Users were interviewed by an expert interviewer. A standard series of 38 questions was presented to users. The questions were designed to be open ended and to encourage the interviewee to contribute. Leading questions were avoided. All participants agreed to be recorded on VCR. Normally audio recording would have been used. Any interviewee that was unhappy being recorded electronically would have been recorded manually using pen and paper.

3.1.3.5 Logged data

Each user has an associated bookmark file which records all areas of the course visited. This enables the orientation and navigation tools to function over different sessions, for example a user can return directly to the last place visited. It is also extremely useful as a quick method of checking how much of the course has been followed by a particular user. In addition to this, there is a tracking file associated with each user which records logging in time and date, passage through the material, time spent in each area of the course, the results of questions and tasks undertaken in the course and logging out time. Later versions of the software have individual configuration files for each user, setting language and difficulty levels as well as sound and colour options.

Three users completed the evaluation in a group and the fourth completed it on their own.   Without the video evidence, the evaluation based on the questionnaires alone would have been far less useful.

The evaluation of computer based multimedia learning materials is especially difficult with users who have learning difficulties and or disabilities. Several evaluation methods have been discussed with regard to this material, three questionnaire methods, taped

interview, video recording of group and individual work and data logging methods. The individual requirements of students undertaking the Horizon work present additional difficulties in the selection of evaluation method. The standard statistical methods will miss many students with highly individual problems. The use of several evaluation methods together has proven to be extremely useful in overcoming some of these problems.

It is hoped that the material produced for the Horizon project will be fully evaluated by experts and users. It is also hoped that by identifying the issues in such evaluation better and more directed evaluation will be achieved.

4.0 Conclusion.

The process of creating multimedia learning applications has been described for a fairly significant project undertaken in a Further Education environment. The process is complex and involves teams of management, lecturing and technical staff from the earliest stages in the initiation of the project to final user evaluation of material produced. The process is resource intensive and requires significant management in order that projects be delivered to time and specified standards. Methods are required to define the standards and quality of multimedia learning applications. Evaluation in terms of comparison with other courses delivered by traditional methods or with other media are unlikely to be fruitful ? Do we for example compare our multimedia course to other courses delivered poorly, or courses delivered well ? (Indeed how do we perform even this comparison?) Others have suggested that comparisons solely in terms of the media are unlikely to be useful. (Reeves, 1991). The use of standard software project phases has been emphasised as being important in the control of projects (Arnold et al 1995) and it is certain that the use of standard usability methods as outlined by Dix and collegues are equally important. (Dix et. al. 1994). However it is important also to define quality in terms of learning outcomes and these are extremely difficult to evaluate.

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The evaluation of learning applications by users involves not just comparison of test scores, but also a vast array of difficult to define variables related to learning. Some of the limitations of the methods available have been demonstrated by this work. The next stage of this work is to look at some of the more complex variables within multimedia learning applications and to examine evaluation and testing methods. The problem of catering for the individual user was found to be especially important in this project. This problem was seen to relate not just to the creation of multimedia learning materials, but also to testing and evaluation. Individually configurable applications are seen as a natural progression, not only in terms of media quality, quantity and presentation, but also in terms of learning style, the use of language and presentation style. The differentiation of the material in this way makes it essential that evaluation be individualised in a similar way.

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6.0 References

Allessi S M and Trollip S R, (1991), Computer Based Instruction, Prentice Hall.

Arnold S, Barr N, Donelly P J, Duffy C, Gray P, Morton D, Neil D M, and Slater N, (1995), Constructing and Implementing Multimedia Teaching Packages,   Edited by P J Donelly, A report by the University of Glasgow's institutional project in the Teaching and Learning Technology Programme.

Barker T (1996), Multimedia Production, A Model for Collaboration between Colleges, Learning Resources Journal, October 1996.

Barker T (1995) Multimedia Authoring in the Curriculum, EDUCA 158, December 1995

Barron A and Atkins D (1994), Audio instruction in multimedia education: Is textual redundancy important?, Journal of Educational Multimedia and Hypermedia, 3, 295-306.

Barron A and Kysilka M L (1993), The effectiveness of digital audio in computer based tarining. Journal of Research on Computing in Education, 25(3), 277

Dix A, Findlay J and Beadle R, (1994), Usability Paradigms and Principles, Human Computer Interaction, Prentice Hall.

Further Education Funding Council (1996), Report of the Learning and Technology Committee, January 1996.

Gray L and Warrander A-M (1995), Learning and technology in further education colleges.   Further Education Development Agency (September 1995)

Henderson R, Podd J, Smith M and Valara-Alvarez, H (1995), An examination of four user-based software evaluation methods., Interacting with Computers, 7(4) 412-432.

Howles L, and Pentergill (1993) Designing Instructional Multimedia Presentations: A Seven Step Process, Tech Horizons in Education j., Vol 20, No. 11

Kenworth N.W, (1993), When Johnny Can't Read: Multimedia Design Strategies to Accomodate Poor Readers. Journal of Instructional Delivery Systems, Winter 1993. 27-30

Laws J V and Barber P J 1989, Video Analysis in Cognitive Ergonomics: a methodological perspective. Ergonomics 32(11), 1303-1318..

McAteer E and Shaw R, (1995) The Design of Multimedia Learning Programs. Establishing Multimedia Authoring Skills in Higher Education. EMASHE Group publication, University of Glasgow.

McAteer E and Shaw R, (1994) The Planning, Development and Testing of Courseware in Higher Education, University of Glasgow (an ITTI product).

National Council for Educational Technology 1995, Teaching and learning in further education. Coventry.

Reeves T C, 1991, Ten commandments for the evaluation of interactive multimedia in higher education, Journal of Computing in Higher Education. 2(2). 84-113.